BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF CALIFORNIA

Application of California-American Water Company (U210W) for Authorization to Increase its Revenues for Water Service by $55,771,300 or 18.71% in the year 2024, by $19,565,300 or 5.50% in the year 2025, and by $19,892,400 or 5.30% in the year 2026.	A.22-07-001 (Filed July 1, 2022)

REBUTTAL TESTIMONY OF NINA MILLER

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REBUTTAL TESTIMONY OF NINA MILLER

I. BACKGROUND

Q1. Please provide your name and business address.

A1. My name is Nina Miller. My business address is 511 Forest Lodge Road, Pacific Grove, California.

Q2. By whom are you employed and in what capacity?

A2. I have been employed by California-American Water Company ("California American Water" or the "Company") since August 2014.

Q3. What are your responsibilities?

A3. As Manager of Capital, GIS and Planning, my responsibilities include the following: 1) supervise and manage capital planning activities on a statewide basis; 2) manage asset planning on a statewide basis; 3) manage GIS activities; 4) manage real property; and 5) provide rate case support and testimony on capital project, GIS, and planning in California.

Q4. Please summarize your educational background.

A4. I received a Bachelor of Science degree in Environmental Science from Bowling Green State University.

Q5. Please summarize your employment experience.

A5. My career in the water industry began in 1996 at the Arizona Department of Environmental Quality as an Environmental Health Specialist in the Drinking Water Section, Compliance and Enforcement Unit. In 1998, I was promoted to Drinking Water Primacy Coordinator, and in 2002 I was promoted to Manager of the Source Water Assessment and Protection Unit. In 2004, I joined Arizona American Water as the Water Quality Manager for over 80 drinking water and wastewater systems in Arizona, New Mexico, Texas, and Hawaii. In 2012 Arizona American Water was acquired by EPCOR Water, and I continued on as the Manager of Water Quality and Environmental Compliance for Arizona and New Mexico until I joined California American Water in August of 2014 as the Manger of Water Quality and Environmental Compliance for the Coastal Division with responsibilities for water, wastewater, air, and hazardous waste permits and compliance for the 8 wastewater and 9 drinking water systems in California American Water's Coastal Division. In 2016, I shifted to Operations Manager of the Coastal Division for the water and wastewater systems, and, in 2020, I started as the Manager of Capital, GIS, and Asset Planning.

Q6. Have you testified before any regulatory agencies?

A6. No, I have not testified before any regulatory agencies.

II. PURPOSE OF TESTIMONY

Q7. What is the purpose of your testimony?

A7. My rebuttal testimony addresses several topics. First, I address the significance of our capital projects. Next, my testimony confronts the significant adjustment proposed by the Public Advocates Office ("Cal Advocates") regarding the Comprehensive Planning Study

("CPS") and Geographic Information System ("GIS") expense line item. In addition, my rebuttal testimony addresses Cal Advocates' presumption that an additional study is needed for portable generator consideration; Cal Advocates' request to eliminate contingency from all capital projects; and Cal Advocates' suggested imbalance between the depreciation reserve and plant in service.

Q8. Do you agree with Cal Advocates that a significant number of California American Water's projects are unnecessary and do not benefit the customer?

A8. A. No, I do not agree.   California American Water's capital projects are critical to ensuring our customers have reliable access to safe and clean water. This helps achieve equity for our customers by addressing issues affecting their water supplies. California American Water proactively addresses water quality issues for our customer's health and their consumer confidence. If customers lose faith in the quality of their water, they may resort to purchasing bottled water, which is significantly more costly and creates a substantial financial burden. For example, as is detailed in the Rebuttal Testimony of Mark Reifer, Section III.B.1.e for project ER – El Rio Well 2 Nitrate Treatment (I15-510058), the nitrate levels in the water do not currently exceed the MCL, but treatment is necessary now. We provide an ingestible product, so do not take a "wait and see" position while recognizing contaminant levels are rising for an acute contaminant and knowing surrounding area water systems already must treat water for the same acute contaminant. Watching and waiting under the circumstances does not ensure equity for our customers. California American Water is committed to not just meeting but surpassing drinking water standards for the health and safety of all our customers. Again, these capital projects help ensure all our customers have reliable access to safe, affordable water.

III. TESTIMONY

A. GIS and Planning Studies

Q9. Cal Advocates has suggested a reduction of California American Water's proposed expense amount for GIS and Planning Studies line item by nearly 72% (approximately 40% reduction for studies other than CPS, 100% reduction for CPSs, and approximately 92% reduction for GIS) based on four things. First, a history of not spending the previously approved funds in the prior test year of 2021. Second, Cal Advocates' claim that Comprehensive Planning Studies do not need to be updated, and, even if they did, internal California American Water engineering staff could complete the CPS for all the Divisions Third, Cal Advocates' claim there were duplicate expenses already accounted for Planning Studies and Maps expenses. Lastly, Cal Advocates claim there is an averaging error in forecasting for several Districts. Has Cal Advocates accurately summarized the historical spend record and projected budget on this line item?

A9. No, they have not. It is important to recognize that Cal Advocates has agreed in the past on the importance of the CPS work and mapping, and it appears Cal Advocates continues to agree with California American Water's mission to continue efforts with CPS and GIS related work activities; however, Cal Advocates proposed reductions in this case are unwarranted.

Q10. Cal Advocates points out underspending for California American Water's planning studies, mapping, and GIS expenses. Cal Advocates then suggests an approximate 72% reduction in the budget. Do you agree with the adjustment made by Cal Advocates to the planning studies and GIS expense line item in this GRC?

A10. No. First, I will discuss the planning studies portion of this specific expense line item. It is true California American Water underspent in 2021 on some unique planning studies. Some of these were one-off studies where no comparable budget was available to update the projected budget from the CPS and basic discussions with contractors on the studies resulted in the 2019 rate case proposed budgets. Cal Advocates insinuates the underspend is a pattern and results in pure profits for California American Water; however, Cal Advocates only included 2021 spend and provided no other years details to support its claim of a pattern. One test year does not a pattern make. Regardless, the planning study budget included in this rate case ($5,428,500) was based on actual prior spend for CPS, Risk and Resiliency Assessment, Urban Water Management Plan, and Seismic Assessments with additional dollars for projected expansion of scope for some studies and inflation included, so Cal Advocates is aware of the actual spend. Therefore, when historical measurements are not cherry-picked, actual historical spend coupled with inflation adjustments help show no reduction is justified, and the budget should be approved as submitted.

Q11. Do you agree with Cal Advocates' view that Comprehensive Planning Studies do not need to be updated every six years, or that even if they do, internal staff can complete these studies?

A11. No, I do not agree with Cal Advocate's postulation that updating Comprehensive Planning Studies is not necessary or that internal staff can adequately accomplish this significant additional workload. California American Water completed its most recent CPSs and Conditioned Based Assessments ("CBAs") in 2019. CPSs were also completed for recently acquired systems in 2022 with the assistance of consultants and will be updated via a memo level document. CBAs are critical in completing a CPS as the Assessment provides a view of the current condition of assets (surface level and underground). The CPS presents a strategy for facility improvements to enable California American Water to continue to provide safe, adequate, and reliable service to its customers. Specifically, the CPS presents customer and demand projections; examines source of supply and production; analyzes the water system distribution system and storage facilities; and presents a capital improvement plan to address facility needs. It should be noted that with system updates and changes completed through capital projects, emerging contaminants, new drinking water regulations, perpetual and unplanned main breaks, infrastructure aging, and unforeseen local government sewer and/or paving projects, the CPSs need to be reviewed and updated every six years. This timing aligns with the filing of General Rate Cases to ensure the most up to date data is used to develop informed and relevant capital improvement plans. The updating of CPSs is a standard necessity to determine the needs for future capital programs, as CPSs only determine capital plans for the near future. California American Water does use outside consultants to assist with the CPS preparations, due to extensive data compilation, data analysis, capital project development, and capital project budgeting. Again, the scope of data analysis, modeling, and report generation for the 35 public water systems owned by California American Water justifies the use of consultants and the historical spend (2017-2019 total of approximately $2,634,000) supports no reduction in the proposed CPS budget (approximately $2,30,000), as the submitted budget also reflects the memo level documents for the new acquired systems.

Q12. Would you comment on the GIS/Mapping portion of the NARUC Account #756 Miscellaneous Expenses line item for which Cal Advocates suggested a reduction in budget.

A12. Yes. As discussed in the Direct Testimony of Ian C. Crooks, dated July 1, 2022, Section V. ("Crooks Direct Testimony"), California American Water's asset records management staff maintains system plans, maps, drawings, and other records as required by the California Public Utilities Commission's ("the Commission") General Order 103-A. In addition, there are requirements imposed on water utilities by the Waterworks Standards issued by the California Department of Drinking Water. In summary, California American Water is required to have on file updated plans, maps, drawings, or other records of all system facilities.

I agree with Cal Advocates that in 2019, California American Water did have expense on this line item for mapping using consultants to collect data points in our Larkfield system which had experienced a fire in 2017 and for which we only had CAD files for the system. With asset replacement necessary, it was critical to obtain GPS data points for the existing assets in the system. GPS data was also collected for the newly acquired Meadowbrook system, for which we were given little to no GPS data for assets, so this was unplanned but necessary spend.

While Cal Advocates is also correct that spend in 2021 was below forecast, this lower than plan spend was due to COVID-19. Regardless of Cal Advocates' dismissive posture, in 2021 California American Water was still implementing social distancing as were many other companies, which significantly limited travel and consequently field GPS data collection and thus spend.

In 2022, California American Water re-analyzed existing GPS data and determined the number of assets that still needed GPS points collected. The resulting GPS budget dollar amount included in the 2024-2026 GRC of $708,000 incorporates completing the collection of GPS data points by 2026. Since 2019, California American Water has been advising vendors on the purchase and use of current GPS technology and has seen vast improvement by said vendors with GPS data collection and uploading of data. This improvement was realized through these vendors working on our capital and developer projects. California American Water predicts this mentoring will ensure smooth, consistent, and timely data collection and uploading for this larger project. California American Water will, with Commission approval, work to complete this necessary collection of GPS points for all assets by 2026. Thus, the budget of $708,000 is justified and will be utilized for this project.

Q13. Cal Advocates' claim there were duplicate expenses already accounted for Planning Studies and Maps expenses, do you agree?

A13. Yes, California American Water inadvertently included duplicate $198,394.89 of CPS and GIS expenses for the individual newly acquired systems (Dunnigan, Geyserville, Meadowbrook, Fruitridge, and Hillview) in the RO model. These expenses should be removed from the forecast in the RO model and the "rolled up" expenses will remain in the respective District level GIS/Mapping and CPS portion of NARUC Account # 756.

Q14. Do you support Cal Advocates' claim that California American Water submitted an averaging error in forecasting for several Districts regarding the GIS and Planning Study portion of the NARUC Account #756 and that the respective budget should be further reduced by $65,128.74?

A14. No, the budget should not be reduced to reflect an averaging error, as there was no averaging error. As explained in Bahman Pourtaherian's Rebuttal Testimony, Section III.G., California American Water utilized an averaging methodology that excludes the year of acquisition as it does not reflect the entire year's data and Cal Advocates utilized a methodology that doesn't prorate the cost of the acquired systems in the year that acquisitions happen. California American Water's methodology, which does a correct calculation, should be adopted, therefore there is no averaging error in the forecasting budget and no reduction for GIS and Planning Study line item is justified.

B. Generators and Emergency Power Study

Q15. Do you agree with Cal Advocates that another generator study is necessary to weigh the costs and benefits of stationary versus portable generators?

A15. No, I do not agree another study is necessary. In California American Water's Response to Cal Advocates Data Request JMI-11, Cal Advocates was provided a copy of California American Water's Emergency Power Study performed by NCS Engineering. Page 2 of this study specifically discussed the utilization and appropriateness of portable and stationary generators at California American Water locations. As stated in this study provided to Cal Advocates, "EPA's 2019 'Power Resilience Guide for Water and

Wastewater Utilities' recommends installing stationary generators with automatic transfer switches at all 'critical' facilities. Cal Am and NCS utilized the recommendation in this study and has reviewed each site based on criticality and operator safety." Based on this EPA Guide, "Critical sites were automatically categorized as needing stationary generators. However, some critical sites do not have the space for a stationary generator, so portable generators will be purchased and utilized at these and other sites which experience power outages. Critical sites were also evaluated on their location and terrain (Safety and Response Time), the number of historical power outages, and the functional space at the site".[1] So it is clear the consultants along with California American Water did evaluate portable generator use, and based on the EPA recommendation, safety, and site terrain, it was more prudent to use stationary generators for most of our critical site locations, but also to have the portable generators available for use at the remaining critical sites along with the other 150 plus statewide non-critical sites. In addition, the study evaluations regarding site safety and response time were discussed with Cal Advocates during its site inspections in November 2022. Therefore, to ensure California American Water has vital backup power for continued water service to customers in the case of severe weather and wildfires, the following capital projects should be approved with the corresponding submitted budgets:

I15400140	MRY-Standby Generator Improvement Program (2021-2023)
15400163	MRY-Standby Generator Improvement Program (2024-2026)
I15510040	VEN-Tier 4 Compliance/Standby Power
I15510055	VEN-Standby Generator Improvements
I15510062	VEN-Standby Generator Improvements Program (2024-2026)
I15670001	HILL-PSPS Generator Improvements-Hillview
I15500058	LA-Emergency Generators

[1] See Attachment 1, - California American Water Response Cal Advocates Data Request JMI-11, Question 1, Attachment 1.

I15500065 LA-Standby Generator Improvement Program (2021-2023)
I15500081 LA-Standby Generator Improvement Program (2024-2026)

C. Contingency

Q16. Cal Advocates recommends that the Commission reject California American Water's proposal to include the 5% to 25% contingency. Instead, Cal Advocates requests to eliminate all contingency from capital project budgets. Does California American Water agree with this recommendation?

A16. No. Cal Advocates' recommendation to eliminate project contingencies is erroneous for several reasons. Cal Advocates states that California American Water bases the cost of replacement on historical costs; however, Cal Advocates neglects to include the several other factors discussed in California American Water's testimony that are considered when assessing projects for cost and contingency factors. Additionally, Cal Advocates' position is inconsistent with positions it took in prior cases regarding contingency, disregards standard industry best management practices, and ignores the application of contingency utilized across both private and public industries. Finally, Cal Advocates' recommendation to exclude contingency places a substantial and improper financial burden on California American Water.

Q17. Is Cal Advocates' example regarding California American Water's historical cost utilization for projects accurate?

A17. No. Cal Advocates has cherry-picked historical cost and has framed it as the single component California American Water utilizes to assign appropriate project and contingency costs. Cal Advocates has failed to include additional information provided in California American Water's testimony describing how additional studies and practices are utilized in determining infrastructure risk factors. Those additional studies and practices include CPS, CBA studies, criticality analysis, population, likelihood of failure scores, hydraulic modeling, as well as operator knowledge, all of which are considered as a part of project risk determination, and subsequently play a role contingency determination.[2] Historical project costs represent the true and actual cost of the project at the time of project completion. While these historical costs serve as a component of consideration when establishing project costs for a new and similar project, these historical costs could underestimate future costs. Historical costs do not account for inflation, including increased cost of materials and increased cost of labor. Historical costs for previous projects are simply one component of a variety of assessment points utilized when estimating costs and contingencies for a project.

Q18. Is Cal Advocates' testimony regarding contingency consistent with previous testimony in general rate cases for California American Water and other Class A utilities?

A18. No. Cal Advocates' stance that "The Commission should not allow Cal Am to collect from ratepayers advanced funding for contingency factors in initial capital project budgets. Blanket contingency factors are not appropriate in ratemaking..."[3] is inconsistent with Cal Advocates' testimony in prior rate cases. Cal Advocates has previously supported contingency costs for both California American Water as well as other Class A water utilities. For example:

- In A.16-07-002, California American Water's 2016 GRC, Cal Advocates testimony acknowledged need to utilize contingency for projects, "to account for the unforeseen issues that will arise during preliminary engineering design, permitting, and construction of the project."[4]
- In A.19-07-004, California American Water's 2019 GRC, Cal Advocates did not recommended removal of all contingency costs, but more reasonably

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[2] Crooks Direct Testimony, Section XI.B.12., pages 72-73.

[3] *Cal Advocates Report on Contingency, Plant Retirement, Construction Work in Progress, Southern District and Corporate Plant Additions, and Special Request Number 4* ("Ibrahim Testimony"), page 1 10-12.

[4] See Attachment 2 - A.16-07-002, *Report on Recommendations on Proposed Utility Plant in Service*, dated February 13, 2017, page 67 4-6.

recommended any redundant contingency costs be removed and certain contingency costs be 15%.[5]

- In California Water Service's ("Cal Water") 2015 GRC, Cal Advocates did not dispute the utility's contingency allowance of 10% and agreed that "contingency is typically needed for unforeseen events."[6]
- In Cal Water's 2018 General Rate Case, Cal Advocates expressed that "use of contingency factors is an acceptable practice to account for unseen changes in scope or unexpected expenses of capital projects."[7]

Considering Cal Advocates' previous support of contingencies in past rate cases and the fact that use of contingencies is common and generally accepted practice, Cal Advocates has not sufficiently provided sound reasoning for denying contingency in this proceeding but accepting contingency in others. Cal Advocates stance on contingency is inconsistent with its own testimony in prior years where contingency costs were supported and approved – not just for California American Water, but for other water utilities.

Q19. Have contingencies been disallowed for other utilities in previous rate cases?

A19. Yes, the Commission has disallowed some contingencies. However, the examples provided by Cal Advocates do not support its overall stance that all contingencies should be disallowed. Cal Advocates relies on D.21-08-036, determining Southern California Edison Company's ("SCE") 2021 Test Year GRC, to support the recommendation to disallow all contingencies. D.21-08-036 did disallow some contingency costs[8], but also approved other contingency costs, and determined that the contingencies that should be

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[5] See Attachment 3 - A.19-07-004, Exhibit Cal PA-5, *Report and Recommendations on California-American Water Company's Proposed Plant, Depreciation and Special Request # 16 – Public Version,* dated February 14, 2020, pages 2, 27-28, 33-34, 38-39, 42, 72, 75-77, 90-91

[6] See Attachment 4 - A.15-07-015, Exhibit ORA-6, *Report on Plant – Common Issues – Public Version,* dated March 2016, page 56.

[7] See Attachment 5 - A.18-07-001, Exhibit PA-02, *Report on Plant - Common Issues*, dated February 2019, page 20.

[8] D.21-08-036, *Decision on Test Year 2021 General Rate Case for Southern California Edison Company,* dated August 20, 2021, page 331, ("D.21-08-036")

removed are those that are unreasonably high or insufficiently supported. It does not support a recommendation that all contingencies be disallowed.

Cal Advocates also points to D.19-05-020[9], determining SCE's 2018 GRC, to support the claim that California American Water can just seek recovery of "legitimate cost overruns" in a future GRC. Cal Advocates does not explain how the finding in D.19-05-020 related to contingencies on capitalized software forecasts are relevant or supports a recommendation to eliminate all contingencies.

The Commission also regularly approves contingency costs. For example, in D.20-08-032, the Commission adopted SCE's proposal to undertake a $220 million capital project with an additional $19 million in contingency costs.[10] In D.21-04-014, the Commission approved a budget of $43.5 million for San Diego Gas & Electric Company's Electric Vehicle Charging Program as well as an additional 10% contingency for cost escalations.[11] The Commission decisions relied on by Cal Advocates suggest that instances where the Commission has disallowed contingencies are the exception.[12] It would be a significant departure from precedent for the Commission to completely remove all project contingency costs from the revenue requirement as Cal Advocates suggests.

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[9] D.19-05-020, *Decision on Test Year 2018 General Rate Case for Southern California Edison Company,* dated May 24, 2019, ("D.19-05-020").

[10] D.20-08-032, *Decision Granting Certificate of Public Convenience and Necessity for the Eldorado-Lugo-Mohave Series Capacitor Project,* dated September 3, 2020, page 37.

[11] D.21-04-014, *Decision Authorizing San Diego Gas & Electric Company's Power Your Drive Extension Electric Vehicle Charging Program,* dated April 19, 2021, page 79.

[12] D.03-10-014, page 32, which states, "The Commission adopts contingency factors for cost estimates when the work to be done, and the requirements that must be met to do the work, may change substantially over time." For examples when the Commission has adopted contingency factors, see D.10-04-028, page 38; D.06-11-048, page 21-22; D.03-12-059, page 49; and D.03-10-014, page 36.

Q20. Why are the decisions referenced by Cal Advocates in support of contingency removal problematic in terms of their support for removal in this case?

A20. Cal Advocates provides examples from two SCE rate cases discussed above, where the Commission disallowed contingencies for software projects and seismic retrofitting.[13] These two cases were utilized in a misguided attempt to support Cal Advocates' reasons for a blanket contingency removal of 5-25% from California American Water capital project budgets. Cal Advocates states that contingency "covers unforeseen and unknown conditions" and because California American Water is unable to "demonstrate the reasonableness of every dollar authorized to be collected from ratepayers,"[14] contingencies should be removed from California American Water projects. Cal Advocates misguidedly believes that California American Water should be able to budget for projects years in advance in an exact manner, without allowing any room for reasonable cost, project, or timeline changes, even though the use of contingencies is standard within the industry. Given that ratemaking in California is forward-looking, and that California American Water must develop cost estimates as much as 4 years in advance for hundreds of capital and recurring projects in any given GRC, the notion that California American Water must be able to precisely budget projects to the exact dollar is unrealistic and inconsistent with industry standards. Likewise, Cal Advocates' position that it is reasonable to seek recovery of cost overages in California American Water's next rate case, which could be several years after the project's completion, is unreasonable. Cal Advocates' recommendation does not align with industry best management practices, as discussed below, and is completely dismissive of the probable cost California American Water will incur carrying cost overages until the next rate case.

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[13] D.21-08-036, pages 537-538 and 643. The Commission reduced SCE's proposed contingency cost for its fuel cell power plant decommissioning project from 25% to 15%. The project was approved as an increase to authorized depreciation expense.

[14] Ibrahim Testimony, page 2 3-4.

Q21. Explain why Cal Advocates' testimony is not consistent with Industry Standard Practice regarding contingency.

A21. Cal Advocates' request to remove contingency is counter to the recommendations of several professional associations with established guidance regarding project management and contingency. As noted in the Rebuttal Testimony of Tim O'Halloran Section III.B.1, it is also contrary to the experience of California American Water engineers, including those who have worked for California State Agencies.

The Construction Management Association of America ("CMAA"), a leading professional construction association, recommends the inclusion project contingencies. A white paper on the CMAA website states "professionals and experienced estimators recommend contingencies," and that "weak contingency estimating and misuse account for a significant percentage of claims, which are failures in properly assigning and managing project risk."[15] According to CMAA, contingency is "intended to be used for changes that are expected to happen even if the extent is not known."[16] Cost Management Procedures, a guide developed by CMAA, provides guidance on contingency and states developing a project contingency should be based on the phase of the project (i.e., preliminary estimate, budget estimate, design and bid, or construction), confidence level, and risks anticipated, with recommended contingency amounts varying from +10% to +50% of the total project cost.[17]

In addition to CMAA, the Association for the Advancement of Cost Engineering ("AACE"), the largest international cost management professional association, also recommends allowances for contingency. AACE has developed the Total Cost Management ("TCM") Framework. This framework provides guidance on current best management practices regarding cost engineering, how to plan and control costs,

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[15] See Attachment 6 - CMAA, White Paper: Control of Project Risk for Owners, page 2.
[16] Id. page 8.
[17] Id. page 28.

resources, and risk at any level of project or portfolio management. Contingencies, per AACE, are a best practice for proactively accounting for project risks as part of proper risk mitigation planning.[18] The TCM framework defines contingencies as "an amount added to an estimate (of cost, time, or other planned resource) to allow for items, conditions, or events for which the state, occurrence, and/or effect is uncertain and that experience shows will likely result, in aggregate, in additional cost."[19] The TCM framework finds that contingencies will generally be required on a project, and it is important to allocate funding toward mitigating risks and preventing further costs and/or delays to the project.

These statements from large, reputable cost engineering and construction management organizations illustrate that project contingencies are reasonable, a standard practice, and should not be considered out of line if applied appropriately.

Q22. Are contingencies used outside of Private or Class A Utilities when assessing project costs?

A22. The inclusion of contingencies in project costs is standard universal practice advocated by cost estimating professionals and widely used across industries worldwide. Contingencies are also required and widespread practice by many federal and state agencies, such as the US Army Corps of Engineers,[20] US Department of Energy,[21] and California Department of Transportation[22]. Contingencies are in fact a risk mitigation tool

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[18] See - Attachment 7 - AACE, Total Cost Management Framework, pages 206-209.

[19] Id.

[20] See Attachment 8 - US Army Corps of Engineers, ER 1110-2-1302 Engineering and Design Civil Works Cost Engineering.

[21] See Attachment 9 - US Department of Energy, G 413.3-21 Cost Estimating Guide.

[22] See Attachment 10 - California Department of Transportation, Preparation Guidelines for Project Development Cost Estimates.

for addressing known and unknown risks that have a reasonable probability of affecting the overall budget and schedule.

Q23. Why are contingencies critical for project success, and key to mitigating risks of project unknowns?

A23. Project risk management focuses on identifying and assessing project risks and managing those risks to minimize the impact. Contingencies are a mitigation tool utilized to address unknown and known risks that could affect a project's overall budget and schedule. Additionally, design errors and omissions are recognized as "known unknown" risks that cost engineers need to consider during budget estimation. Given that California American Water must forecast a project scope, timing, and budget sometimes up to 4 years in advance, it is unreasonable for Cal Advocates to expect a perfectly precise scope, timeline, and project budget can be developed. As discussed in this testimony, multiple agencies, organizations, and articles support the utilization of contingencies. These contingencies are considered reasonable costs applied based on sound industry practices to mitigate the risk of unknowns.

Q24. Please describe the contingency applied across capital projects in California American Water's application.

A24. Over half of California American Water's capital projects in this GRC application apply a minimal 0-5% contingency. In rare cases, less than 1% of California American Water's projects within this GRC application, a maximum project contingency is applied at 25%. In review, California American Water's total investment projects, roughly 58% of projects had 0-5% contingency applied, approximately 42% of projects have a contingency of 15% applied, and less than 1% of projects have a contingency of 25%.

Q25. How would the blanket removal of all requested contingency factors impact California American Water financially?

A25. California American Water's estimated capital costs include an estimated contingency over the three-year rate case cycle of 2024 to 2026 of $48.6 million and $5.7 million for 2023. In year 2023 alone, following Cal Advocates' recommendation to exclude all contingency would result in California American Water absorbing capital-related revenue requirements of up to approximately $745,000 per year until 2027. This equates to California American Water absorbing $2.2 million over 3 years. Cal Advocates' recommendation to exclude contingency places significant, unreasonable financial burden on California American Water.

Q26. Should the Commission reject California American Water's proposal to include the 5% to 25% contingency and requests to eliminate all contingency from capital project budgets?

A26. No. Cal Advocates cherry-picked historical cost and has framed it as the single component California American Water utilizes to assign appropriate project and contingency costs which is inaccurate. Cal Advocates is inconsistent with its previous position in testimony regarding contingency, disregards standard industry best management practices, and ignores the application of contingency utilized across both private and public industries. Cal Advocates ignores that contingencies are required by many state and federal agencies for project cost estimating (e.g., California Department Transportation, Department of Energy, US Army Corps of Engineers), and that contingencies are strongly advocated for by recognized industry associations as a best management practice (e.g., CMAA, AACE). Finally, Cal Advocates' recommendation to exclude contingency places a significant unreasonable financial burden on California American Water.

D. Retirements

Q27. Do you have any comments on Cal Advocate's analysis of the retirement data in Ibrahim Testimony Attachment 4 Early Retirement Calculation? [23]

A27. Yes, First, California American Water does not use a methodology that depreciates assets based on whole life individually but uses the methodology of "Average Remaining Life of a group" which was previously approved by the Commission and is summarized in Dave Stephenson's Rebuttal Testimony, Section III.C.

Second, California American Water's review of Ibrahim Testimony Attachment 4 noted that the relative magnitude of the original cost of individual retired plant items is low; thus, as stated in Dave Stephenson's Rebuttal Testimony, Section III.C., it is within reason not to term the items "major units of property."

To illustrate the misapplied use of "major units of property" in Ibrahim Testimony Attachment 4, I refer to the eight items out of 655 items of recorded retirements in 2018-2022 that had original cost between 5% to 15.8% of their respective plant account year-end balance and the one item that was 29.3% ($11,813 retired of $40,370 total in the account). All other 646 items were less than 5% of their respective plant account year-end balance. The nine total items greater than 5% of their respective year-end plant account balance include the following: two items retired in California American Water Corporate district, which made up a combined 13.4% ; one item in Larkfield district, which was 29.3% ($11,813 retired of $40,370 total for the Misc. Equipment account); three items in the Ventura District, each retired between 5.2% to 15.8%; and lastly, the Sacramento District had three items retired, each between 12.2% to 13.3%. Of all these items just mentioned, the magnitude of original cost relative to the district's overall plant ranged from 0.0% to a high of 0.9%. All other items with the highest original cost in a

[23] Ibrahim Testimony, Attachment 4.

district fell between 0.0% to 0.4% of the respective district's total plant balance. In addition, only California American Water Corporate District (3) and Sacramento (2) had items of original cost greater than $100,000. Los Angeles, Larkfield, Monterey County, Monterey Wastewater, San Diego, and Ventura had no items valued greater than $100,000. Details of the recorded retirements are listed in the table below. (YE-year end is retired year -1, otherwise the item would be $0 in the year retired.) Please note, none of the items provided by Cal Advocates in Ibrahim Testimony Attachment 4 would meet the categorical definition of major units of property, if a methodology of whole life for individual assets was being utilized. And as I reviewed earlier, California American Water employs the previously approved methodology of "Average Remaining Life of a group" and that should be upheld and applied in this case.

Table 1. Highest Original Cost of Recorded Retirements in Cal Advocates Attachment 4; all those greater than $100,000 plus the next five highest in the District [24] [25]

Ref	District	Original Cost	Account	% District YE Plnt Acct Bal	% District YE Total Plnt Bal
	Original cost >= 5% of District account				
1	CA Corp	$227,869	340200 - Comp & Periph Equip	7.4%	0.9%
2	CA Corp	$183,042	340200 - Comp & Periph Equip	6.0%	0.7%
3	Larkfield	$11,813	347000 - Misc Equipment	29.3%	0.1%
4	Ventura	$35,547	345000 - Power Operated Equipment	7.0%	0.0%
5	Ventura	$26,272	345000 - Power Operated Equipment	5.2%	0.0%
6	Ventura	$12,508	340200 - Comp & Periph Equip	15.8%	0.0%
7	Sacramento	$85,864	341100 - Trans Equip Lt Duty Trks	13.3%	0.0%
8	Sacramento	$78,703	341100 - Trans Equip Lt Duty Trks	12.2%	0.0%
9	Sacramento	$81,506	341100 - Trans Equip Lt Duty Trks	12.6%	0.0%
	Original cost < 5% of District account				
11	CA Corp	$157,470	340310 - Comp Software Mainframe	0.7%	0.4%
12	CA Corp	$98,590	340300 - Computer Software	1.8%	0.3%
13	CA Corp	$68,857	340200 - Comp & Periph Equip	3.6%	0.2%

[24] Ibrahim Testimony Attachment 4.

[25] See ALL_CH07_PLT_RO_Recorded, Plant Balances WS-1 (California American Water, 2022 GRC, RO Model, 2023-01-27 Updated Application) for year-end balances.

Ref	District	Original Cost	Account	% District YE Plnt Acct Bal	% District YE Total Plnt Bal
14	CA Corp	$63,712	340300 - Computer Software	1.2%	0.2%
15	CA Corp	$58,705	340300 - Computer Software	1.1%	0.2%
16	CA Corp	$46,315	340300 - Computer Software	0.8%	0.1%
17	Los Angeles	$55,546	346100 - Comm Equip Non-Telephone	2.9%	0.0%
18	Los Angeles	$50,167	346100 - Comm Equip Non-Telephone	2.6%	0.0%
19	Los Angeles	$49,501	346100 - Comm Equip Non-Telephone	2.6%	0.0%
20	Los Angeles	$49,177	346100 - Comm Equip Non-Telephone	2.6%	0.0%
21	Los Angeles	$47,929	346100 - Comm Equip Non-Telephone	2.5%	0.0%
22	Larkfield	$45,089	311200 - Pump Eqp Electric	4.5%	0.3%
23	Larkfield	$36,179	334100 - Meters	4.1%	0.2%
24	Larkfield	$27,989	335000- Hydrants	3.9%	0.2%
25	Larkfield	$10,407	335000- Hydrants	1.5%	0.1%
26	Monterey County	$48,341	304100 - Struct & Imp-Supply	0.9%	0.0%
27	Monterey County	$46,591	311200 - Pump Eqp Electric	0.2%	0.0%
28	Monterey County	$31,723	311200 - Pump Eqp Electric	0.2%	0.0%
29	Monterey County	$30,285	311200 - Pump Eqp Electric	0.1%	0.0%
30	Monterey County	$30,285	311200 - Pump Eqp Electric	0.1%	0.0%
31	Monterey WW	$17,649	371100 - WW Pump Equip Elect	1.1%	0.1%
32	Monterey WW	$10,470	371100 - WW Pump Equip Elect	0.6%	0.1%
33	Monterey WW	$10,115	371100 - WW Pump Equip Elect	0.6%	0.1%
34	Monterey WW	$3,316	380625 - WW TD Equip Gen Trmt	3.6%	0.0%
35	Monterey WW	$3,118	354400 - WW Struct & Imp Treatment	0.2%	0.0%
36	San Diego	$20,720	334100 - Meters	0.6%	0.0%
37	San Diego	$18,788	334100 - Meters	0.5%	0.0%
38	San Diego	$18,603	334100 - Meters	0.5%	0.0%
39	San Diego	$15,156	333000 - Services	0.1%	0.0%
40	San Diego	$14,075	334100 - Meters	0.4%	0.0%
41	Ventura	$16,621	335000 - Hydrants	0.4%	0.0%
42	Ventura	$11,026	333000 - Services	0.1%	0.0%
43	Sacramento	$233,446	307000 -Wells & Springs	1.8%	0.1%

Ref	District	Original Cost	Account	% District YE Plnt Acct Bal	% District YE Total Plnt Bal
44	Sacramento	$127,163	346100 - Comm Equip Non-Telephone	2.9%	0.0%
45	Sacramento	$82,438	320100 - WT Equip Non-Media	0.3%	0.0%
46	Sacramento	$79,289	307000 - Wells & Springs	0.5%	0.0%

Q28. What does the analysis reveal about retired items over or under $100,000?

A28. California American Water's review of Cal Advocates' Attachment 4 confirms Stephenson Rebuttal Testimony regarding Cal Advocates' incorrect assertion of assets as Major units because, in the entire data set, only five items out of 655 were over $100,000 (0.8%) and 523 out of 655 were under $10,000 (79.8%). Therefore, again, as stated in Stephenson Rebuttal Testimony, it is within reason not to term the items a major unit of property. Please see the table below.

Table 2. Original Cost of Recorded Retirements in Cal Advocates Attachment 4 [26]

# Occurrences	<= $10,000	$10,001 to $99,999	>= $100,000	Total
CA Corp	131 84.0%	22 14.1%	3 1.9%	156
Los Angeles	22 44.9%	27 55.1%	0 0.0%	49
Larkfield	39 88.6%	5 11.4%	0 0.0%	44
Monterey County	79 81.4%	18 18.6%	0 0.0%	97
Monterey WW	15 83.3%	3 16.7%	0 0.0%	18
San Diego	23 82.1%	5 17.9%	0 0.0%	28
Ventura	10 62.5%	6 37.5%	0 0.0%	16
Sacramento	204 82.6%	41 16.6%	2 0.8%	247

[26] Ibrahim Testimony Attachment 4.

# Occurrences	<= $10,000	$10,001 to $99,999	>= $100,000	Total
Total	523 79.8%	127 19.4%	5 0.8%	655

IV. CONCLUSION

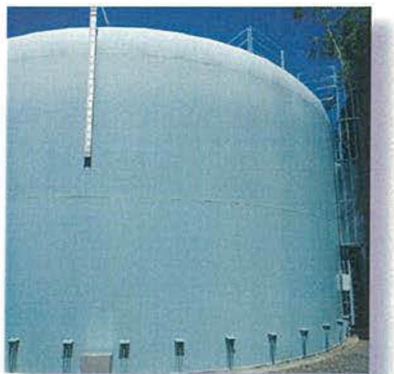
Q29. Does this conclude your testimony?

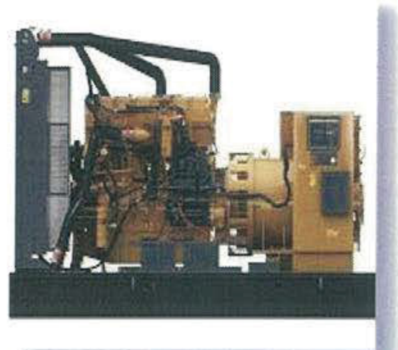
A29. Yes, it does.

ATTACHMENT 1

CALIFORNIA
AMERICAN WATER

Water System Redundancy Emergency Power Study Report





FINAL REPORT

AUGUST 2022

REGISTERED PROFESSIONAL ENGINEER
RAMESH NARASIMHAN
No. 51059
CIVIL
STATE OF CALIFORNIA
8/16/22

CELEBRATING 25 YEARS
NCS Engineers
DELTA SYSTEMS
Established 1997

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2.0 COMPARISON OF PORTABLE AND STATIONARY GENERATORS

CalAm recently completed PSPS analyses and the Federally required, confidential AWIA Risk and Resilience Assessments. These two exercises provided a consolidated list of critical assets for the individual systems. Emergency power at critical assets ensures CalAm can maintain water service to most customers. EPA's 2019 "Power Resilience Guide for Water and Wastewater Utilities" recommends installing stationary generators with automatic transfer switches at all 'critical' facilities. CalAm and NCS utilized the recommendation in this study and has reviewed each site based on criticality and operator safety.

Critical sites were automatically categorized as needing stationary generators. However, some critical sites do not have the space for a stationary generator, so portable generators will be utilized. Other sites were evaluated on their location and terrain (Safety and Response Time), the number of historical power outages, and the functional space at the site.

Operator safety is also reflected in this study's results. The terrain of the various sites, the increased frequency and intensity of storms, and the threat of wildfires, often resulting in minimal to no access to facilities, necessitated a review of the risks of hauling portable generators during these events. In order to ensure our utility workers are exposed to the least risk, CalAm evaluates how risks can be reasonably engineered out and avoided. Therefore, installing stationary emergency generators were recommended in the highest risk locations.

ATTACHMENT 2

Docket:	:	A.16-07-002
Exhibit Number	:	ORA - ____
Commissioner	:	M. Picker
Administrative Law Judge	:	S. Park
ORA Witness	:	Justin Menda

ORA
OFFICE OF RATEPAYER ADVOCATES

REPORT AND RECOMMENDATIONS ON PROPOSED UTILITY PLANT IN SERVICE

Application 16-07-002

San Francisco, California
February 13, 2017

TABLE OF CONTENTS

MEMORANDUM

The requests and data presented by California American Water (“Cal Am”) in Application (“A.”) A.16-07-002 were examined in order to provide the Commission with recommendations that represent the interests of ratepayers for safe and reliable service at lowest cost. Suzie Rose is ORA’s project lead for the proceeding. Richard Rauschmeier is ORA’s oversight supervisor. Paul Angelopulo and Kerriann Sheppard are ORA’s legal counsels.

Although every effort was made to comprehensively review, analyze and provide the Commission with recommendations on each ratemaking and policy aspect presented in the application, the absence from ORA’s testimony of any particular issue does not necessarily constitute its endorsement or acceptance of the underlying request, methodology, or policy position related to that issue.

1

I. COMMON PLANT ISSUES

A. INTRODUCTION

This chapter provides ORA's analysis and recommendations on common plant issues affecting plant estimates in multiple Cal Am's districts.

B. SUMMARY OF RECOMMENDATIONS

The following recommendations are based on examination of capital planning and budgets issues that affect plant estimates in multiple districts. These recommendations serve as a basis for specific adjustments to Cal Am's proposed projects and capital budget for the 2018-2019 period.

1. Advanced Metering Infrastructure (AMI)

Full implementation of AMI in the Los Angeles, Ventura, San Diego, and Monterey districts should not be authorized without first receiving and evaluating results of Cal Am's completed pilot tests and ensuring that the findings of the pilot tests are incorporated into any full program implementation proposals.

2. Tank Painting

Only one of Cal Am's six proposed tank painting projects in the 2018-2019 period should be authorized based on Cal Am's historical execution of authorized tank painting projects.

3. Recycled Water Supply Projects

The Commission should not approve the proposed recycled water projects at this time, prior to knowing the full cost and scope of the projects, and prior to Cal Am submitting the required information for recycled water projects detailed in Decision (D.)14-08-058.

4. Recurring Project (RP) Budget (2018-2019)

The Commission should authorize in rates a lower total 2018-2019 RP budget for the Los Angeles, Monterey, and Sacramento district of $7,261,254, $5,362,540, and $6,983,534 respectively, to better reflect Cal Am's historic spending on tank rehabilitation projects.[1] In addition, the Commission should authorize a lower total 2018-2019 RP budget for the Garrapata service area of $60,125, to better reflect Cal Am's recorded historical expenditure in the Garrapata service area.

5. Carryover Projects Expected to be Completed in 2019 (or Later)

Due to the uncertainty in the schedule of carryover projects that are now scheduled to be completed in 2019 or later but were originally supposed to be completed prior to 2019, the Commission should not authorize their continued inclusion in rates at this time. A list of these projects is shown in Table 1-8 later in this chapter. In the event that Cal Am is able to complete the projects by the revised completion date, Cal Am may request to recover the cost of the project in its next general rate case application, which will be submitted in 2019.

6. Engineering Overhead

The cost estimate for the engineering overhead should be proportional to the number of capital projects allowed in rate base, as opposed to a flat annual amount regardless of the number of capital projects allowed in rate base.

7. 2020 Plant Additions

In this rate case, ORA does not take a position on the prudency or reasonableness of projects scheduled for completion in 2020 (after 2019). The Commission should follow the guidelines put forth in D.07-05-062 for calculating rate base additions in 2020, the attrition year.

C. DISCUSSION

The following recommendations result from ORA's evaluation of capital planning and budgeting issues that affect Cal Am's proposed plant estimates in multiple districts.

[1] The recommended 2018-2019 RP budget for the Sacramento District includes the proposed RP budget for the Dunnigan and Meadowbrook systems.

1. Advanced Metering Infrastructure

Cal Am requests full implementation of AMI in its Los Angeles, Ventura, San Diego, and Monterey districts.[2] Cal Am asserts that the deployment of AMI would result in reduced water consumption, claiming AMI would assist customers in water conservation and help detect leaks (allowing those leaks to be promptly fixed).[3] Table 1-1 displays Cal Am's capital funding[4] request for AMI implementation in the 2018-2019 period. [5]

Table 1-1: Cal Am's Proposed 2018-2019 AMI Projects[6]

District	PID	2018	2019	2018-2019 Total
Ventura	I15-510038	$ 524,727	$ 2,294,356	$ 2,819,083
Los Angeles	I15-500056	$ 705,018	$ 3,105,486	$ 3,810,504
San Diego	I15-300012	$ 544,525	$ 2,457,993	$ 3,002,518
Monterey	I15-400104	$ 1,108,883	$ 5,265,197	$ 6,374,080
Total		$ 2,883,153	$ 13,123,032	$ 16,006,185

In the aforementioned districts, Cal Am divides its request for AMI spending into two project types: through the proposed recurring project budget, and the proposed AMI projects shown in Table 1-1 above.[7] Cal Am intends to utilize its recurring project budget for routine meter replacements to replace existing meters that are scheduled for replacement from 2018-2020 with AMI meters.[8] The projects shown in Table 1-1 above

[2] Testimony of Richard Svindland, p. 41. According to Cal Am, the company recently installed automated meter reading (AMR) meter reading systems in the Larkfield and Sacramento districts and Cal Am does not think it is prudent at this time to install AMI in those districts.

[3] Testimony of Mark Schubert, p. 148. AMI technology allows automated data collection from customer meters (as opposed to having to manually read the meters). The proposed AMI project includes implementation of a web portal that would give customers the ability to access their usage data.

[4] Cal Am requests additional funding for annual expenses related to full implementation of AMI which are discussed in the report and testimony of ORA witness, Daphne Goldberg.

[5] According to Cal Am, it is not intending on replacing all of the meters in the aforementioned districts. When appropriate, Cal Am plans on retrofitting existing meters by installing a Meter Transmission Unit (MTU).

[6] Testimony of Mark Schubert, pp. 149, 158, 162, and 164.

[7] Cal Am intends on replacing approximately 36,600 meters during the 2018-2020 period.

[8] Testimony of Richard Svindland, p. 47. Recurring Project category code R15-xxJ1 is dedicated for

accelerate Cal Am's normal meter replacement rate and replace meters not currently scheduled for replacement before 2021 with AMI meters in the 2018–2020 timeframe.[9] Cal Am's total budget request for AMI implementation for the two project types listed above is $17,963,279 for the 2018-2019 period with an additional $1,367,222 per year in increased operations and maintenance (O&M) expenses related to AMI implementation.[10] If Cal Am's proposed AMI implementation is adopted as proposed, customers would expect an estimated monthly rate increase of $17.[11]

Currently, Cal Am is operating two pilots. Both are "piggybacking" pilots, which in addition to testing AMI meters, also tests the technical feasibility of utilizing an existing Energy Investor Owned Utility's existing AMI data transmission network to transmit data from Cal Am's customers' AMI water meters to Cal Am. Cal Am's current pilots are: 1) an approximate 194 customer pilot in the Monterey District, in conjunction with Pacific Gas and Electric Company (PG&E),[12] and 2) an approximate 1,288 customer pilot in the Ventura District, in conjunction with Southern California Gas Company (SoCal Gas).[13] According to Cal Am, both of the pilots are currently in

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scheduled and unscheduled meter replacement. The "xx" in the RP category code varies depending on the individual district.

[9] According to the Testimony of Richard Svindland at p. 46, approximately 18,400 of the 36,600 meters are part of the accelerated meter replacement. A portion of meters that are part of the accelerated meter replacement are meters that are not compatible with the MTUs. Cal Am states that it intends on replacing old water meters that are slated for replacement in 2022 and 2023, which is outside the rate case period. Cal Am explains that it does not make practical sense to install a new MTU on these meters during the 2018-2020 period only to visit the meter again a few years later. Therefore, Cal Am is proposing to accelerate the replacement of certain meters that are near the end of their useful service life and to include those in the AMI deployment plan.

[10] Cal Am's proposed capital AMI projects cost (both RP and individual) is taken from the ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab. The estimated O&M budget is taken from p. 27 of the Testimony of Todd Pray and ALL_CH_O&M_WP_Other O&M Exp Adj Workpaper, OUT_CAW Specific Adj tab.

[11] 2020 Annual Revenue Requirement of AMI ($7,350,350) / Number of Meters (36,600) / 12 months; where the 2020 Annual Revenue Requirement is assumed as 15% the total (2018-2020) capital cost ($39,444,755) plus the forecasted 2020 annual expense as calculated per the escalation and attrition process of the Rate Case Plan for Class A Water Utilities (D.07-05-062).

[12] Testimony of Richard Svindland, p. 55.

[13] Ibid, pp. 55-56. According to Cal Am's response to data request ORA JMI-007, Q.1.a, provided herein

progress. For the Ventura District AMI pilot, the first AMI meter for the pilot test was installed in August 2016, and the customers participating in the pilot study were just informed in December 2016 that they now have access to the web portal.[14] For the Monterey District AMI pilot, Cal Am is planning to continue the pilot through at least February 2017.[15] Cal Am plans on expanding its pilot in the Monterey District by adding additional customers.[16] Cal Am has not yet provided the Commission with an evaluation of the results of either of these pilots. Cal Am intends on reviewing the results of the pilots once the pilots are complete.[17]

While there are potential benefits to AMI implementation in general, there are also costs. Any net benefits are best realized in programs that are deployed effectively. Effective deployment requires adequate planning, weighing costs and benefits, an alternative analysis, the incorporation of lessons learned from the pilot programs, and other project-relevant analysis and decisions that results from analysis of pilot program results. It is not prudent to authorize funding for full deployment of AMI in the Los Angeles, Ventura, San Diego, and Monterey districts before the on-going AMI pilots in Ventura and Monterey are complete, the results evaluated, and the net benefits to ratepayers measured and demonstrated. To facilitate the development of AMI Water Utility Pilot Programs as partnership projects for water and energy utilities, ORA participated in workshops and provided detailed feedback on proposed AMI Pilots in the Water-Energy Nexus proceeding. As stated in ORA's Comments on the Water-Energy Nexus AMI Proposed Decision, "gaining well-identified estimates of the effect of AMI-based behavior change information will provide both water and electric utilities (and the

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as Attachment 2, approximately 1,288 meters are part of the pilot in the Ventura District.

[14] Cal Am's response to data request ORA JMI-007, Q.1.f, provided herein as Attachment 2. This response also states that as of December 7, 2016 all of the meters in the pilot program were installed.

[15] Ibid, Q.4, provided herein as Attachment 2.

[16] Ibid, Q.3.a, provided herein as Attachment 2. Cal Am is intending on adding another six commercial customers to the pilot program. As of December 7, 2016, 194 customer meters are part of the pilot program.

[17] Ibid, Q.4, provided herein as Attachment 2.

CPUC) with much-needed data points on the cost effectiveness of such programs".[18] The completion of the pilots will allow Cal Am to apply lessons learned from each pilot into its proposal for full deployment in order to create the most efficient AMI system possible, and provide the most cost-effective and beneficial outcomes to the ratepayers. To ensure that the potential benefits of AMI are captured in any future deployment, the results of the on-going pilots must be evaluated and incorporated into Cal Am's proposal for deployment. Since the pilots are not complete and the results are not yet known, it is premature for the Commission to approve funding in rates for the full implementation of an AMI program in this GRC.

Cal Am identifies the following measurements to determine whether the pilot programs are successful: 1) reduction in the volume of field visits to verify reads for pilot accounts; 2) number of proactive notifications of potential leaks; 3) number of customers registering with the web portal; and 4) overall customer satisfaction with the web portal or mobile application.[19] While Cal Am has identified measurements and measuring methods to evaluate to determine the pilot programs success, it has not determined any baselines or performance metrics to compare the results of the pilot tests.[20] Since no baselines for performance metrics have been established, it is unknown at this time what results would indicate the success (or failure) of the pilot tests' objectives.

It is uncertain whether Cal Am intends to, and is collecting data to measure the effectiveness of other potential benefits of AMI, including (but not limited to): sustained decrease in water usage (increased water conservation), and the potential of AMI to help customers detect and repair leaks more quickly. It will also be important to assess, how any water conservation achieved as a result of AMI implementation compares to the effective and cost-effectiveness of other conservation programs. Additionally, in order to

[18] Rulemaking 13-12-011, Comments of the Office of Ratepayer Advocates Regarding AMI Piggybacking Partnership Pilot Program Proposals filed March 4, 2016, p.4.

[19] Cal Am's response to data request A.16-07-002 JMI-007, Q.3.h, provided herein as Attachment 2.

[20] Ibid, Q.3.j, provided herein as Attachment 2.

ensure that the AMI interfaces that would potentially be implemented are as user friendly as possible, Cal Am should solicit customer feedback and incorporate that feedback into the pilot tests' findings.[21]

One of the benefits of AMI asserted by Cal Am is the ability to detect leaks throughout the system. If AMI implementation does in fact detect additional leaks (which has yet to be determined), the leaks would need to be repaired to reduce the amount of water lost through leaks. Cal Am states that it is still in the process of formulating test parameters related to leak detection.[22] It is not yet possible to confirm whether the AMI implementation: 1) successfully increases leak detection, 2) results in leaks being repaired at a higher rate and/or more quickly than sans AMI implementation, and 3) if the pilot tests are capable of assessing success in this area.

Another potential benefit of AMI implementation is the ability of AMI meters to detect backflow incidents in the distribution system. A backflow incident occurs when water moves backwards through the meter from the customer's side of the meter into the distribution system). Backflow incidents present a potential health hazard due to the potential for cross-examination issues.[23] While backflow detection is a potential benefit of AMI implementation, the pilot programs are currently not set up to assess this potential benefit.[24]

Cal Am is considering two options for the proposed full implementation of AMI: 1) Cal Am owns and operates its own communications network; and 2) Cal Am contracts

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[21] Cal Am intends on soliciting feedback from their customers either through their web portal or a separate electronic survey prior to the completion date of the pilot program.

[22] Cal Am's response to data request ORA JMI-007, Q.1.m.i and Q.3.k.i, provided herein as Attachment 2.

[23] Cross-contamination can occur within a water system when there is a connection between the potable water system and any other source or system. This may introduce any used water or other substances into the potable water system. Backflow incidents may cause the potable water supply to be contaminated when the normal water pressure in the system drops suddenly and reverses the flow from the customer-side of the meter back into the drinking water supply.

[24] Cal Am's response to data request ORA JMI-007, Q.1.m.ii and Q.3.k.ii, provided herein as Attachment 2.

with an existing communication network provider.[25] Cal Am is evaluating both of these options and is determining cost and feasibility of each option.[26] At this time, Cal Am considers the latter option as the more viable option.[27] However, Cal Am has not received any formal pricing for the "piggyback" option and notes that any cost estimation at this time is preliminary.[28] The pilot tests are intended to provide more insight on which option is more feasible and cost effective.

AMI deployment requires a significant initial capital investment, and also requires significant ongoing operation and maintenance expenses for network upkeep, data management and storage, and other expenses. It is therefore essential to ensure that, if deployed, the type of meters selected, the vendors contracted, and the set-up of the system are efficient, effective, user-friendly, and cost-effective. While Cal Am lists the *potential* benefits of AMI, the benefits are speculative and unconfirmed at this time. Cal Am does not provide a cost effectiveness analysis, nor an assessment of the return on investment expected for AMI implementation.

The pilot projects have the potential to provide significant useful information regarding the extent of the actual benefits of AMI, the cost-effectiveness of these benefits compared to other potential water conservation programs, and the potential return on investment of AMI implementation when all benefits are considered. Since the two AMI pilots are still in process and evaluation of outcomes and net benefits to ratepayers are not yet complete, the Commission should not commit ratepayer funds to full AMI implementation at this time. In addition, to ensure that the proposed AMI deployment is cost-effective and prior to making the investment of full AMI implementation, the results of the pilot tests must demonstrate that any proven benefits of AMI are at least as cost-effective as other methods of conservation.

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[25] Testimony of Richard Svindland, Attachment 5: Cal Am 2018 AMI Plan, p. 9.

[26] Ibid. According to Cal Am, it has not yet solicited any AMI vendors for requests for proposal (RFP) quality pricing and has not received any formal pricing from host utilities for the "piggyback" option.

[27] Ibid.

[28] Testimony of Richard Svindland, p. 58.

D.16-12-026 from Rulemaking (R.) 11-11-008 provides guidance for utilities in proposing AMI deployment. For Class A water IOUs, the Decision orders a gradual approach to AMI deployment, to be conducted through two rate case cycles.[29] Regarding proposals for AMI deployment in GRC applications, the decision states that the proposals will be assessed for consistency with a number of general principles, as well as "their contribution to leak, backflow, and theft detection, and ability to enable action to address those issues."[30] Cal Am proposal fails to address any of these issues in significant detail. While Cal Am submitted its proposal before D.16-12-026 was issued, leak, backflow, and theft detection are all significant issues that should be addressed in Cal Am's proposal for consideration by the Commission.

In order to ensure that Cal Am's AMI implementation plan is prudent, well-developed, and provides maximum benefit to Cal Am's ratepayers for their significant investment in AMI infrastructure, the results of the pilot programs should be evaluated, submitted to the Commission for review, and incorporated into Cal Am's AMI proposal before the Commission considers funding full deployment of AMI. Cal Am's proposal should include a cost-effective analysis of AMI deployment based on the results of the pilot programs. Additionally, in accordance with D.16-12-026, Cal Am's AMI proposal should address leak, theft, and backflow protection.

Cal Am can submit its AMI proposal which incorporates the results of the pilot programs, provides a cost-benefit analysis, and provides additional specificity regarding the issues discussed in D.16-12-026 in its next GRC application. If Cal Am is able to provide a well-developed proposal before its next GRC cycle, it may also submit an application specifically targeting AMI deployment.

2. Tank Painting

Table 1-2 below displays Cal Am's proposed tank painting projects.[31]

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[29] At p. 64.

[30] At p. 65.

[31] On p.86 of the Amended Partial Settlement Agreement between Cal Am and ORA for the 2013 rate

Table 1-2: Cal Am's Proposed 2018-2019 Tank Painting Projects[32]

San Diego

Tank	2018	2019	Total
Montgomery Tank	$ 0	$ 0	$ 0
Highland Tank	$ 0	$ 0	$ 0
Total	$ 0	$ 0	$ 0

Los Angeles

Tank	2018	2019	Total
Olympiad Reservoir	$ 4,320	$ 0	$ 4,320
Oak Knoll Reservoir	$ 0	$ 4,320	$ 4,320
Danford Reservoir	$ 4,320	$ 4,480	$ 8,800
Mt. Vernon Reservoir	$ 0	$ 4,320	$ 4,320
Garth Reservoir	$ 0	$ 4,480	$ 4,480
Patton Reservoir	$ 2,458	$ 0	$ 2,458
Lamanda Reservoir	$ 4,320	$ 0	$ 4,320
Rosemead Reservoir	$ 4,320	$ 0	$ 4,320
Longden Reservoir	$ 108,000	$ 0	$ 108,000
Spinks Reservoir	$ 27,000	$ 2,800	$ 29,800
Bliss Canyon Reservoir	$ 4,320	$ 3,920	$ 8,240
Scott Reservoir	$ 14,580	$ 2,800	$ 17,380
Starpine Reservoir	$ 4,320	$ 0	$ 4,320
Homeland Reservoir	$ 0	$ 4,480	$ 4,480
Angeles Mesa Reservoir	$ 0	$ 4,320	$ 4,320
Vineyard Reservoir	$ 0	$ 0	$ 0
Total	$ 177,958	$ 35,920	$ 213,878

case (A.13-07-002), Cal Am and ORA agreed that all tank painting /maintenance expense should be deferred and amortized to expense of five years for study costs and ten years for all other tank painting costs. In its current application, Cal Am refers to tank painting projects as deferred tank improvement projects.

[32] Testimony of Mark Schubert, pp. 193-196.

Ventura

Tank	2018	2019	Total
Potrero Reservoir #1	$ 4,320	$ 0	$ 4,320
Las Posas Tank #2	$ 4,320	$ 0	$ 4,320
Dos Vientos IIA	$ 4,160	$ 0	$ 4,160
Dos Vientos IIB	$ 4,493	$ 0	$ 4,493
Dos Vientos III	$ 4,852	$ 0	$ 4,852
Pace Reservoir	$ 0	$ 4,320	$ 4,320
Moorpark Reservoir	$ 0	$ 4,320	$ 4,320
Los Robles Tank#1	$ 0	$ 4,320	$ 4,320
Orbis Tank	$ 0	$ 4,480	$ 4,480
Shopping Center Reservoir #2	$ 0	$ 4,480	$ 4,480
Wildwood Tank	$ 0	$ 0	$ 0
Industrial Park Reservoir #1	$ 0	$ 0	$ 0
Industrial Park Reservoir #2	$ 0	$ 0	$ 0
Janss Tank	$ 0	$ 0	$ 0
Potrero Reservoir #2	$ 0	$ 0	$ 0
Total	$ 22,145	$ 21,920	$ 44,065

Monterey

Tank	2018	2019	Total
Hilby Tank#1	$ 2,278	$ 492,744	$ 495,022
Hilby Tank#2	$ 9,490	$ 473,735	$ 483,225
La Rancheria Tank #2	$ 240,816	$ 0	$ 240,816
Paseo Pravada Upper Tank	$ 4,606	$ 0	$ 4,606
Pebble Beach Tank #2	$ 132,000	$ 0	$ 132,000
Tierra Grande Middle Tank	$ 4,000	$ 0	$ 4,000
Rio Vista Tank #1	$ 9,212	$ 0	$ 9,212
Ryan Ranch Tank	$ 4,700	$ 0	$ 4,700
Upper Airways	$ 2,369	$ 105,021	$ 107,390
Lower Toyon #1	$ 0	$ 2,369	$ 2,369
Tierra Grande Lower	$ 0	$ 4,790	$ 4,790
Tierra Grande Upper	$ 0	$ 9,212	$ 9,212
Presidio #1	$ 0	$ 2,369	$ 2,369
Total	$ 409,471	$ 1,090,240	$ 1,499,711

Sacramento

Tank	2018	2019	Total
Rose Parade Finished Tank	$ 4,300	$ 0	$ 4,300
Rose Parade Backwash Tank	$ 4,300	$ 0	$ 4,300
Cook-Riolo Tank	$ 4,300	$ 0	$ 4,300
Parksite Backwash Tank #2	$ 9,000	$ 0	$ 9,000
Vintage Treatment Plant Tank	$ 0	$ 4,700	$ 4,700
Isleton Elevated Tank	$ 0	$ 4,700	$ 4,700
Isleton TP Recovery Tank	$ 0	$ 4,700	$ 4,700
Isleton TP Backwash Tank	$ 0	$ 4,700	$ 4,700
Roseville Road Tank	$ 0	$ 4,700	$ 4,700
WG Islandview TP Tank	$ 0	$ 4,700	$ 4,700
Total	$ 21,900	$ 28,200	$ 50,100

Larkfield

Tank	2018	2019	Total
Upper Wikiup #2	$ 4,300	$ 0	$ 4,300
Lower Wikiup #2	$ 0	$ 4,700	$ 4,700
North Wikiup #2	$ 0	$ 4,700	$ 4,700
North Wikiup #1	$ 0	$ 0	$ 0
Total	$ 4,300	$ 9,400	$ 13,700

Cal Am has not completed a significant number of tank painting projects authorized and funded in rates over the last two GRCs. In the 2013 rate case, ORA identified that Cal Am had not completed all 43 tank painting projects that were previously authorized and funded in rates. In fact, only seven of the 43 tank painting projects were completed.[33] This issue of Cal Am significantly over-estimating the number of tanks in need of painting appears to be a recurring problem. Currently, Cal Am has completed only five of the 23 projects authorized and funded from the last rate case.[34] Table 1-3 below shows the tank painting projects authorized in the 2013 GRC and their completion status.

[33] Cal Am's response to data request ORA TS2-011, Q.1 from A.13-07-002. For an additional two projects that were also to have been completed, Cal Am indicated that work had begun.

[34] Authorized in D. 15-04-007. Attachment A (Partial Settlement between Cal Am, ORA, and City of Pacific Grove, Las Palmas Wastewater Committee, Monterey Peninsula Water Management District) Attachment B-4, Cal Am set a schedule of the tank painting projects Cal Am intended on completing.

Table 1-3: Cal Am Planned Tank Painting Projects[35]

Tank	District	Year	Completed	Additional Funding Requested in this Rate Case?
Mather	Sacramento	2015	No	No
Parksite #1	Sacramento	2015	No	No
Parksite #2	Sacramento	2016	No	Yes
Upper Wikiup	Larkfield	2015	No	No
Backwash/Sludge Tank	Larkfield	2014	No	No
Airways Lower	Monterey	2014	No	No
Airways Upper	Monterey	2015	No	Yes
Forest Lake #1	Monterey	2016	No	No
High Meadows	Monterey	2016	No	No
Hilby #1	Monterey	2015	No	Yes
Hilby#2	Monterey	2015	No	Yes
Pebble Beach #2	Monterey	2015	No	Yes
Pebble Beach #3	Monterey	2013	No	No
Presidio#1	Monterey	2016	No	Yes
Presidio#2	Monterey	2013	No	No
Toyon Lower #1	Monterey	2016	No	No
La Rancheria #2	Monterey	2015	No	Yes
Janss	Ventura	2016	Yes	No
Wildwood	Ventura	2014	Yes	No
Lamanda	LA (SM-Upper)	2015	in 2017	No
Oak Knoll	LA (SM-Upper)	2014	Yes	No
Starpine	LA(Duarte)	2013	Yes	No
Highland Tank	San Diego	2015	No	Yes

Table 1-3 also shows that Cal Am is requesting additional funding in this application for a number of tank painting projects that were previously authorized and funded in its 2013 rate case. Since these projects were approved and funded in the 2013

[35] Cal Am's response to data request ORA JMI-010 and ORA JMI-010.2, provided herein as Attachments 3 and 4, respectively. For the Lamanda Tank in the Los Angeles District, Cal Am anticipates completing this project in 2017.

GRC but Cal Am has not yet completed these projects, no additional funding should be provided in this GRC.

The tank inspection report conducted by Tank Industry Consultants (TIC) provides a cost estimate of the improvements necessary for a given tank. However, the cost estimate provides the costs for both capital improvements and deferred tank improvements (tank painting). According to Cal Am, any capital tank improvements would be funded through the Tank Rehabilitation recurring project budget category.[36] Table 1-4 compares Cal Am's funding requests with ORA's recommendations for individual tank painting projects. Table 1-5 below compares Cal Am's funding requests with ORA's recommendations for tank painting projects.

Table 1-4: ORA's Recommended 2018-2019 Tank Painting Projects

			Recommended Budget	
Tank	District	Year	Cal Am	ORA
Longden Reservoir	Los Angeles	2018	$ 108,000	$ 108,000
Upper Airways	Monterey	2019	$ 105,021	$ 0
Hilby Tank#1	Monterey	2019	$ 492,744	$ 0
Hilby Tank #2	Monterey	2019	$ 473,735	$ 0
Pebble Beach #2	Monterey	2018	$ 132,000	$ 0
La Rancheria	Monterey	2018	$ 240,816	$ 0

Table 1-5 Cal Am's and ORA's Recommended 2018-2019 Tank Painting Project Cost Comparison

San Diego

	ORA		Cal Am	
Tank	2018	2019	2018	2019
Montgomery Tank	$ 0	$ 0	$ 0	$ 0
Highland Tank	$ 0	$ 0	$ 0	$ 0
Total	$ 0	$ 0	$ 0	$ 0

[36] Testimony of Mark Schubert, p. 192.

Los Angeles

Tank	ORA		Cal Am	
	2018	2019	2018	2019
Olympiad Reservoir	$ 4,320	$ 0	$ 4,320	$ 0
Oak Knoll Reservoir	$ 0	$ 4,320	$ 0	$ 4,320
Danford Reservoir	$ 4,320	$ 4,480	$ 4,320	$ 4,480
Mt. Vernon Reservoir	$ 0	$ 4,320	$ 0	$ 4,320
Garth Reservoir	$ 0	$ 4,480	$ 0	$ 4,480
Patton Reservoir	$ 2,458	$ 0	$ 2,458	$ 0
Lamanda Reservoir	$ 4,320	$ 0	$ 4,320	$ 0
Rosemead Reservoir	$ 4,320	$ 0	$ 4,320	$ 0
Longden Reservoir	$ 108,000	$ 0	$ 108,000	$ 0
Spinks Reservoir	$ 27,000	$ 2,800	$ 27,000	$ 2,800
Bliss Canyon Reservoir	$ 4,320	$ 3,920	$ 4,320	$ 3,920
Scott Reservoir	$ 14,580	$ 2,800	$ 14,580	$ 2,800
Starpine Reservoir	$ 4,320	$ 0	$ 4,320	$ 0
Homeland Reservoir	$ 0	$ 4,480	$ 0	$ 4,480
Angeles Mesa Reservoir	$ 0	$ 4,320	$ 0	$ 4,320
Vineyard Reservoir	$ 0	$ 0	$ 0	$ 0
Total	$ 177,958	$ 35,920	$ 177,958	$ 35,920

Ventura

Tank	ORA		Cal Am	
	2018	2019	2018	2019
Potrero Reservoir #1	$ 4,320	$ 0	$ 4,320	$ 0
Las Posas Tank #2	$ 4,320	$ 0	$ 4,320	$ 0
Dos Vientos IIA	$ 4,160	$ 0	$ 4,160	$ 0
Dos Vientos IIB	$ 4,493	$ 0	$ 4,493	$ 0
Dos Vientos III	$ 4,852	$ 0	$ 4,852	$ 0
Pace Reservoir	$ 0	$ 4,320	$ 0	$ 4,320
Moorpark Reservoir	$ 0	$ 4,320	$ 0	$ 4,320
Los Robles Tank#1	$ 0	$ 4,320	$ 0	$ 4,320
Orbis Tank	$ 0	$ 4,480	$ 0	$ 4,480
Shopping Center Reservoir #2	$ 0	$ 4,480	$ 0	$ 4,480
Wildwood Tank	$ 0	$ 0	$ 0	$ 0
Industrial Park Reservoir #1	$ 0	$ 0	$ 0	$ 0
Industrial Park Reservoir #2	$ 0	$ 0	$ 0	$ 0
Janss Tank	$ 0	$ 0	$ 0	$ 0
Potrero Reservoir #2	$ 0	$ 0	$ 0	$ 0
Total	$ 22,145	$ 21,920	$ 22,145	$ 21,920

Sacramento

Tank	ORA		Cal Am	
	2018	2019	2018	2019
Rose Parade Finished Tank	$ 4,300	$ 0	$ 4,300	$ 0
Rose Parade Backwash Tank	$ 4,300	$ 0	$ 4,300	$ 0
Cook-Riolo Tank	$ 4,300	$ 0	$ 4,300	$ 0
Parksite Backwash Tank #2	$ 9,000	$ 0	$ 9,000	$ 0
Vintage Treatment Plant Tank	$ 0	$ 4,700	$ 0	$ 4,700
Isleton Elevated Tank	$ 0	$ 4,700	$ 0	$ 4,700
Isleton TP Recovery Tank	$ 0	$ 4,700	$ 0	$ 4,700
Isleton TP Backwash Tank	$ 0	$ 4,700	$ 0	$ 4,700
Roseville Road Tank	$ 0	$ 4,700	$ 0	$ 4,700
WG Islandview TP Tank	$ 0	$ 4,700	$ 0	$ 4,700
Total	$ 21,900	$ 28,200	$ 21,900	$ 28,200

Larkfield

Tank	ORA		Cal Am	
	2018	2019	2018	2019
Upper Wikiup #2	$ 4,300	$ 0	$ 4,300	$ 0
Lower Wikiup #2	$ 0	$ 4,700	$ 0	$ 4,700
North Wikiup #2	$ 0	$ 4,700	$ 0	$ 4,700
North Wikiup #1	$ 0	$ 0	$ 0	$ 0
Total	$ 4,300	$ 9,400	$ 4,300	$ 9,400

Monterey

Tank	ORA		Cal Am	
	2018	2019	2018	2019
Hilby Tank#1	$ 2,278	$ 0	$ 2,278	$ 492,744
Hilby Tank#2	$ 9,490	$ 0	$ 9,490	$ 473,735
La Rancheria Tank #2	$ 0	$ 0	$ 240,816	$ 0
Paseo Pravada Upper Tank	$ 4,606	$ 0	$ 4,606	$ 0
Pebble Beach Tank #2	$ 0	$ 0	$ 132,000	$ 0
Tierra Grande Middle Tank	$ 4,000	$ 0	$ 4,000	$ 0
Rio Vista Tank #1	$ 9,212	$ 0	$ 9,212	$ 0
Ryan Ranch Tank	$ 4,700	$ 0	$ 4,700	$ 0
Upper Airways	$ 2,369	$ 0	$ 2,369	$ 105,021
Lower Toyon #1	$ 0	$ 2,369	$ 0	$ 2,369
Tierra Grande Lower	$ 0	$ 4,790	$ 0	$ 4,790
Tierra Grande Upper	$ 0	$ 9,212	$ 0	$ 9,212
Presidio #1	$ 0	$ 2,369	$ 0	$ 2,369
Total	$ 36,655	$ 18,740	$ 409,471	$ 1,090,240

3. Recycled Water Projects

In this rate case, Cal Am is proposing three separate recycled water projects in their Los Angeles (Baldwin Hills; I15-500059), San Diego (I15-300016), and Sacramento (I15-600091) districts. Cal Am requests pre-approval of the three projects as Tier 2 Advice Letter (AL) projects.

An AL is an informal request by the utility to the Commission to approve a change in rates, a term of service (including changes in tariffs), or a proposed utility action that has not been approved in a previous proceeding. AL requests to recover the funding for completed plant addition projects separate from Cal Am's proposed rate increase in its GRC application. Cal Am's proposed rate increase in its GRC exclude any rate increases due to ALs filed during that rate case cycle period. Therefore, if AL projects are approved, the proposed rate increase seen in the GRC application does not provide a true representation of the increase in rates that customers will experience over the rate case cycle. Cal Am customers expressed concern and frustration at Public Participation Hearings regarding this issue. For example, one customer in the Monterey District noted: *"the process before the PUC deals in silos, as I kind of describe it. So this general rate case will exclude a number of issues that are not directly related to the general rate case… that are treated independently and separately by the PUC… in many ways the people who participate in these decision-making silos don't get the full picture… and yet the impacts of individual silos on the community is what the community feels…"*[37]

It is important to note that D.14-08-058 (*Decision Adopting a Comprehensive Policy Framework and Minimum Project Criteria Requirements for Recycled Water Projects*; R.10-11-014) provides authorization for Cal Am to file ALs for recycled water projects, provided that the recycle water project meets three eligibility criteria.[38] D.14-

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[37] A.16-07-002 Seaside Public Participation Hearing Transcript, pp. 281-282.

[38] Which are, as stated on p. B-1: "1) The proposed project has a revenue impact of less than five (5) percent of the proposing Investor Owned Water and Sewer Utility's (IOWSU's) revenue requirement in the associated ratemaking area; 2). The proposed project does not require National Environmental Protection Act ("NEPA") or California Environmental Quality Act (CEQA) review and/or the lead agency has completed and certified NEPA / CEQA review for the proposed project; and 3) The proposed

08-058 provides a Tier 3 Advice Letter Template for a Proposed Recycled Water Project that includes basic information necessary to assess the proposed recycled water project.[39] This decision also provides a Tier 2 advice letter process for the review of recycled water project proposals that have no impact on revenue requirement and on potable customers' rates in the service are where the project is proposed.

Cal Am's request in this application for the Commission to pre-approve these three recycled water projects as Tier 2 AL projects seeks to bypass the requirements of D.14-08-058, as requested in Cal Am's Special Request #10.

In general, ORA supports promoting and facilitating the production, distribution, and use of recycled water, where cost-effective and compatible with the protection of public health. However, significant uncertainties exist in each of Cal Am's three proposed recycled water projects. Cal Am has not provided enough information to determine whether these projects are cost effective and compatible with the protection of public health.

The Commission has specific policy measures in place for recycled water projects for good reason, and should not allow Cal Am to bypass these measures. Therefore, the Commission should not authorize pre-approval of these three proposed recycled water projects. The Testimony of Suzie Rose discusses this issue in relation to Cal Am's Special Request #10. The below discussion provides more detail on the significant uncertainties of each of the proposed recycled water projects, further demonstrating that Cal Am has not provided the Commission with enough information in this GRC application to warrant pre-approval of these projects as AL projects.

Additionally, it is important to note that the construction for each of these proposed recycled water projects would not occur, even in the best scenario, until the next rate case.[40] In the absence of pre-approval of these projects as AL projects, Cal Am

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project does not involve direct potable reuse as defined by Water Code Section 13560 et. seq. 2."

[39] Appendix B

[40] Testimony of Mark Schubert, p. 162 for I15-300016, p. 156 for I15-500059, and p. 187 for I15-600091. For I15-600091, I15-300016, and I15-500059, only design and permitting is scheduled for this rate case

has multiple avenues of moving these proposed recycled water projects forward. If the Commission does not pre-approve these projects, it should not slow down the development of these potential recycled water projects. This concept is discussed further in the Testimony of Suzie Rose.

a) Baldwin Hills Recycled Water Project (I15-500059)

Cal Am is proposing to provide purchased recycled water from the West Basin Municipal Water District (WBMWD) to serve approximately 600 acre feet per year (AFY) of demand for existing customers within the Baldwin Hills service area and potentially to customers adjacent to Cal Am's service area for landscaping purposes. The scope of the project includes a connection to the existing WBMWD recycled water pipe within the City of Inglewood, a new pipeline that extends north into Cal Am's service area, two pressure reducing valves, and two pump stations.[41]

Cal Am has not yet confirmed the initial potential customer demand for the potential recycled water. The cost of the proposed recycled water will vary based on the number of interested customers. Based on Cal Am's preliminary demand estimates, one of Cal Am's potential recycled water customers represents approximately 42% of the estimated 600AFY demand.[42]

Cal Am is also considering serving customers outside Cal Am's service area, such as within the service area of the Golden State Water Company (GSWC), and within Culver City and the City of Los Angeles, which are served by the Los Angeles Department of Water and Power.[43] The need for one of Cal Am's proposed pump stations for this recycled water project is contingent on serving potential customers

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cycle.

[41] Testimony of Mark Schubert, p. 155.

[42] California American Water Recycled Water Study Final Technical Memorandum and Cost Estimate Baldwin Hills Service Area, Appendix A. The total estimated demand from the largest potential recycled customers is252 AFY, which is 42% of the entire 597.5 AFY.

[43] Ibid.

outside the service area. According to Cal Am, one of the booster stations is needed to help serve recycled water to additional customers within the GSWC and Los Angeles Department of Water and Power service areas north of the Baldwin Hills service area.[44] Since some of the components of this project are only needed to provide service to customers outside of Cal Am's service area and are not needed for providing service to customers within Cal Am's service area, Cal Am's customers should not be responsible for funding those components. The rates for the potential customers outside Cal Am's service area should also produce enough revenue to fund the full cost of the facilities necessary to only serve the customers outside Cal Am's service area in addition to supplementing a portion of the facilities that serves all potential recycled water customers.

Before authorizing this portion of the project, the Commission needs to ensure that the rates for the potential customers outside Cal Am's service area would produce enough revenue to: 1) fund the full cost of the facilities necessary to serve those customers; and 2) fund their fair-share of the facilities that serve all potential recycled water customers. The Recycled Water Minimum Criteria Requirements detailed in D.14-08-058 were put in place to ensure that utilities proposing recycled water projects and recycled water rates provide the Commission with this type of analysis. The absence of this analysis in Cal Am's GRC application provides yet another reason why this recycled water project should not be pre-approved.

At this time, Cal Am's preliminary cost estimate for the project is approximately $14.6 million, with an upper cost range at approximately $20.4 million.[45] Cal Am identifies this as an Association for the Advancement of Cost Engineering (AACE) International Class 5 cost estimate, which is a cost estimate based on limited information with an engineering design from two to ten percent complete, often used for strategic

[44] Ibid, pp. 155-156.

[45] California American Water Recycled Water Study Final Technical Memorandum and Cost Estimate Baldwin Hills Service Area, Appendix B

planning purpose.[46] According to the AACE guideline, for Class 5 cost estimates, there is a +40% cost uncertainty over the current cost estimate.[47] This means that the cost of the project may exceed Cal Am's preliminary cost estimate by up to $5.8 million. Due to the current cost uncertainty of this project, it does not make sense to approve this project at this time. Cal Am should submit its request when there is more certainty in the project scope and the project cost.

b) Coronado/Imperial Beach Recycled Water Project (I15-300016)

Cal Am is proposing to provide recycled water to existing customers within the Coronado and Imperial Beach service areas. Cal Am states that the recycled water it is proposing to provide would be utilized for landscaping purposes (e.g. for parks, schools, landscaping, and golf courses).[48] The scope of the project would include a wastewater reclamation facility (WRF) and pipeline to convey the finished water to the customer base.

Cal Am has been unable to confirm some of the most critical components of the proposed recycled water project, such as the source of supply and the location of the wastewater reclamation facility. The primary source of source water for recycling considered by Cal Am at this time is the City of Imperial Beach wastewater.[49] Cal Am states that this option would require the acquisition of the sewer system.[50] However, the amount of wastewater that would be available from the City of Imperial Beach sewer system for the proposed recycled water project is uncertain at this time.[51] While Cal Am

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[46] Ibid.

[47] Ibid. The additional +40% cost uncertainty for the cost estimate is on top of a 20% design contingency and 5% construction change contingency used in the cost estimate.

[48] California American Water Recycled Water Study Final Technical Memorandum and Cost Estimate Coronado/Imperial Beach Service Area, p.1.

[49] Cal Am's response to data request ORA JMI-009, Q.2.e, provided herein as Attachment 5.

[50] California American Water Recycled Water Study Final Technical Memorandum and Cost Estimate Coronado/Imperial Beach Service Area, p.1.

[51] Cal Am's response to data request ORA JMI-009, Q.2.e, provided herein as Attachment 5.

has stated it is also evaluating other potential sources, Cal Am has not confirmed that any of these supply source are in fact available.[52]

As mentioned earlier, part of the scope of the project includes a wastewater reclamation facility to provide tertiary treatment to the wastewater, in order to produce the recycled water. Cal Am has not identified a location for the wastewater reclamation facility at this time.[53] Cal Am is considering two options for the reclamation treatment facility: use the City of San Diego South Bay Reclamation Plant, which already produces tertiary treated water that meets Title 22 recycled water standards,[54] or construct a new water reclamation facility in Imperial Beach.[55] The overall cost of the project would vary depending on which option is ultimately selected. For the City of San Diego South Bay Reclamation Plant option, Cal Am has not confirmed whether additional capacity necessary to provide recycled water to Cal Am.[56] The other alternative currently being considered is constructing a new reclamation facility in Imperial Beach.[57] Funding for that option would be through Cal Am (supplemented by any potential grant funding).[58]

At this time, Cal Am's preliminary cost estimate for the project is approximately $44.2 million, with an upper cost range at approximately $62 million.[59] Cal Am identifies this as an AACE International Class 5 cost estimate, which is a cost estimate based on limited information with an engineering design from two to ten percent

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[52] Ibid.

[53] Testimony of Mark Schubert, p. 161.

[54] According to the City of San Diego South Bay Reclamation Plant website, https://www.sandiego.gov/mwwd/facilities/southbay.

[55] Cal Am's response to data request ORA JMI-009, Q.2.d.i, provided herein as Attachment 5.

[56] Ibid, Q.2.d.ii, provided herein as Attachment 5.

[57] Ibid.

[58] Ibid.

[59] California American Water Recycled Water Study Final Technical Memorandum and Cost Estimate Coronado/Imperial Beach Service Area, Appendix B.

complete, often used for strategic planning purpose.[60] According to the AACE guideline, for Class 5 cost estimates, there is a +40% cost uncertainty over the current cost estimate.[61] This means that the cost of the project may exceed Cal Am's preliminary cost estimate by up to $17.8 million. Due to the current cost uncertainty of this project, it does not make sense to approve this project at this time. Cal Am should submit its request when there is more certainty in the project scope and project cost.

c) Sacramento Recycled Water Project (I15-600091)

Cal Am is proposing to serve recycled water purchased from the City of Roseville to the West Placer service area. The project would involve constructing 1) a connection to an existing City of Roseville recycled pipeline, 2) a storage tank, and 3) two pump stations.

At this time, Cal Am's preliminary cost estimate for the project is approximately $36.8 million, with an upper cost range at approximately $51.5 million.[62] Cal Am identifies this as an AACE International Class 5 cost estimate, which is a cost estimate based on limited information with an engineering design from two to ten percent complete, often used for strategic planning purpose.[63] According to the AACE guideline, for Class 5 cost estimates, there is a +40% cost uncertainty over the current cost estimate.[64] This means that the cost of the project may exceed Cal Am's preliminary cost estimate by up to $14.7 million. Due to the current cost uncertainty of this project, it does not make sense to approve this project at this time. Cal Am should submit its request when there is more certainty in the project cost.

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[60] Ibid.

[61] Ibid. The additional +40% cost uncertainty for the cost estimate is on top of a 20% design contingency and 5% construction change contingency used in the cost estimate.

[62] California American Water Recycled Water Study Final Technical Memorandum and Cost Estimate West Placer Service Area, Appendix B.

[63] Ibid.

[64] Ibid. The additional +40% cost uncertainty for the cost estimate is on top of a 20% design contingency and 5% construction change contingency used in the cost estimate.

According to Cal Am, the proposed recycled water is intended for the West Placer service area and future customers.[65] Cal Am has not been in contact with any of the potential customers.[66] There is no basis to determine whether Cal Am's expected demand for the recycled water is accurate, and consequently there is no way current to determine cost effectiveness of the proposed recycled water.

The technical memorandum for the aforementioned recycled water projects each recommend performing a cost comparison of the recycled water with the existing portable water supplies.[67] For each of the recycled water projects, the construction phase portion of the project would not likely begin until the next rate case cycle (2021-2023).[68] Due to the uncertainty in the cost, scope, demand, cost-effectiveness, and number of customers for the proposed recycled water projects, it is not prudent to approve these projects at this time. When Cal Am has more details regarding the scope of the proposed recycled water projects (including costs), Cal Am may submit an application or advice letter (whichever is appropriate per guidance of D.14-08-058) for authorization for these projects. Cal Am should include the minimum criteria requirements as required by in D.14-08-058, in its submittal.

4. Recurring Project Budget (2018-2019)

Table 1-6 shows Cal Am's proposed 2018-2019 Recurring Project (RP) budget.

Table 1-6: Cal Am's Proposed 2018-2019 Recurring Project Budget[69]

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[65] Cal Am's response to data request ORA JMI-009, Q.3.b.i, provided herein as Attachment 5.

[66] Ibid.

[67] California American Water Recycled Water Study Final Technical Memorandum and Cost Estimate West Placer Service Area, p. 14. California American Water Recycled Water Study Technical Memorandum and Cost Estimate Baldwin Hills Service Area, p. 17. California American Water Recycled Water Study Final Technical Memorandum and Cost Estimate Coronado/ Imperial Beach Service Area, p. 13.

[68] Testimony of Mark Schubert, p. 162 for I15-300016, p. 156 for I15-500059, and p. 187 for I15-600091. For I15-600091, I15-300016, and I15-500059, only design and permitting is scheduled for this rate case cycle.

[69] ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab. In the workpapers, Cal Am incorporates the RP budget for the Meadowbrook and Dunnigan service areas into the Sacramento District.

District	2018	2019	2018-2019 Total
Los Angeles	$ 4,579,289	$ 4,899,832	$ 9,479,121
San Diego	$ 1,159,265	$ 1,137,233	$ 2,296,498
Ventura	$ 2,817,684	$ 2,765,843	$ 5,583,527
Monterey	$ 3,014,976	$ 2,938,954	$ 5,953,930
Monterey WW	$ 272,058	$ 259,265	$ 531,323
Toro	$ 135,690	$ 131,882	$ 267,572
Garrapata	$ 52,930	$ 50,441	$ 103,371
Sacramento	$ 4,038,620	$ 3,060,991	$ 7,099,611
Larkfield	$ 345,830	$ 329,563	$ 675,393
Total	$16,416,342	$ 15,574,004	$ 31,990,346

Within the RP budget, one area of expenditures is the capitalized tank category. In the Los Angeles District, Cal Am requests over a million dollars annually in the capitalized tank category.[70] Cal Am's proposed total 2018-2019 RP budget for the Los Angeles District represents an increase of $2,813,121 over the total 2015-2016 RP budget of $6,666,000 authorized in Cal Am's previous GRC for the Los Angeles District.[71] Over the past six years, Cal Am has not spent any of its authorized funding in the capitalized tank category in its Los Angeles District.[72] It is not prudent to increase funding in the capitalized tank RP category when Cal Am has historically not spent any of its authorized funding in this project category.[73]

In the Monterey District, Cal Am requests $455,263 and $446,869 for 2018 and 2019, respectively, in the capitalized tank category.[74] However, Cal Am has an inconsistent spending pattern related to capitalized tank rehabilitation in its Monterey District. During the 2010-2015 period, Cal Am did not spend any funds on capital tank

[70] According to the ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab, Cal Am requests approximately $2,217,867 for Tank Rehabilitation in Los Angeles during the 2018-2019 period.

[71] Settlement for A.13-07-002, p. 188.

[72] Cal Am's response to data request ORA JMI-002, Q.1, provided herein as Attachment 6.

[73] Ibid. According to the ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab, Cal Am is requesting $1,119,251 and $1,098,616 in 2018 and 2019, respectively.

[74] ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab.

rehabilitation in four of the six years.[75] In the remaining two years, Cal Am spent a total of $671,216 on capital tank rehabilitation.[76] Due to the infrequent spending toward capitalized tank rehabilitation in the Monterey District, a five-year average (with cost inflation to the appropriate year[77]) should be authorized. This results in an annual budget of approximately $157,240 and $153,502 for 2018 and 2019, respectively for capitalized tank rehabilitation for the Monterey District.

Cal Am requests $105,859 and $103,908 for 2018 and 2019, respectively, for capitalized tank rehabilitation in its Sacramento District.[78] In the Sacramento District, there is also an inconsistent spending pattern related to capitalized tank rehabilitation (similar to what was previously mentioned in the Monterey District). During the 2010-2015 period, Cal Am did not spend any funding in three of the six years.[79] In the remaining three years, Cal Am spent a total of $194,884.[80] Similarly in the Sacramento District, Cal Am has not completed tank painting projects that were projected and authorized in the 2013 GRC, as shown in Table 1-3 above. Due to the infrequent spending toward capitalized tank rehabilitation in the Sacramento District, a five-year average (with cost inflation to the appropriate year) should be authorized. This results in an annual budget of $47,409 and $46,281 for 2018 and 2019, respectively for capitalized tank rehabilitation portion of the RP budget for the Sacramento District.

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[75] Cal Am's response to data request ORA JMI-002, Q.1, provided herein as Attachment 6. In the Monterey District, Cal Am spent no RP funding on capitalized tank improvements in 2010-2012 and 2015.

[76] Ibid.

[77] The cost estimate is escalated based on the escalation rates from the May 2016 ECOS Escalation Memorandum.

[78] According to the ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab, Cal Am requests $105,859 and $103,908 in 2018 and 2019, respectively for RP funding on capitalized tank improvements in the Sacramento District

[79] Cal Am's response to data request ORA JMI-002, Q.1, provided herein as Attachment 6. In the Monterey District, Cal Am spent no RP funding on capitalized tank improvements in 2010, 2013 and 2014.

[80] Ibid.

As shown in Table 1-F above, Cal Am requests $103,370 over the 2018-2019 period for the Garrapata service area, which represents a doubling of Cal Am's actual spend for recurring projects in this service area. The Commission approved Cal Am's acquisition of the Garrapata system in D.13-01-033 on January 24, 2013.[81] Cal Am spent just over $50,000 over the entire 2014-2015 period.[82] An average of the 2014 and 2015 actual expenditure on recurring projects should be authorized for 2018-2019 (escalated to the appropriate year).[83] ORA recommends an annual RP budget of $30,424 and $29,701 for the years 2018-2019, respectively, for the Garrapata service area.

Table 1-7 shows the revised recommended annual recurring project budget for each district.

Table 1-7: ORA Recommended Recurring Project Budget (2018-2019).

2018

District	Cal Am	ORA	ORA/Cal Am
Los Angeles	$ 4,579,289	$ 3,460,038	76%
San Diego	$ 1,159,265	$ 1,159,265	100%
Ventura	$ 2,817,684	$ 2,817,684	100%
Monterey	$ 3,014,976	$ 2,716,953	90%
Monterey WW	$ 272,058	$ 272,058	100%
Toro	$ 135,690	$ 135,690	100%
Garrapata	$ 52,930	$ 30,424	57%
Sacramento	$ 4,038,620	$ 3,980,170	99%
Larkfield	$ 345,830	$ 345,830	100%
Total	$16,416,342	$ 14,918,112	91%

[81] D. 15-04-007, Attachment A (Partial Settlement between Cal Am, ORA, and City of Pacific Grove, Las Palmas Wastewater Committee, Monterey Peninsula Water Management District), p. 48.

[82] Cal Am's response to data request ORA JMI-002, Q.1, provided herein as Attachment 6. Cal Am spent a total of $10,810 and $41,021 in 2014 and 2015, respectively.

[83] Ibid. Cal Am states that $0 was spent in 2013.

2019

District	Cal Am	ORA	ORA/Cal Am
Los Angeles	$ 4,899,832	$ 3,801,216	78%
San Diego	$ 1,137,233	$ 1,137,233	100%
Ventura	$ 2,765,843	$ 2,765,843	100%
Monterey	$ 2,938,954	$ 2,645,587	90%
Monterey WW	$ 259,265	$ 259,265	100%
Toro	$ 131,882	$ 131,882	100%
Garrapata	$ 50,441	$ 29,701	59%
Sacramento	$ 3,060,991	$ 3,003,364	98%
Larkfield	$ 329,563	$ 329,563	100%
Total	$15,574,004	$ 14,103,654	91%

5. Carryover Projects Expected to be Completed in 2019 (or Later)

Table 1-8 shows previously approved projects that Cal Am now expects to be completed in 2019 (or later).[84]

Table 1-8: Carryover Projects Expected to be Completed in 2019 (or Later).[85]

District	Project	Description	Original Completion Date	Revised Completion Date	Estimated Completion Cost
Los Angeles	I15-500032	Redrill Winston Well at Danford Reservoir	2014	2019	$ 3,566,000
Sacramento	I15-600007	Elverta Road Bridge Water Main	2012	2019	$ 348,000
Sacramento	I15-600051	Arden Intertie	2013	2019	$ 2,557,275
Sacramento	I15-600073	Antelope 1 MG Tank, Booster Station, and Well	this rate case cycle	next rate case cycle	$ 150,000
Larkfield	I15-610009	Londonberry Drive Creek Crossing	2016	2020	$ 915,500

According to Cal Am, the completion date for the aforementioned projects has been delayed due to the uncertainty of the projects.[86] Due to continuing uncertainty, it remains speculative whether the projects will be completed by the revised completion

[84] Table 1-8 does not include projects where the original completion date was 2019 or later.

[85] Testimony of Mark Schubert, pp. 37, 62-63, 64-65, 142 and 146. For I15-600073, only the land portion of the project was approved in the 2013 rate case. Cal Am is planning to propose the remaining project scope of I15-600073 (funding for tank, booster station, and well portion of the project) in the next rate case. For I15-610009, the cost shown in Table 1-8 is a revised project cost taken from a cost estimate prepared by Carollo Engineers.

[86] Ibid.

date. According to Cal Am, the aforementioned projects will not be complete until Cal Am submits its application for the next rate cycle. Therefore, the costs associated with the aforementioned projects were removed from rates in 2018 and 2019. If Cal Am is able to complete any of these project before that time, then it can propose to recover the cost of that project in the next rate case.[87] This will provide the Commission the opportunity to review the actual costs of the project for reasonableness and prudency. The Commission should not include funding for the projects listed in Table 1-8 in this rate case. For discussion and analysis on the individual projects, refer to the individual district chapters.

6. Engineering Overhead

Cal Am proposes a set amount of engineering overhead to be distributed amongst proposed projects proportionally based on the cost of the project. For example, if the projected cost of a project represents approximately five percent of the total annual plant additions, then five percent of a set amount of engineering overhead would be allocated to that specific project. In Cal Am's workpapers, the overhead numbers are hardcoded. This means that adjusting the cost of a particular project does not affect the total overhead for all of the projects. Instead, when the cost of a particular project is adjusted, the total overhead budget is simply reallocated.

Cal Am defines engineering overhead as the costs that are incurred for capital projects that cannot be assigned directly to a specific project, but are beneficial for all capital projects.[88] Some of the items Cal Am defines to be included in the engineering overhead are indirect Company labor, labor overhead (including benefits, payroll taxes, workers compensation and transportation costs) and other costs such as employee travel costs, communication costs, contractor costs, other transportation costs.[89]

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[87] Ibid. Cal Am should not be able to recover the recorded cost of projects until the projects are completed and placed into service.

[88] Testimony of Edward Grubb, p. 9.

[89] Ibid.

While some items included in the overhead estimate may be fixed costs such as labor overhead related to benefits, payroll taxes, and worker's compensation, there are many items such as contractor and transportation costs that are clearly dependent on whether a project is undertaken. The overhead costs are dependent on whether a project is constructed, and on the scale of the project.[90] Therefore, it is not appropriate to allocate a set total amount of overhead regardless of whether projects are authorized or completed. Instead, overhead costs should be determined for each individual project, and should only be included in the budget if the project is authorized. If the project is authorized at a lower budget amount than the requested amount, the overhead amount for the project should be reduced proportionally.

To prevent the reallocation of overhead to the other projects after making adjustments to a particular proposed plant project, ORA hardcoded the overhead costs for each individual project in the workpapers. Then for individual projects where adjustments to the proposed budget are recommended, ORA adjusts the individual overhead cost estimate proportionally.[91] This recommendation results in a $2,613,534 reduction in Cal Am's proposed budget for engineering overhead in the 2018-2019 period.

7. 2020 Plant Additions

In this rate case, Cal Am proposes plant additions for the 2018-2020 period. Since the year 2020 falls outside of the two test years of this rate case, ORA did not forecast 2020 plant additions or take a position on the prudency or the reasonableness of projects scheduled for completion in 2020 (or after 2019). The year 2020 is not a forecasted test

[90] Cal Am's proposed cost estimate also includes a contingency line item to account for the uncertainties in the project (which may include uncertainties in the overhead costs).

[91] For example, if the cost of the project is reduced by 10%, then the overhead for the project would be reduced by 10%. Also, if a project is not included in the rate base, the total project overhead would be reduced by the proposed overhead cost of the individual project.

year and the Commission should avoid giving the perception of endorsing another test year.[92]

Both D.04-06-018 and D.07-05-062 (the "Rate Case Plan" and the "Revised Rate Case Plan," respectively) clearly state that all rate base items, including capital additions, are subject to two test years and an attrition year.[93] The Revised Rate Case Plan provides a calculation methodology for rate base additions in the attrition year, stating: "The attrition allowance methodology provides for rate base additions in year 3 by adding the difference between test year 1 and test year 2 rate base to test year 2 rate base."[94] In addition, Cal Am does not forecast proposed 2020 plant expenditures in its workpapers.[95]

The Commission should follow its own guidelines for calculating rate base additions in the attrition year. The Commission should not authorize any specific plant improvement projects after 2019 in this rate case, as Cal Am requests.

D. CONCLUSION

ORA's recommendations regarding the common plant issues are applied to multiple districts among Cal Am's service area and should be approved by the Commission.

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[92] According to D.04-06-018, the attrition allowance methodology estimates the rate base additions for the third year of the rate case cycle (2020 in this rate case cycle) based on the difference between the first and second test year rate base.

[93] D.07-05-062 states at p. A-19 "All rate base items, including capital additions and depreciation, shall not be escalated but rather shall be subject to two test years and an attrition year, consistent with D.04-06-018."

[94] Ibid at p. A-19.

[95] ALL_CH07_PLT_RO_Forecast Workpaper.

II. LOS ANGELES DISTRICT

A. INTRODUCTION

ORA reviewed and analyzed Cal Am's testimony, application, Minimum Data Requirements, workpapers, capital project details, estimating methods, Comprehensive Planning Studies ("CPS"), and responses to various data requests. ORA conducted a field investigation of most of the proposed specific plant additions on October 26, 2016. The differences between ORA's and Cal Am's estimates of specific plant additions are listed in Table 2-2.

B. SUMMARY OF RECOMMENDATIONS

Table 2-1 and Table 2-2 below summarize ORA's adjustments in comparison to Cal Am's proposed project budget.[96]

Table 2-1: Los Angeles Plant Additions, Including Carryovers, and Recurring Project

Los Angeles ($000)	2018	2019
ORA	$ 8,525.8	$ 12,282.3
Cal Am	$ 10,571.9	$ 21,003.9
Cal Am > ORA	$ 2,046.1	$ 8,721.6
ORA as % of Cal Am	81%	58%

[96] ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab. The costs include any cost add-ons such as contingency, overhead, etc.

Table 2-2: Los Angeles Plant Comparison

2018	Project #	Project Description	ORA	Cal Am	Cal Am > ORA	ORA / Cal Am
1	I15-500056	Advanced Metering Infrastructure	$ -	$ 705,018	$ 705,018	0%
2	I15-500038	Booster Station Upgrade Program	$ 962,166	$ 962,166	$ -	100%
3	I15-500057	Annual Main Replacement Program	$ 776,462	$ 776,462	$ -	100%
4	I15-500042	Purchase Groundwater Rights	$ -	$ 221,846	$ 221,846	0%
5	I15-500058	Tier 4 Compliance/ Standby Power	$ 383,794	$ 383,794	$ -	100%
6	I15-500060	Reconstruct Rosemead Operations Center	$ 312,362	$ 312,362	$ -	100%
Specifics Total			**$ 2,434,784**	**$ 3,361,648**	**$ 926,864**	**72%**
Recurring Projects			**$ 3,460,038**	**$ 4,579,289**	**$1,119,251**	**76%**
Carry-Overs Total			**$ 2,630,957**	**$ 2,630,957**	**$ -**	**100%**
TOTAL 2018			**$ 8,525,779**	**$ 10,571,894**	**$2,046,115**	**81%**

2019	Project #	Project Description	ORA	Cal Am	Cal Am > ORA	ORA / Cal Am
1	I15-500056	Advanced Metering Infrastructure	$ -	$ 3,105,486	$ 3,105,486	0%
2	I15-500038	Booster Station Upgrade Program	$ 1,152,743	$ 1,152,743	$ -	100%
3	I15-500057	Annual Main Replacement Program	$ 794,450	$ 794,450	$ -	100%
4	I15-500042	Purchase Groundwater Rights	$ -	$ 2,118,532	$ 2,118,532	0%
5	I15-500058	Tier 4 Compliance/ Standby Power	$ 808,220	$ 808,220	$ -	100%
6	I15-500060	Reconstruct Rosemead Operations Center	$ -	$ 2,398,962	$ 2,398,962	0%
Specifics Total			**$ 2,755,413**	**$ 10,378,393**	**$7,622,980**	**27%**
Recurring Projects			**$ 3,801,216**	**$ 4,899,832**	**$1,098,616**	**78%**
Carry-Overs Total			**$ 5,725,720**	**$ 5,725,720**	**$ -**	**100%**
TOTAL 2019			**$ 12,282,349**	**$ 21,003,945**	**$8,721,596**	**58%**

C. DISCUSSION

Cal Am's Los Angeles District is comprised of three systems: San Marino, Duarte, and Baldwin Hills. The three systems are supplied by both groundwater and purchased water.[97]

[97] Testimony of Richard Svindland, p. 11. The San Marino system pumps groundwater from the Main San Gabriel Basin (MSGB) and Raymond Basin and purchased water from the Metropolitan Water District (MWD) and the City of South Pasadena. The Duarte system extracts groundwater from the

1. Carryover Projects

a) Redrill Winston Well at Danford Reservoir (I15-500032)

In the 2010 general rate case (A.10-07-007), Cal Am proposed to replace the Winston Well at the Danford Reservoir site. In A.10-07-007, Cal Am originally anticipated the project to be completed in 2014. According to Cal Am, the project is currently being delayed due to the San Gabriel County Water District contesting where the new well is to be drilled. San Gabriel County Water District is concerned that the influence from the production of the proposed well would have a negative effect on an existing San Gabriel County Water District well.[98] Cal Am states that the project is currently on hold awaiting an update from San Gabriel County Water District, and Cal Am is also looking for alternative sites.[99] Cal Am now anticipates I15-500032 to be completed in 2019,[100] and expects the project to cost $3,566,000.[101] However, Cal Am does not yet have a confirmed location for this well nor the necessary permits. Therefore, the Commission should not authorize funding in this rate case for I15-500032. In the event that Cal Am is able to complete I15-500032 by 2019, Cal Am may propose to recover the cost of the project in the next rate case.

2. Proposed Projects

a) Purchase Groundwater Rights (I15-500042)

Cal Am requests $2,340,378 over the 2018-2019 period to purchase 100 to 150 acre-feet (AF) of groundwater water rights within the Los Angeles District to reduce Cal Am's reliance of purchased water. In the last rate case, Cal Am proposed a similar project to purchase groundwater rights for the 2015-2017 period, which was authorized

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MSGB and Canyon Basin and surface water from the San Gabriel River. The Baldwin Hills system obtains groundwater from the Central Basin.

[98] Testimony of Mark Schubert, p. 37.

[99] Ibid.

[100] Ibid.

[101] Ibid.

by the Commission.[102] According to Cal Am, the company used the previously approved funds for the acquisition of the Adams Ranch Mutual Water Company in 2016.[103] Cal Am has shown in the past that it sometimes uses funding allocated for water rights to acquire water systems.

Cal Am has been shown to file an application with the Commission to acquire the system when it is interested in acquiring an existing water system and to establish a rate base for the acquired system assets.[104] Cal Am presents in this rate case a list of water systems that it has acquired (or in the process of acquiring) since the last rate case (A.13-07-002).[105] For example, Cal Am filed A.15-08-024 to authorize the purchase of the Geyserville Water Works system.[106] In A.15-08-024, Cal Am requests the Commission to approve the purchase of the existing Geyserville Water Works system, expand its certificate of public convenience and necessity (CPCN) for the Sacramento District, and allow Cal Am to operate the system after the acquisition.[107] In addition, Cal Am also requested in A.15-08-024 to establish a rate base for the acquired assets at the time of approval of the purchase, including any new plant investments made by the Geyserville Water Works (after December 31, 2013 and not included in the approved rate base).[108] It seems from Cal Am's applications to acquire water systems that its request includes the cost recovery of the water system assets in rate base. In the past, Cal Am has used funding approved in previous rate cases that were allocated to acquire water rights in order to instead acquire new systems. Cal Am is required by the Commission to file an

[102] Ibid, p. 99.

[103] Ibid, p. 100.

[104] Ibid. According to Cal Am, Cal Am has acquired (or in the process of acquiring) the following five systems: 1) Dunnigan Water Works system; 2) Geyserville Water Works system; 3) Oxford Mutual Water Company system; 4) Adams Ranch Water Company system (acquired as part of I15-500042 from A.13-07-002); and the 5) Meadowbrook Water Company system.

[105] Testimony of Sherrene Chew, pp. 5-6.

[106] A.15-08-024, pp. 1-2.

[107] Ibid.

[108] Ibid, pp. 2-3. The acquisition of the Geyserville Water Works system was approved in D.16-11-014.

application for the acquisition of new water systems pursuant to Sections 851-854 and 2718-2720 of the CPUC Code and D.99-10-064, Article 2 of the CPUC Rules of Practice and Procedures, and Rule 3.6. Therefore, the Commission should not allow Cal Am's request for I15-500042. In the event that Cal Am would acquire a water system, the company would have to file an application with the Commission. In addition, there are no safeguards included in this project proposal to ensure that there is a limit on the unit cost for purchasing water rights. Therefore, the Commission should not provide funding for this project.

b) Reconstruct Rosemead Operations Center (I15-500060)

Cal Am requests a total of $2,711,324 in the 2018-2019 period to construct a new operations center to replace the existing operations center due to alleged deficiencies in the existing operations center.[109] According to Cal Am, it will conduct a cost comparison between constructing a new operations center and retrofitting the existing building prior to the construction of the project.[110] Prior to agreeing to the construction of a new operations center, all possible alternatives should first be considered to address the operations center's alleged deficiencies in a cost effective matter. In addition, the design and cost comparison of all alternatives should be performed prior to approval of the full project to get the full scope of the proposed project and a more accurate cost estimate.

In the 2013 General Rate Case (A.13-07-002), for its San Diego District, Cal Am requested funding for capital improvements to move into a new operations center that Cal Am intended to lease on Palm Avenue in Imperial Beach (IP-0530-27 or R15-30N1).[111]

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[109] Testimony of Mark Schubert, pp. 156-157. According to Cal-Am, the proposed project is to address the following issues: 1) inadequate restroom facilities (for the number of employees working at the existing operations center); 2) non-Americans with Disability Act (ADA) compliant restrooms; 3) unreliable heating, ventilation, and air conditioning (HVAC); 4) insufficient office space for the number of employees; 5) no break room; 6) limited area common areas for common area (i.e. conference room); 7) there is no fire protection sprinkler system; and 8) number of structure-related roof leaks.

[110] Ibid, p. 158. Cal Am's proposed budget is based on a new operations center.

[111] In A.13-07-002, Cal Am identified this project as a planned project but not approved of in a previous

Similar to the proposed project I15-500060, Cal Am proposed IP-0530-27 to address the deficiencies at the former operations center such as ADA compliance issues, fire protection, and inadequate office space for the number of employees working in the building.[112] In A.13-07-002, Cal Am estimated that the total cost of all of the proposed improvements to the new operations center would be $544,000.[113] In rebuttal for A.13-07-002, Cal Am informed ORA that the cost of the improvements at the new operations center would require an additional $150,000 of funding due to improvements required by the City of Imperial Beach.[114]

In this rate case, Cal Am reports that IP-0530-27 was completed in the summer of 2014.[115] According to Cal Am, the recorded cost of the project was $915,311.[116] The cost overrun in IP-0530-27 and additional requirements required during the permitting process demonstrate the importance of Cal Am going through the design and permitting process for I15-500060 in order to get a more accurate cost for the entire project. This will minimize the uncertainties related to the design and permitting phase of the project, which can have significant yet avoidable impacts upon customer rates. Therefore, in this rate case, only the design dollars should be allowed ($312,362 in 2018), not the estimated cost of the entire project, as requested by Cal Am.

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proceeding.

[112] Testimony of Mark Schubert, pp.47-48 from A.13-07-002.

[113] In A.13-07-002, Cal Am was only requesting $420,000 for IP-0530-27 due to the owner agreeing to contribute $124,000 toward necessary leasehold capital improvements.

[114] Rebuttal Testimony of Mark Schubert, p.41 from A.13-07-002. In addition, some of the cost overrun is due to additional architect fees and building modifications.

[115] Testimony of Mark Schubert, p. 70.

[116] Capital Investment Project (CIP) Workpapers, R15-30N1, Attachment 1. In Attachment 1, the some of the additional cost were due to IT, security, landscaping, and graywater. Cal Am funded some of this cost overrun through its recurring project or conservation budget.

c) Advanced Metering Infrastructure (I15-500056)

Cal Am requests $3,810,504 during the 2018-2019 period to fully implement AMI meters in the Los Angeles District.[117] Refer to the common issues section regarding Cal-Am's proposed implementation of AMI in the Los Angeles District, and a discussion of why the Commission should not authorize funding for this project in this rate case.

d) Baldwin Hills Recycled Water Project (I15-500059)

Cal Am is proposing to provide purchased recycled water from the West Basin Municipal Water District to serve approximately 600 AFY to existing customers within the Baldwin Hills service area and potential customers adjacent to Cal Am's service area for landscaping purposes. The scope of the project includes a connection to the existing WBMWD recycled water pipe within the City of Inglewood, a new pipeline that extends north into Cal Am's service area, two pressure reducing valves, and two pump stations.[118] Cal Am requests I15-500059 as an advice letter project. The Commission should not approve this proposed recycled water project prior to knowing the full cost and scope of the projects, and prior to Cal Am submitting the required information for recycled water projects detailed in D.14-08-058. Cal Am has not yet provided this required information. Therefore, the Commission should request this request at this time. Refer to the common issues section of this report regarding Cal Am's proposed recycled water project for the Baldwin Hills service area.

e) Recurring Project Budget (2018-2019)

Cal Am requests a total of approximately $9,479,121 over the 2018-2019 period for smaller unforeseen operational and routine capital investment projects.[119] The Commission should adopt a budget of $7,261,254 for the 2018-2019 period for the Los

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[117] Testimony of Mark Schubert, p. 149. Proposed cost estimate for the 2018-2019 period is taken from the ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab.

[118] Testimony of Mark Schubert, p. 155.

[119] ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab.

Angeles District. Refer to the common issues section of this report regarding ORA's recommendation regarding Cal Am's proposed 2018-2019 RP budget.

D. CONCLUSION

In the Los Angeles District, the adjustments recommended for Cal Am's proposed budget reflect the uncertainty of the information available for the projects (including pilot projects that are still in progress) and Cal Am's historical spending on tank painting projects. In addition, for the proposed operations center replacement project, the design and cost comparison of all alternatives should be completed prior to full project approval, to get the full scope of the proposed project.

III. VENTURA COUNTY DISTRICT

A. INTRODUCTION

ORA reviewed and analyzed Cal Am's testimony, application, Minimum Data Requirements, workpapers, capital project details, estimating methods, Comprehensive Planning Studies, and responses to various data requests. ORA conducted a field investigation of most of the proposed specific plant additions on October 25, 2016. The differences between ORA's and Cal Am's estimates of specific plant additions are listed in Table 3-2.

B. SUMMARY OF RECOMMENDATIONS

Table 3-1 and Table 3-2 below summarize ORA's adjustments in comparison to Cal Am's proposed project budget.[120]

Table 3-1: Ventura Plant Additions, Including Carryovers, and Recurring Project

Ventura ($000)	2018	2019
ORA	$5,190.2	$5,209.5
Cal Am	$5,714.9	$7,503.9
Cal Am > ORA	$ 524.7	$2,294.4
ORA as % of Cal Am	91%	69%

Table 3-2: Ventura Plant Comparison

2018	Project #	Project Description	ORA	Cal Am	Cal Am > ORA	ORA / Cal Am
1	I15-510038	Advanced Metering Infrastructure	$ -	$ 524,727	$ 524,727	0%
2	I15-510040	Tier 4 Compliance/Standby Power	$ 332,769	$ 332,769	$ -	100%
Specifics Total			**$ 332,769**	**$ 857,496**	**$ 524,727**	**39%**
Recurring Projects			**$ 2,817,684**	**$2,817,684**	**$ -**	**100%**
Carry-Overs Total			**$ 2,039,733**	**$2,039,733**	**$ -**	**100%**
TOTAL 2018			**$ 5,190,186**	**$5,714,913**	**$ 524,727**	**91%**

[120] ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab. The costs include any cost add-ons such as contingency, overhead, etc.

2019	Project #	Project Description	ORA	Cal Am	Cal Am > ORA	ORA / Cal Am
1	I15-510038	Advanced Metering Infrastructure	$ -	$ 2,294,356	$ 2,294,356	0%
Specifics Total			**$ -**	**$ 2,294,356**	**$ 2,294,356**	**0%**
Recurring Projects			**$ 2,765,843**	**$ 2,765,843**	**$ -**	**100%**
Carry-Overs Total			**$ 2,443,704**	**$ 2,443,704**	**$ -**	**100%**
TOTAL 2019			**$ 5,209,547**	**$ 7,503,903**	**$ 2,294,356**	**69%**

C. DISCUSSION

The Ventura District is supplied solely on purchased water primarily from the Calleguas Municipal Water District (CMWD).[121]

1. Proposed Projects

a) Advanced Metering Infrastructure (I15-510038)

Cal Am requests $2,819,083 during the 2018-2019 period to fully implement AMI meters in the Ventura District.[122] Refer to the common issues section regarding Cal Am's proposed implementation of AMI in the Ventura District, and a discussion of why the Commission should not authorize funding for this project in this rate case.

b) Recurring Project Budget (2018-2019)

Cal Am requests a total of $5,583,527 over the 2018-2019 period for smaller unforeseen operational and routine capital investment projects.[123] ORA does not oppose Cal Am's proposed RP budget of $5,583,527 for the 2018-2019 period for the Ventura District. Refer to the common issues section of this report regarding ORA's recommendation regarding Cal Am's proposed 2018-2019 RP budget.

[121] Testimony of Richard Svindland, p. 12.

[122] Testimony of Mark Schubert, p.162.

[123] Ibid, Attachment 7.

D. CONCLUSION

In the Ventura District, the adjustments recommended for Cal Am's proposed budget reflect the uncertainty of the information available for the projects, including pilot projects that are still in progress.

IV. SAN DIEGO DISTRICT

A. INTRODUCTION

ORA reviewed and analyzed Cal Am's testimony, application, Minimum Data Requirements, workpapers, capital project details, estimating methods, Comprehensive Planning Studies, and responses to various data requests. ORA conducted a field investigation of most of the proposed specific plant additions on October 27, 2016. The differences between ORA's and Cal Am's estimates of specific plant additions are listed in Table 4-2.

B. SUMMARY OF RECOMMENDATIONS

Table 4-1 and Table 4-2 below summarize ORA's adjustments in comparison to Cal Am's proposed project budget.[124]

Table 4-1: San Diego Plant Additions, Including Carryovers, and Recurring Project

San Diego ($000)	2018	2019
ORA	$3,903.4	$ 6,746.3
Cal Am	$5,806.9	$11,715.6
Cal Am > ORA	$1,903.5	$ 4,969.3
ORA as % of Cal Am	67%	58%

Table 4-2: San Diego Plant Comparison

2018	Project #	Project Description	ORA	Cal Am	Cal Am > ORA	ORA / Cal Am
1	I15-300002	Small Main Replacement Program	$ 265,623	$ 265,623	$ -	100%
2	I15-300015	Replace 500' Main in Palm Avenue	$ 190,735	$ 190,735	$ -	100%
3	I15-300012	Advanced Metering Infrastructure	$ -	$ 544,525	$ 544,525	0%
4	I15-300014	Coronado Reliability Supply Project	$ 207,996	$ 648,092	$ 440,096	32%
Specifics Total			**$ 664,354**	**$ 1,648,975**	**$ 984,621**	**40%**
Recurring Projects			**$1,159,265**	**$ 1,159,265**	**$ -**	**100%**
Carry-Overs Total			**$2,079,808**	**$ 2,998,671**	**$ 918,863**	**69%**
TOTAL 2018			**$3,903,427**	**$ 5,806,911**	**$1,903,484**	**67%**

124 ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab. The costs include any cost add-ons such as contingency, overhead, etc.

2019	Project #	Project Description	ORA	Cal Am	Cal Am > ORA	ORA / Cal Am
1	I15-300002	Small Main Replacement Program	$ 253,132	$ 253,132	$ -	100%
2	I15-300015	Replace 500' Main in Palm Avenue	$ 647,013	$ 647,013	$ -	100%
3	I15-300012	Advanced Metering Infrastructure	$ -	$ 2,457,993	$ 2,457,993	0%
4	I15-300014	Coronado Reliability Supply Project	$ 133,319	$ 623,110	$ 489,791	21%
Specifics Total			**$ 1,033,464**	**$ 3,981,248**	**$2,947,784**	**26%**
Recurring Projects			**$ 1,137,233**	**$ 1,137,233**	**$ -**	**100%**
Carry-Overs Total			**$ 4,575,626**	**$ 6,597,145**	**$2,021,519**	**69%**
TOTAL 2019			**$ 6,746,323**	**$11,715,626**	**$4,969,303**	**58%**

C. DISCUSSION

The San Diego District is supplied solely by purchased water primarily from the San Diego Water County Authority (SDWA).[125]

1. Carryover Projects

a) Silver Strand Main Replacement (I15-300010)

Cal Am requests $9,595,816 in the 2018-2019 period to replace 5.7 miles over the rate case cycle along the Silver Strand.[126] In addition, Cal Am intends on spending $232,000 in 2017 for design dollars for the project.[127] Originally, the scope of the project was to replace the full span of the Silver Strand main over a ten year period.[128] The full span of the Silver Strand main is approximately 10 miles; therefore, the original average proposed replacement rate was approximately one mile annually over the ten year period.

[125] Testimony of Richard Svindland, p. 11.

[126] Testimony of Mark Schubert, p. 109. The total scope of I15-300010 is to replace 52,000 linear feet (9.85 miles) of main along the Silver Strand. The proposed cost estimate for the 2018-2019 period is taken from the ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab.

[127] On p. 81 of Settlement from the 2013 rate case, only projects completed prior to 2017 were approved and included in rate base. Therefore, the amount of funding Cal Am plans to spend in 2017 for I15-300010 has not been approved by the Commission.

[128] Capital Investment Project Workpapers, I15-300010, p. 3.

In this application, Cal Am recommends accelerating the replacement rate of the Silver Strand main based on the alleged existing condition, age, and leak history of the main.[129] The accelerated proposed replacement of 5.7 miles over the 2018-2020 period corresponds to an average replacement rate of 3.8 miles in 2018-2019. However, due to the uncertainty in the scheduling of the project, challenges in construction, and Cal Am's start date for the project, this replacement rate is not realistic.

Cal Am states that this project presents challenges during construction due to the State Highway 75 being a major road between Imperial Beach and Coronado and adjacent public bike path.[130] In addition, the project will also require coordination between multiple agencies such as the City of Coronado, the City of Imperial Beach, the United States Navy, California Department of Transportation (Caltrans), and the California Coastal Commission.[131] Cal Am anticipates that under optimum conditions, construction for the project would be begin in the second half of 2019, but fully acknowledges that the actual start date could be delayed to 2020 or later, depending on discussion with the aforementioned stakeholders.[132] Due to the uncertainty in the commencement and schedule of the construction, it is not appropriate to accelerate the replacement of the main beyond the original proposed replacement rate of approximately one mile annually.[133] Therefore, only two miles of main should be replaced during the 2018-2019 period since at earliest, construction would begin in 2019.

According to Cal Am, 8,800 feet of the existing 16" Silver Strand main crosses through the upcoming United States Navy (US) new Coastal Campus and is in conflict with the US Navy's planned new construction, and the US Navy will therefore by installing a new water transmission main that will replace that portion of the existing

[129] Ibid.

[130] Testimony of Mark Schubert, p. 109.

[131] Ibid.

[132] Ibid, p. 110.

[133] According to the Testimony of Mark Schubert, p. 108, Cal Am does not intend to start the design of the project until 2017, and is requesting additional design funding in 2018.

Silver Strand main.[134] Cal Am states that the US Navy is committed to help ensure that there is adequate infrastructure for both the needs of the campus and to complement the overall water transmission main replacement project proposed along the Silver Strand.[135] Cal Am states: "The United States Navy has discussed funding the entire cost of the portion that interferes with the Navy Coast Campus Project which is 8,800 feet. The United States Navy funded the design plans and specifications for the relocation."[136] As the US Navy is has already funded the design and specifications for replacement of 8,800 feet of the Silver Strand main, and seemingly plans to fund the replacement of this portion of the main due to its need to relocate this main. For the 2018-2019 period, a budget of $6,655,434 should be used for PID 300010.[137] This recommended budget includes funding for the design of the entire span of the project.

2. Proposed Projects

a) Coronado Reliability Supply Project (I15-300014)

Cal Am is proposing $1,271,202 over the 2018-2019 period to address the existing transmission main section identified by the company as a high priority project. The scope of the project would also include a study and analysis, and implementation of the

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[134] Cal Am's response to data request ORA JMI-011, Q.1.a.i, provided herein as Attachment 7.

[135] Testimony of Mark Schubert, p. 110.

[136] Cal Am's response to data request ORA JMI-011, Q.1.b.i and 1.b.ii, provided herein as Attachment 7.

[137] Cal Am provided to ORA in its response to data request ORA JMI-011 a cost estimate for the entire I15-300010 project. The construction portion of the project cost consists of four components: pipeline installation, slurry encasement, additional trench depth, and traffic control, paving, and tie-ins. The pipeline installation, slurry encasement, and additional trench depth cost components are based on a unit cost. The recommended project cost for the aforementioned components are adjusted based on the lower amount of main recommended to be installed. The traffic control, paving, and tie-ins line item is a lump sum in the cost estimate for the entire project. Therefore, this line item was adjusted proportionally based on the recommended replacement length in the 2018-2019 period in relation to the total length involved for the entire project. In addition, the cost estimate provided by Cal Am includes the cost for support during construction component (construction administration, construction inspection, and technical support during construction) for the entire span of the projects. Since only a portion of the project is recommended to be completed, this line item is adjusted proportionally based on the recommended amount of main to be replaced. The recommended budget includes funding for the design of the entire span of the project.

recommended improvements of the main.[138] According to Cal Am, the company is unaware of the existing condition of the main.[139] In addition, Cal Am also identifies the uncertainty of the project by assigning a high contingency rate of 25%. Therefore, due to the uncertainty of the improvements necessary, the study and analysis should be completed in order to determine the full scope of the project and determine most cost effective alternative for I15-300014. In the proposed cost estimate for I15-300014, the annual budget is divided by into a design and construction component.[140] The Commission should only allow $341,315 in the 2018-2019 period for the initial design and preliminary engineering component of the project.[141] In the event Cal Am is able complete the study and analysis prior to the company filing its next rate case application in 2019, Cal Am may request the construction portion of I15-300014 in the next rate case.

b) Advanced Metering Infrastructure (I15-300012)

Cal Am requests $3,002,518 during the 2018-2019 period to fully implement AMI meters in the San Diego District.[142] Refer to the common issues section regarding ORA's recommendation regarding Cal Am's proposed implementation of AMI in the San Diego District, and a discussion of why the Commission should not authorize funding for this project in this rate case.

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[138] Capital Investment Project Workpapers, I15-300014, p. 3. The proposed cost estimate for the 2018-2019 period is taken from the ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab. According to Cal Am, the study and analysis of the existing transmission main is to determine what improvements are necessary for the transmission main.

[139] Ibid.

[140] Cal Am's response to data request ORA JMI-003, Q.2.

[141] Ibid

[142] Testimony of Mark Schubert, p. 158.

c) Coronado/Imperial Beach Recycled Water Project (I15-300016)

Cal Am is proposing to provide recycled water to serve existing customers within the Coronado and Imperial Beach service areas. The recycled water Cal Am I proposing to provide would be utilized for landscaping purposes (e.g. for parks, schools, landscaping, and golf courses).[143] The scope of the project would include a wastewater reclamation facility and pipeline to convey the finished water to the customer base. Cal Am requests I15-300016 as an advice letter project. The Commission should not approve this proposed recycled water project prior to knowing the full cost and scope of the projects, and prior to Cal Am submitting the information required for recycled water projects detailed in D.14-08-058. Cal Am has not provided this information. Therefore, the Commission should not approve this project at this time. Refer to the common issues section of this report regarding Cal Am's proposed recycled water project for the Coronado/Imperial Beach service area.

d) Recurring Project Budget (2018-2019)

Cal Am requests a total of $2,296,498 over the 2018-2019 period for smaller unforeseen operational and routine capital investment projects.[144] ORA does not oppose Cal Am's proposed RP budget of $2,296,498 for the 2018-2019 period for the San Diego service area. Refer to the common issues section of this report regarding ORA's recommendation regarding Cal Am's proposed 2018-2019 RP budget.

D. CONCLUSION

In the San Diego District, the adjustments recommended for Cal Am's proposed budget reflect the uncertainty of the information available for the projects requested, including pilot projects that are still in progress.

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[143] California American Water Recycled Water Study Final Technical Memorandum and Cost Estimate Coronado/Imperial Beach Service Area, p.1.

[144] Ibid, Attachment 7.

V. SACRAMENTO DISTRCT

A. INTRODUCTION

ORA reviewed and analyzed Cal Am's testimony, application, Minimum Data Requirements, workpapers, capital project details, estimating methods, Comprehensive Planning Studies, and responses to various data requests. ORA conducted a field investigation of most of the proposed specific plant additions on October 19, 2016. The differences between ORA's and Cal Am's estimates of specific plant additions are listed in Table 5-2.

B. SUMMARY OF RECOMMENDATIONS

Table 5-1 and Table 5-2 below summarizes ORA's adjustments in comparison to Cal Am's proposed project budget.[145]

Table 5-1: Sacramento Plant Additions, Including Carryovers, and Recurring Project

Sacramento ($000)	2018	2019
ORA	$ 9,647.2	$ 13,881.6
Cal Am	$10,447.1	$ 17,974.0
Cal Am > ORA	$ 800.0	$ 4,092.4
ORA as % of Cal Am	92%	77%

[145] ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab. The costs include any cost add-ons such as contingency, overhead, etc.

Table 5-2: Sacramento Plant Comparison

2018	Project #	Project Description	ORA	Cal Am	Cal Am > ORA	ORA / Cal Am
1	I15-600071	Annual Well Rehabilitation	$ 749,342	$ 809,179	$ 59,837	93%
2	I15-600068	Annual SCADA Maintenance	$ 776,462	$ 776,462	$ -	100%
3	I15-600082	Standby Generators	$ 554,616	$ 554,616	$ -	100%
4	I15-600072	Main Replacement Program	$ 809,179	$ 809,179	$ -	100%
5	I15-600085	Water Level Monitoring Program	$ -	$ 277,308	$ 277,308	0%
6	I15-600088	Water Quality Monitoring Program	$ 110,923	$ 110,923	$ -	100%
7	I15-600089	Dunnigan Water System Improvements	$ 815,736	$ 924,776	$ 109,040	88%
8	I15-600095	1,2,3 TCP Treatment Meadowbrook Well #5	$ 236,266	$ 236,266	$ -	100%
9	I15-600094	Nut Plains Well PFOA Treatment	$ 59,067	$ 59,067	$ -	100%
10	I15-600093	New Lincoln Oaks Well	$ -	$ 236,266	$ 236,266	0%
Specifics Total			**$ 4,052,525**	**$ 4,794,042**	**$ 741,517**	**85%**
Recurring Projects			**$ 3,980,170**	**$ 4,038,620**	**$ 58,450**	**99%**
Carry-Overs Total			**$ 1,614,474**	**$ 1,614,474**	**$ -**	**100%**
TOTAL 2018			**$ 9,647,168**	**$10,447,136**	**$ 799,968**	**92%**

2019	Project #	Project Description	ORA	Cal Am	Cal Am > ORA	ORA / Cal Am
1	I15-600083	Backyard Main Replacement	$ 1,880,207	$ 1,880,207	$ -	100%
2	I15-600071	Annual Well Rehabilitation	$ 2,355,703	$ 2,543,810	$ 188,107	93%
3	I15-600068	Annual SCADA Maintenance	$ 741,486	$ 741,486	$ -	100%
4	I15-600072	Main Replacement Program	$ 2,543,810	$ 2,543,810	$ -	100%
5	I15-600085	Water Level Monitoring Program	$ -	$ 264,817	$ 264,817	0%
6	I15-600088	Water Quality Monitoring Program	$ 344,262	$ 344,262	$ -	100%
7	I15-600095	1,2,3 TCP Treatment Meadowbrook Well #5	$ 1,128,118	$ 1,128,118	$ -	100%
8	I15-600094	Nut Plains Well PFOA Treatment	$ 789,683	$ 789,683	$ -	100%
9	I15-600093	New Lincoln Oaks Well	$ -	$ 1,128,118	$ 1,128,118	0%
Specifics Total			**$ 9,783,269**	**$11,364,311**	**$1,581,042**	**86%**
Recurring Projects			**$ 3,003,364**	**$ 3,060,991**	**$ 57,627**	**98%**
Carry-Overs Total			**$ 1,094,944**	**$ 3,548,712**	**$2,453,768**	**31%**
TOTAL 2019			**$13,881,577**	**$17,974,014**	**$4,092,437**	**77%**

C. DISCUSSION

Cal Am's Sacramento District consists of nine separate water systems: Antelope, Arden, Isleton, Lincoln Oaks, Parkway, Security Park, Suburban Rosemont, Walnut Grove, and West Placer. The systems in the Sacramento District are supplied through groundwater, surface water or a combination of the two.[146] In A.15-12-016, Cal Am requested for the acquisition of the Meadowbrook system.[147] The Commission granted the acquisition of the Meadowbrook system in December 2016.[148] In addition, Cal Am acquired the Dunnigan system in 2015 and the acquisition was approved in D.15-11-012.[149]

1. Carryover Projects

a) Elverta Road Bridge Water Main (I15-600007)

In Cal Am's 2007-2009 General Rate Case, this project was approved to coordinate a main replacement project in conjunction with Sacramento County's planned the proposed bridge widening project along a portion of Elverta Road. [150] According to Cal Am, its project is currently delayed due to delays in Sacramento County's bridge widening project.[151] Cal Am is planning on relocating their main once the aforementioned bridge widening project is complete; I15-600007 is now tentatively scheduled to be completed in 2019.[152] Due to the delay in the completion of the bridge widening project, and the fact that Cal Am has not been able to complete this project over the course of multiple rate cases after receiving funding, it is unlikely that Cal Am will be

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[146] Testimony of Richard Svindland, p. 3.

[147] Meadowbrook Update to the Testimony of Sherrene Chew, p. 1. Cal Am estimates approximately 1,600 Meadowbrook customers would be added to the Sacramento District.

[148] D. 16-12-014, p. 2. The purchase price of $4 million will be divided as $3,425,000 as rate base and $575,000 as contribution in aid of construction.

[149] Testimony of Sherrene Chew, p. 5.

[150] Testimony of Shawn D. Sevey, p. 33 from A.09-01-013.

[151] Testimony of Mark Schubert, p. 63.

[152] Ibid, p. 62.

able to complete I15-60007 by 2019. Therefore, the funding for I15-600007 should be removed until Cal Am completes the project.[153]

b) Arden Intertie (I15-600051)

Cal Am originally proposed I15-600051 its 2009 rate case (A.09-01-013) to construct a booster station, piping, meter vault, and appurtenances to interconnect its Arden system with the City of Sacramento.[154] In Cal Am's 2009 rate case, this project was partially approved for an interconnection with the City of Sacramento (which includes a booster station).[155] Then in Cal Am's 2010 rate case (A.10-07-007), additional funding was approved for 2012-2013 to complete the project.[156] In the 2013 rate case (A.13-07-002), Cal Am stated that I15-600051 would be completed in 2014.[157] In this rate case, Cal Am now anticipates this project being completed in 2019.[158] According to Cal Am, the delay in the project is due to Cal Am having difficulty acquiring land for the booster station and the strong reluctance by adjoining property owners to sell a portion of the property or provide an easement. Due to the number of rate cases it has taken to complete the project, it is uncertain whether Cal Am will be able to complete the project by 2019, and also uncertain whether the initial assumptions and justifications that supported Cal Am's original request are still valid. Therefore, additional funding of I15-600051 should be removed until Cal Am completes the project. In the event that Cal Am is able to complete I15-600051 by 2019, then Cal Am may

[153] According to the Testimony of Mark Schubert, p.63, Cal Am still anticipates that I15-60007 will still be within the previously approved project cost estimate of $348,000.

[154] Arden Intertie, Booster Pumping Station, and Pipeline Project Status Memoranda (referenced as IP-0560-53 in A.09-01-013), p. 1 from A.09-01-013.

[155] Settlement for A.10-07-007, p. 247. In the 2009 rate case, $500,000 was approved for the 2009-2011 period.

[156] Ibid. The total completed cost of IP-0560-53 was estimated to be $2,243,000.

[157] Testimony of Mark Schubert, p. 42 from A.13-07-002.

[158] Testimony of Mark Schubert, p. 65. According to the ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab, Cal Am is expecting to spend $2,453,768 in 2019 for I15-600051 ($103,507 has already been spent on I15-600051).

propose to recover the cost of the project when Cal Am applies for its next rate case in 2019.

c) Antelope 1 Million Gallon Tank, Booster Station, and Well (I15-600073)

Cal Am originally requested I15-600073 in the 2013 rate case for the purchase of land, design, and permitting for a million gallon tank, booster station and production well. In the 2013 rate case, the parties settled I15-600073 for funding to acquire additional land for the project in 2015.[159] In this rate case, Cal Am states that there is an issue with the original proposed location for I15-600073. The original property location that Cal Am was intending to use for I15-600073 was re-zoned into a flood plain.[160] Cal Am now intends to meet with adjoining property owners to acquire additional land so the original proposed project site identified by Cal Am is useable for the design and permitting requirements of the project (prior to commencing construction).[161]

In the last rate case, Cal Am intended to complete this project during this rate case cycle. Now, Cal Am intends to schedule the design and permitting for 2020.[162] Cal Am now intends to complete the project during the 2019 rate case cycle (2021-2023).[163] Due to the uncertainty in the acquisition of land to make the proposed project site acceptable, it does not make sense to approve the design of the project. Additionally, Cal Am is delaying the proposed design and permitting schedule to 2020, which falls outside the forecasted period of plant and ratebase. Therefore, these funds should not be authorized. In the 2013 rate case settlement regarding I15-600073, Cal Am and ORA only agreed for funding to acquire additional land.[164] If Cal Am is able resolve the location for I15-

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[159] Settlement for A.13-07-002, p. 213

[160] Testimony of Mark Schubert, p. 141.

[161] Ibid, p. 142.

[162] Ibid.

[163] Ibid.

[164] Settlement for A.13-07-002, p. 213.

600073 and purchases the land needed, then Cal Am may request recovery when Cal Am files their next rate case application in 2019.

In addition, the cost threshold for the land should be maintained. The cost for the land should not exceed the threshold of $150,000 established in the settlement from the previous rate case unless Cal Am provides justification for supporting the increased cost, which would be reviewed in Cal Am's next rate case (2019 rate case).[165]

2. Proposed Projects

a) New Lincoln Oaks Well (I15-600093)

Cal Am requests $1,364,384 in the 2018-2019 period to drill a new well in the Lincoln Oaks system.[166] This project was originally proposed in Cal Am's 2009 GRC as part of an overall project for a storage tank, booster station, and a new well (referenced as both IP-0540-74 and I15-600093).[167] Project I15-600093 was ultimately approved as an advice letter project.[168] On November 18, 2016, Cal Am filed Advice Letter 1127-A to request to recover the cost of I15-600093.[169] According to Cal Am, I15-600093 was recorded at $6,581,710.[170] The reason the recorded cost of I15-600093 was under the approved budget is due to the well component of the project not being completed.[171] According to Cal Am, the tank that was part of I15-600093 was built in the Citrus Heights Water District's service area due to the availability of land. Citrus Heights Water District allowed Cal Am to construct the tank but not the well.[172] Cal Am is now

[165] Settlement for A.13-07-002, p. 213.

[166] Capital Investment Project Workpapers, I15-600093, p. 3. Cal Am expects the project to be completed in 2019. The proposed cost estimate for the 2018-2019 period is taken from the ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab.

[167] IP-0540-74 was expected to cost $8,354,508. In Cal Am's 2009 GRC, this project was referenced as IP-0540-74.

[168] Settlement for A.09-07-002, p.64. This project was also identified as IP-0560-53.

[169] In addition, Cal Am filed AL 1127-A to recover the cost of the Crowder Lane Controls project.

[170] Testimony of Mark Schubert, p. 83.

[171] Cal Am completed the storage tank and booster station component of IP-0540-74.

[172] Capital Investment Project Workpapers, I15-600093, p. 3

proposing a new well project under I15-600093. When Cal Am originally proposed I15-600093 as project I15-600055 in the 2009 rate case, Cal Am's analysis of the supply capacity of the Lincoln Oaks system was based on the 2006 Comprehensive Planning Study. Due to the completion time of I15-600055, Cal Am has more updated information regarding the Lincoln Oaks service area. In the most recent CPS, it states that the maximum day demand (MDD) firm capacity shows a surplus throughout 2025.[173] Therefore, the proposed well is no longer needed and the Commission should not authorize funding for I15-600093.

b) Water Level Monitoring Program (I15-600085)

Cal Am requests $542,125 over the 2018-2019 period to install fifteen sets of well level monitoring equipment throughout the Sacramento District.[174] According to the company, a study will be conducted as part of this project to identify all wells that can be equipped with the proposed level monitors.[175] It does not make sense to approve this project prior to the study being conducted. In addition, there is a discrepancy with Cal Am's cost estimate for the construction portion of I15-600085. Cal Am provided to ORA a cost estimate for the construction portion of I15-600085.[176] Cal Am's cost estimate is based on twenty sets of well level monitoring equipment even though the scope of the project is only for fifteen sets of well level monitoring equipment.

c) Well Rehabilitation Program (I15-600071)

Cal Am requests $3,352,989 over the 2018-2019 period to maintain the condition and performance of the existing wells in the Sacramento District.[177] Cal Am estimates

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[173] In Table E.3 of Cal Am's 2012 Comprehensive Planning Study for the Sacramento District, it shows that the Lincoln Oaks system has a MDD firm capacity surplus of 4.2 million gallons per day (MGD) and 4 MGD for 2020 and 2025, respectively.

[174] Testimony of Mark Schubert, p. 178.

[175] Ibid, p. 184.

[176] Cal Am's response to data request ORA JMI-003, Q.4.

[177] Testimony of Mark Schubert, p. 178.

the costs for well rehabilitation assuming that the improvements at each well site are the same.[178] Cal Am's proposed methodology is not appropriate since the specific needs for the individual wells are not known. Cal Am acknowledges that the cost of the project is based on conceptual knowledge about the project and the amount of work at a particular well site is dependent on the specific site needs.[179] Similar to Cal Am's proposed well rehabilitation project in the Monterey District (I15-400093), Cal Am states that due to the unpredictable nature of the condition of individual wells, the condition cannot be determined until the individual well is examined.[180] Therefore, ORA based the estimated unit cost for the individual wells on an average of the recorded cost of recently completed well rehabilitation projects in the Sacramento District.[181] This methodology represents an average rehabilitation cost that is typically spent in the Sacramento District and should be used to calculate the project budget in Sacramento. The unit cost used to calculate the project budget does not include the recorded overhead since overhead costs are included later as an add-on line item.[182] Based on the aforementioned project cost estimate methodology used to calculate the project budget, the recommended budget for I15-600071should be $3,105,045 for the 2018-2019 period.

d) Dunnigan Water System Improvements (I15-600089)

Cal Am requests $924,776 in 2018 for Supervisory Control and Data Acquisition (SCADA) improvements, converting unmetered connections in the system to metered connections, and to seismically retrofit the two existing tanks and the treatment plant.[183]

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[178] Cal Am's response to data request ORA JMI 003, Q.4. The unit cost Cal Am used for their cost estimate is for above ground improvements, well cleaning/inspection, and tank replacement.

[179] Capital Investment Project Workpapers, I15-600071, p. 3.

[180] Capital Investment Project Workpapers, I15-400093, p. 4.

[181] Cal Am's response to data request ORA JMI-005, Q.1.

[182] In Cal Am's response to data request ORA JMI-005, Q.1, the recorded well rehabilitation cost in the Sacramento District is divided into recorded contractor, consultant (or inspection), overhead (including labor overhead), and labor costs.

[183] Testimony of Mark Schubert, p. 186. Cal Am acquired the Dunnigan water system in 2015. The

Although its application requests funds to seismically retrofit two existing tanks at the treatment building, according to Cal Am the four tanks at the treatment building have developed leaks which resulted in flooding of the steel superstructure where the tanks are set.[184] As a result, Cal Am more recently stated that it intends to reconfigure the existing system. As a result, Cal Am now stated that it intends to reconfigure the existing system. Cal Am's new plan is to bypass the treatment plant building and relocate the treatment near the bolted steel tank[185] and abandoning the use of the four existing tanks at the treatment building. Since Cal Am is planning on reconfiguring the system to bypass the treatment building, it does not make sense to retrofit the tanks at the treatment building. Therefore, the funds related to the seismic retrofitting of the four tanks at the treatment plant should not be authorized, and the Commission should only authorize $815,736 for this project.

e) Sacramento Recycled Water Project (I15-600091)

Cal Am is proposing to serve recycled water purchased from the City of Roseville to the West Placer service area. The project would involve constructing 1) a connection to the existing City of Roseville recycled pipeline, 2) a storage tank, and 3) two pumping stations. Cal Am requests I15-600091 as an advice letter project. The Commission should not approve the proposed recycled water projects at this time prior to knowing the full cost and scope of the projects, and prior to Cal Am submitting the required information for recycled water projects detailed in D.14-08-058. Cal Am has not provided this information. Therefore, the Commission should not approve this project at

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seismic retrofits involved at the treatment plant include seismically retrofitting the four tanks within the treatment building. In this project, Cal Am intends to convert the unmetered connections in the system to metered connections. The proposed cost estimate for I15-600089 is taken from the ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab.

[184] Cal Am's response to data request ORA JMI-006, Q.1.a, provided herein as Attachment 8.

[185] Ibid. According to Cal Am, the four tanks at the treatment building have developed leaks which resulted in flooding of the steel superstructure where the tanks are set.

this time. Refer to the common issues section of this report regarding Cal Am's proposed recycled water project for the Sacramento District.

f) Recurring Project Budget (2018-2019)

Cal Am requests a total of $7,099,611 over the 2018-2019 period for smaller unforeseen operational and routine capital investment projects.[186] The Commission should adopt a budget of $6,983,534 for the 2018-2019 period for the Sacramento District. Refer to the common issues section of this report regarding ORA's recommendation regarding Cal Am's proposed 2018-2019 RP budget.

D. CONCLUSION

In the Sacramento District, ORA's recommended adjustments to Cal Am's proposed plant projects are based on historical expenditure and updated needs of the system (as indicated in the CPS). In addition, the adjustments recommended for Cal Am's proposed budget reflect the uncertainty of the information available for the projects, including pilot projects that are still in progress.

[186] The proposed cost estimate for the 2018-2019 period is taken from the ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab. The estimate includes the proposed funding for the Dunnigan and Meadowbrook service areas.

VI. LARKFIELD DISTRCT

A. INTRODUCTION

ORA reviewed and analyzed Cal Am's testimony, application, Minimum Data Requirements, workpapers, capital project details, estimating methods, Comprehensive Planning Studies, and responses to various data requests. ORA conducted a field investigation of most of the proposed specific plant additions on October 18, 2016. The differences between ORA's and Cal Am's estimates of specific plant additions are listed in Table 6-2.

B. SUMMARY OF RECOMMENDATIONS

Table 6-1 and Table 6-2 below summarizes ORA's adjustments in comparison to Cal Am's proposed project budget.[187]

Table 6-1: Larkfield Plant Additions, Including Carryovers, and Recurring Project

Larkfield ($000)	2018	2019
ORA	$ 345.8	$ 329.6
Cal Am	$ 345.8	$ 440.2
Cal Am > ORA	$ -	$ 110.6
ORA as % of Cal Am	100%	75%

Table 6-2: Larkfield Plant Comparison

2018	Project #	Project Description	ORA	Cal Am	Cal Am > ORA	ORA / Cal Am
1	n/a	n/a	$ -	$ -	$ -	n/a
Specifics Total			**$ -**	**$ -**	**$ -**	**n/a**
Recurring Projects			**$ 345,830**	**$ 345,830**	**$ -**	**100%**
Carry-Overs Total			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2018			**$ 345,830**	**$ 345,830**	**$ -**	**100%**

[187] ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab. The costs include any cost add-ons such as contingency, overhead, etc.

2019	Project #	Project Description	ORA	Cal Am	Cal Am > ORA	ORA / Cal Am
1	n/a	n/a	$ -	$ -	$ -	n/a
Specifics Total			**$ -**	**$ -**	**$ -**	**n/a**
Recurring Projects			**$ 329,563**	**$ 329,563**	**$ -**	**100%**
Carry-Overs Total			**$ -**	**$ 110,600**	**$ 110,600**	**0%**
TOTAL 2019			**$ 329,563**	**$ 440,163**	**$ 110,600**	**75%**

C. DISCUSSION

The Larkfield District is supplied by groundwater and purchased water from the Sonoma County Water Agency (SCWA).

1. Carryover Projects

a) Londonberry Drive Creek Crossing (I15-610009)

In the 2013 General Rate Case, Cal Am proposed to replace a section of main due to the existing condition of the main. Project I15-610009 was originally supposed to be completed in 2016. The Commission authorized a total of $444,000 in 2015 and 2016 for this project.[188] Cal Am did not record any capital expenditures for this project.[189]

Cal Am now estimates that I15-610009 will cost $850,000, approximately 91% over the original approved cost of $444,000.[190]

At this time Cal Am is uncertain when the construction of the project will begin due to the permitting issues with several regulatory agencies.[191] Cal Am now anticipates the project will be completed in 2020. The original construction cost of the project included funding for piping (based on jack and bore operation), existing pipe tie-ins, site work restoration (clearing, grubbing, and golf course site restoration).[192] The revised cost estimate of I15-610009 prepared by Carollo Engineers now includes costs for a

[188] Settlement for A.13-07-002, p. 219.

[189] ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab.

[190] Testimony of Mark Schubert, p. 146.

[191] Ibid.

[192] Comprehensive Planning Study for Larkfield District, Appendix B.

geotechnical investigation (and report)[193] and additional permitting costs.[194] Cal Am now anticipates that the design and permitting portion of I15-610009 would commence and be completed in 2019.[195] At this time, it is difficult to determine whether Cal Am would be able to complete the design in 2019 due to the need for additional permitting. According to Cal Am, multiple permits are required from multiple State (California Department of Fish and Wildlife and Regional Water Quality Control Board) and federal agencies (National Marine Fisheries with the United States Army Corp. of Engineers as the lead agency).[196] Cal Am states that the carryover project crosses the Mark West Creek which contains the Steelhead Trout, a species that is on the Endangered Species List.[197] This will require coordination with multiple agencies and presents uncertainty in the permitting costs necessary for the project. [198] The cost estimate prepared by Carollo Engineers assumes that I15-610009 require the Section 401 Water Quality Certification from the Regional Water Quality Control Board, Lake and Stream Bed Alteration Permit

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[193] In Cal Am's response to data request ORA JMI-012, Q.1.a, Cal Am states that two methods of construction were evaluated for this project, and the least intrusive option is horizontal boring. The cost of the geotechnical report assumes that the existing soil and groundwater conditions are suitable for jack and bore installation. Cal Am's response to data request ORA JMI-012, Q.1.a, provided herein as Attachment 9.

[194] The additional permitting costs assume the preparation of California Environmental Quality Act Initial Study/ Mitigated Negative Declaration and Cultural Resources Technical Report. The cost estimate assumes the project does not require Section 401 Water Quality Certification from the Regional Water Quality Control Board, Lake and Stream Bed Alteration Permit from California Department of Fish and Wildlife, or other permits associated with in-creek work.

[195] Testimony of Mark Schubert, p. 146.

[196] Cal Am's response to data request ORA JMI-012, Q.1.a, provided herein as Attachment 9.

[197] Ibid.

[198] According to Cal Am's response to data request ORA JMI012, Q.1.a, Cal Am states that the California Department of Fish and Wildlife will take up to six months (after filing the application) to review and determine any necessary conditions that may be required for the project. Then the Regional Water Quality Control Board will issue a 401 Water Quality Certification with conditions. The California Department of Fish and Wildlife would then issue a Streambed Alteration Permit and California Endangered Species Permit with any necessary conditions (which are expected to take approximately four to six months). A Zoning Permit from the Sonoma County Permit and Resource Management Department is necessary for the department to make its review and evaluate the temporary and/or permanent impacts to the riparian corridor associated with the project and to ensure that all other appropriate permits from other agencies have been obtained (which is expected to take between three to four months to obtain).

from California Department of Fish and Wildlife, or other permits associated with in-creek work which may be required given the presence of Steelhead Trout in the Mark West Creek.[199]

In addition, the project funding allocated for contingency increased from 10% to 25% indicating an increase in the uncertainty in the cost of the project. Due to the anticipated cost overrun over the original approved project cost and increased uncertainty in the project, additional funding above what was previously authorized for the project should not be authorized in the current GRC. When Cal Am applies for its next rate case, it may request to recover the cost of I15-610009 once it has completed the design of the project and provides a revised cost estimate which incorporates the findings from reports generated during the design and permitting process of the project.

D. CONCLUSION

The adjustment made to the Londonberry Drive Creek Crossing carryover project reflects the uncertainty in both the revised schedule and scope of the project.

[199] Ibid.

VII. MONTEREY COUNTY DISTRICT

A. INTRODUCTION

ORA reviewed and analyzed Cal Am's testimony, application, Minimum Data Requirements, workpapers, capital project details, estimating methods, Comprehensive Planning Studies, and responses to various data requests. ORA conducted a field investigation of most of the proposed specific plant additions on November 1-2, 2016 before making its own independent estimates including adjustments where appropriate. The differences between ORA's and Cal Am's estimates of specific plant additions are listed in Table 7-2.

B. SUMMARY OF RECOMMENDATIONS

Table 7-1 and Table 7-2 below summarizes ORA's adjustments in comparison to Cal Am's proposed project budget.[200]

Table 7-1: Monterey Plant Additions, Including Carryovers, and Recurring Project

Monterey ($000)	2018	2019
ORA	$ 8,399.6	$ 10,193.0
Cal Am	$ 9,931.7	$ 15,871.1
Cal Am > ORA	$ 1,532.0	$ 5,678.1
ORA as % of Cal Am	85%	64%

[200] ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab. The costs include any cost add-ons such as contingency, overhead, etc.

Table 7-2: Monterey Plant Comparison

2018	Project #	Project Description	ORA	Cal Am	Cal Am > ORA	ORA / Cal Am
1	I15-400093	Well Rehabilitation Program	$ 1,132,557	$ 1,155,970	$ 23,413	98%
2	I15-400090	Booster Station Rehabilitiation	$ 452,902	$ 554,616	$ 101,714	82%
3	I15-400089	Main Replacement Program	$ 1,155,970	$ 1,155,970	$ -	100%
4	I15-400092	Valve and PRV Repalcement	$ 346,791	$ 346,791	$ -	100%
5	I15-400095	Fire Flow Improvement	$ 360,812	$ 360,812	$ -	100%
6	I15-400096	SCADA Upgrade Program	$ 346,791	$ 346,791	$ -	100%
7	I15-400104	Advanced Metering Infrastructure	$ -	$ 1,108,883	$ 1,108,883	0%
8	I15-400106	New Well Development Program	$ 62,472	$ 62,472	$ -	100%
9	I15-400108	Standby Power Generators	$ 277,308	$ 277,308	$ -	100%
10	I15-400109	Los Padres Facility Improvements	$ 346,791	$ 346,791	$ -	100%
11	I15-400110	Begonia Iron Removal Plant Improvements	$ 288,992	$ 288,992	$ -	100%
12	I15-400113	Replace Carola Tank #1	$ 817,675	$ 817,675	$ -	100%
13	I15-400114	Replace Chualar Tank #1	$ 93,634	$ 93,634	$ -	100%
Specifics Total			**$ 5,682,695**	**$ 6,916,705**	**$1,234,010**	**82%**
Recurring Projects			**$ 2,716,953**	**$ 3,014,976**	**$ 298,023**	**90%**
Carry-Overs Total			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2018			**$ 8,399,649**	**$ 9,931,681**	**$1,532,032**	**85%**

2019	Project #	Project Description	ORA	Cal Am	Cal Am > ORA	ORA / Cal Am
1	I15-400093	Well Rehabilitation Program	$ 1,083,604	$ 1,106,004	$ 22,400	98%
2	I15-400090	Booster Station Rehabilitiation	$ 432,502	$ 529,633	$ 97,131	82%
3	I15-400089	Main Replacement Program	$ 3,318,013	$ 3,318,013	$ -	100%
4	I15-400092	Valve and PRV Repalcement	$ 331,801	$ 331,801	$ -	100%
5	I15-400095	Fire Flow Improvement	$ 345,823	$ 345,823	$ -	100%
6	I15-400096	SCADA Upgrade Program	$ 331,801	$ 331,801	$ -	100%
7	I15-400104	Advanced Metering Infrastructure	$ -	$ 5,265,197	$ 5,265,197	0%
8	I15-400106	New Well Development Program	$ 83,964	$ 83,964	$ -	100%
9	I15-400108	Standby Power Generators	$ 264,817	$ 264,817	$ -	100%
10	I15-400110	Begonia Iron Removal Plant Improvements	$ 829,503	$ 829,503	$ -	100%
11	I15-400114	Replace Chualar Tank #1	$ 525,573	$ 525,573	$ -	100%
Specifics Total			**$ 7,547,401**	**$ 12,932,129**	**$5,384,728**	**58%**
Recurring Projects			**$ 2,645,587**	**$ 2,938,954**	**$ 293,367**	**90%**
Carry-Overs Total			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2019			**$10,192,988**	**$ 15,871,083**	**$5,678,095**	**64%**

C. DISCUSSION

The Monterey District consists of the Main Monterey system and eight satellite systems (Ryan Ranch, Bishop, Hidden Hills, Ambler, Ralph Lane, Chualar, Toro, and Garrapata).

1. Proposed Projects

a) Well Rehabilitation Program (I15-400093)

Cal Am requests a total of $2,261,974 for the 2018-2019 period to maintain the condition and performance of the existing wells in the Monterey District.[201] According to Cal Am, the well rehabilitation program includes but is not limited to the following capital rehabilitation activities: removal of in-well pumping equipment, columns, and components; video examination of the wells for both as-found and as-left conditions; restorative activities such as brushing, swapping, pressure washing, chemical cleaning, swaging, and lining; replacement and installation of mechanical equipment; disinfection and performance testing prior to return to service.[202] Cal Am schedules the well rehabilitation based on each well's performance, age, and the time since the well was previously rehabilitated.

Cal Am states that the condition of any individual well is currently unknown and the amount of improvements needed at each well site will not be known until the well is examined.[203] Therefore, Cal Am based its proposed annual budget for the construction costs of this project on the recorded cost of completed well rehabilitation projects.[204] The recorded costs of the well rehabilitation projects that Cal Am used in its calculation are separated into five categories: contractor, consultant/inspection, overhead, labor, and

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[201] Testimony of Mark Schubert, pp. 164-165. The proposed cost estimate for the 2018-2019 period is taken from the ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab.

[202] Capital Investment Project Workpapers, I15-400093, p. 3.

[203] Ibid, p. 4.

[204] Ibid. The unit cost of each well is based on the average recorded cost of eight well rehabilitation projects completed between 2012 and 2013.

labor overhead.[205] However, for each of Cal Am's proposed projects, Cal Am applies cost mark-ups to the construction cost of the project that includes a line-item for overhead.[206] Therefore, overhead is already included separately in the budgeted funds for this project (on top of the construction costs). The inclusion of overhead costs in the recorded projects, which are averaged to develop the estimated construction costs for the proposed project, results in double-counting of the overhead for these projects. ORA does not object to including funds for well rehabilitation projects, but recommends removing the overhead costs from recorded costs prior to averaging the recorded costs to avoid double-counting of overhead costs.[207] Based on the aforementioned adjustment, the recommended budget for I15-400093 should be approximately $2,216,162 total during the 2018-2019 period.

b) Booster Station Rehabilitation Program (I15-400090)

Cal Am requests $1,084,249 in the 2018-2019 period to address the alleged deficiencies of the existing booster stations throughout the district.[208] For the 2018-2019 period, Cal Am identifies improvements necessary for five booster stations.[209] Cal Am provided ORA with a cost estimate for the proposed improvements for the five aforementioned booster stations. Cal Am overestimates the construction cost for the

[205] Capital Investment Project Workpapers, I15-400093, p. 3.

[206] For each proposed project, Cal Am applies mark-ups for contingency and overhead to the estimated construction cost determine the total cost of the project. The contingency and overhead costs for each project are shown in the ALL_CH07_PLT_RO_Forecast Workpaper, Contingency by Project WS-6 tab and Engineering Overhead by Project WS-7 tab, respectively.

[207] For each recorded individual well rehabilitation project, the overhead cost was subtracted from the recorded cost. The average is calculated by taking the sum of the individual well rehabilitation projects and dividing by the number of well rehabilitation projects. This results in a lower average unit cost.

[208] Testimony of Mark Schubert, p. 168. The proposed cost estimate for the 2018-2019 period is taken from the ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab.

[209] Cal Am's response to data request ORA JMI-003, Q.6. The booster stations identified in the aforementioned data request include: Lower Airways #17, High Meadows#45, Del Mesa Carmel#42, Encina #54, and Carmel Woods #8.

proposed improvements in the CIP Workpapers for I15-400090.[210] The estimated construction cost of the project is given as a range of a low end and a high end estimate, and Cal Am utilizes the high end estimate.[211] However, for all projects, Cal Am adds a contingency mark-up to the construction cost estimate.[212] The purpose of the contingency mark-up is to account for the unforeseen issues that will arise during preliminary engineering design, permitting, and construction of the project.[213] Therefore, for the construction cost estimate, the low end estimate should be used, resulting in a recommended budget of $885,404 for PID 400090 for the 2018-2019 period.[214]

c) Advanced Metering Infrastructure (I15-400104)

Cal Am requests $6,374,080 during the 2018-2019 period to fully implement AMI meters in the Monterey District.[215] Refer to the common issues section regarding ORA's recommendation regarding Cal Am's proposed implementation of AMI in the Monterey District, and a discussion of why the Commission should not authorize funding for this project in this rate case.

d) Recurring Project Budget (2018-2020)

Cal Am requests a total of $5,953,930 over the 2018-2019 period for smaller unforeseen operational and routine capital investment projects.[216] The Commission

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[210] Ibid.

[211] Ibid. Cal Am estimates that the low and high end construction cost for I15-400090 to be $483,333 and $716,667, respectively for the 2018-2019 period. Cal Am's construction cost estimate is based on the high end estimate.

[212] The contingency rate varies among each plant improvement project. For I15-400090, Cal Am is requesting a contingency rate of 5% according to the ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-6 tab.

[213] Testimony of Edward Grubb, p. 10.

[214] ORA's recommended budget of $885,404 for I15-400090 for 2018-2019 is the low end construction cost of $483,333 plus the cost add-ons (contingency and overhead).

[215] Testimony of Mark Schubert, p. 164.

[216] Ibid, Attachment 7.

should adopt a budget of $5,362,540 for the 2018-2019 period for the Monterey District. Refer to the common issues section of this report regarding ORA's recommendation regarding Cal Am's proposed 2018-2019 RP budget.

e) Tank Painting Projects

Cal Am requests a total of $1,444,316 for five tank painting projects in the 2018-2019 period for existing tanks in the Monterey District.[217] The Commission should not authorize any funding for the proposed tank painting projects based on Cal Am's historic spending on tank painting projects. Refer to the common issues section of this report regarding Cal Am's proposed tank painting projects.

D. CONCLUSION

In the Monterey District, the adjustments recommended for Cal Am's proposed budget reflect the uncertainty of the information available for the projects (including pilot projects that are still in progress), budgets based on past expenditure on similar projects, and Cal Am's historic spending to complete tank painting projects.

[217] Testimony of Mark Schubert, p. 195. Cal Am is requests two projects in 2018 and three in 2019.

VIII. MONTEREY WASTEWATER, TORO, AND GARRAPATA

A. INTRODUCTION

ORA reviewed and analyzed Cal Am's testimony, application, Minimum Data Requirements, workpapers, capital project details, estimating methods, Comprehensive Planning Studies, and responses to various data requests. The differences between ORA's and Cal Am's estimates of specific plant additions are listed in Table 8-2, Table 8-4, and Table 8-6.

B. SUMMARY OF RECOMMENDATIONS

Table 8-1 through Table 8-6 below summarizes ORA's adjustments in comparison to Cal Am's proposed project budget.

Table 8-1: Monterey Wastewater Plant Additions, Including Carryovers, and Recurring Project[218]

Monterey Wastewater ($000)	2018	2019
ORA	$ 272.1	$ 259.3
Cal Am	$ 272.1	$ 259.3
Cal Am > ORA	$ -	$ -
ORA as % of Cal Am	100%	100%

Table 8-2: Monterey Wastewater Plant Comparison

2018	Project #	Project Description	ORA	Cal Am	Cal Am > ORA	ORA / Cal Am
1	n/a	n/a	$ -	$ -	$ -	n/a
Specifics Total			**$ -**	**$ -**	**$ -**	**n/a**
Recurring Projects			**$ 272,058**	**$ 272,058**	**$ -**	**100%**
Carry-Overs Total			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2018			**$ 272,058**	**$ 272,058**	**$ -**	**100%**

2019	Project #	Project Description	ORA	Cal Am	Cal Am > ORA	ORA / Cal Am
1	n/a	n/a	$ -	$ -	$ -	n/a
Specifics Total			**$ -**	**$ -**	**$ -**	**n/a**
Recurring Projects			**$ 259,265**	**$ 259,265**	**$ -**	**100%**
Carry-Overs Total			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2019			**$ 259,265**	**$ 259,265**	**$ -**	**100%**

[218] ALL_CH07_PLT_RO_Forecast Workpaper, Total CAPEX by Project WS-9 tab. The costs include any cost add-ons such as contingency, overhead, etc.

Table 8-3: Toro Additions, Including Carryovers, and Recurring Project

Toro ($000)	2018	2019
ORA	$ 217.1	$ 181.8
Cal Am	$ 217.1	$ 181.8
Cal Am > ORA	$ -	$ -
ORA as % of Cal Am	100%	100%

Table 8-4: Toro Plant Comparison

2018	Project #	Project Description	ORA	Cal Am	Cal Am > ORA	ORA / Cal Am
1	I15-480010	Booster Station Replacement	$ 52,019	$ 52,019	$ -	100%
2	I15-480012	SCADA Enhancements	$ 28,899	$ 28,899	$ -	100%
Specifics Total			**$ 80,918**	**$ 80,918**	**$ -**	**100%**
Recurring Projects			**$136,216**	**$ 136,216**	**$ -**	**100%**
Carry-Overs Total			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2018			**$217,134**	**$ 217,134**	**$ -**	**100%**
2019	**Project #**	**Project Description**	**ORA**	**Cal Am**	**Cal Am > ORA**	**ORA / Cal Am**
1	I15-480010	Booster Station Replacement	$ 49,770	$ 49,770	$ -	100%
Specifics Total			**$ 49,770**	**$ 49,770**	**$ -**	**100%**
Recurring Projects			**$132,071**	**$ 132,071**	**$ -**	**100%**
Carry-Overs Total			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2019			**$181,841**	**$ 181,841**	**$ -**	**100%**

Table 8-5: Garrapata Plant Additions, Including Carryovers, and Recurring Project

Garrapata ($000)	2018	2019
ORA	$ 30.4	$ 29.7
Cal Am	$ 52.9	$ 50.4
Cal Am > ORA	$ 22.5	$ 20.7
ORA as % of Cal Am	57%	59%

Table 8-6: Garrapata Plant Comparison

2018	Project #	Project Description	ORA	Cal Am	Cal Am > ORA	ORA / Cal Am
1	n/a	n/a	$ -	$ -	$ -	n/a
Specifics Total			**$ -**	**$ -**	**$ -**	**n/a**
Recurring Projects			**$ 30,424**	**$ 52,930**	**$ 22,506**	**57%**
Carry-Overs Total			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2018			**$ 30,424**	**$ 52,930**	**$ 22,506**	**57%**

2019	Project #	Project Description	ORA	Cal Am	Cal Am > ORA	ORA / Cal Am
1	n/a	n/a	$ -	$ -	$ -	n/a
Specifics Total			**$ -**	**$ -**	**$ -**	**n/a**
Recurring Projects			**$ 29,701**	**$ 50,441**	**$ 20,740**	**59%**
Carry-Overs Total			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2019			**$ 29,701**	**$ 50,441**	**$ 20,740**	**59%**

C. DISCUSSION

The Monterey Wastewater District is comprised of the following systems: Carmel Valley Ranch, Indian Springs, Las Palmas, Pasadera (or Laguna Seca), Oak Hills, Spreckels, White Oaks, and Village Green.[219] In the CPS, Cal Am projected the fifteen year average flow and compared this value to the design capacity of each system. For each system, the projected fifteen year average flow was below the design capacity. Cal Am concludes that each system has sufficient capacity for this rate cycle.[220] In the 2018-2019 period, Cal Am is only requesting recurring project funding for the Monterey Wastewater service area.

Cal Am acquired the Toro system in 2008. The Toro system is supplied through groundwater wells.[221]

[219] Testimony of Eric Sabolsice, p. 3.

[220] Monterey Wastewater District CPS, p. E-1. A comparison summary of the projected 15-year average flow and design capacity can be seen in Monterey Wastewater CPS. Table E-1: Summary of Projected Customer Count and Flows, p. E-3.

[221] Toro CPS, p. 4-1.

In 2013, Cal Am acquired the Garrapata system in the Monterey County.[222] In the Garrapata service area, Cal Am is only requesting funding for their annual recurring project budget.

1. Proposed Projects

a) Recurring Project Budget (2018-2019)—Monterey Wastewater

Cal Am requests a total of $531,323 over the 2018-2019 period for smaller unforeseen operational and routine capital investment projects in the Monterey Wastewater service area.[223] ORA does not oppose Cal Am's proposed RP budget of $531,323 for the 2018-2019 period for the Monterey Wastewater District. Refer to the common issues section of this report regarding ORA's recommendation regarding Cal Am's proposed 2018-2019 RP budget.

b) Recurring Project Budget (2018-2019)—Toro

Cal Am requests a total of $267,572 over the 2018-2019 period for smaller unforeseen operational and routine capital investment projects in the Toro service area.[224] ORA does not oppose Cal Am's proposed RP budget of $267,572 for the 2018-2019 period for the Toro service area. Refer to the common issues section of this report regarding ORA's recommendation regarding Cal Am's proposed 2018-2019 RP budget.

c) Recurring Project Budget (2018-2019)—Garrapata

Cal Am requests a total of approximately $103,371 over the 2018-2019 period for smaller unforeseen operational and routine capital investment projects in the Garrapata service area.[225] The Commission should recommend a budget of $60,125 for the 2018-2019 period for the Garrapata service area. Refer to the common issues section of this

[222] Testimony of Mark Schubert, p. 8.

[223] Ibid, Attachment 7.

[224] Ibid.

[225] Ibid.

report regarding ORA's recommendation regarding Cal Am's proposed 2018-2019 RP budget.

D. CONCLUSION

The adjustments recommended for Cal Am's proposed budget reflects Cal Am's historical expenditure of its Recurring Project budget.

Attachment 1: Witness Qualifications

QUALIFICATIONS AND PREPARED TESTIMONY OF JUSTIN MENDA

Q.1 Please state your name and business address.

A.1 My name is Justin Menda and my business address is 505 Van Ness Avenue, San Francisco, California 94102.

Q.2 By whom are you employed and in what capacity?

A.2 I am a Utilities Engineer in the Communications and Water Policy Branch of the Office of Ratepayer Advocates.

Q.3 Briefly describe your pertinent educational background.

A.3 I received a Bachelor of Science Degree and a Masters in Science in Civil Engineering from the University of California Irvine.

Q.4 Briefly describe your professional experience.

A.4 I have been employed by the Office of Ratepayer Advocates – Communications and Water Policy Branch since June 2012. Since that time, I worked on testimony for California Water Service Company's 2012 GRC regarding the plant in service and water quality chapters for the Chico, Marysville, Oroville, Redwood Valley, and Willows districts. In addition, I worked on testimony for California Water Services Company's 2015 GRC regarding depreciation and the plant in service for the Bayshore, Bear Gulch, Chico, Redwood Valley, Stockton districts. I also worked on testimony for California-American Water's 2013 GRC regarding the plant in service and water quality chapters for the Los Angeles County, Ventura County, San Diego County, and Monterey Wastewater districts. For the San Jose Water Company 2014 GRC, I worked on plant in service and water quality. Besides working on plant in service and water quality, I worked on Golden State Water Company's 2014 GRC regarding depreciation and rate base. In addition, I worked on testimony for California-American Water's proposed Monterey Peninsula Water Supply Project regarding brine disposal, post treatment, and operation and maintenance costs.

Q.5 What is your responsibility in this proceeding?

A.5 I am sponsoring testimony regarding California-American Water Company's proposed utility plant in service projects (including tank painting projects).

Q.6 Does that conclude your direct testimony?

A.6 Yes, at this time.

Attachment 2: Cal Am's Response to Data Request ORA JMI-007, Q. 1.a., 1.f, 1.m.i, 3.a., 3.h., 3.k.i, and 4.

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By:	**Richard C. Svindland**
Title:	**Vice President - Operations**
Address:	**California American Water** **4701 Beloit Drive, Sacramento, CA 95838**
ORA Request:	**ORA A.16-07-002 JMI-007**
Company Number:	**CAW-ORA A.16-07-002 JMI-007 Q001a**
Date Received:	**November 16, 2016**
Date Response Due:	**November 30, 2016; Extension to December 7, 2016**
Subject Area:	**Advanced Metering Infrastructure**

DATA REQUEST:

1. In regards to the Advanced Metering Infrastructure (AMI) pilot that is being conducted in the Ventura district:

   a) How many meters are part of the overall pilot project?

CAL-AM'S RESPONSE:

1,299 customers were included. We currently have eleven opt-outs, so approximately 1,288 total, at this point.

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By:	**Richard C. Svindland**
Title:	**Vice President - Operations**
Address:	**California American Water** **4701 Beloit Drive, Sacramento, CA 95838**
ORA Request:	**ORA A.16-07-002 JMI-007**
Company Number:	**CAW-ORA A.16-07-002 JMI-007 Q001f**
Date Received:	**November 16, 2016**
Date Response Due:	**November 30, 2016; Extension to December 7, 2016**
Subject Area:	**Advanced Metering Infrastructure**

DATA REQUEST:

1. In regards to the Advanced Metering Infrastructure (AMI) pilot that is being conducted in the Ventura district:

   f) When were customers informed that their meters have been replace/retrofitted with an AMI meter and had access to the web portal? If customers have not yet been informed at this time, when does Cal Am expect all of the customers who are part of the pilot project to be informed?

CAL-AM'S RESPONSE:

Customers received a letter about the meter upgrade program in July 2016. Customers will receive a second letter (December) informing them about the web portal/mobile application with instructions on how to register/gain access.

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By:	**Richard C. Svindland**
Title:	**Vice President - Operations**
Address:	**California American Water** **4701 Beloit Drive, Sacramento, CA 95838**
ORA Request:	**ORA A.16-07-002 JMI-007**
Company Number:	**CAW-ORA A.16-07-002 JMI-007 Q001m**
Date Received:	**November 16, 2016**
Date Response Due:	**November 30, 2016; Extension to December 7, 2016**
Subject Area:	**Advanced Metering Infrastructure**

DATA REQUEST:

1. In regards to the Advanced Metering Infrastructure (AMI) pilot that is being conducted in the Ventura district:

   m) With the current configuration of the AMI meters that are part of the pilot project:

      i. What is the capacity of the current pilot project testing parameters to be able to detect leaks and notify Cal Am?

      ii. What is the capacity of the pilot project for Cal Am to be able to detect backflow? If applicable, please detail how Cal Am is notified of backflow events using the current configuration of the AMI pilot project.

CAL-AM'S RESPONSE:

i. California American, along with its partners in the project, are still formulating the testing parameters in connection with leak detection. Based on discussions with the selected vendor, it is expected the vendor will have the ability to assist with determining potential anomalies in usage which could indicate leaks. Our goal is to complete the leak detection project scope and design by the end of Q2 2017, so we can start to better analyze the project's impact, direction, and benefits.

ii. At present, i.e., without AMI, we have the limited tool of using our customer information system (SAP) reports to determine negative usage, which is an indication of potential backflow issues. Basically, how this works is that if the usage for the billing period reads negative, that would indicate a backflow issue.

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By:	**Richard C. Svindland**
Title:	**Vice President - Operations**
Address:	**California American Water** **4701 Beloit Drive, Sacramento, CA 95838**
ORA Request:	**ORA A.16-07-002 JMI-007**
Company Number:	**CAW-ORA A.16-07-002 JMI-007 Q003a**
Date Received:	**November 16, 2016**
Date Response Due:	**November 30, 2016; Extension to December 7, 2016**
Subject Area:	**Advanced Metering Infrastructure**

DATA REQUEST:

3. In regards to the AMI pilot that is being conducted in the Monterey district:

   a) How many customers of each customer type (i.e. residential, commercial, etc.) are part of the pilot project?

CAL-AM'S RESPONSE:

At present there are 175 residential and 19 commercial customers. Our agreement with Pacific Gas and Electric (PGE) allows for installation of up to 200 Meter Transmission Unit's (MTU's). We plan to add another 6 commercial customers.

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By:	**Richard C. Svindland**
Title:	**Vice President - Operations**
Address:	**California American Water** **4701 Beloit Drive, Sacramento, CA 95838**
ORA Request:	**ORA A.16-07-002 JMI-007**
Company Number:	**CAW-ORA A.16-07-002 JMI-007 Q003h**
Date Received:	**November 16, 2016**
Date Response Due:	**November 30, 2016; Extension to December 7, 2016**
Subject Area:	**Advanced Metering Infrastructure**

DATA REQUEST:

3. In regards to the AMI pilot that is being conducted in the Monterey district:

   h) What criteria will Cal Am use to determine whether the pilot project is successful?

CAL-AM'S RESPONSE:

Success for the Monterey pilot will be measured by:

1. Reduced volume of field visits to verify reads for pilot accounts.
2. Number of proactive notification of potential leaks.
3. Number of customers registering for portal.
4. Overall satisfaction with portal / mobile application.

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By:	**Richard C. Svindland**
Title:	**Vice President - Operations**
Address:	**California American Water** **4701 Beloit Drive, Sacramento, CA 95838**
ORA Request:	**ORA A.16-07-002 JMI-007**
Company Number:	**CAW-ORA A.16-07-002 JMI-007 Q003k**
Date Received:	**November 16, 2016**
Date Response Due:	**November 30, 2016; Extension to December 7, 2016**
Subject Area:	**Advanced Metering Infrastructure**

DATA REQUEST:

3. In regards to the AMI pilot that is being conducted in the Monterey district:

   k) With the current configuration of the AMI meters that are part of the pilot project:

      i. What is the capacity of the current pilot project testing parameter for Cal Am to be able to detect leaks?

      ii. What is the capacity of the pilot project for Cal Am to be able to detect backflow? If applicable, please detail how Cal Am would be able to detect backflow events with the current configuration of the AMI pilot project.

CAL-AM'S RESPONSE:

i. Currently the pilot project can identify continuous usage that may be a leak through the MTU recording hourly meter reads. If there is continuous usage a notification is sent to the customer and to the local CAW office. The local office contacts the customers to discuss the continuous usage and if necessary a field visit is scheduled.

ii. At present, i.e., without AMI, we have the limited tool of using our customer information system (SAP) reports to determine negative usage, which is an indication of potential backflow issues. Basically, how this works is that if the usage for the billing period reads negative, that would indicate a backflow issue.

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By:	**Richard C. Svindland**
Title:	**Vice President - Operations**
Address:	**California American Water** **4701 Beloit Drive, Sacramento, CA 95838**
ORA Request:	**ORA A.16-07-002 JMI-007**
Company Number:	**CAW-ORA A.16-07-002 JMI-007 Q004**
Date Received:	**November 16, 2016**
Date Response Due:	**November 30, 2016; Extension to December 7, 2016**
Subject Area:	**Advanced Metering Infrastructure**

DATA REQUEST:

4. For both the Ventura and Monterey AMI Pilot Project provide all (1) implementation plans, (2) test results, and (3) interim and final pilot test reports.

CAL-AM'S RESPONSE:

(1) Implementation Plans: In terms of implementation, frequent meetings occur where action items are discussed. Those items included discussions of key areas to ensure project delivery/success. The key areas focused on include: Implementation Date, Customer Activities/Communications, Installation/Transmission Processes, and Training for National Customer Service and Local Team Members. For the Ventura Project, weekly meetings are occurring with internal team members and the partners we are working with on the pilot project. *See* attached ORA JMI-007 Q004 Svindland-Attachment 1 Document. This includes documents reviewed during our Five Partner Kick-Off Meeting; PowerPoint, Information Technology Infrastructure, and Agenda.

(2) Test Results – our focus for both projects was to make certain meter reads transmits successfully from both PGE (for Monterey) and So Cal Gas (for Ventura). Initially there were some challenges with PGE transmission, however, we have since worked through these challenges. We only had one minor issue with So Cal Gas in the beginning, but have not had any issues recently. In Monterey we are not currently using reads for billing. In Ventura, we are using reads for billing and have not encountered any issues which have prevented issuance of bills. Thus far, we have confirmed meter reads can be transmitted over the energy utility's system and transferred to our system. We have also

confirmed that once available, that information can be made available to and has been used by our customers in Monterey to, among other things, set usage alerts and monitor usage.

(3) Pilot Test Reports – the pilot projects are running concurrently. The Monterey pilot is scheduled to end February 2017 and the Ventura pilot is scheduled to end August 2017. Analysis of results of results, such as the usage by customers in Monterey, is ongoing. Any final review of the project will occur once it ends.

Attachment 3: Cal Am's Response to Data Request ORA JMI-010.

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By:	**Walter E Sadler**
Title:	**Engineering Manager – Project Delivery**
Address:	**California-American Water Company** **4701 Beloit Drive, Sacramento, CA 95838**
ORA Request:	**ORA A.16-07-002 JMI-010**
Company Number:	**CAW-ORA A.16-07-002 JMI-010 Q001**
Date Received:	**December 1, 2016**
Date Response Due:	**December 13, 2016**
Subject Area:	**Deferred Tank Improvement**

DATA REQUEST:

1. In regards to the previous deferred tank improvement projects in the Sacramento district:

   a. For the tanks listed in the table below, have the tank painting projects been completed? If so, when were each of the tank painting projects completed?

Tank
Mather
Parksite #1

   b. For the tank painting projects that were completed in response to question 1(a) above, what was the completed cost of each project?

   c. For the tank painting projects that were completed in response to question 1(a) above, please provide all vendor costs for the completed tank painting projects.

CAL-AM'S RESPONSE:

a. Neither tank painting project has been completed.

b. Not applicable.

c. Not applicable.

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By:	**Christopher Cook**
Title:	**Senior Project Engineer**
Address:	**California American Water** **511 Forest Lodge Rd., Suite 100, Pacific Grove, CA 93950**
ORA Request:	**ORA A.16-07-002 JMI-010**
Company Number:	**CAW-ORA A.16-07-002 JMI-010 Q002**
Date Received:	**December 1, 2016**
Date Response Due:	**December 13, 2016**
Subject Area:	**Deferred Tank Improvement**

DATA REQUEST:

2. In regards to the previous deferred tank improvement projects in the Monterey district:

    a. For the tanks listed in the table below, have the tank painting projects been completed? If so, when were each of the tank painting projects completed?

Tank
Pebble Beach #3
Presidio#2
Airways Lower

    b. For the tank painting projects that were completed in response to question 2(a) above, what was the completed cost of each project?

    c. For the tank painting projects that were completed in response to question 2(a) above, please provide all vendor costs for the completed tank painting projects.

CAL-AM'S RESPONSE:

a. These tank painting projects have not been completed.

b. Not applicable.

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

c. Not applicable.

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By:	**Walter E Sadler**
Title:	**Engineering Manager – Project Delivery**
Address:	**California-American Water Company** **4701 Beloit Drive, Sacramento, CA 95838**

ORA Request:	**ORA A.16-07-002 JMI-010**
Company Number:	**CAW-ORA A.16-07-002 JMI-010 Q003**
Date Received:	**December 1, 2016**
Date Response Due:	**December 13, 2016**
Subject Area:	**Deferred Tank Improvement**

DATA REQUEST:

3. In regards to the previous deferred tank improvement projects in the Larkfield district:

   a. For the tanks listed in the table below, have the tank painting projects been completed? If so, when were each of the tank painting projects completed?

Tank
Upper Wikiup
Backwash/Sludge Tank

   b. For the tank painting projects that were completed in response to question 3(a) above, what was the completed cost of each project?

   c. For the tank painting projects that were completed in response to question 3(a) above, please provide all vendor costs for the completed tank painting projects.

CAL-AM'S RESPONSE:

a. Neither tank painting project has been completed. An evaluation of the backwash/sludge tank was performed and it was determined to be more cost-effective to replace the tank. The tank is being replaced under I15-610012.

b. Not applicable.

c. Not applicable.

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By:	**Mark Reifer**
Title:	**Operations Engineer**
Address:	**California-American Water Company** **8657 Grand Avenue, Rosemead, CA 91770**
ORA Request:	**ORA A.16-07-002 JMI-010**
Company Number:	**CAW-ORA A.16-07-002 JMI-010 Q004**
Date Received:	**December 1, 2016**
Date Response Due:	**December 13, 2016**
Subject Area:	**Deferred Tank Improvement**

DATA REQUEST:

4. In regards to the previous deferred tank improvement projects in the Ventura district:

   a. For the tanks listed in the table below, have the tank painting projects been completed? If so, when were each of the tank painting projects completed?

Tank
Janss
Wildwood

   b. For the tank painting projects that were completed in response to question 4(a) above, what was the completed cost of each project?

   c. For the tank painting projects that were completed in response to question 4(a) above, please provide all vendor costs for the completed tank painting projects.

CAL-AM'S RESPONSE:

a. Both tank projects have been completed and returned to service. Wildwood was completed and returned to service in April 2014. Janss tank was completed and returned to service in May 2016. However, after the tank was reconnected to the SCADA system, operators began to notice anomalous loss of data, which was traced back to the antenna wire installed by the Contractor. The replacement of the wire is still being resolved, however Operations can keep the reservoir in service.

b. Wildwood Capex: $193,033.35

   Janss Capex: $163,595.05

c. Wildwood Vendor Costs: $155,482.32

   Janss Vendor Costs: $142,872.44

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By: **Mark Reifer**

Title: **Operations Engineer**

Address: **California-American Water Company**
8657 Grand Avenue, Rosemead, CA 91770

ORA Request: **ORA A.16-07-002 JMI-010**

Company Number: **CAW-ORA A.16-07-002 JMI-010 Q005**

Date Received: **December 1, 2016**

Date Response Due: **December 13, 2016**

Subject Area: **Deferred Tank Improvement**

DATA REQUEST:

5. In regards to the previous deferred tank improvement projects in the Los Angeles district:

   a. For the tanks listed in the table below, have the tank painting projects been completed? If so, when were each of the tank painting projects completed?

Tank	District
Lamanda	LA (SM-Upper)
Oak Knoll	LA (SM-Upper)
Starpine	LA(Duarte)

   b. For the tank painting projects that were completed in response to question 5(a) above, what was the completed cost of each project?

   c. For the tank painting projects that were completed in response to question 5(a) above, please provide all vendor costs for the completed tank painting projects.

CAL-AM'S RESPONSE:

a. Lamanda – in process; to be completed in Spring 2017. Starpine was completed in March 2013. Oak Knoll was completed in May 2014.

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

b. Lamanda cost is projected to be $197,075. Starpine cost $311,425.86. Oak Knoll cost $424,585.28.

c. See ORA JMI-010 Q005 Attachment 1.

Attachment 4: Cal Am’s Response to Data Request ORA JMI-010.2

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By:	**Christopher Cook**
Title:	**Senior Project Engineer**
Address:	**California American Water** **511 Forest Lodge Rd., Suite 100, Pacific Grove, CA 93950**
ORA Request:	**ORA A.16-07-002 JMI-010.2**
Company Number:	**CAW-ORA A.16-07-002 JMI-010.2 Q001a**
Date Received:	**January 5, 2017**
Date Response Due:	**January 17, 2017**
Subject Area:	**Deferred Tank Improvement Follow Up**

DATA REQUEST:

1. In regards to the previous deferred tank improvement projects in the Monterey District:

    a. For the tanks listed in the table below, have the tank painting projects been completed. If so, when were the tank painting projects completed?

Tank
Forest Lake #1
High Meadows

CAL-AM'S RESPONSE:

These tank painting projects are not yet complete.

Attachment 5: Cal Am's Response to Data Request A.16-07-002 JMI-009, Q. 2.d.i, 2.d.ii, 2.e, and 3.b.i.

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By:	**Mark Reifer**
Title:	**Operations Engineer**
Address:	**California-American Water Company** **8657 Grand Avenue, Rosemead, CA 91770**
ORA Request:	**ORA A.16-07-002 JMI-009**
Company Number:	**CAW-ORA A.16-07-002 JMI-009 Q002d**
Date Received:	**December 1, 2016**
Date Response Due:	**December 13, 2016**
Subject Area:	**Recycled Water Projects**

DATA REQUEST:

2. In regards to the Coronado/Imperial Beach Recycle Water Project (I15-300016):

    d. On page 161 of the Direct Testimony of Mark Schubert, it states that "the proposed project would include a Wastewater Reclamation Facility, the location has not yet been determined."

        i. Which locations or existing Wastewater Reclamation Facilities are being considered? For the each of the existing Wastewater Reclamation facilities being considered, what is the capacity of the treatment facilities?

        ii. For each of the existing facilities being considered in response to question 2(d.i) above, would the proposed project require expanding the existing capacity of the treatment facilities? If so, who would be responsible for funding the potential capacity expansion of the treatment facility?

        iii. For each of the existing facilities being considered in response to question 2(d.i) above, would the proposed project require additional treatment facilities? If so, what additional treatment facilities are required and who would be responsible for funding the additional potential treatment processes?

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By:	**Mark Reifer**
Title:	**Operations Engineer**
Address:	**California-American Water Company** **8657 Grand Avenue, Rosemead, CA 91770**
ORA Request:	**ORA A.16-07-002 JMI-009**
Company Number:	**CAW-ORA A.16-07-002 JMI-009 Q002e**
Date Received:	**December 1, 2016**
Date Response Due:	**December 13, 2016**
Subject Area:	**Recycled Water Projects**

DATA REQUEST:

2. In regards to the Coronado/Imperial Beach Recycle Water Project (I15-300016):

    e. Has Cal Am determined the potential sources for source water? If so, what potential sources are being evaluated and what is the potential amount of supply for each potential source?

CAL-AM'S RESPONSE:

e. California American Water is still analyzing the potential sources for recycled water. At this time, the main source under consideration is from the City of Imperial Beach sewer system. California American Water does not know the exact amount of source water that would be available from the City of Imperial Beach. Other sources are being evaluated but none have been confirmed available to date.

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By:	**Lacy Carothers**
Title:	**Project Manager**
Address:	**California-American Water Company 4701 Beloit Drive, Sacramento, CA 95838**
ORA Request:	**ORA A.16-07-002 JMI-009**
Company Number:	**CAW-ORA A.16-07-002 JMI-009 Q003b**
Date Received:	**December 1, 2016**
Date Response Due:	**December 13, 2016**
Subject Area:	**Recycled Water Projects**

DATA REQUEST:

3. In regards to the Sacramento Recycled Water Project (I15-600091):

   b. Page A-1 of the Cal Am Recycled Water Study Technical Memorandum and Cost Estimate for the West Placer Service Area lists potential customers for the proposed recycled water.

      i. Has Cal Am been in contact with the potential customers to evaluate customer interest in recycled water? If so, please state which potential customers Cal Am has been in contact with and whether not those customers have expressed interest in recycled water.

      ii. Has Cal Am been in contact with any other potential customers not listed in Table A- 2 regarding potential interest for recycled water? If so, please list each new potential customer, with the potential demand, and date of last contact for each.

      iii. If the demands have been updated after being in contact with the potential customers mentioned in response to question 3(b.i) and 3(b.ii), please provide an updated Table A-2.

CAL-AM'S RESPONSE:

3. b.i. This recycled water project is for the West Placer Service Area which is an area

planned for future development, thus there are currently no identified customers.

3.b.ii. California American Water has not been in contact with any potential customers not listed in Table A-2 at this time.

3.b.iii. The Draft Technical Memorandum is being updated at this time and a new Draft is scheduled for release in the first quarter of 2017.

Attachment 6: Cal Am's Response to Data Request ORA JMI-002, Q.1—Attachment 1

CALIFORNIA AMERICAN WATER

JMI-002 Recurring Projects - Q001 - Attachment 1

1. Please list all projects completed in the last six years (2010-2015) under recurring projects ("RP") for each district. For convenience, fill in the chart below in Microsoft Excel format for each district.

San Diego

Recurring Project Description	2010	2011	2012	2013	2014	2015
Mains-New	$62,663	$59,891	$0	$0	$0	$0
Mains-Replacement/Restored	$27,361	$69,351	$9,757	$0	$0	$132,544
Mains-Unscheduled	$22,625	$127,026	$167,499	$569,605	$31,361	$181,662
Mains-Relocated	$22,348	$0	$13,668	$0	$0	$0
Hydrants, Valves, Manholes-New	$0	$0	$9,159	$359	$0	$2,848
Hydrants, Valves, Manholes-Replaced	$39,874	$87,620	$35,618	$162,237	$41,604	$180,604
Services-New	$0	$14,047	$6,147	$7,754	$7,700	$1,410
Services-Replaced	$206,670	$255,013	$182,175	$298,554	$286,460	$368,777
Meters-New	$2,829	$6,821	$14,938	$491	$4,490	$9,732
Meters-Replaced	$115,784	$236,412	$414,968	$402,825	$222,026	$240,050
ITS Equipment and Systems	$4,766	$0	$0	$91,191	$65,136	$5,667
SCADA Equipment and Systems	$0	$0	$0	$4,228	$10,464	$0
Security Equipment and Systems	$0	$0	$0	$6,829	$27,981	$46,161
Offices and Operations Centers	$11,274	$30,143	$15,070	$8,146	$905,727	$173,189
Vehicles	$0	$0	$0	$0	$0	$0
Tools and Equipment	$23,810	$71,177	$17,812	$54,128	$6,819	$27,241
Process Plant Facilities and Equipment	$0	$0	$0	$0	$0	$0
Capitalized Tank Rehabilitation/Painting	$11,371	$0	$0	$0	$0	$0
Engineering Studies	$22,284	$42,625	$0	$0	$0	$0
Total Recurring Project Recorded	$573,658	$1,000,126	$886,811	$1,606,347	$1,609,768	$1,369,885

Los Angeles

Recurring Project Description	2010	2011	2012	2013	2014	2015
Mains-New	$0	$78,864	$41	$0	$0	$28,075
Mains-Replacement/Restored	$0	$50,939	($11,114)	$0	$0	$237,388
Mains-Unscheduled	$108,989	$190,373	$113,236	$56,140	$147,336	$144,186
Mains-Relocated	$146,201	$210,395		$0	$0	$283,749
Hydrants, Valves, Manholes-New	$30,170	$19,933	$2,902	$24,946	$3,571	$2,897
Hydrants, Valves, Manholes-Replaced	$85,317	$100,054	$77,521	$171,897	$96,601	$158,563
Services-New	$27,819	$10,090	$8,493	$10,158	$22,976	$35,068
Services-Replaced	$968,152	$938,564	$971,209	$809,195	$909,804	$1,084,910
Meters-New	$0	$1,765	$670	$0	$2,545	$0
Meters-Replaced	$345,951	$491,703	$703,214	$629,055	$926,189	$694,680
ITS Equipment and Systems	$9,103	$9,252	$0	$2,142	$32,419	$36,528
SCADA Equipment and Systems	$19,367	$25,002	$32,290	$75,052	$32,143	$59,913
Security Equipment and Systems	$0	$126,678	$0	$2,324	$47,563	$207,395
Offices and Operations Centers	$4,658	$1,724	$0	$57,170	$26,689	$13,261
Vehicles	$0	$0	$0	$0	$0	$0
Tools and Equipment	$96,733	$11,618	$10,316	$7,802	$0	$9,055
Process Plant Facilities and Equipment	$535,501	$403,692	$467,783	$426,822	$660,021	$840,710
Capitalized Tank Rehabilitation	$0	$0	$0	$0	$0	$0
Engineering Studies	$726	$0	$0	$0	$0	$157,049
Total Recurring Project Recorded	$2,378,687	$2,670,646	$2,376,562	$2,272,703	$2,907,857	$3,993,427

Ventura						
Recurring Project Description	2010	2011	2012	2013	2014	2015
Mains-New	$0	$0	$0	$0	$0	$0
Mains-Replacement/Restored	$0	$0	$0	$0	$0	($0)
Mains-Unscheduled	$81,171	$24,368	$0	$57,352	$119,158	$85,055
Mains-Relocated	$0	$0	$0	$33,527	$0	$0
Hydrants, Valves, Manholes-New	$0	$0	$15,647	$60,768	($60,765)	$51,098
Hydrants, Valves, Manholes-Replaced	$206,206	$66,948	$42,118	$62,308	$399,622	$257,220
Services-New	$0	$0	$0	($0)	$27	($3)
Services-Replaced	$1,020,046	$787,911	$1,632,026	$573,867	$1,171,034	$743,921
Meters-New	$617	$22,858	$122	$46,002	$2,490	$7,015
Meters-Replaced	$515,373	$619,559	$240,044	$343,564	$311,304	$827,638
ITS Equipment and Systems	$9,244	$17,060	($126)	$7,193	$19,349	$15,224
SCADA Equipment and Systems	$0	$0	$0	$0	$0	$18,417
Security Equipment and Systems	$0	$0	$22,757	$103,971	$22,025	$30,288
Offices and Operations Centers	$13,431	$8,846	$1,209	$15,467	$49,911	$17,416
Vehicles	$0	$0	$0	$0	$0	$0
Tools and Equipment	$10,621	$14,930	$7,996	$13,915	$6,446	$28,134
Process Plant Facilities and Equipment	$131,832	$189,144	$61,103	$203,881	$85,570	$111,030
Capitalized Tank Rehabilitation	$180	$0	$0	$0	$0	$0
Engineering Studies	$43,518	$41,632	$0	$0	$0	$0
Total Recurring Project Recorded	$2,032,239	$1,793,255	$2,022,896	$1,521,814	$2,126,172	$2,192,452

Monterey Main						
Recurring Project Description	2010	2011	2012	2013	2014	2015
Mains-New	($935)	$716	$0	$2,310	$1,565	$0
Mains-Replacement/Restored	$2,422	$403,199	$403,426	$577,506	$759,988	$179,830
Mains-Unscheduled	$384,660	$72,599	$74,287	$337,417	$276,349	$284,894
Mains-Relocated	$0	$0	$0	$0	$0	$0
Hydrants, Valves, Manholes-New	$84,793	$23,310	$17,331	$18,582	$8,216	$26,042
Hydrants, Valves, Manholes-Replaced	$47,939	$86,539	$48,003	$210,164	$507,094	$168,783
Services-New	$217,084	$38,009	$0	$3,623	$31,357	$46,952
Services-Replaced	$241,123	$300,304	$115,483	$401,181	$745,624	$293,745
Meters-New	$0	$0	$0	$0	$269	$0
Meters-Replaced	($31,208)	$5,532	$135,757	$372,884	($1,109)	$752,553
ITS Equipment and Systems	$53,836	$0	$7,889	$75,711	$57,986	$77,120
SCADA Equipment and Systems	$156,657	$105,102	$20,820	$0	$44,440	$195,867
Security Equipment and Systems	$65,794	$5,481	$148,762	$354,307	$54,618	$116,292
Offices and Operations Centers	$6,556	$56,030	$47,169	$0	$185,497	$7,772
Vehicles	$0	$0	$0	$0	$0	$0
Tools and Equipment	$10,110	$165,511	$5,381	$16,289	$87,588	$137,981
Process Plant Facilities and Equipment	$378,197	$920,289	$426,311	$1,444,872	$1,772,840	$1,123,547
Capitalized Tank Rehabilitation	$0	$0	$0	$364,444	$306,672	$0
Engineering Studies	$0	$269	$0	($162)	$0	$0
Total Recurring Project Recorded	$1,617,028	$2,182,892	$1,450,618	$4,179,127	$4,838,994	$3,411,378

Toro						
Recurring Project Description	2010	2011	2012	2013	2014	2015
Mains-New	$0	$0	$0	$0	$0	$0
Mains-Replacement/Restored	$0	$0	$0	$0	$132,051	$12,174
Mains-Unscheduled	$26,092	$5,805	$13,274	$1,286	$0	$0
Mains-Relocated	$0	$0	$0	$0	$0	$0
Hydrants, Valves, Manholes-New	$0	$0	$0	$0	$0	$0
Hydrants, Valves, Manholes-Replaced	$0	$0	$0	$0	$4,148	$0
Services-New	$0	$3,317	$0	$0	$0	$0
Services-Replaced	$0	$0	$0	$0	$0	$0
Meters-New	$0	$0	$0	$0	$0	$0
Meters-Replaced	$0	$0	$0	$0	$0	$0
ITS Equipment and Systems	$0	$0	$0	$0	$0	$0
SCADA Equipment and Systems	$3,536	$0	$0	$0	$0	$0
Security Equipment and Systems	$0	$0	$0	$0	$0	$0
Offices and Operations Centers	$0	$0	$0	$0	$0	$0
Vehicles	$0	$0	$0	$0	$0	$0
Tools and Equipment	$0	$0	$0	$0	$0	$0
Process Plant Facilities and Equipment	$119,070	$224,951	$11,752	$126,953	$89,056	$22,036
Capitalized Tank Rehabilitation	$0	$0	$0	$0	$0	$0
Engineering Studies	$0	$0	$0	$0	$0	$0
Total Recurring Project Recorded	$148,698	$234,074	$25,026	$128,239	$225,255	$34,210

Garrapata						
Recurring Project Description	2010	2011	2012	2013	2014	2015
Mains-New					$0	$0
Mains-Replacement/Restored					$0	$0
Mains-Unscheduled					$0	$0
Mains-Relocated					$0	$0
Hydrants, Valves, Manholes-New					$0	$0
Hydrants, Valves, Manholes-Replaced					$0	$0
Services-New					$0	$0
Services-Replaced					$0	$0
Meters-New					$0	$18,495
Meters-Replaced					$0	$0
ITS Equipment and Systems					$0	$0
SCADA Equipment and Systems					$0	$0
Security Equipment and Systems					$0	$0
Offices and Operations Centers					$0	$0
Vehicles					$0	$0
Tools and Equipment					$0	$0
Process Plant Facilities and Equipment					$10,810	$22,526
Capitalized Tank Rehabilitation					$0	$0
Engineering Studies					$0	$0
Total Recurring Project Recorded	$0	$0	$0	$0	$10,810	$41,021

Monterey Wastewater

Recurring Project Description	2010	2011	2012	2013	2014	2015
Mains-New	$0	$0	$0	$0	$0	$0
Mains-Replacement/Restored	$0	$0	$8,953	$0	$0	$0
Mains-Unscheduled	$0	$0	$0	$0	$0	$0
Mains-Relocated	$0	$0	$0	$0	$0	$0
Hydrants, Valves, Manholes-New	$0	$0	$0	$0	$0	$0
Hydrants, Valves, Manholes-Replaced	$0	$0	$0	$0	$0	$0
Services-New	$0	$0	$0	$0	$0	$0
Services-Replaced	$0	$0	$0	$0	$0	$0
Meters-New	$0	$0	$0	$0	$0	$0
Meters-Replaced	$0	$0	$0	$0	$0	$0
ITS Equipment and Systems	$0	$0	$0	$0	$0	$0
SCADA Equipment and Systems	$8,098	$8,794	$0	$0	$0	$0
Security Equipment and Systems	$0	$0	$0	$0	$0	$0
Offices and Operations Centers	$0	$0	$0	$0	$0	$0
Vehicles	$0	$0	$336,978	$336,978	$0	$0
Tools and Equipment	$0	$0	$0	$0	$0	$14,904
Process Plant Facilities and Equipment	$173,321	$124,843	$113,995	$71,801	$564,959	$207,007
Capitalized Tank Rehabilitation	$0	$0	$0	$0	$0	$0
Engineering Studies	$10,961	$0	$0	$0	$0	$0
Total Recurring Project Recorded	$192,380	$133,637	$459,926	$408,779	$564,959	$221,912

Sacramento

Recurring Project Description	2010	2011	2012	2013	2014	2015
Mains-New	$0	$47,102	$0	$372	($372)	$323,261
Mains-Replacement/Restored	$126,183	$149,077	$0	$4,777	$1	$0
Mains-Unscheduled	$0	$30,949	$32,919	$84,918	$64,749	$71,633
Mains-Relocated	$0	$1,618	$390,263	($559)	$0	$0
Hydrants, Valves, Manholes-New	$15,314	$1,987	$35,032	$66,967	$0	$9,403
Hydrants, Valves, Manholes-Replaced	$113,880	$221,644	$60,723	$165,791	$221,242	$131,398
Services-New	$14,617	$12,429	$11,237	$4,636	$7,049	$7,333
Services-Replaced	$537,307	$626,750	$441,419	$593,309	$710,148	$801,001
Meters-New	$38,507	$117,689	$97,240	$41,013	$1,781	$1
Meters-Replaced	$579,803	$197,182	$131,457	$148,462	$216,094	$184,310
ITS Equipment and Systems	$67,453	$50,545	($1,588)	$239,746	$148,612	$62,847
SCADA Equipment and Systems	$4,745	$54,729	$39,419	$0	$38,970	$82,617
Security Equipment and Systems	$0	$0	$9,929	$22,823	$11,011	$227,888
Offices and Operations Centers	$11,891	$22,288	$88,004	$312,457	$85,533	$56,017
Vehicles	$0	$0	$0	$0	$0	$0
Tools and Equipment	$65,921	$53,377	$0	$9,274	$0	$9,193
Process Plant Facilities and Equipment	$965,032	$683,133	$532,514	$971,575	$1,928,961	$727,241
Capitalized Tank Rehabilitation	$0	$179,011	$15,529	$0	$0	$344
Engineering Studies	$0	$0	$0	$0	$0	$10,189
Total Recurring Project Recorded	$2,540,655	$2,449,509	$1,884,097	$2,665,561	$3,433,779	$2,704,676

Larkfield						
Recurring Project Description	2010	2011	2012	2013	2014	2015
Mains-New	$74,771	$13,397	$30,358	$170,380	($8,237)	$45,832
Mains-Replacement/Restored	$15,661	$0	$0	$0	$0	$0
Mains-Unscheduled	$0	$19,238	$5,154	($0)	$3,384	$18,099
Mains-Relocated	$0	$0	$0	$0	$0	$0
Hydrants, Valves, Manholes-New	$0	$1,328	$9,564	$0	$0	$21,152
Hydrants, Valves, Manholes-Replaced	$5,959	$34,385	$9,525	$0	$5,444	$9,720
Services-New	$17,346	$0	$19,617	$2,358	$0	$0
Services-Replaced	$35,252	$20,396	$17,290	$3,562	$4,183	$65,975
Meters-New	$2,050	$2,174		$0	$0	$2,601
Meters-Replaced	$0	$10,493	$5,838	($0)	$26,322	$11,632
ITS Equipment and Systems	$6,504	$17,068	$0	$0	$9,562	$4,256
SCADA Equipment and Systems	$22,709	$14,754	$0	$15,440	$7,048	$52,589
Security Equipment and Systems	$0	$0	$4,260	$0	$0	$4,800
Offices and Operations Centers	$12,830	$13,883	$11,651	$0	$0	$0
Vehicles	$0	$0	$0	$0	$0	$0
Tools and Equipment	$7,207	$0	$4,112	$0	$56,228	$0
Process Plant Facilities and Equipment	$116,443	$124,133	$70,609	$50,063	$7,642	$102,546
Capitalized Tank Rehabilitation	$8,652	$140,445	$17,499	$1,869	$94,846	$77,621
Engineering Studies	$0	$0	$0	$0	$0	$0
Total Recurring Project Recorded	$325,383	$411,695	$205,477	$243,673	$206,423	$416,823

California Corporate (CA Corp)						
Recurring Project Description	2010	2011	2012	2013	2014	2015
Mains-New						
Mains-Replacement/Restored						
Mains-Unscheduled						
Mains-Relocated						
Hydrants, Valves, Manholes-New						
Hydrants, Valves, Manholes-Replaced						
Services-New						
Services-Replaced						
Meters-New						
Meters-Replaced				$422,574		
ITS Equipment and Systems	-$1,800	$1,900	$152,971	$30,340	$1,635,714	$3,011,284
SCADA Equipment and Systems						
Security Equipment and Systems					$126,832	$4,021
Offices and Operations Centers		$24,421	$25,421	$22,411	$36,763	
Vehicles				$183,042		
Tools and Equipment						
Process Plant Facilities and Equipment						
Capitalized Tank Rehabilitation						
Engineering Studies						
Total Recurring Project Recorded	-$1,800	$26,321	$178,392	$658,367	$1,799,309	$3,015,305

Attachment 7: Cal Am's Response to Data Request ORA JMI-011, Q. 1.a.i and 1.b.i.

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By:	**Mark Reifer**
Title:	**Operations Engineer**
Address:	**California-American Water Company** **8657 Grand Avenue, Rosemead, CA 91770**
ORA Request:	**ORA A.16-07-002 JMI-011**
Company Number:	**CAW-ORA A.16-07-002 JMI-011 Q001a**
Date Received:	**December 6, 2016**
Date Response Due:	**December 16, 2016**
Subject Area:	**Silver Strand Main Replacement**

DATA REQUEST:

1. In regards to the Silver Strand Main Replacement project (I15-300010):

   a. On pages 111 to 112 of the Direct Testimony of Mark Schubert, it states that the United States Navy will be installing a new water transmission main that will replace the existing water transmission main that currently crosses through the new Coastal Campus and is in conflict with the planned new construction.

      i. Is Cal Am aware of when the United States Navy will begin construction of the area that interferes with the new campus? If so, when.

      ii. What length of the Silver Strand main interferes with the new Coastal Campus and needs to be relocated due to the new campus?

CAL-AM'S RESPONSE:

i. California American Water is aware of the United States Navy Coastal Campus expansion that will require relocation of a portion of the Silver Strand main with construction expected to begin by September 15, 2017.

ii. Approximately 8,800 feet of the existing 16-inch Silver Strand main interferes with the new Coastal Campus.

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By:	**Mark Reifer**
Title:	**Operations Engineer**
Address:	**California-American Water Company** **8657 Grand Avenue, Rosemead, CA 91770**
ORA Request:	**ORA A.16-07-002 JMI-011**
Company Number:	**CAW-ORA A.16-07-002 JMI-011 Q001b**
Date Received:	**December 6, 2016**
Date Response Due:	**December 16, 2016**
Subject Area:	**Silver Strand Main Replacement**

DATA REQUEST:

1. In regards to the Silver Strand Main Replacement project (I15-300010):

   b. During the district tour in October 2016, Cal Am informed ORA that due to the section of main that needs to be relocated, the United States Navy will help fund the section of the main that needs to be relocated.

      i. How much is the United States Navy intending on funding for the relocation of the section of the main that interferes with the new Coastal Campus project?

      ii. Due to relocation of the Silver Strand main section, does the United States Navy expect Cal Am to fund the entire design of the Silver Strand main section that needs to be relocated? Will the United States Navy be funding the portion of design costs due to relocating the main? If a portion, what portion does Cal Am expect will be funding by the United States Navy?

CAL-AM'S RESPONSE:

i. The United States Navy has discussed funding the entire relocation costs of the portion that interferes with the Navy Coastal Campus Project which is 8,800 feet.

ii. The United States Navy funded the design plans and specifications for the relocation.

Attachment 8: Cal Am's Response to Data Request ORA JMI-006, Q. 1.a.

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By:	**Stephen A. Foster**
Title:	**Director of Operations, Norther Division**
Address:	**California-American Water Company** **4701 Beloit Drive, Sacramento, CA 95838**
ORA Request:	**ORA A.16-07-002 JMI-006**
Company Number:	**CAW-ORA A.16-07-002 JMI-006 Q001a**
Date Received:	**November 16, 2016**
Date Response Due:	**November 30 2016**
Subject Area:	**Dunnigan Water System**

DATA REQUEST:

1. In regards to the Dunnigan Water System Improvements project (Project I15-600089):

   a. On page 188 of Mark Schubert's testimony, it states that a portion of the scope of the project is for seismic improvements for the two tanks and the treatment building. Please elaborate on the improvements that are being proposed to be completed at the treatment building.

CAL-AM'S RESPONSE:

Operation of the Dunnigan system on a daily basis following acquisition has allowed operations to review the structure and configuration of the treatment and distribution systems. California American Water now intends to bypass the treatment building including the 4 tanks within the building and relocate treatment to the bolted steel tank site. The four poly storage tanks housed in the current treatment building have developed leaks. These leaks are a safety concern for employees as the leaks have caused flooding of the steel superstructure upon which they are set. There is also the possibility of damage to the floors below the tanks.

Attachment 9: Cal Am's Response to Data Request A.16-07-002 JMI-012, Q. 1.a.

California-American Water Company

APPLICATION NO. A.16-07-002
DATA REQUEST RESPONSE

Response Provided By:	**Walter E Sadler**
Title:	**Engineering Manager – Project Delivery**
Address:	**California-American Water Company 4701 Beloit Drive, Sacramento, CA 95838**
ORA Request:	**ORA A.16-07-002 JMI-012**
Company Number:	**CAW-ORA A.16-07-002 JMI-012 Q001a**
Date Received:	**December 6, 2016**
Date Response Due:	**December 16, 2016**
Subject Area:	**Londonberry Drive Creek Crossing Project**

DATA REQUEST:

1. In regards to the Londonberry Drive Creek Crossing project (I15-610009) in the Sonoma County (Larkfield) district:

   a. On page 146 of the Direct Testimony of Mark Schubert, it states that permitting issues with several regulatory agencies were determined to affect the timing on when construction could actually begin. Elaborate on the permitting issues (including with which regulatory agencies) that are affecting the construction schedule of the project.

CAL-AM'S RESPONSE:

Two methods of construction were evaluated for this project, the least intrusive being horizontal boring. Permitting procedures for the State agencies that will be involved with this project first require sign off or approval by certain Federal agencies before they will issue permits with conditions for mitigation and construction. The State agencies include the California Department of Fish and Wildlife (DFW) and the Regional Water Quality Control Board (RWQCB). The creek to be crossed by this project, the Mark West Creek, contains Steelhead Trout which are on the Endangered Species List; therefore, consultation with National Marine Fisheries will be required, with the Federal lead agency most likely being the U.S. Army Corp of Engineers (USACE). The time frame for this activity is difficult to predict; however, it can take up to six months after a formal application is submitted. Once the National Marine Fisheries has made a determination and listed any conditions it deems necessary, the RWQCB will issue a 401 Water Quality Certification with conditions. Then the DFW will issue a Streambed

Alteration Permit and California Endangered Species Permit both with appropriate conditions. It is estimated that the time frame for the State permits is approximately 4-6 months. A Zoning Permit from Sonoma County Permit and Resource Management Department (PRMD) will be the last permit to be issued. As part of this zoning permit process, PRMD will perform their own review to evaluate the temporary and/or permanent impacts to the riparian corridor associated with the project, and ensure that all the appropriate permits from other agencies have been obtained. The PRMD estimates that obtaining a Zoning Permit will take approximately 3 to 4 months.

ATTACHMENT 3

Docket:	:	A.19-07-004
Exhibit Number	:	Cal PA - 5
Commissioner	:	Genevieve Shiroma
Administrative Law Judge	:	Gerald F. Kelly
Cal PA Witness	:	Justin Menda

PUBLIC ADVOCATES OFFICE

REPORT AND RECOMMENDATIONS ON CALIFORNIA-AMERICAN WATER COMPANY'S PROPOSED PLANT, DEPRECIATION AND SPECIAL REQUEST #16

Application 19-07-004

PUBLIC VERSION

San Francisco, California
February 14, 2020

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MEMORANDUM

The Public Advocates Office at the California Public Utilities Commission ("Public Advocates Office") examined requests and data presented by California American Water Company ("Cal Am") in Application ("A.") 19-07-004 ("Application") to provide the California Public Utilities Commission ("Commission") with recommendations that represent the interests of California ratepayers for safe and reliable service at the lowest cost. Mukunda Dawadi is the Public Advocates Office's project lead for this proceeding. Richard Rauschmeier is the oversight supervisor and Kerriann Sheppard and Robyn Purchia are the legal counsels.

Although every effort was made to comprehensively review, analyze, and provide the Commission with recommendations on each ratemaking and policy aspect presented in the Application, the absence from the Public Advocates Office's testimony of any particular issue does not constitute its endorsement or acceptance of the underlying request, methodology, or policy position related to that issue.

CHAPTER 1: COMMON PLANT

A. INTRODUCTION

This chapter provides the recommendations the Commission should adopt on common plant issues affecting plant estimates in multiple districts, including deferred tank improvements, recurring project budgets, project contingency costs, advice letters, and plant additions.

B. SUMMARY OF RECOMMENDATIONS

The following recommendations are based on an examination of capital planning and budgeting issues that affect plant estimates in multiple districts. These recommendations serve as a basis for specific adjustments to Cal Am's proposed projects and capital budget for the two test years (2021 and 2022):

1. Deferred Tank Improvements

- Lower Wikiup Tank #1— The Commission should allow $114,446 which is the cost of the tank painting improvements recommended in the Larkfield District Tank Study.
- North Wikiup Tank #2—The Commission should allow an additional $89,898 in 2022 to include the cost of the tank painting improvements recommended in the Larkfield District Tank Study. The tank painting cost was transferred from the proposed project I15-610018 for the North Wikiup Tank #2.
- Industrial Tank #2—The Commission should not allow the proposed Industrial Tank #2 project in 2021 based on the most recent tank inspection report.

- Upper Wikiup Tank #1—The Commission should not allow $4,300 in 2022 for deferred tank improvements because the tank is no longer in service.

2. Recurring Project Budget

The Commission should authorize in rates a lower total 2021-2022 recurring project budget for the Sacramento, Ventura, and Los Angeles districts of $6,925,153, $6,546,304, and $8,621,595, respectively, to better reflect Cal Am's historic spending on the process plant project category and lower recommended budget for the newly acquired systems. In addition, the Commission should allow a 2021-2022 recurring budget of $11,634 for the Dunnigan Wastewater system to better reflect Cal Am's recorded historical expenditure in the Dunnigan Wastewater system.

3. Contingency

The Commission should allow a 15% project contingency rate for Standby Generator Improvement projects in the Ventura (I15-510055), Los Angeles (I15-500065), and Larkfield (I15- 610019) districts. In addition, the Commission should allow a 15% contingency for Main Replacement Program projects in the Sacramento (I15-600072), Larkfield (I15-610015), and Los Angeles (I15-500066) districts.

4. Advice Letters

The Commission should not allow Cal Am to submit an advice letter for funding the Walerga Road Bridge Pipe Relocation project (I15-600032) because Cal Am is already accounting for the cost of the project in its general rate case workpapers. The Commission should not authorize any new advice letter projects or the continuation of previously authorized advice letter projects that remain incomplete in this rate case cycle.

5. 2023 Plant Additions

In this rate case, the Public Advocates Office does not take a position on the prudency or reasonableness of projects scheduled for completion in 2023 (after 2022). The Commission should follow the guidelines set forth in Decision (D).07-05-062 for calculating rate base additions in 2023, the attrition year, which falls outside of the two test years (2021 and 2022) where capital budgets are developed.[1]

C. DISCUSSION

The following recommendations result from the Public Advocates Office's evaluation of capital planning and budgeting issues that affect Cal Am's proposed plant estimates in multiple districts.

1) Deferred Tank Improvements

Cal Am states that tank painting expenses are part of the proposed deferred tank improvements.[2] Table 1-A below shows Cal Am's proposed 2021-2022 deferred tank improvement projects and the Public Advocates Office's recommended deferred tank improvements budget.

Table 1-A. 2021-2022 Deferred Tank Improvements Projects Cost Comparison

San Diego

	2021		2022	
Tank	Cal Am Proposed	Public Advocates Office Recommendation	Cal Am Proposed	Public Advocates Office Recommendation
Highland Tank	$ 683,820	$ 683,820	$ -	$ -
Total	**$ 683,820**	**$ 683,820**	**$ -**	**$ -**

Los Angeles

[1] The 2023 ratebase will be derived by formula in the 2023 attrition advice letter filing.

[2] Direct Testimony of Ian Crooks, p. 258.

	2021		2022	
Tank	Cal Am Proposed	Public Advocates Office Recommendation	Cal Am Proposed	Public Advocates Office Recommendation
Longden Reservoir	$ 108,000	$ 108,000	$ -	$ -
Scott Reservoir	$ 14,580	$ 14,580	$ 2,800	$ 2,800
Spinks Reservoir	$ 27,000	$ 27,000	$ 2,800	$ 2,800
Total	**$ 149,580**	**$ 149,580**	**$ 5,600**	**$ 5,600**

Ventura

	2021		2022	
Tank	Cal Am Proposed	Public Advocates Office Recommendation	Cal Am Proposed	Public Advocates Office Recommendation
Deer Ridge Tank	$ 125,000	$ 125,000	$ -	$ -
Industrial Tank #2	$ 2,000,000	$ -	$ -	$ -
Total	**$ 2,125,000**	**$ 125,000**	**$ -**	**$ -**

Sacramento

	2021		2022	
Tank	Cal Am Proposed	Public Advocates Office Recommendation	Cal Am Proposed	Public Advocates Office Recommendation
Cook Riolo Tank	$ 4,300	$ 4,300	$ -	$ -
Countryside Backwash Tank	$ 4,101	$ 4,101	$ -	$ -
Isleton Backwash Tank	$ 4,700	$ 4,700	$ -	$ -
Isleton Recovery Tank	$ 4,700	$ 4,700	$ -	$ -
Lincoln Oaks Tank	$ -	$ -	$ 4,700	$ 4,700
Parksite Backwash Tank #1	$ 4,101	$ 4,101	$ -	$ -
Parksite Backwash Tank #2	$ 140,000	$ 140,000	$ -	$ -
Rose Parade Backwash Tank	$ -	$ -	$ 4,300	$ 4,300
Roseville Road Tank	$ -	$ -	$ 4,700	$ 4,700
Security Park Tank #1	$ -	$ -	$ 4,300	$ 4,700
Vintage Backwash Tank	$ 270,000	$ 270,000	$ -	$ -
Walerga Tank	$ 4,300	$ 4,300	$ -	$ -
Walnut Grove Backwash Tank	$ -	$ -	$ 4,700	$ 4,700
Total	**$ 436,202**	**$ 436,202**	**$ 22,700**	**$ 23,100**

Larkfield

	2021		2022	
Tank	Cal Am Proposed	Public Advocates Office Recommendation	Cal Am Proposed	Public Advocates Office Recommendation
Lower Wikiup Tank #1	$ -	$ -	$ 236,300	$ 114,446
Lower Wikiup Tank #2	$ -	$ -	$ 4,700	$ 4,700
North Wikiup Tank #1	$ -	$ -	$ 5,100	$ 5,100
North Wikiup Tank #2	$ -	$ -	$ 4,700	$ 94,598
Upper Wikiup Tank #1	$ -	$ -	$ 4,300	$ -
Upper Wikiup Tank #2	$ -	$ -	$ 4,300	$ 4,300
Total	**$ -**	**$ -**	**$ 259,400**	**$ 223,144**

Monterey

	2021		2022	
Tank	Cal Am Proposed	Public Advocates Office Recommendation	Cal Am Proposed	Public Advocates Office Recommendation
Airways Upper	$ 300,000	$ 300,000	$ -	$ -
Fairways #1	$ 300,000	$ 300,000	$ -	$ -
Fairways #2	$ 300,000	$ 300,000	$ -	$ -
Fairways #3	$ 300,000	$ 300,000	$ -	$ -
Total	**$ 1,200,000**	**$ 1,200,000**	**$ -**	**$ -**

Discrepancies between Cal Am's proposal and what the Commission should adopt are discussed below.

(a) Lower Wikiup Tank #1 (Larkfield)

The Commission should reduce the proposed 2022 budget from $236,300 to $114,446 to allow the deferred tank improvements portion of the proposed improvements. The remaining $121,854 for the proposed capital improvements is being funded in the proposed improvements for Lower Wikiup Tank #1 as part of the Tank Rehabilitation and Seismic Upgrades program capital project (I15-610018). Refer to Chapter 3 of this report discussing the proposed Tank

Rehabilitation and Seismic Upgrades Program in the Larkfield district. The estimated tank painting cost of $114,446 is calculated by the summation of the base tank painting cost ($58,700), mobilization costs, contingency, and design and construction management fees.[3] This calculation is summarized in Table 1-B below.[4]

Table 1-B. Lower Wikiup Tank #1 Tank Painting Cost Estimate

Item	Cost	
Tank Painting cost (from I15-610018)	$	58,700
Mobilization	$	11,721
Subtotal	**$**	**70,421**
Contingency	$	21,117
Subtotal	**$**	**91,537**
Design and Construction Management Fee	$	22,908
Total	**$**	**114,446**

(b) North Wikiup Tank #2 (Larkfield)

The Commission should allow a total of $94,598 for the North Wikiup Tank #2 which includes the tank painting portion of improvements of the proposed Tank Rehabilitation and Seismic Upgrades program (I15-610018) for the Larkfield district. Refer to Chapter 3 of this report regarding the proposed Tank Rehabilitation and Seismic Upgrades Program. The estimated tank painting cost of $89,898 is calculated by the summation of the base tanking painting cost ($46,100), mobilization costs, contingency, and design and construction management fees.[5] This calculation is summarized in Table 1-C below.[6]

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[3] Larkfield District Tank Study, Exhibit 4.2.

[4] The mobilization line item is approximately 20% of the tank painting cost (from I15-610018). The contingency line item is approximately 30% of subtotal 1. The design and construction management fee line item is approximately 25% of subtotal 2.

[5] Larkfield District Tank Study, Exhibit 3.2.

The total deferred tank improvement cost of $94,598 for the North Wikiup Tank #2 is calculated by adding the tank painting cost ($89,898) to the cost of the other proposed deferred tank improvements (of $4,700).

Table 1-C. North Wikiup Tank #2 Tank Painting Cost Estimate

Item	Cost	
Tank painting cost (from I15-610018)	$	46,100
Mobilization	$	9,208
Subtotal	**$**	**55,308**
Contingency	$	16,598
Subtotal	**$**	**71,906**
Design and Construction Management Fee	$	17,992
Subtotal	**$**	**89,898**
Proposed Amount	$	4,700
Total Deferred Tank Improvements	**$**	**94,598**

(c) Upper Wikiup Tank #1 (Larkfield)

The Commission should not allow $4,300 in 2022 for deferred tank improvements for the Upper Wikiup Tank #1 since the Upper Wikiup Tank #1 no longer exists. The Upper Wikiup Tank #1 was destroyed during the Tubbs fire in 2017.[7] Cal Am confirmed this by stating that there are no deferred improvements for the Upper Wikiup Tank since it no longer exists and the estimated deferred tank improvements of $4,300 should be removed from the forecasted deferred tank improvements.[8] The Commission should not allow the costs for the proposed

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[6] The mobilization line item is approximately 20% of the tank painting cost (from I15-610018). The contingency line item is approximately 30% of subtotal 1. The design and construction management fee line item is approximately 25% of subtotal 2.

[7] Direct Testimony of Ian Crooks, p. 160.

[8] Cal Am Response to Data Request A.19-07-004 JMI-007, Q. 1.e.

deferred tank improvements for Upper Wikiup #1 because the tank is no longer in existence; it is not use and useful.

(d) Industrial Tank #2 (Ventura)

The Commission should not allow $2,000,000 in 2021 for the Industrial Tank #2 (Ventura) because Cal Am's proposed improvements are not needed at this time. Cal Am provided the most recent tank inspection report for the Industrial Tank #2.[9] The tank inspection report recommended that no improvements were needed.[10] Therefore, no improvements are needed at this time and the Commission should not increase rates to provide funding for this project.[11]

2) Recurring Project Budget

According to Cal Am, the recurring project capital budget is for smaller unforeseen operational capital investment tasks and routine projects.[12] Table 1-D below shows Cal Am's proposed 2021-2022 Recurring Project budget.

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[9] Cal Am Response to Data Request A.19-07-004 JMI-001, Q. 4.c.

[10] Tank Industry Consultants (TIC) Industrial Park Tank #2 Inspection Report, p. 16

[11] Cal Am states in its workpapers (ALL_CH04_O&M_WP_Def Prog Maint, Tab REC) that the amortization period for the proposed deferred tank improvements for Industrial Tank #2 is 60 months. According to page 258 of the Direct Testimony of Ian Crooks, the amortization period for tank painting and rehab projects should be 120 months. If the Commission approves any funding for Cal Am's proposed deferred tank improvements for Industrial Tank #2, the Commission should set the amortization period to 120 months.

[12] Direct Testimony of Ian Crooks, p. 20.

Table 1-D. Cal Am's Proposed 2021-2022 Recurring Project Budget[13]

District		2021		2022
Sacramento	$	4,393,166	$	4,499,442
Larkfield	$	283,211	$	291,707
Monterey	$	4,122,259	$	4,237,879
Toro	$	116,720	$	120,222
Garrapata	$	44,299	$	45,628
Monterey Wastewater	$	312,967	$	319,599
Ventura	$	3,588,174	$	3,750,250
Los Angeles	$	4,329,669	$	4,530,622
San Diego	$	1,445,779	$	1,524,388
Corporate	$	7,149,044	$	5,886,257

Within the recurring project budget, one area of expenditures is the process plant category. In the Sacramento and Ventura districts, the proposed budget for the process plant recurring project category[14] greatly exceeds what Cal Am historically spends for this category. For the newly acquired water systems (Fruitridge, Hillview, Bellflower, and Rio Plaza), the proposed budget per service connection exceeds what Cal Am normally spends per service connection (for the process plant recurring project category). The recommended adjustments for the process plant category for various districts are discussed below.

[13] ALL_CH07_PLT_RO_Forecast, Tab Total Direct CAPEX WS-5. The proposed annual budgets in the table are the combined recurring project budget for all of the recurring project categories.

[14] Cal Am states that it uses funding from this project category for scheduled and unscheduled projects related to water supply, water treatment, pumping water, storage, and facilities related to regulating water pressure (including any associated building and equipment components).

(a) Sacramento

In the Sacramento district, each recurring project category is divided into five separate line items for the following systems: Meadowbrook, Dunnigan Wastewater (Dunnigan WW), Fruitridge, Hillview, and Sacramento Main (all the systems in the Sacramento district excluding the previously mentioned systems). Cal Am requests a total of $2,414,523 in 2021 and $2,477,740 in 2022 for the process plant recurring project category in the Sacramento district.

(1) Meadowbrook

In the Meadowbrook system, Cal Am requests $195,288 in 2021 and $202,525 in 2022 for the process plant category (R15-65Q). Over the 2017-2018 period,[15] Cal Am spent an annual average of approximately $86,766 for the process plant category.[16] Cal Am's request represents an increase of 145% in 2021 and 154% in 2022 of the 2017-2018 annual average of what Cal Am has historically spent for this project category. The 2017-2018 annual average of historical expenditure is a better representation of what Cal Am has normally spent in the past on an annual basis for this recurring project category.

The 2017-2018 annual average annual historical expenditure for recurring project budgets is $86,766. The Commission should use $86,766 as the starting point and escalate to years 2021-2022.[17] Therefore, the Commission should approve no more than $181,060 for the 2021-2022 period for the process plant recurring project category in the Meadowbrook system.

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[15] Cal Am acquired the Meadowbrook system in April 2017.

[16] Direct Testimony of Ian Crooks, Attachment 2. Cal Am only has two years (2017-2018) of annual expenditure for the recurring project budget for the Meadowbrook system.

[17] The historical expenditure was escalated using the October 2019 Energy Cost of Service (ECOS) escalation factors to calculate the budget in 2021 dollars for 2021 and 2022 dollars for 2022.

(2) Dunnigan Wastewater

Cal Am requests $99,252 in 2021 and $102,230 in 2022 for the Dunnigan Wastewater system.[18] This represents an increase of 1,837% in 2021 and 1,895% in 2022 of the 2016-2018 total average annual expenditure for recurring projects in the Dunnigan Wastewater system.

Cal Am acquired the Dunnigan Wastewater system in December 2015. In 2016-2018, Cal Am averaged $5,575 annually on recurring projects.[19] The 2016-2018 annual average of historical expenditure is a better representation of what Cal Am spends on an annual basis for recurring projects in Dunnigan Wastewater. The average 2016-2018 actual expenditure on recurring project budget of $5,575 should be escalated and authorized for 2021 and 2022.[20] Therefore, the Commission should approve a total recurring project budget of no more than $11,634 for the 2021-2022 period for the Dunnigan Wastewater system.

Table 1-E below shows the comparison between Cal Am proposal and the Public Advocates Office's recommendation for the Sacramento district process plant recurring project. Adjustments related to the Fruitridge and Hillview systems are discussed later in this chapter.

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[18] ALL_CH07_PLT_RO_Forecast, Tab Total Direct CAPEX WS-5. Cal Am only has three years (2016-2018) of annual expenditure for the recurring project budget for the Dunnigan Wastewater system.

[19] Direct Testimony of Ian Crooks, Attachment 2.

[20] The historical expenditure was escalated using the October 2019 ECOS escalation factors to calculate the budget in 2021 dollars for 2021 and 2022 dollars for 2022.

Table 1-E. 2021-2022 Sacramento Process Plant Recurring Project Budget Cost Comparison

	Cal Am Proposed				Public Advocates Office Recommendation			
System		2021		2022		2021		2022
Sacramento (Main)	$	1,273,768	$	1,310,299	$	1,273,768	$	1,310,299
Fruitridge	$	449,299	$	458,305	$	85,938	$	87,330
Hillview	$	429,908	$	438,363	$	20,708	$	21,044
Dunnigan WW	$	66,260	$	68,248	$	5,770	$	5,864
Meadowbrook	$	195,288	$	202,525	$	89,803	$	91,258
Total	**$**	**2,414,523**	**$**	**2,477,740**	**$**	**1,475,987**	**$**	**1,515,794**

(b) Ventura (Thousand Oaks and Las Posas)

In the Ventura district, Cal Am requests $339,334 in 2021 and $349,514 in 2022 for the process plant category (R15-51Q).[21] Over the 2014-2018 period, Cal Am spent an annual average of approximately $43,696 for the process plant category.[22] Cal Am's request represents an increase of 1,416% in 2021 and 1,460% in 2022 of its 2014-2018 annual average spend for this project category. The 2014-2018 annual average spend is a better representation of what Cal Am spends for this recurring project category.

The 2014-2018 annual average historical expenditure of $43,696, for this recurring project category should be used for 2021 and 2022, escalated to the appropriate year.[23] Therefore, the Commission should approve no more than $91,183 for the 2021-2022 period for the process plant recurring project category.

[21] ALL_CH07_PLT_RO_Forecast, Tab Total Direct CAPEX WS-5.

[22] Direct Testimony of Ian Crooks, Attachment 2.

[23] The historical expenditure was escalated using the October 2019 ECOS escalation factors to calculate the budget in 2021 dollars for 2021 and 2022 dollars for 2022.

(c) Newly Acquired Systems (Fruitridge, Hillview, Rio Plaza, and Bellflower)

Table 1-F shows Cal Am's requested annual recurring project budget for Fruitridge, Hillview, Rio Plaza, and Bellflower systems.

Table 1-F. 2020-2022 Cal Am's Proposed Recurring Project Budget for Fruitridge, Hillview, Rio Plaza and Bellflower[24]

System	2020	2021	2022
Fruitridge	$ 440,477	$ 449,299	$ 458,305
Hillview	$ 421,637	$ 429,908	$ 438,363
Bellflower	$ 250,519	$ 255,482	$ 260,628
Rio Plaza	$ 95,576	$ 97,414	$ 99,252

Cal Am is requesting funding for only the process plant category for Fruitridge, Hillview, Bellflower, and Rio Plaza systems.[25] Since Cal Am is in the process of acquiring these systems or the acquisition was recently approved, Cal Am does not have any recorded expenditure for the annual recurring project for the Fruitridge, Hillview, Bellflower, and Rio Plaza systems.[26]

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[24] ALL_CH07_PLT_RO_Forecast, Tab Total Direct CAPEX WS-5. Cal Am plans to incorporate the Fruitridge and Hillview systems as part of the Sacramento district. Cal Am plans to incorporate the Bellflower system as part of the Los Angeles district. Cal Am plans to incorporate the Rio Plaza system as part of the Ventura district.

[25] ALL_CH07_PLT_RO_Forecast, Tab Total Direct CAPEX WS-5.

[26] Cal Am filed A.17-10-016 to acquire the Fruitridge system from the Fruitridge Vista Water Company and A.18-04-025 to acquire the Hillview system from the Hillview Water Company. Cal Am filed A.18-09-013 to acquire the Cal Am filed A.17-12-006 to acquire the Rio Plaza system and approved in D.19-04-014.

Cal Am's request for recurring project budget funding for the Fruitridge, Hillview, Bellflower, and Rio Plaza systems are not reasonable because the proposed funding per service connection greatly exceeds the recorded five year (2014-2018) average expenditure per service connection for the current Sacramento, Los Angeles, and Ventura districts. Over the past five years (2014-2018), Cal Am spent an annual average of $1,040,011, $530,514 and, $43,696 for the process plant category in the Sacramento, Los Angeles, and Ventura districts, respectively.[27] This represents an average annual expenditure of approximately $17, $19, and $2 per service connection for the Sacramento, Los Angeles, and Ventura districts, respectively.[28]

Table 1-G below compares Cal Am's proposed amount per service connection for Fruitridge, Hillview, Bellflower, and Rio Plaza systems to the Sacramento, Los Angeles, and Ventura districts. In addition, Table 1-G shows how much Cal Am's proposed unit cost per service connection for the process plant recurring project category exceeds the annual historical average process plant recurring category per service connection for the Sacramento, Los Angeles, and Ventura districts.

[27] Direct Testimony of Ian Crooks, Attachment 2.

[28] According to the 2018 Electronic Annual Report (EAR) Lead Service Line Replacement (LSLR), the Sacramento, Los Angeles, and Ventura districts have approximately 59,621 service connections, 27,699 service connections, and 21,448 service connections, respectively.

Table 1-G. Comparison 5-Year (2014-2018) Average per Service Connection Compared to Cal Am's Proposed Recurring Project per Service Connection[29]

System	Sacramento 5-Year Average per service connection (process plant recurring project category)	Cal Am's Proposed Recurring Project Cost per service connection exceeds Sacramento 5-Year Average per service connection (process plant recurring		
		2020	2021	2022
Fruitridge	$ 17.44	430%	441%	452%
Hillview	$ 17.44	2007%	2049%	2091%

System	Los Angeles 5-Year Average per service connection (process plant recurring project category)	Cal Am's Proposed Recurring Project Cost per service connection exceeds Los Angeles 5-Year Average per service connection (process plant recurring		
		2020	2021	2022
Bellflower	$ 19.15	88%	92%	96%

System	Ventura 5-Year Average per service connection (process plant recurring project category)	Cal Am's Proposed Recurring Project Cost per service connection exceeds Ventura 5-Year Average per service connection (process plant recurring project category)		
		2020	2021	2022
Rio Plaza	$ 2.04	8922%	9095%	9269%

As shown in Table 1-G above, the proposed recurring project cost per service connection greatly exceeds what Cal Am normally spends on the process plant recurring project category per service connection for the Sacramento, Los Angeles, and Ventura districts.[30] Based on Cal Am's historical spending, the

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[29] According to the 2018 EAR Lead Service Line Replacement, the Fruitridge, Hillview, Bellflower, and Rio Plaza systems have approximately 4,760, 1,147, 6,941, and 520 service connections, respectively.

[30] The proposed 2020, 2021, and 2022 recurring project budget per service connection for the Fruitridge system is approximately $93, $94, and $96, respectively. The proposed 2020, 2021, and 2022 recurring project budget per service connection for the Hillview system is

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average annual 2014-2018 recorded expenditure per service connection for the Sacramento, Los Angeles, and Ventura districts is a better representation of what Cal Am spends on the process plant recurring project category. For the Fruitridge, Hillview, Bellflower, and Rio Plaza systems, the process plant recurring project category annual budget is calculated by multiplying the average annual amount spent on the process plant recurring project category per service connection and the number of service connections in that system. This amount is then escalated to years 2020, 2021, and 2022.[31] Therefore, the Commission should adopt the Public Advocates Office's recommendation for the 2020-2022 recurring project budget for the Fruitridge, Hillview, Bellflower, and Rio Plaza systems as shown in Table 1-H below.

Table 1-H. 2020-2022 The Public Advocates Office Recommended Recurring Project Budget for the Fruitridge, Hillview, Bellflower, and Rio Plaza Systems

System	2020	2021	2022
Fruitridge	$ 84,869	$ 85,938	$ 87,330
Hillview	$ 20,451	$ 20,708	$ 21,044
Bellflower	$ 135,880	$ 137,593	$ 139,822
Rio Plaza	$ 1,083	$ 1,096	$ 1,114

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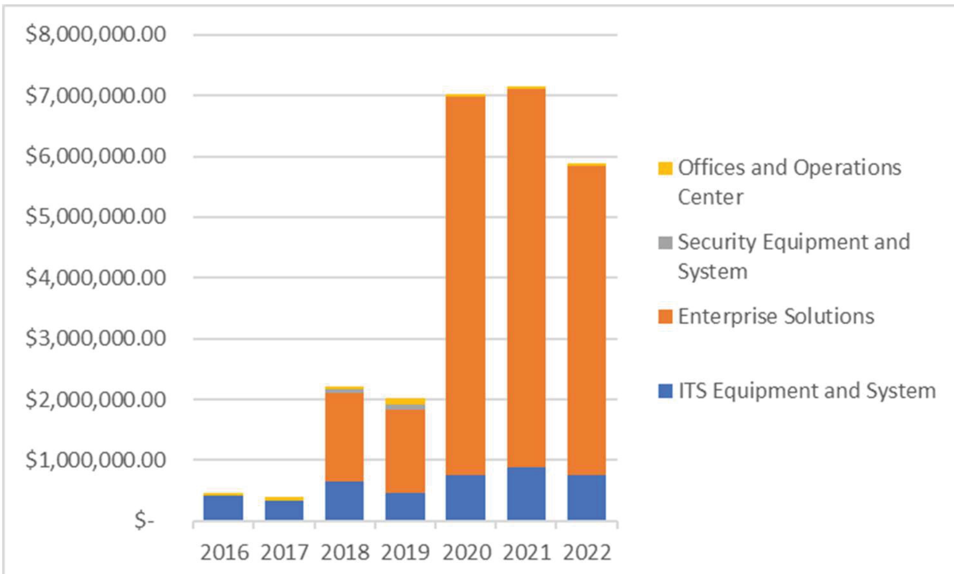
approximately $368, $375, and $382, respectively. The proposed 2020, 2021, and 2022 recurring project budget per service connection for the Bellflower system is $36, $37, and $38, respectively. The proposed 2020, 2021, and 2022 recurring project budget per service connection for the Rio Plaza system is $184, $187, and $191, respectively.

[31] The historical expenditure was escalated using the October 2019 ECOS escalation factors to calculate the budget in 2021 dollars for 2021 and 2022 dollars for 2022.

(d) Corporate

Table 1-I below shows Cal Am's requested annual recurring project budget for Corporate since 2016.

Table 1-I. 2016-2022 Cal Am's Annual Proposed Corporate Recurring Project Budget[32]



As shown in Table 1-I above, Cal Am's proposed annual recurring project budget has increased significantly over time. The majority of Cal Am's request is related to the Enterprise Solutions recurring project category (R15-xxK3).[33] According to Cal Am, the Enterprise Solutions recurring project category is for technology and information investments for the American Water enterprise for the

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32 ALL_CH07_PLT_RO_Forecast, Tab Total Direct CAPEX WS-5.

ALL_CH07_PLT_RO_Forecast, Tab Total Direct CAPEX WS-5 (from A.16-07-002). RB 100 thru 105-2013 Statewide GRC-CAW Corporate, Tab SCEP Summary (from A.13-07-002). Cal Am requested no funding in 2016 and 2017 for the Enterprise Solutions recurring project budget category.

33 In the 2016 rate case (A.16-07-002), Cal Am referenced R15-xxK3 as the "Information Technology System (ITS) Centrally Sponsored Projects" recurring project budget category.

use of the Service Company in any of American Water regulated subsidiaries (e.g. Cal Am).[34] Some examples of improvements related to this recurring project budget item include hardware, software, and related appurtenances.[35]

Cal Am did not start the Enterprise Solutions recurring project category until the 2016 rate case (A.16-07-002). Cal Am's proposed budget for the 2020-2022 greatly exceeds what Cal Am historically spends for this recurring project category. Table 1-J below shows how the proposed 2020-2022 budget for the Enterprise Solutions recurring project category compared to the amount Cal Am spent in the last five years (2014-2018).[36]

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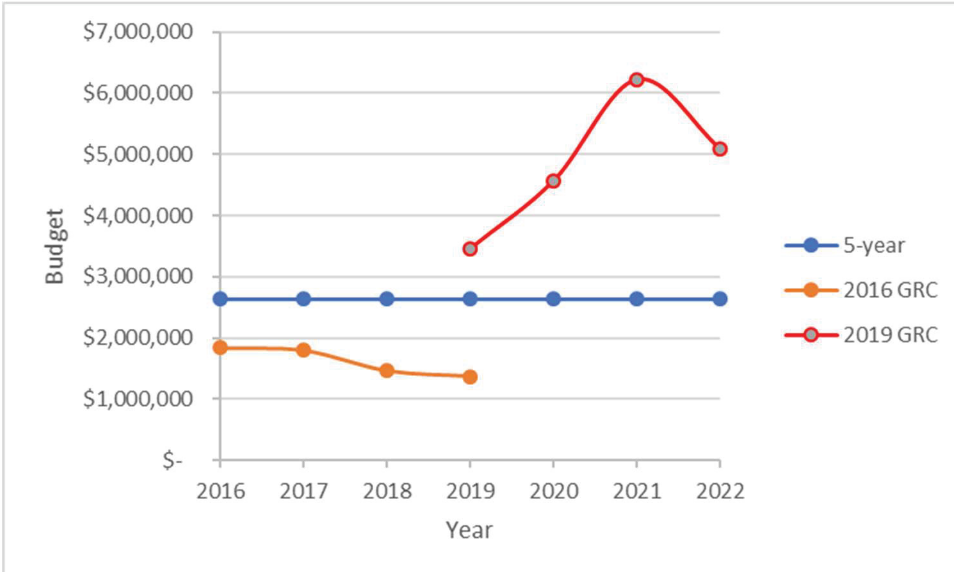
[34] Direct Testimony of Ian Crooks, pp. 23-24.

[35] Direct Testimony of Ian Crooks, pp. 23-24. Cal Am states that improvements made under this recurring project category include enhancements to geographic information system (GIS), customer service infrastructure, foundational technologies, applications, and third-party hosted services.

[36] Direct Testimony of Ian Crooks, Attachment 2. ALL_CH07_PLT_RO_Forecast, Tab Total Direct CAPEX WS-5. ALL_CH07_PLT_RO_Forecast, Tab Total Direct CAPEX WS-5 (from A.16-07-002).

Table 1-J. Cal Am's Proposed R15-xxK3 Budget Compared to 5-Year Average (2014-2018)[37]



According to Cal Am, American Water started developing several applications to improve employee effectiveness.[38] Some of the applications include MapCall,[39] Customer1View,[40] Meter Ops,[41] and Work1View.[42] Cal Am

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[37] ALL_CH07_PLT_RO_Forecast, Tab Total Direct CAPEX WS-5. As shown in Table 1-J above, the proposed revised planned 2019 expenditure for the Enterprise Solutions recurring project budget exceeds what was adopted for 2019. ALL_CH07_PLT_RO_Forecast, Tab Total Direct CAPEX WS-5 (from A.16-07-002).

[38] Direct Testimony of Gary Hofer, pp. 54-55.

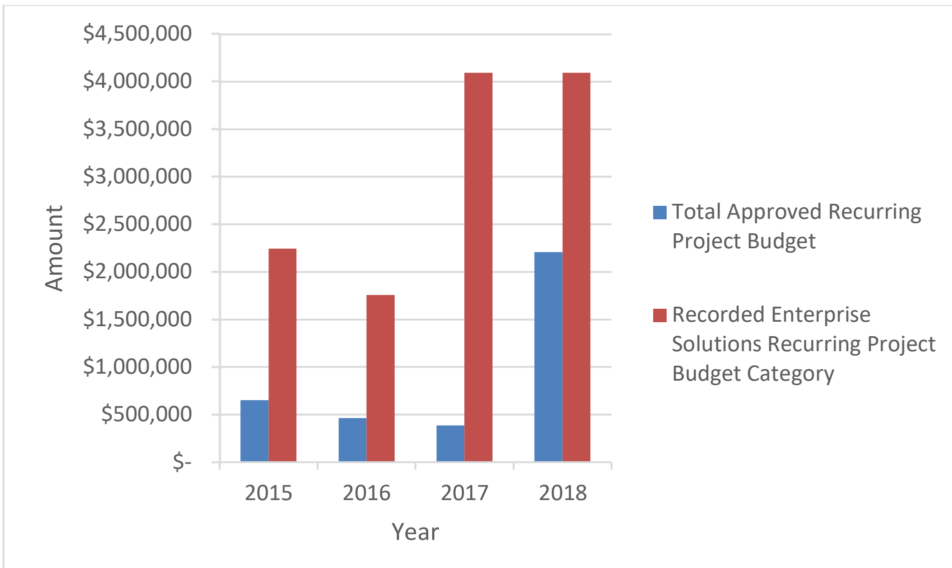
[39] According to Cal Am, MapCall is an intuitive interface to allow employees to create work orders, configure workflows, and report the progress of projects on the field.

[40] According to Cal Am, Customer1View allows field service representatives who interact with customers access to customer information (e.g. premise, service order history, meter details, billing, and payment information).

[41] According to Cal Am, Meter Ops provides local operations supervisors and managers real-time information of customer meters providing information such as meter information (e.g. historical data, work orders, reading information, billing information).

has historically overspent on the Enterprise Solutions recurring project budget category. Table 1-K below shows Cal Am's spend on the Enterprise Solutions recurring project budget category exceed the total annual approved recurring project budget.

Table 1-K.   Comparison of Recorded Enterprise Solutions Recurring Project Budget Category and Total Annual Approved Recurring Project Budget[43]



Starting with the 2016 rate case (A.16-07-002), Cal Am has only requested recurring project funding for Corporate.[44] Many of the planned and recorded applications mentioned above seem to be unique capital projects that should be analyzed on a project by project basis rather than being lumped into a recurring

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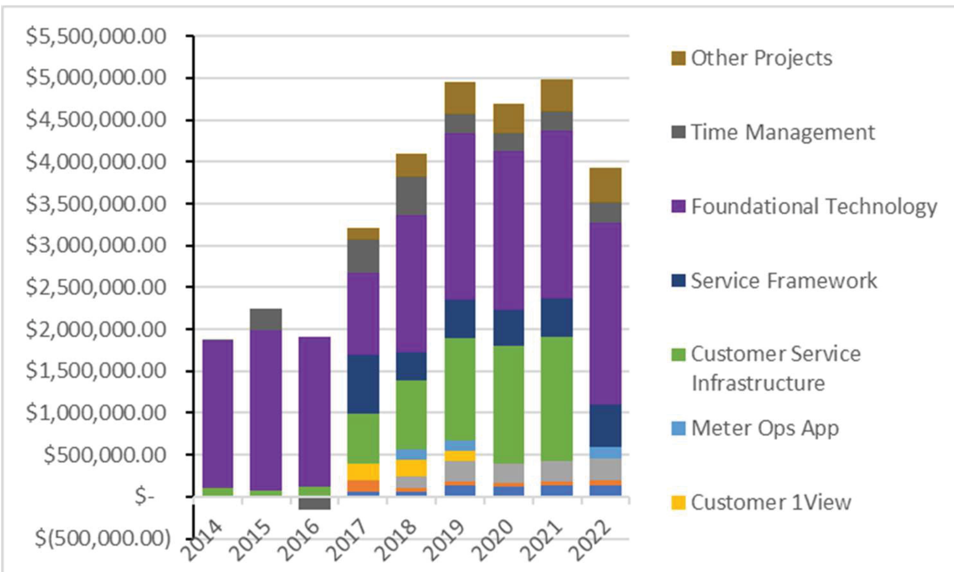
[42] Direct Testimony of Gary Hofer, pp. 54-56. According to Cal Am, Work1View is a real-time operations map to view work orders with optimized route (factoring nearby events such as other types of work and alerts).

[43] Direct Testimony of Ian Crooks, p. 25. RB 100 thru 105-2013 Statewide GRC-CAW Corporate, Tab SCEP Summary (from A.13-07-002). ALL_CH07_PLT_RO_Forecast, Tab Total Direct CAPEX WS-5 (from A.16-07-002).

[44] ALL_CH07_PLT_RO_Forecast, Tab Total Direct CAPEX WS-5 (from A.16-07-002).

project budget for non-descript projects. According to Cal Am, the recurring project budget is supposed to be for routine capital expenditures.[45] However, the software applications that American Water is planning to implement seem to be individual planned projects[46] as well as one-time projects (as opposed to continual projects).[47] Table 1-L below shows the amount Cal Am has spent in the past for the Enterprise Solutions recurring project category and what Cal Am plans on spending in the future.

Table 1-L. 2014-2022 Recorded or Planned Expenditures for Enterprise Solutions Recurring Project Category[48]



Placing all Corporate plant projects under the recurring project budget circumvents the approval process for planned projects. This impairs the Commission's ability to proactively examine the need and cost for the planned

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45 Direct Testimony of Ian Crooks, p. 19.

46 Direct Testimony of Gary Hofer, pp. 54-57.

47 Direct Testimony of Gary Hofer, p. 54.

48 Direct Testimony of Ian Crooks, p. 25.

capital projects ensuring ratepayers are not responsible for unnecessary increases in rates due to imprudent projects. This is especially troublesome because Cal Am has consistently overspent on the total recurring project budget. In addition, presenting all Corporate capital costs in the recurring project budget artificially inflates what Cal Am normally spends on routine projects because many of the new software applications are not routine projects. This inflated historical expenditure would then be used to justify a larger recurring project budget in future rate cases. Cal Am should remove all costs for these unique software application-projects and all other planned projects from the recurring project budget and present them as separate line items which can be individually reviewed for reasonableness and prudency prior to ratepayer funding. The Commission should adopt this requirement so that in future rate cases, Cal Am will not receive funding for unique capital projects through a non-descript recurring budget.

Table 1-M shows Cal Am's proposed total recurring project budget by district compared to what the Commission should adopt for each district. As stated above, Cal Am includes funding of its Corporate capital budgets in the total recurring project budget.[49]

[49] ALL_CH07_PLT_RO_Forecast, Tab Total Direct CAPEX WS-5.

Table 1-M. 2021-2022 District Total Recurring Project Budget Cost Comparison

	Cal Am Proposed		Public Advocates Office Recommendation	
District	2021	2022	2021	2022
Sacramento	$ 4,393,166	$ 4,499,442	$ 3,421,639	$ 3,503,514
Larkfield	$ 283,211	$ 291,707	$ 283,211	$ 291,707
Monterey	$ 4,122,259	$ 4,237,879	$ 4,122,259	$ 4,237,879
Toro	$ 116,720	$ 120,222	$ 116,720	$ 120,222
Garrapata	$ 44,299	$ 45,628	$ 44,299	$ 45,628
Monterey Wastewater	$ 312,967	$ 319,599	$ 312,967	$ 319,599
Ventura	$ 3,588,174	$ 3,750,250	$ 3,197,748	$ 3,348,556
Los Angeles	$ 4,329,669	$ 4,530,622	$ 4,211,780	$ 4,409,815
San Diego	$ 1,445,779	$ 1,524,388	$ 1,445,779	$ 1,524,388
Corporate	$ 7,149,044	$ 5,886,257	$ 7,149,044	$ 5,886,257

3) Contingency

Project cost contingency accounts for unforeseen issues that might appear during the preliminary engineering design, permitting, and construction phase of the project.[50] Cal Am states that some items that would be included in the project cost contingency include minor design changes, corrections to compensate for incorrect assumptions, unforeseen price changes, and unforeseen new regulations.[51] In addition, Cal Am states that project contingency cost should not include **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[52]

For each project, Cal Am assigns a contingency flag number based on the complexity of the project and stage in the project's overall development.[53] A

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[50] Direct Testimony of Bahman Pourtaherian, p. 25.

[51] Direct Testimony of Bahman Pourtaherian, p. 25.

[52] 2018 Sacramento Comprehensive Planning Study, Appendix II—Cost Estimates for Capital Improvement Plan, p. II-3.

[53] Direct Testimony of Bahman Pourtaherian, p. 26.

contingency rate is assigned to each contingency flag number ranging from 5-25%.[54] Cal Am's proposed contingency rate for certain routine capital improvement projects varies among the districts as shown in Table 1-N below.

Table 1-N. Project Contingency for Programmatic Project Among Districts[55]

Standby Generators

District	Contingency Flag	%
Sacramento	3	15
Larkfield	4	20
Monterey	3	15
Los Angeles	4	20
Ventura	5	25

Main Replacement

District	Contingency Flag	%
Sacramento	4	20
Larkfield	4	20
Monterey	3	15
Los Angeles	4	20
San Diego	3	15

(a) Standby Generator Improvement Program

As shown in Table 1-N above, the contingency used in the Standby Generator Improvement program varies between 15% to 25% among the districts. In the Ventura district, Cal Am uses a 25% contingency for the proposed Standby Generator Improvement Program (I15-510055).[56] In addition, the Cost Estimate for Capital Improvement plan states that projects with a cost risk level of five are **<<BEGIN CONFIDENTIAL>>** [redacted]

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[54] Direct Testimony of Bahman Pourtaherian, p. 26.

[55] ALL-CH07_PLT_RO_Forecast, Tab Contingency By Project WS-6.

[56] ALL-CH07_PLT_RO_Forecast, Tab Contingency By Project WS-6.

[redacted] **<<END CONFIDENTIAL>>**.[57] In the past, Cal Am has installed generators as part of capital projects including Standby Generator Improvement program projects.[58] For the proposed Standby Generator Improvement Program (I15-510055), Cal Am plans on installing generators at **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[59] Because Cal Am is planning to install generators at existing Cal Am facilities, Cal Am should have some familiarity with the planned sites for the generator project candidates. In the Sacramento and Monterey districts, Cal Am uses a contingency of 15% for their proposed Standby Generator Improvement Program projects.[60] The Cost Estimate for Capital Improvement plan states that projects with a cost risk level of three are **<<BEGIN CONFDIENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[61] Therefore, a contingency of 15% should be used for the proposed Ventura district Standby Generator Improvement Program (I15-510055).

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[57] 2018 Sacramento Comprehensive Planning Study, Appendix II—Cost Estimates for Capital Improvement Plan, p. II-3.

[58] For example, in the 2016 rate case (A.16-07-002), Cal Am has proposed standby generator improvement projects in the Ventura (I15-510034), Los Angeles (I15-500058), Monterey (I1-400108), and Sacramento (I15-600082) districts.

[59] Workpapers- Engineering Projects, Tab 128 (I15-510055).

[60] ALL-CH07_PLT_RO_Forecast, Tab Contingency By Project WS-6.

[61] 2018 Sacramento Comprehensive Planning Study, Appendix II—Cost Estimates for Capital Improvement Plan, p. II-3.

In the Larkfield and Los Angeles districts, Cal Am uses a 20% contingency for the proposed Standby Generator Improvement Programs.[62] The Cost Estimate for Capital Improvement plan states that projects with a cost risk level of four are **<<BEGIN CONFDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[63] In the past, Cal Am has installed generators as part of capital projects including Standby Generator Improvement program projects in past rate cases.[64] For both the Larkfield (I15-610019) and Los Angeles (I15-500065) districts, Cal Am plans on installing generators at **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[65] Similar to the explanation above to use a 15% contingency for I15-510055 in the Ventura district, the proposed standby generator projects in the Larkfield (I15-610019) and Los Angeles (I15-500065) district are projects **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**. Therefore, Cal Am should also use a 15% contingency for the proposed standby generator projects in the Larkfield (I15-610019) and Los Angeles (I15-500065) districts.

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[62] ALL-CH07_PLT_RO_Forecast, Tab Contingency By Project WS-6.

[63] 2018 Sacramento Comprehensive Planning Study, Appendix II—Cost Estimates for Capital Improvement Plan, p. II-3.

[64] For example, in the 2016 rate case (A.16-07-002), Cal Am has proposed standby generator improvement projects in the Ventura (I15-510034), Los Angeles (I15-500058), Monterey (I15-400108), and Sacramento (I15-600082) districts.

[65] Workpapers- Engineering Projects, Tab 28 (I15-500065). Workpapers- Engineering Projects, Tab 8 (I15-610019).

(b) Main Replacement Project Program

As shown in Table 1-N above, the contingency percentage used in the Main Replacement Project Program varies between 15% -20% among the districts. In the Sacramento, Larkfield, and Los Angeles districts, Cal Am uses a 20% contingency for the Main Replacement Programs.[66] The Cost Estimate for Capital Improvement plan states that projects with a cost risk level of four are **<<BEGIN CONFDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[67] In the past, Cal Am has replaced mains as part of capital projects including Main Replacement Program projects.[68] For the Main Replacement Program projects in the Sacramento (I15-600072), Larkfield (I15-610015), and Los Angeles (I15-500066) districts, Cal Am plans to replace mains based on project candidates prioritized by the Condition Based Assessment reports (as part of the Comprehensive Planning Studies).[69] The Condition Based Assessment reports prioritize main replacement project candidates based on **<<BEGIN CONFIDENTIAL>>** [redacted]

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[66] ALL-CH07_PLT_RO_Forecast, Tab Contingency By Project WS-6.

[67] 2018 Sacramento Comprehensive Planning Study, Appendix II—Cost Estimates for Capital Improvement Plan, p. II-3.

[68] For example, in the 2016 rate case (A.16-07-002), Cal Am has proposed main replacement program projects in the San Diego (I15-300002), Los Angeles (I15-500057), Monterey (I1-400089), and Sacramento (I15-600072) districts.

[69] The project candidates are prioritized based on the characteristics and location of the main.

[redacted] **<<END CONFIDENTIAL>>**.[70] Due to Cal Am's prior experience with main replacement projects, Cal Am should have familiarity with the planned main replacement project candidates. In the San Diego and Monterey districts, Cal Am uses a contingency of 15% for their proposed Main Replacement program projects.[71] The Cost Estimate for Capital Improvement plan states that projects with a cost risk level of three are **<<BEGIN CONFDIENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[72] Since Cal Am **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**, a contingency of 15% should be used for I15-600072, I15-610015, and I15-500066.

4) Advice Letters

An advice letter (AL) is an informal request by the utility to the Commission to approve a change in rates, a term of service (including changes in tariffs), or a proposed utility action that has not been approved in a previous proceeding.[73] AL requests to recover the funding for completed plant addition projects are separate from Cal Am's proposed rate increase in its GRC application. Cal Am's proposed rate increase in its rate cases normally exclude any rate increases due to ALs filed during that rate case cycle period.

[70] Sacramento Condition Based Assessment, pp. 1-9 to 1-20. For the other districts, the main project candidates are prioritized in a similar matter.

[71] ALL-CH07_PLT_RO_Forecast, Tab Contingency By Project WS-6.

[72] 2018 Sacramento Comprehensive Planning Study, Appendix II—Cost Estimates for Capital Improvement Plan, p. II-3.

[73] General Order 96-B, p. 2.

In this rate case, Cal Am is requesting funding for one advice letter project in its workpapers,[74] the Walerga Road Bridge Pipe Relocation (I15-600032)[75] project in the Sacramento district.[76] In the 2010 rate case (A.10-07-007), I15-600032 was approved as an advice letter.[77] Cal Am received AL approval with the expectation that the project would be complete in 2013 (I15-600032 referred to as IP-0560-160 in the 2010 rate case).[78] In the 2013 rate case (A.13-07-002), Cal Am received continuing AL authorization revising its schedule to note that the project will be completed in 2016.[79] In the 2016 rate case (A.16-07-002), Cal Am stated that the project was temporarily deferred due to the unknown schedule of Placer County's project.[80]

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[74] ALL_CH07_PLT_RO_Forecast, Tab Total Direct CAPEX WS-5.

[75] Cal Am also references this project as investment project (IP)-0560-160.

[76] Cal Am is requesting $657,305 in 2019 and $662,820 in 2020.

[77] A.10-07-007 Partial Settlement Agreement between the [Public Advocates Office], The Utility Reform Network, and California American Water Company on Revenue Requirement Issues, pp. 230-231.

[78] A.10-07-007 Partial Settlement Agreement between the [Public Advocates Office], The Utility Reform Network, and California American Water Company on Revenue Requirement Issues, pp. 230-231.

[79] A.13-07-002 Partial Settlement Agreement between the California American Water Company, City of Pacific Grove, Las Palmas Wastewater Committee, Monterey Peninsula Water Management District and the [Public Advocates Office], Attachment C-1.

[80] Direct Testimony of Mark Schubert (from A.16-07-002), pp. 83-84. Placer County is planning to widen the Walerga Road Dry Creek bridge to include more lanes.

In Cal Am's workpapers,[81] Cal Am is requesting to recover the cost from this project in revenue requirements. Because Cal Am is already accounting for the cost of I15-600032 in its workpapers, Cal Am should not be able to recover funding for I15-600032 through an advice letter. In this rate case, Cal Am states that Placer County issued a construction contract Notice to Proceed in February 2019 and the project is now expected to be completed in 2020.[82]

Additionally, the Commission should not authorize any new advice letter projects or permit the continuation of any previously authorized advice letter projects that are not submitted before the test year of this general rate case (i.e. 2021). Although Cal Am's advice letter requests to recover the costs are handled separately from Cal Am's rate case application, all charges are combined on customers' bills. Thus, the proposed rate increase seen in the GRC application does not provide a true representation of the increase in rates that customers will experience over the rate case cycle if any authorized advice letter projects are submitted between rate cases.

5) 2023 Plant Additions

In this rate case, the Public Advocates Office does not take a position on the prudency or reasonableness of projects scheduled for completion in 2023 (after 2022). The Commission should follow the guidelines put forth in D.07-05-062 for calculating rate base additions in 2023, the attrition year.[83]

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[81] ALL_CH07_PLT_RO_Forecast, Tab Total Direct CAPEX WS-5.

[82] Direct Testimony of Ian Crooks, pp. 151-152.

[83] D.07-05-062, which adopted the Revised Rate Case Plan for Class A Water Utilities, the Commission stated that "all rate base items, including capital additions and depreciation, shall not be escalated but rather shall be subjected to two test years and an attrition year…" The 2023 ratebase will be derived by formula in the 2023 attrition advice letter filing. D.07-05-062 adopted

(continued on next page)

D. CONCLUSION

The Commission should adopt the recommendations of the Public Advocates Office discussed in this chapter regarding common plant issues as applied to Cal Am's multiple districts.

(continued from previous page)
changes to the rate case plan for class water utilities from D.04-06-018 and updated the new schedule for future GRC filings. In D.04-06-018, the attrition allowance for rate base additions is calculated by adding the difference between the first and second test year (2021 and 2022, respectively) and add it to the test year 2 (2022) rate base.

CHAPTER 2: SACRAMENTO

A. INTRODUCTION

Cal Am's Sacramento district is comprised of the following water systems: Antelope, Arden, Dunnigan, Isleton, Lincoln Oaks, Meadowbrook, Parkway, Suburban Rosemont, Security Park, Walnut Grove, and West Placer.[84] Cal Am has also filed two applications with the Commission to acquire the Fruitridge system (from the Fruitridge Vista Water Company) and the Hillview systems (from the Hillview Water Company) systems.[85] The Sacramento district is supplied through a combination of groundwater wells and purchased water.[86] The Public Advocates Office reviewed Cal Am's testimony, application, work-papers, minimum data requirements, capital project justifications, Comprehensive Planning Study ("CPS"), Condition Based Assessment of Buried Infrastructure, cost estimates, and responses to the Public Advocates Office's data requests. The Public Advocates Office conducted a field investigation of the Sacramento district's water system on October 22-23, 2019 before making its recommendations. This chapter presents the Public Advocates Office's recommendations which the Commission should adopt for the proposed Plant in Service for Cal Am's Sacramento district.

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[84] Direct Testimony of Gary Hofer, p. 3.

[85] Direct Testimony of Gary Hofer, p. 69. Cal Am filed A.17-10-016 to acquire the Fruitridge system. Cal Am filed A.18-04-025 to acquire the Hillview system.

[86] Direct Testimony of Gary Hofer, pp. 3-4.

B. SUMMARY OF RECOMMENDATIONS

Table 2-A and Table 2-B compares Cal Am's proposed capital investment project budget with the adjustments that the Commission should adopt as a result of the analysis and recommendations discussed in this report. The project costs shown in Table 2-A and Table 2-B are direct project costs (without add-on costs such as contingency and overhead).

Table 2-A. Sacramento Plant Additions, Including Carryovers, and Recurring Project

Sacramento ($000)	2021	2022	Annual Average
Public Advocates Office Recommendation	$ 13,192.93	$ 16,039.55	$ 14,616.24
Cal Am's Proposed	$ 15,463.02	$ 18,560.74	$ 17,011.88
Cal Am> Public Advocates Office	$ 2,270.09	$ 2,521.19	$ 2,395.64
Public Advocates Office as % of Cal Am	85%	86%	86%

Table 2-B. Sacramento Plant Comparison

2021	Project #	Project Description	Public Advocates Office Recommendation	Cal Am Proposed	Cal Am > Public Advocates Office	Public Advocates/ Cal Am
1	I15-600097	Main Replacement Program	$ 2,966,700	$ 2,966,700	$ -	100%
2	I15-600098	Well Installation and Replacement Program	$ 2,046,000	$ 2,046,000	$ -	100%
3	I15-600099	Well Rehabilitation Program	$ 1,438,920	$ 1,534,500	$ 95,580	94%
4	I15-600100	SCADA Maintenance and Improvements Program	$ 767,250	$ 767,250	$ -	100%
5	I15-600101	Standby Generator Improvement Program	$ 202,083	$ 613,800	$ 411,717	33%
6	I15-600102	Service Saddle Replacement Program	$ 776,820	$ 1,534,500	$ 757,680	51%
7	I15-600103	Suburban Rosemont Hydraulic Improvements	$ 171,014	$ 204,600	$ 33,586	84%
8	I15-600105	Fruitridge Vista Metering	$ 1,402,500	$ 1,402,500	$ -	100%
Specifics Total			**$ 9,771,287**	**$ 11,069,850**	**$ 1,298,563**	**88%**
Recurring Project Total			**$ 3,421,639**	**$ 4,393,166**	**$ 971,528**	**78%**
Carry-Overs			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2021			**$ 13,192,926**	**$ 15,463,016**	**$ 2,270,090**	**85%**

2022	Project #	Project Description	Public Advocates Office Recommendation	Cal Am Proposed	Cal Am > Public Advocates Office	Public Advocates Office/ Cal Am
1	I15-600097	Main Replacement Program	$ 2,966,700	$ 2,966,700	$ -	100%
2	I15-600098	Well Installation and Replacement Program	$ 2,046,000	$ 2,046,000	$ -	100%
3	I15-600099	Well Rehabilitation Program	$ 1,438,920	$ 1,534,500	$ 95,580	94%
4	I15-600100	SCADA Maintenance and Improvements Program	$ 767,250	$ 767,250	$ -	100%
5	I15-600101	Standby Generator Improvement Program	$ 202,083	$ 613,800	$ 411,717	33%
6	I15-600102	Service Saddle Replacement Program	$ 776,820	$ 1,534,500	$ 757,680	51%
7	I15-600103	Suburban Rosemont Hydraulic Improvements	$ 1,325,362	$ 1,585,650	$ 260,288	84%
8	I15-600104	Security Park Booster Pump Project	$ 511,500	$ 511,500	$ -	100%
9	I15-600105	Fruitridge Vista Metering	$ 1,683,000	$ 1,683,000	$ -	100%
10	I15-650002	Meadowbrook Storage Project	$ 511,500	$ 511,500	$ -	100%
11	I15-640001	Geyserville Storage Project	$ 306,900	$ 306,900	$ -	100%
Specifics Total			**$ 12,536,035**	**$ 14,061,300**	**$ 1,525,265**	**89%**
Recurring Project Total			**$ 3,503,514**	**$ 4,499,442**	**$ 995,927**	**78%**
Carry-Overs			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2022			**$ 16,039,549**	**$ 18,560,742**	**$ 2,521,192**	**86%**

C. DISCUSSION

Cal Am's requested capital budget consists of proposed projects (Section 1) and recurring project budget (Section 2). Unless otherwise stated, the project costs listed below are direct project costs.[87]

1) Proposed Projects

(a) Standby Generator Improvements Program (I15-600101)

The Commission should reduce Cal Am's proposed 2021-2022 budget from $1,227,600 to $404,167 because only three of the eleven proposed generator project candidates should be constructed and two generators should be relocated as

[87] The direct project costs are the cost of the project without add-on costs (e.g. overhead).

mentioned in the 2016 Cal Am Generator Master Plan.[88] Table 2-C below show the proposed generator project candidates Cal Am plans to replace over the 2021-2026 period.

Table 2-C. 2021-2026 Standby Generator Improvements Program (I15-600101) Project Candidates[89]

<<BEGIN CONFIDENTIAL>>

[redacted]

<<END COFIDENTIAL>>

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88 2016 Cal Am Generator Master Plan, p. 2.

89 Workpapers- Engineering Projects, Tab 92 (I15-600101).

Six of Cal Am's eleven proposed generator projects are either duplicative as part of different project budgets or superfluous based upon existing standby power at that station. For example, three of the eleven proposed generator project candidates (**<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**) were funded under the previously approved Sacramento District Standby Generators Improvement project (I15-600082) from the 2016 general rate case (A.16-07-002).[90] Cal Am states that it plans to install a generator as part of **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[91] In the Sacramento Comprehensive Planning Study, Cal Am states that there is already standby power at **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[92]

In 2016, Cal Am hired **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** to prepare a generator master plan (2016 Cal Am Generator Master Plan). The 2016 Cal Am Generator Master Plan recommends relocating existing diesel generators from other stations to the **<<BEGIN CONFIDENTIAL>>** [redacted]

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[90] Direct Testimony of Mark Schubert (from A.16-07-002), p. 183. According to page 137 of the Direct Testimony of Ian Crooks, Cal Am plans to install the **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** and **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** in 2019.

[91] Direct Testimony of Ian Crooks, p. 150.

[92] Sacramento 2018 Comprehensive Planning Study, p. 6-26 (Table 6.3-1) and p. 11-35 (Table 11.3-1).

<<**END CONFIDENTIAL**>>.[93] Therefore, Cal Am should relocate the two generators rather than purchase two new generators.

The Commission should only allow the cost for three new generators because eight of the eleven proposed project candidates are not necessary as discussed above. In addition, the Commission should include the cost to relocate two generators. Table 2-D below shows the revised project cost the Commission should allow for the proposed Standby Generator Improvements Program (I15-600101).[94] Based on adjustments mentioned above, the Commission should only allow $404,167 for the 2021-2022 period for I15-600101. In addition, the Commission should direct Cal Am to conduct a portable generator and power shutoff study as described in the testimony of the Public Advocates Office witness Cameron Reed.

Table 2-D. Standby Generator Improvements Program (I15-600101) Project Candidate Direct Project Cost Comparison

<<BEGIN CONFIDENTIAL>>

[93] 2016 Cal Am Generator Master Plan, p. 2. **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.

[94] The revised project cost for the projects planned is calculated as part of determining the annual recommended budget for 2021-2022 period. As stated earlier in this report, the Public Advocates Office does not take a position on the prudency or reasonableness of projects scheduled for completion in 2023 (after 2022) in this rate case.

[redacted]

<<END CONFIDENTIAL>>

(b) Suburban Rosemont Hydraulic Improvements Project (I15-600103)

The Commission should reduce Cal Am's proposed direct cost for the proposed Suburban Rosemont Hydraulics Improvements project from $1,790,250 to $1,496,377 in the 2021-2022 period to remove redundant contingency project costs. Cal Am requests funding to create another pressure zone in the Suburban Rosemont service area.[95] Cal Am accounts for project contingency costs for this project twice, as a line item in the direct project cost and as a separate project cost line item that is proportional to the direct project cost. Table 2-E below shows the direct project costs for I15-600103, which includes a **<<BEGIN CONTINGENCY>>** [redacted] **<<END CONTINGENCY>>** contingency. However, Cal Am already applies a 20% contingency to the total direct cost of the project in its workpapers.[96] Because Cal Am already estimates the funding for contingency separately in workpapers, the project contingency in the cost estimate shown in Table 2-E below should be removed. Table 2-E shows the revised direct project

[95] Direct Testimony of Ian Crooks, p. 225.

[96] ALL-CH07_PLT_RO_Forecast, Tab Contingency By Project WS-6, cell J820.

cost for I15-600103. After removing the redundant contingency, the Commission should allow $1,496,377 for the 2021-2022 period for I15-600103.[97]

Table 2-E. Suburban Rosemont Hydraulic Improvements (I15-600103) Direct Project Cost Comparison[98]

<<BEGIN CONFIDENTIAL>>

[redacted]

<<END CONFIDENTIAL>>

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97 Cal Am plans on spending approximately $200,000, 1,550,000, $1.7 million in 2021, 2022, and 2023, respectively for I15-600103. Cal Am intends on spending approximately 5.80% of the total $3,450,000 in 2021, 44.93% of the total $3,450,000 million in 2022, and 49.28% of the total $3,450,000 in 2023. With a revised total direct cost of $2.95 million, 5.8% of the total $2.95 million was allocated to 2021 and 44.93% of the total $2.95 million was allocated to 2022. The revised project cost for the projects planned is calculated as part of determining the annual recommended budget for 2021-2022 period. As stated earlier in this report, the Public Advocates Office does not take a position on the prudency or reasonableness of projects scheduled for completion in 2023 (after 2022) in this rate case.

98 Workpapers- Engineering Projects, Tab 94 (I15-600103).

(c) Service Saddle Replacement Program (I15-600102)

The Commission should reduce the proposed 2021-2022 budget for saddle service replacement[99] from $3,069,000 to $1,553,640 based on the historical annual number of saddle services replaced in the Sacramento district. Cal Am's annual proposed budget of approximately $1,500,000 is based on replacing approximately **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** service saddles per year.[100] Cal Am's proposed replacement rate is excessive given Cal Am's historical replacement rate for service saddles in the Sacramento district.

During the 2006-2018 period, Cal Am has replaced approximately **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** service saddles, or an average annual replacement rate of **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[101] Cal Am's historical replacement rate is a better representation of the number of service saddles Cal Am normally replaces versus Cal Am's proposed replacement rate.

The Commission should allow an annual budget based on the historical average annual replacement rate of approximately **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** service saddles. After modifying the annual budget to reflect the historical annual replacement rate for

[99] According to Cal Am, the service saddles are used to help connect the service line to the water main.

[100] Workpapers- Engineering Projects, Tab 93 (I15-600102). Cal Am proposes to replace approximately **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** saddle services over a six-year period.

[101] Workpapers- Engineering Projects, Tab 93 (I15-600102).

service saddles, the Commission should approve $1,553,640 for the 2021-2022 period for I15-600102.

(d) Well Rehabilitation Program (I15-600099)

The Commission should reduce Cal Am's total 2021-2022 proposed budget to rehabilitate existing wells from $3,069,000 to $2,877,839 since six of the proposed projects were recently completed. In 2017, Cal Am rehabilitated the following wells: **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[102] In addition, Cal Am rehabilitated the **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** in 2019.[103] Because these wells were recently rehabilitated, they do not need to be rehabilitated at this time. The Commission should remove the cost of the already rehabilitated wells and only allow $2,877,839 for the 2021-2022 period for I15-600099.[104]

2) Recurring Project Budget

The Commission should reduce the total proposed 2021-2022 recurring project budget from $8,892,608 to $6,925,153 due to a reduction in the total

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[102] Cal Am Response to the Public Advocates Office Data Request DG-004, Q. 1.

[103] Cal Am Response to the Public Advocates Office Data Request DG-004, Q. 1.

[104] The total revised project cost of the project candidates Cal Am plans for the 2021-2026 period is approximately $8,633,517. Because the proposed project candidates are planned for the 2021-2026 period, the total 2021-2026 project cost was divided by six years, or approximately $1,438,920 per year. The revised project cost for the projects planned is calculated as part of determining the annual recommended budget for 2021-2022 period. As stated earlier in this report, the Public Advocates Office does not take a position on the prudency or reasonableness of projects scheduled for completion in 2023 (after 2022) in this rate case.

recurring project budget for the Dunnigan Wastewater system and the Process Plant recurring project category for the Fruitridge, Hillview, and Meadowbrook systems. Refer to Chapter 1 of this report regarding recurring project budgets.

D. CONCLUSION

The Commission should make the following adjustments on Cal Am's requests for the Sacramento district:

1. Approve $404,167 for the 2021-2022 period for the proposed Standby Generator Improvements Program (I15-600101).
2. Approve $1,496,377 for the 2021-2022 period for the Suburban Rosemont Hydraulic Improvements (I15-600103).
3. Approve $1,553,640 for the 2021-2022 for the Service Saddle Replacement Program (I15-600102).
4. Approve $2,877,839 for the 2021-2022 period for the Well Rehabilitation Program (I15-600099).
5. Approve $6,925,153 for the 2021-2022 period for the recurring project budget.

CHAPTER 3: LARKFIELD

A. INTRODUCTION

Cal Am's Larkfield district is supplied through a combination of groundwater from four wells and purchased water from the Sonoma County Water Agency.[105] The Public Advocates Office reviewed Cal Am's testimony, application, work-papers, minimum data requirements, capital project justifications, Comprehensive Planning Study, Condition Based Assessment of Buried Infrastructure, cost estimates, and responses to the Public Advocates Office's data requests. The Public Advocates Office conducted a field investigation of the Larkfield district's water system on October 24, 2019 before making its recommendations. This chapter presents the recommendations the Commission should adopt for the proposed Plant in Service for Cal Am's Larkfield district.

B. SUMMARY OF RECOMMENDATIONS

Table 3-A and Table 3-B compares Cal Am's proposed capital investment project budget with the adjustments that the Commission should adopt as a result of the analysis and recommendations discussed in this report. The project costs shown in Table 3-A and Table 3-B are direct project costs (without add-on costs such as contingency and overhead).

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[105] Direct Testimony of Gary Hofer, p. 5.

Table 3-A. Larkfield Plant Additions, Including Carryovers, and Recurring Project

Larkfield ($000)	2021	2022	Annual Average
Public Advocates Office Recommendation	$ 3,778.64	$ 4,064.24	$ 3,921.44
Cal Am's Proposed	$ 4,475.86	$ 4,761.47	$ 4,618.66
Cal Am> Public Advocates Office	$ 697.22	$ 697.22	$ 697.22
Public Advocates Office as % of Cal Am	84%	85%	85%

Table 3-B. Larkfield Plant Comparison

2021	Project #	Project Description	Public Advocates Office Recommendation	Cal Am Proposed	Cal Am > Public Advocates Office	Public Advocates Office/ Cal Am
1	I15-610015	Main Replacement Program	$ 555,399	$ 1,023,000	$ 467,601	54%
2	I15-610016	Well Rehabilitation and Maintenance Program	$ 102,300	$ 102,300	$ -	100%
3	I15-610017	SCADA Improvements Program	$ 358,050	$ 358,050	$ -	100%
4	I15-610018	Tank Rehabilitation and Seismic Upgrades	$ 179,580	$ 409,200	$ 229,620	44%
5	I15-610022	Wikiup Main Replacement	$ 1,739,100	$ 1,739,100	$ -	100%
Specifics Total			**$ 2,934,429**	**$ 3,631,650**	**$ 697,221**	**81%**
Recurring Project Total			**$ 283,211**	**$ 283,211**	**$ -**	**100%**
Carry-Overs			**$ 561,000**	**$ 561,000**	**$ -**	**100%**
TOTAL 2021			**$ 3,778,640**	**$ 4,475,861**	**$ 697,221**	**84%**

2022	Project #	Project Description	Public Advocates Office Recommendation	Cal Am Proposed	Cal Am > Public Advocates Office	Public Advocates Office/ Cal Am
1	I15-610015	Main Replacement Program	$ 555,399	$ 1,023,000	$ 467,601	54%
2	I15-610016	Well Rehabilitation and Maintenance Program	$ 102,300	$ 102,300	$ -	100%
3	I15-610017	SCADA Improvements Program	$ 358,050	$ 358,050	$ -	100%
4	I15-610018	Tank Rehabilitation and Seismic Upgrades	$ 179,580	$ 409,200	$ 229,620	44%
5	I15-610019	Standby Generator Improvement Projects	$ 332,475	$ 332,475	$ -	100%
6	I15-610020	Windsor Emergency Interconnect	$ 143,220	$ 143,220	$ -	100%
7	I15-610021	Storage Tank at Water Treatment Plant	$ 306,900	$ 306,900	$ -	100%
8	I15-610022	Wikiup Main Replacement	$ 1,766,721	$ 1,766,721	$ -	100%
Specifics Total			**$ 3,744,645**	**$ 4,441,866**	**$ 697,221**	**84%**
Recurring Project Total			**$ 319,599**	**$ 319,599**	**$ -**	**100%**
Carry-Overs			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2022			**$ 4,064,244**	**$ 4,761,465**	**$ 697,221**	**85%**

C. DISCUSSION

As discussed below, Cal Am's requested capital budget consists of proposed projects (Section 1) and memorandum account capital project (Section 2). Unless otherwise stated, the project costs listed below are direct project costs.[106]

1) Proposed Projects

(a) Main Replacement Program (I15-610015)

The Commission should reduce the proposed 2021-2022 Main Replacement Program project budget from $2,046,000 to $1,110,797 to prioritize the main replacement projects highlighted in Cal Am's 2018 Conditional Based Assessment report.

As part of the 2018 Sonoma Comprehensive Planning Study, a Conditional Based Assessment report (2018 Sonoma District Condition Based Assessment)

[106] The direct project costs are the cost of the project without add-on costs (e.g. overhead).

was prepared by **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** to evaluate the existing mains and prioritize the main replacement projects. The 2018 Sonoma District Conditional Based Assessment recommends main replacement project candidates identified in the following categories: **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[107] This results in total direct project costs of $2,443,754, which includes **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[108] Based on the adjustments previously described above, the Commission should only allow $1,110,797 for the 2021-2022 period for I15-610015.[109]

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[107] 2018 Sonoma District Conditional Based Assessment, p. 3-22.

[108] 2018 Sonoma District Conditional Based Assessment, p. 3-22. 2018 Sacramento Comprehensive Planning Study, Appendix II—Cost Estimates for Capital Improvement Plan, p. II-3. **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**. The percentage used in Appendix II for multiple projects among all of Cal Am's districts.

[109] Cal Am plans on spending approximately $1,000,000 in 2021, $1,000,000 in 2022 and $2,400,000 in 2023 for I15-610015. Cal Am intends on spending approximately 22.73% of the total $4,400,000 in 2021, 22.73% of the total $4,400,000 in 2022, and 54.55 % of the total $4,400,000 in 2023. With a revised total direct cost of $2,443,754, 32.63% of the total $2,443,754 was allocated to 2021 and 22.73% of the total $2,443,754 was allocated to 2022. The revised project cost for the projects planned is calculated as part of determining the annual recommended budget for 2021-2022 period. As stated earlier in this report, the Public Advocates

(continued on next page)

(b) Tank Rehabilitation and Seismic Upgrades Program (I15-610018)

The Commission should reduce Cal Am's proposed tank rehabilitation and seismic upgrades cost from $818,400 to $359,161 in the 2021-2022 period to account for 1) removing the tank painting costs; 2) removing the five-year anniversary tank maintenance costs; and 3) removing the redundant project contingency from the project cost.

In this rate case cycle, Cal Am plans to make structural improvements for the North Wikiup Tank #2 and the Lower Wikiup Tank #1. Cal Am estimates the structural improvements for the Lower Wikiup Tank #1 and North Wikiup Tank #2 will cost $604,800 and $148,400, respectively. The estimated costs for the structural improvements are based on a Larkfield District Tank Study report.[110] The Larkfield District Tank Study states that the estimated cost of $604,800 is the cost to replace the existing Lower Wikiup Tank #1.[111] Cal Am states that it intends to make structural improvements to Lower Wikiup Tank #1 rather than replacing the existing tank.[112] The Larkfield District Tank Study report estimates the cost to rehabilitate the existing Lower Wikiup Tank #1 is $236,300[113] and

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(continued from previous page)
Office does not take a position on the prudency or reasonableness of projects scheduled for completion in 2023 (after 2022) in this rate case.

[110] Workpapers- Engineering Projects, Tab 7 (I15-610018).

[111] Larkfield District Tank Study, p. 7. The Larkfield District Tank Study was provided in Cal Am's response to Data Request A.19-07-004 JMI-004.

[112] Cal Am Response to Data Request A.19-07-004 JMI-007, Q. 1.a.i.

[113] Larkfield District Tank Study, Exhibit 4.2.

$148,400 for the North Wikiup Tank #2.[114] However, Cal Am already allocates $236,300 in 2022 for deferred tank improvements for the Lower Wikiup Tank #1.[115] Table 3-C below shows the cost estimate for the proposed improvements for the Lower Wikiup Tank #1 and Table 3-D shows the estimated cost for the proposed improvements for the North Wikiup Tank#2. As shown in Table 3-C and Table 3-D, approximately $58,700 is allocated for tank painting for the Lower Wikiup Tank #1 and $46,100 is allocated for tank painting for the North Wikiup Tank #2. The tank painting costs for both tanks should be removed because funding is provided under deferred tank improvements proposed in 2022.[116] After removing the tank coating costs, the cost of the improvements for Lower Wikiup Tank #1 should be $93,744 (as shown in Table 3-C below) and $44,997 for the North Wikiup Tank #2 (as shown in Table 3-D below) .

[114] Larkfield District Tank Study, Exhibit 3.2.

[115] Direct Testimony of Ian Crooks, p. 260.

[116] On page 258 of the Direct Testimony of Ian Crooks, tank painting expenses are part of the deferred tank improvements.

Table 3-C. I15-610018 Proposed Lower Wikiup Tank #1 Improvements Direct Project Cost Comparison

Item	Total Direct Cost: Cal Am Proposed	Total Direct Cost: Public Advocates Office Recommendation
Seismic Enhancement Design		
Concrete Strength Testing	$ 2,500	$ 2,500
Steel Reinforcement Scanning, Location Testing and X-Ray	$ 25,000	$ 25,000
Foundation Potholing and Investigation	$ 2,500	$ 2,500
Concrete Structural Integrity	$ 10,000	$ 10,000
Analysis and Foundation Design (Retro-fit Design Only)	$ 10,000	$ 10,000
Subtotal	**$ 50,000**	**$ 50,000**
Miscellaneous Recommendations		
Stainless Steel Mesh Installation, Remove existing vent screens	$ 12,500	$ 12,500
Subtotal	**$ 12,500**	**$ 12,500**
Coating Recommendations		
Sand Blasting (Interior)	$ 12,600	$ -
Spot Primer and Application of 2-coat epoxy coating	$ 26,000	$ -
Pressure Wash Cleaning (Exterior)	$ 3,600	$ -
Preparation and application of epoxy coatings (exterior concrete walls)	$ 15,000	$ -
Disinfection, Sampling and Testing	$ 1,500	$ -
Subtotal	**$ 58,700**	**$ -**
Recommendations for Designing Seismic Enhancement	$ 50,000	$ 50,000
Miscellaneous Recommendations	$ 12,500	$ 12,500
Coating Recommendations	$ 58,700	$ -
Subtotal 1	**$ 121,200**	**$ 62,500**
Mobilization (Taxes, Bonds, Insurance, Start-Up) 20% of Subtotal 1	$ 24,200	$ 12,479
Subtotal 2	**$ 145,400**	**$ 74,979**
Contingency 30% of Subtotal 2	$ 43,600	$ -
Total Construction Cost	**$ 189,000**	**$ 74,979**
Design and Construction Management Fee 25% Total Construction Cost	$ 47,300	$ 18,765
Total Direct Project Cost	**$ 236,300**	**$ 93,744**

Table 3-D. I15-610018 Proposed North Wikiup Tank #2 Improvements Cost Comparison

	Total Direct Cost	
Item	Cal Am Proposed	Public Advocates Office Recommendation
Seismic Enhancement Design		
Initial Screening Analysis for Welds	$ 2,500	$ 2,500
Analysis and Anchorage System Design	$ 10,000	$ 10,000
Analysis and Foundation Design (Retro-fit Design Only)	$ 15,000	$ 15,000
Analysis and Roof Framing System	$ -	$ -
Subtotal	**$ 27,500**	**$ 27,500**
Miscellaneous Recommendations		
Grout Injection at Voids between Foundation and Tank	$ 2,500	$ 2,500
Subtotal	**$ 2,500**	**$ 2,500**
Coating Recommendations		
Sand Blasting (Interior)	$ 11,600	$ -
Preparation, spot primer and application of two coating expoxy coating	$ 15,000	$ -
Pressure Wash Cleaning (Exterior)	$ 7,000	$ -
SSPC-SP3 Power Tool Cleaning (Exterior Roof Spots)	$ 2,500	$ -
Preparation and application of epoxy and polyurethane coatings (exterior roof spots)	$ 7,500	$ -
Disinfection, Sampling and Testing	$ 2,500	$ -
Subtotal	**$ 46,100**	**$ -**
Recommendations for Designing Seismic Enhancement	$ 27,500	$ 27,500
Miscellaneous Recommendations	$ 2,500	$ 2,500
Coating Recommendations	$ 46,100	$ -
Subtotal 1	**$ 76,100**	**$ 30,000**
Mobilization (Taxes, Bonds, Insurance, Start-Up) 20% of Subtotal 1	$ 15,200	$ 5,990
Subtotal 2	**$ 91,300**	**$ 35,990**
Contingency 30% of Subtotal 2	$ 27,400	$ -
Total Construction Cost	**$ 118,700**	**$ 35,990**
Design and Construction Management Fee 25% Total Construction Cost	$ 29,700	$ 9,007
Total Direct Project Cost	**$ 148,400**	**$ 44,997**

Cal Am requests approximately **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** for the five-year anniversary tank maintenance for five tanks.[117] Cal Am states that the five-year anniversary tank maintenance is related to their routine tank inspections of existing tanks.[118] Cal Am states that the costs for the five-year anniversary tank maintenance should be included as a deferred maintenance expense, and therefore should not be included in the proposed capital project costs.[119] The proposed costs of the five-year anniversary tank maintenance should be removed from I15-610018.

As shown in Table 3-C and Table 3-D, the proposed project costs for both the Lower Wikiup Tank #1 and North Wikiup Tank #2 include a 30% contingency cost. However, in Cal Am's workpapers, Cal Am applies a 15% contingency cost rate to the total project direct cost for I15-610018.[120] Cal Am accounts for the project contingency cost twice in proposed improvement costs for the Lower Wikiup Tank #1 and North Wikiup Tank #2. The Engineering Project Workpaper for I15-610018 recommends a project contingency of **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[121] Therefore, the 30% contingency cost included in the proposed improvement costs for the Lower

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[117] Workpapers- Engineering Projects, Tab 7 (I15-610018). Cal Am proposes five-year anniversary tank maintenance for the following tanks: **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.

[118] Cal Am Response to Data Request A.19-07-004 JMI-007, Q. 2.c.1.

[119] Cal Am Response to Data Request A.19-07-004 JMI-007, Q. 2.c.2.

[120] ALL-CH07_PLT_RO_Forecast, Tab Contingency By Project WS-6.

[121] Workpapers- Engineering Projects, Tab 7 (I15-610018).

Wikiup Tank #1 and North Wikiup Tank #2 should be removed to avoid duplication.

After making the adjustments mentioned above, the Commission should allow $359,161 for the 2021-2022 period for I15-610018. The cost comparison between Cal Am's proposal and Public Advocates Office's recommendation is shown in Table 3-E below.[122]

Table 3-E. Tank Rehabilitation and Seismic Upgrades Program (I15-610018) Direct Project Cost Comparison

<<BEGIN CONFIDENTIAL>>

[redacted]

<<END CONFIDENTIAL>>

[122] The revised project cost for the projects planned is calculated as part of determining the annual recommended budget for 2021-2022 period. As stated earlier in this report, the Public Advocates Office does not take a position on the prudency or reasonableness of projects scheduled for completion in 2023 (after 2022) in this rate case.

2) Memorandum Account Capital Investment Projects

(a) Larkfield Wildfire Water System Recovery (I15-610014)

The Commission should not allow $7,500,000 in 2020 for the improvements planned for the district as a result of the Tubbs fire in 2017[123] until Cal Am receives the insurance claims. For more information, refer to the testimony of the Public Advocates Office witness Anusha Nagesh.

D. CONCLUSION

The Commission should make the following adjustments to Cal Am's requests for the Larkfield district:

1. Allow $1,110,797 for the 2021-2022 period for the Main Replacement Program (I15-610015).
2. Allow $359,161 for the 2021-2022 period for the Tank Rehabilitation and Seismic Upgrades Program (I15-610018).
3. Not allow the proposed improvements for the Larkfield Wildfire Water system Recovery project (I15-610014) until Cal Am receives the insurance claims.

[123] For I15-610014, Cal Am plans to replace 570 meters and boxes, replace the Upper Wikiup Tank #1, install 46 fire hydrants, construct a booster pump station with a hydropneumatic tank and standby generator.

CHAPTER 4: MONTEREY

A. INTRODUCTION

Cal Am's Monterey district is comprised of the following systems: Monterey Main, Ryan Ranch, Hidden Hills, Bishop, Toro, Ambler Park, Ralph Lane, Chualar, and Garrapata.[124] The Monterey district is supplied through a combination of surface water from the Carmel River, shallow wells in Carmel Valley, wells in the Seaside Basin, and wells along the Highway 68 corridor.[125] The Public Advocates Office reviewed Cal Am's testimony, application, work-papers, minimum data requirements, capital project justifications, Comprehensive Planning Study, Condition Based Assessment of Buried Infrastructure, cost estimates, and responses to the Public Advocates Office's data requests. The Public Advocates Office conducted a field investigation of the Monterey district's water system on November 4-5, 2019 before making its recommendations. This chapter presents the recommendations the Commission should adopt for the proposed Plant in Service for Cal Am's Monterey district.

B. SUMMARY OF RECOMMENDATIONS

Table 4-A and Table 4-B compares Cal Am's proposed capital investment project budget with the adjustments that the Commission should adopt as a result of the analysis and recommendations discussed in this report. The project costs shown in Table 4-A and Table 4-B are direct project costs (without add-on costs such as contingency and overhead).

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[124] Direct Testimony of Chris Cooks, p. 4.

[125] Direct Testimony of Chris Cooks, pp. 4-5.

Table 4-A. Monterey Plant Additions, Including Carryovers, and Recurring Project

Monterey ($000)	2021	2022	Annual Average
Public Advocates Office Recommendation	$ 11,601.42	$ 22,059.02	$ 16,830.22
Cal Am's Proposed	$ 13,141.11	$ 24,226.53	$ 18,683.82
Cal Am> Public Advocates Office	$ 1,539.69	$ 2,167.51	$ 1,853.60
Public Advocates Office as % of Cal Am	88%	91%	90%

Table 4-B. Monterey Plant Comparison[126]

2021	Project #	Project Description	Public Advocates Office Recommendation	Cal Am Proposed	Cal Am > Public Advocates Office	Public Advocates Office/ Cal Am
1	I15-400125	Main Replacement Program	$ 3,069,000	$ 3,069,000	$ -	100%
2	I15-400126	Fire Protection Program	$ 306,900	$ 306,900	$ -	100%
3	I15-400127	Pump Station Rehabilitation Program	$ 716,100	$ 716,100	$ -	100%
4	I15-400131	Well Rehabilitation Program	$ 507,083	$ 1,023,000	$ 515,917	50%
5	I15-400128	SCADA Maintenance and Improvements Program	$ 414,669	$ 613,800	$ 199,131	68%
6	I15-400129	Tank Rehabilitation Program	$ 276,411	$ 1,023,000	$ 746,589	27%
7	I15-400140	Standby Generator Improvement Program	$ 280,000	$ 358,050	$ 78,050	78%
8	I15-400135	Arc Flash Mitigation	$ 306,900	$ 306,900	$ -	100%
9	I15-400141	New Carmel Valley Well	$ 511,500	$ 511,500	$ -	100%
10	I15-400143	Forest Lake Pump Station	$ 1,023,000	$ 1,023,000	$ -	100%
11	I15-400104	MRY-Metering Infrastructure	$ 67,601	$ 67,601	$ -	100%
Proposed Total			**$ 7,479,164**	**$ 9,018,851**	**$ 1,539,687**	**83%**
Recurring Project Total			**$ 4,122,259**	**$ 4,122,259**	**$ -**	**100%**
Carry-Overs			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2021			**$ 11,601,423**	**$ 13,141,110**	**$ 1,539,687**	**88%**

126 The recurring project budget shown does not include the recurring project budget for the Toro and Garrapata systems.

2022	Project #	Project Description	Public Advocates Office Recommendation	Cal Am Proposed	Cal Am > Public Advocates Office	Public Advocates Office/ Cal Am
1	I15-400125	Main Replacement Program	$ 3,069,000	$ 3,069,000	$ -	100%
2	I15-400126	Fire Protection Program	$ 306,900	$ 306,900	$ -	100%
3	I15-400127	Pump Station Rehabilitation Program	$ 716,100	$ 716,100	$ -	100%
4	I15-400131	Well Rehabilitation Program	$ 507,083	$ 1,023,000	$ 515,917	50%
5	I15-400128	SCADA Maintenance and Improvements Program	$ 414,669	$ 613,800	$ 199,131	68%
6	I15-400129	Tank Rehabilitation Program	$ 276,411	$ 1,023,000	$ 746,589	27%
7	I15-400140	Standby Generator Improvement Program	$ -	$ 358,050	$ 358,050	0%
8	I15-400135	Arc Flash Mitigation	$ 429,660	$ 429,660	$ -	100%
9	I15-400130	Carmel Woods Tanks #1 & 2 Replacement	$ -	$ 347,820	$ 347,820	0%
10	I15-400133	Phase 2 BIRP Improvements	$ 818,400	$ 818,400	$ -	100%
11	I15-400136	Ambler Water Treatment Solids Residual Handling	$ 204,600	$ 204,600	$ -	100%
12	I15-400137	Del Rey Regulation Station	$ 260,865	$ 260,865	$ -	100%
13	I15-400138	Rancho Fiesta Tanks and Pump Station	$ 450,120	$ 450,120	$ -	100%
14	I15-400141	New Carmel Valley Well	$ 1,023,000	$ 1,023,000	$ -	100%
15	I15-400143	Forest Lake Pump Station	$ 1,503,810	$ 1,503,810	$ -	100%
16	I15-400104	MRY-Metering Infrastructure	$ 7,840,522	$ 7,840,522	$ -	100%
Proposed Total			**$ 17,821,140**	**$ 19,988,647**	**$ 2,167,507**	**89%**
Recurring Project Total			**$ 4,237,879**	**$ 4,237,879**	**$ -**	**100%**
Carry-Overs			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2022			**$ 22,059,020**	**$ 24,226,526**	**$ 2,167,507**	**91%**

C. DISCUSSION

As discussed below, Cal Am's requested capital budget consists of proposed projects (Section 1) and projects performed (or planned) but not previously authorized (Section 2). Unless otherwise stated, the project costs listed below are direct project costs.[127]

[127] The direct project costs are the cost of the project without add-on costs (e.g. overhead).

1) Proposed Projects

(a) Well Rehabilitation Program (I15-400131)

The Commission should reduce Cal Am's total proposed budget of $2,046,000 in 2021-2022 to $1,128,733 because the actual summation of project costs is less than Cal Am's request. In addition, one of the project candidates of the Well Rehabilitation Program (I15-400131) should be denied because it is not needed at this time. Table 4-C below shows the list of project candidates Cal Am plans to do under the Well Rehabilitation program for the 2021-2026 period.

Table 4-C. Well Rehabilitation Program (I15-400131) Project Candidates[128]

<<BEGIN CONFIDENTIAL>>

[128] Workpapers- Engineering Projects, Tab 62 (I15-400131).

[redacted]

<<END CONFIDENTIAL>>

Although Cal Am is proposing approximately **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** per year[129] or approximately **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** during the 2021-2026 period, the total project cost for all of

[129] Workpapers- Engineering Projects, Tab 62 (I15-400131).

the project candidates planned for the 2021-2026 period is **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** as shown in Table 4-C above. If Cal Am were to complete all of the proposed project candidates during the 2021-2026 period, it would only cost **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**. In addition, the **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** does not need to be rehabilitated at this time. Cal Am completed re-drilling of the **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[130] According to Cal Am, the **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** was considered in poor condition due to the condition of the casing of the well below the annular seal but above the well screens.[131] When Cal Am completed the re-drilling of **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**, it addressed the issues from the previous well at **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**. Therefore, the **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** does not need to be rehabilitated at this time and the cost associated with the rehabilitation should be removed from the total project cost.

Therefore, all proposed project candidates excluding the **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** can be completed for **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**. Only <<**BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** should be

[130] Direct Testimony of Ian Crooks, p. 82. I15-400094 was approved as part of the 2013 rate case (A.13-07-002).

[131] Workpapers- Engineering Projects, I15-400094 (from A.13-07-002).

allowed at this time for the project candidates planned for the 2021-2026 period.[132] Because the proposed project candidates are planned for the 2021-2026 period, the total 2021-2026 project cost was divided by six years, or approximately $507,083 per year. The Commission should only approve $1,014,167 for the Well Rehabilitation Program (I15-400131) for the 2021-2022 period.

(b) Carmel Woods Tanks #1 and 2 Replacement (I15-400130)

The Commission should disallow $347,820 in 2022 because the total storage volume for the existing two tanks (Carmel Woods Tanks 1 and 2) is not necessary at this time to meet the storage demands for the **<<BEGIN CONFIDENTIAL>>** [redacted] **<< END CONFIDENTIAL>>** pressure zone. According to the 2019 Monterey Comprehensive Planning Study, the total storage requirement is **<< BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[133] In addition, the 2019 Monterey Comprehensive Planning Study states that the **<< BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** pressure zone has **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** storage tanks with a total storage volume of **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[134] Carmel Woods Tanks 1 and 2 have a total storage volume of **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END**

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[132] The revised project cost for the projects planned is calculated as part of determining the annual recommended budget for 2021-2022 period. As stated earlier in this report, the Public Advocates Office does not take a position on the prudency or reasonableness of projects scheduled for completion in 2023 (after 2022) in this rate case.

[133] 2019 Monterey Comprehensive Planning Study, p. 5-32. **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.

[134] 2019 Monterey Comprehensive Planning Study, p. 5-25.

CONFIDENTIAL>>.[135] Without the total storage volume of Carmel Woods Tanks 1 and 2 **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**, the revised storage volume would still be able to meet the storage demand. Therefore, the storage volume from Carmel Woods Tanks 1 and 2 are not needed at this time and the Commission should not allow the $347,820 requested at this time.

(c) Supervisory Control and Data Acquisition (SCADA) Maintenance and Improvements Program (I15-400128)

The Commission should reduce Cal Am's proposed 2021-2022 budget for the proposed SCADA Maintenance and Improvements program from $1,227,600 to $829,337 because the total project cost for all the project candidates in the 2021-2026 period is less than the total proposed project budget during the 2021-2026 period. Table 4-D below shows the list of project candidates Cal Am plans to do under the SCADA Maintenance and Improvements Program for the 2021-2026 period.

Table 4-D. SCADA Maintenance and Improvements Program (I15-400128) Project Candidates[136]

<<BEGIN CONFIDENTIAL>>

[135] 2019 Monterey Comprehensive Planning Study, p. 5-25.

[136] Workpapers- Engineering Projects, Tab 59 (I15-400128).

[redacted]

<<END CONFIDENTIAL>>

Although Cal Am is proposing approximately **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** per year[137] or approximately **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** during the 2021-2026 period, the total project cost for all the project candidates planned for the 2021-2026 period is **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** as shown in Table 4-D above. Because all the proposed project candidates can be completed for **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**, only <<**BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** should be allowed at this time for the 2021-2026 period.[138] This results in a total direct cost of $2,488,012, which includes **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END**

[137] Workpapers- Engineering Projects, Tab 59 (I15-400128).

[138] The revised project cost for the projects planned is calculated as part of determining the annual recommended budget for 2021-2022 period. As stated earlier in this report, the Public Advocates Office does not take a position on the prudency or reasonableness of projects scheduled for completion in 2023 (after 2022) in this rate case.

CONFIDENTIAL>>.[139] Because the proposed project candidates are planned for the 2021-2026 period, the total 2021-2026 project cost was divided by six years, or approximately $414,669 per year. Therefore, the Commission should only allow $829,337 for the 2021-2022 period for I15-400128.

(d) Standby Generator Improvement Program (I15-400140)

The Commission should reduce the proposed 2021-2022 budget from $716,100 to $280,000 for standby generators to allow funding for only **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** at this time. According to the 2019 Comprehensive Planning Study, **<<BEGIN CONFIDIENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** have insufficient standby power.[140] The 2019 Monterey Comprehensive Planning Study defines the power outage analysis based on **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>.**[141] According to the 2019 Monterey Comprehensive Planning Study, only **<<BEGIN CONFIDENTIAL>>** [redacted]

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[139] 2018 Sacramento Comprehensive Planning Study, Appendix II—Cost Estimates for Capital Improvement Plan, p. II-3. **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**. The percentage used in Appendix II for multiple projects among all of Cal Am's districts.

[140] 2019 Monterey Comprehensive Planning Study, pp. 5-36 to 5-38.

[141] 2019 Monterey Comprehensive Planning Study, p. 5-35.

[142] 2019 Monterey Comprehensive Planning Study, pp. 5-36 to 5-38.

[redacted] **<<END CONFIDENTIAL>>**.[144] Therefore, only one generator is needed for the **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**. The Commission should direct Cal Am to conduct a portable generator and power shutoff study as described in the testimony of the Public Advocates Office witness Cameron Reed.

One of the project candidates for the Standby Generator Improvement Program (I15-400140) is for **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[145] While Cal Am completes the aforementioned portable generator and power shutoff study, the Commission should only allow funding for **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** at this time, in the amount of $280,000 for the 2021-2022 period.

(e) Tank Rehabilitation Program (I15-400129)

The Commission should reduce Cal Am's proposed 2021-2022 budget from $2,046,000 to $552,823 to rehabilitate existing tanks in the Monterey district. The Commission should reduce Cal Am's proposed budget due to 1) total direct project cost of all the proposed project candidates being less than Cal Am's total

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143 2019 Monterey Comprehensive Planning Study, p. 5-6.

144 2019 Monterey Comprehensive Planning Study, p. 5-36.

145 Workpapers- Engineering Projects, Tab 69 (I15-400140).

proposed 2021-2026 budget; 2) removing miscategorized tank inspection costs; and 3) removing the duplicate tank painting costs.

Table 4-E below shows a list of the proposed project candidates for the Tank Rehabilitation Program for the 2021-2026 period.

Table 4-E. 2021-2026 Tank Rehabilitation Program (I15-400129) Project Candidates[146]

<<BEGIN CONFIDENTIAL>>

[redacted]

<<END CONFIDENTIAL>>

As shown in Table 4-E, the total direct project cost for all project candidates in the Tank Rehabilitation Program is **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**. Even if the Commission were to accept the total direct project cost of the project candidates as proposed by Cal Am, the annual budget would only be approximately **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.

146 Workpapers- Engineering Projects, Tab 60 (I15-400129).

As shown in Table 4-E above, Cal Am is proposing **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENIAL>>** for tank inspections. According to Cal Am, these tank inspections **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[147] These tank inspection reports are deferred tank improvements and should not be treated as capital project costs. In proposed Tank Rehabilitation Program projects in other districts, Cal Am also requests funding for tank inspection reports. For example, Cal Am requests **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** for tank inspections for the proposed Tank Rehabilitation Program in Larkfield district (I15-610018).[148] For these tank inspections, Cal Am acknowledges that these tank inspections are deferred tank improvements and should not be considered as capital costs.[149] Therefore, the Commission should not include the cost of the tank inspections in I15-400129.

Cal Am's proposed improvements for the tanks listed in Table 4-E above are based on the recommendations from the TIC tank inspection reports.[150] The recommended improvements from the tank inspection reports also include tank painting. According to Cal Am, tank painting is part of the deferred tank improvements[151] and therefore should not be included as capital improvements for I15-400129. In addition, for the **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**, Cal Am is

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[147] 2019 Monterey Comprehensive Planning Study, Appendix B, p. B-423.

[148] Workpapers- Engineering Projects, Tab 7 (I15-610018).

[149] Cal Am Response to Data Request A.19-07-004 JMI-007, Q. 2.

[150] Direct Testimony of Ian Crooks, p. 200.

[151] Direct Testimony of Ian Crooks, p. 258.

already proposing the cost to repaint these tanks as deferred tank improvements in 2021.[152] Therefore, the Commission should not allow the cost for tank painting in I15-400129.

Table 4-F below shows the recommended direct project costs for all of the project candidates. The construction cost was calculated by subtracting the total tank painting construction costs (recommended in the TIC inspection reports) from the total construction costs (for the improvements recommended in the TIC inspection reports) as shown in Table 4-F. Cal Am calculates the direct project cost for each candidate by adding the **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[153] Table 4-F summarizes the calculation of the revised direct project cost for each project candidate.

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[152] Direct Testimony of Ian Crooks, p. 259.

[153] 2019 Monterey Comprehensive Planning Study, Appendix B. **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.

Table 4-F. Tank Rehabilitation Program (I15-400129) Recommended Project Candidate Direct Project Costs[154]

<<BEGIN CONFIDENTIAL>>

[redacted]

<<END CONFIDENTIAL>>

After making the adjustments stated above, the revised total direct project cost for the project candidates should be $1,658,468.[155] Because the proposed project candidates are for the 2021-2026 period, the revised annual budget was calculated by dividing the revised total direct project cost for the project candidates by six, or approximately $276,411 per year. Therefore, the

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[154] TIC Tank Inspection Reports were provided in response to Cal Am data requests A1907004 JMI-001 and JMI-004. In Cal Am's 2019 Monterey Comprehensive Planning Study, the **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.

[155] The revised project cost for the projects planned is calculated as part of determining the annual recommended budget for 2021-2022 period. As stated earlier in this report, the Public Advocates Office does not take a position on the prudency or reasonableness of projects scheduled for completion in 2023 (after 2022) in this rate case.

Commission should only allow $552,823 for the 2021-2022 period for I15-400129.

2) Performed or Planned but not Previously Approved Projects

(a) Huckleberry Hydropneumatic Tank Replacement (I15-400124)

The Commission should reduce the proposed direct project cost to replace a hydropneumatic tank for the Huckleberry Pneumatic pressure zone from $1,200,000 to $399,000 in 2020 due to an incorrect cost estimate. Cal Am originally based the proposed project cost on the construction of a storage tank rather than an installation of a hydropneumatic tank.[156] Cal Am acknowledges this error and provided an updated cost estimate for I15-400124 of $399,000.[157] Therefore, the revised project cost should be used, and the Commission should only allow a direct project cost of $399,000 for I15-400124.

D. CONCLUSION

The Commission should make the following adjustments on Cal Am's requests for the Monterey district:

1. Allow $1,128,733 for the 2021-2022 period for the Well Rehabilitation Program (I15-400131).
2. Not allow the Carmel Woods Tanks 1 and 2 Replacement project (I15-400130) since there is sufficient storage in the **<<BEGIN**

[156] Cal Am Response to Data Request A.19-07-004 JMI-003, Q. 1.a.

[157] Cal Am Response to Data Request A.19-07-004 JMI-003, Q. 1.a.

CONFIDENTIAL>> [redacted] **<<END CONFIDENTIAL>>** pressure zone.

3. Allow $829,337 for the 2021-2022 period for the SCADA Maintenance and Improvements Program (I15-400128).

4. Allow $280,000 for the 2021-2022 period for the Standby Generator Improvement Program (I15-400140).

5. Allow $552,823 for the 2021-2022 period for the Tank Rehabilitation Program (I15-400129).

6. Allow $399,000 in 2020 for the Huckleberry Hydropneumatic Tank Replacement project (I15-400124).

CHAPTER 5: MONTEREY WASTEWATER, TORO, AND GARRAPATA

A. INTRODUCTION

The Monterey Wastewater district is comprised of the following wastewater systems: Las Palmas, Indian Springs, Pasadera, Carmel Valley Ranch, Oak Hills, Spreckels, White Oaks, and Village Greens.[158] The Public Advocates Office conducted a field visit on November 5, 2019. This chapter presents the Public Advocates Office's analyses and recommendations for Plant in Service for Cal Am's Monterey Wastewater district. In the 2021-2022 period, Cal Am is only requesting funding for the recurring project budget in the Toro and Garrapata systems.

B. SUMMARY OF RECOMMENDATIONS

Table 5-A through Table 5-F compares Cal Am's proposed capital investment project budget with the adjustments that the Commission should adopt as a result of the analysis and recommendations discussed in this report. The project costs shown in Table 5-A through Table 5-F are direct project costs (without add-on costs such as contingency and overhead).

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[158] Direct Testimony of Chris Cooks, p. 4.

Table 5-A. Monterey Wastewater Plant Additions, Including Carryovers, and Recurring Project

Monterey WW ($000)	2021	2022	Annual Average
Public Advocates Office Recommendation	$ 425.50	$ 678.51	$ 552.00
Cal Am's Proposed	$ 425.50	$ 728.80	$ 577.15
Cal Am> Public Advocates Office	$ -	$ 50.29	$ 25.15
Public Advocates Office as % of Cal Am	100%	93%	96%

Table 5-B. Monterey Wastewater Plant Comparison

2021	Project #	Project Description	Public Advocates Office Recommendation	Cal Am Proposed	Cal Am > Public Advocates Office	Public Advocates Office/ Cal Am
1	I15-420004	Spreckels Boulevard Main Replacement	$ 112,530	$ 112,530	$ -	100%
Proposed Total			**$ 112,530**	**$ 112,530**	**$ -**	**100%**
Recurring Project Total			**$ 312,967**	**$ 312,967**	**$ -**	**100%**
Carry-Overs			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2021			**$ 425,497**	**$ 425,497**	**$ -**	**100%**

2022	Project #	Project Description	Public Advocates Office Recommendation	Cal Am Proposed	Cal Am > Public Advocates Office	Public Advocates Office/ Cal Am
1	I15-420004	Spreckels Boulevard Main Replacement	$ 204,600	$ 204,600	$ -	100%
2	I15-420003	Las Palmas MBBR Installation	$ 154,308	$ 204,600	$ 50,292	75%
Proposed Total			**$ 358,908**	**$ 409,200**	**$ 50,292**	**88%**
Recurring Project Total			**$ 319,599**	**$ 319,599**	**$ -**	**100%**
Carry-Overs			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2022			**$ 678,507**	**$ 728,799**	**$ 50,292**	**93%**

Table 5-C. Toro Plant Additions, Including Carryovers, and Recurring Project

Toro ($000)	2021	2022	Annual Average
Public Advocates Office Recommendation	$ 116.72	$ 120.22	$ 118.47
Cal Am's Proposed	$ 116.72	$ 120.22	$ 118.47
Cal Am> Public Advocates Office	$ -	$ -	$ -
Public Advocates Office as % of Cal Am	100%	100%	100%

Table 5-D. Toro Plant Comparison

2021	Project #	Project Description	Public Advocates Office Recommendation	Cal Am Proposed	Cal Am > Public Advocates Office	Public Advocates Office/ Cal Am
1	--	--	$ -	$ -	$ -	n/a
Proposed Total			**$ -**	**$ -**	**$ -**	**n/a**
Recurring Project Total			**$ 116,720**	**$ 116,720**	**$ -**	**100%**
Carry-Overs			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2021			**$ 116,720**	**$ 116,720**	**$ -**	**100%**

2022	Project #	Project Description	Public Advocates Office Recommendation	Cal Am Proposed	Cal Am > Public Advocates Office	Public Advocates Office/ Cal Am
1	--	--	$ -	$ -	$ -	n/a
Proposed Total			**$ -**	**$ -**	**$ -**	**n/a**
Recurring Project Total			**$ 120,222**	**$ 120,222**	**$ -**	**100%**
Carry-Overs			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2022			**$ 120,222**	**$ 120,222**	**$ -**	**100%**

Table 5-E. Garrapata Plant Additions, Including Carryovers, and Recurring Projects

Garrapata ($000)	2021	2022	Annual Average
Public Advocates Office Recommendation	$ 44.30	$ 45.63	$ 44.96
Cal Am's Proposed	$ 44.30	$ 45.63	$ 44.96
Cal Am> Public Advocates Office	$ -	$ -	$ -
Public Advocates Office as % of Cal Am	100%	100%	100%

Table 5-F. Garrapata Plant Comparison

2021	Project #	Project Description	Public Advocates Office Recommendation	Cal Am Proposed	Cal Am > Public Advocates Office	Public Advocates Office/ Cal Am
1	--	--	$ -	$ -	$ -	n/a
Proposed Total			**$ -**	**$ -**	**$ -**	**n/a**
Recurring Project Total			**$ 44,299**	**$ 44,299**	**$ -**	**100%**
Carry-Overs			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2021			**$ 44,299**	**$ 44,299**	**$ -**	**100%**

2022	Project #	Project Description	Public Advocates Office Recommendation	Cal Am Proposed	Cal Am > Public Advocates Office	Public Advocates Office/ Cal Am
1	--	--	$ -	$ -	$ -	n/a
Proposed Total			**$ -**	**$ -**	**$ -**	**n/a**
Recurring Project Total			**$ 45,628**	**$ 45,628**	**$ -**	**100%**
Carry-Overs			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2022			**$ 45,628**	**$ 45,628**	**$ -**	**100%**

C. DISCUSSION

Cal Am’s requested capital budget consists of proposed projects. Unless otherwise stated, the project costs listed below are direct project costs.[159]

[159] The direct project costs are the cost of the project without add-on costs (e.g. overhead).

1) **Proposed Projects**

(a) Las Palmas Moving Bed Bioreactor (MBBR) Installation (I15-420003)

The Commission should reduce the proposed direct project cost in the Las Palmas Ranch Wastewater Treatment Plant from $204,600 to $154,308 in 2022 to remove redundant contingency project costs. Cal Am accounts for project contingency costs as both a direct project cost and as a separate project cost line item that is proportional to the direct project cost. Table 5-G below shows the cost estimate for the direct project costs for I15-420003 prepared by Valentine Environmental Engineers. Because Cal Am already estimates the funding for project contingency costs separately in their workpapers based on 15% of the direct project cost, the project contingency cost of **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** in the direct project cost should be removed.[160] The Engineering Project Workpaper for I15-420003 recommends a project contingency cost of **<<BEGIN CONFIDENTIAL>>**[redacted] **<<END CONFIDENTIAL>>**.[161] Table 5-G below shows the revised direct project cost for I15-420003.

[160] ALL-CH07_PLT_RO_Forecast, Tab Contingency By Project WS-6, cell J791.

[161] Workpapers- Engineering Projects, Tab 72 (I15-420003).

Table 5-G. Las Palmas MBBR Installation (I15-420003) Project Direct Cost Comparison[162]

<<BEGIN CONFIDENTIAL>>

[redacted]

[162] Workpapers- Engineering Projects, Tab 72 (I15-420003). **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.

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After removing the redundant contingency, the Commission should allow $154,308 in 2022 for I15-420003.[163]

D. CONCLUSION

The Commission should make the following adjustments to Cal Am's requests for the Monterey Wastewater district:

1. Approve $154,308 in 2022 for the Las Palmas MBBR project (I15-420003).

[163] Cal Am plans on spending approximately $200,000 in 2022 and $412,918 in 2023 for I15-420003. Cal Am intends on spending approximately 32.63% of the total $612,918 in 2022 and 67.37% of the total $612,918 in 2023. With a revised total direct cost of $472,890, 32.63% of the total $472,890 was allocated to 2022.

CHAPTER 6: VENTURA

A. INTRODUCTION

Cal Am's Ventura district is comprised of the Thousand Oaks and Las Posas systems.[164] The Commission approved Cal Am's acquisition of the Rio Plaza Water Company (D.19-04-014).[165] The Ventura district is supplied through purchased water from the Calleguas Municipal Water District. The Public Advocates Office reviewed Cal Am's testimony, application, work-papers, minimum data requirements, capital project justifications, Comprehensive Planning Study, Condition Based Assessment of Buried Infrastructure, cost estimates, and responses to the Public Advocates Office's data requests. The Public Advocates Office conducted a field investigation of the Ventura district's water system on October 17, 2019 before making its recommendations. This chapter presents the recommendations the Commission should adopt for the proposed Plant in Service for Cal Am's Ventura district.

B. SUMMARY OF RECOMMENDATIONS

Table 6-A and Table 6-B compares Cal Am's proposed capital investment project budget with the adjustments that the Commission should adopt as a result of the analysis and recommendations discussed in this report. The project costs shown in Table 6-A and Table 6-B are direct project costs (without add-on costs such as contingency and overhead).

[164] Direct Testimony of Gary Hofer, p. 6.

[165] Direct Testimony of Gary Hofer, pp. 68-69.

Table 6-A. Ventura Plant Additions, Including Carryovers, and Recurring Project

Ventura ($000)	2021	2022	Annual Average
Public Advocates Office Recommendation	$ 4,456.08	$ 7,662.09	$ 6,059.09
Cal Am's Proposed	$ 5,235.24	$ 10,052.69	$ 7,643.96
Cal Am> Public Advocates Office	$ 779.16	$ 2,390.59	$ 1,584.87
Public Advocates Office as % of Cal Am	85%	76%	79%

Table 6-B. Ventura Plant Comparison

2021	Project #	Project Description	Public Advocates Office Recommendation	Cal Am Proposed	Cal Am > Public Advocates Office	Public Advocates Office/ Cal Am
1	I15-510041	Pump Station Replacement and Rehabilitation	$ 941,171	$ 1,329,900	$ 388,729	71%
2	I15-510042	SCADA Maintenance and Improvements Program	$ 276,210	$ 276,210	$ -	100%
3	I15-510038	VEN-Metering Infrastructure	$ 40,953	$ 40,953	$ -	100%
Proposed Total			**$ 1,258,334**	**$ 1,647,063**	**$ 388,729**	**76%**
Recurring Project Total			**$ 3,197,748**	**$ 3,588,174**	**$ 390,426**	**89%**
Carry-Overs			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2021			**$ 4,456,081**	**$ 5,235,237**	**$ 779,155**	**85%**

2022	Project #	Project Description	Public Advocates Office Recommendation	Cal Am Proposed	Cal Am > Public Advocates Office	Public Advocates Office/ Cal Am
1	I15-510041	Pump Station Replacement and Rehabilitation	$ 941,171	$ 1,329,900	$ 388,729	71%
2	I15-510042	SCADA Maintenance and Improvements Program	$ 276,210	$ 276,210	$ -	100%
3	I15-510054	Tank Rehabilitation and Seismic Upgrades Program	$ 231,000	$ 1,227,600	$ 996,600	19%
4	I15-510055	Standby Generator Improvements	$ -	$ 511,500	$ 511,500	0%
5	I15-510043	Springwood Gradient Main Replacement	$ 511,500	$ 511,500	$ -	100%
6	I15-510049	Academy Turnout Rehabilitation	$ -	$ 92,070	$ 92,070	0%
7	I15-510044	Los Robles Zone PRVs	$ 235,290	$ 235,290	$ -	100%
8	I15-510045	Charles Oaks Apartment Main Replacement	$ 409,200	$ 409,200	$ -	100%
9	I15-510038	VEN-Metering Infrastructure	$ 1,709,165	$ 1,709,165	$ -	100%
Proposed Total			**$ 4,313,536**	**$ 6,302,435**	**$ 1,988,899**	**68%**
Recurring Project Total			**$ 3,348,556**	**$ 3,750,250**	**$ 401,694**	**89%**
Carry-Overs			**$ -**	**$ -**	**$ -**	**n/a**
TOTAL 2022			**$ 7,662,092**	**$ 10,052,685**	**$ 2,390,593**	**76%**

C. DISCUSSION

As discussed below, Cal Am's requested capital budget consists of proposed projects (Section 1) and recurring project budget (Section 2). Unless stated otherwise, the project costs listed below are direct project costs.[166]

1) Proposed Projects

(a) Tank Rehabilitation and Seismic Upgrades Program (I15-510054)

The Commission should reduce the proposed 2022 budget from $1,227,600 to $231,000 for tank rehabilitation and seismic upgrades because funding for seismic improvements should not be allowed until Cal Am completes the tank seismic study for the Ventura district and has a better understanding of the scope of the seismic upgrades needed and the associated cost.

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[166] The direct project costs are the cost of the project without add-on costs (e.g. overhead).

Table 6-C below shows the proposed tank rehabilitation project candidates Cal Am plans to replace over the 2021-2026 period.

Table 6-C. Tank Rehabilitation and Seismic Upgrades Program (I15-510054) Project Candidates[167]

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[redacted]

<<END CONFIDENTIAL>>

As shown in Table 6-C above, Cal Am assumes a seismic upgrade cost of **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**, regardless of the size of the tank. Cal Am states that the cost estimate for the seismic upgrades is based on an estimate from **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**, the consultant who prepared 2018 Ventura Comprehensive Planning Study report. Cal Am states that **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** did not thoroughly evaluate each tank and could not provide a detailed cost estimate to seismically upgrade each tank.[168] The estimated unit cost was not based on any previous seismic tank upgrades Cal Am

167 Workpapers- Engineering Projects, Tab 126 (I15-510054).

168 Cal Am Response to Data Request A.19-07-004 JMI-004, Q. 3.b.

has conducted, but on two seismic upgrade projects in Oak Lodge Water District constructed in 2013.[169]

Because the cost estimate did not evaluate any specific tank and lacks necessary details, the unit cost estimate does not reflect the appropriate seismic upgrades for the specific tank. Therefore, funding for seismic upgrades should not be allowed until Cal Am completes the tank seismic study and Cal Am has a better understanding of the appropriate seismic upgrades at each tank. In 2021, Cal Am plans to conduct a seismic study for the existing storage tanks in the Ventura district. When the tank seismic study is completed, Cal Am would be able to present these costs in a future rate case where the costs can be reviewed for prudency.

Cal Am estimates that the total rehabilitation costs for each of the tank project candidates for the 2022-2026 period is approximately **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[170] Because the proposed project candidates are planned for the 2022-2026 period, the total 2022-2026 project candidate cost was divided by five years, or approximately $231,000 per year. Therefore, the Commission should only allow $231,000 in 2022 for I15-510054.

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[169] Cal Am Response to Data Request A.19-07-004 JMI-004, Q. 3.c.

[170] The revised project cost for the projects planned is calculated as part of determining the annual recommended budget for 2021-2022 period. As stated earlier in this report, the Public Advocates Office does not take a position on the prudency or reasonableness of projects scheduled for completion in 2023 (after 2022) in this rate case.

(b) Pump Station Replacement and Rehabilitation Program (I15-510041)

The Commission should reduce the proposed 2021-2022 budget from $2,659,800 to $1,882,342 to make improvements to existing booster pump stations because the permanent generators should not be installed as part of the scope of the project candidates. Table 6-D shows a list of the project candidates Cal Am plans for the 2021-2026 period.

Table 6-D. 2021-2026 Pump Station Replacement and Rehabilitation Program (I15-510041) Project Candidates[171]

<<BEGIN CONFDIENTIAL>>

[redacted]

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The Commission should direct Cal Am to conduct a portable generator and power shutoff as described in the testimony of the Public Advocates Office witness Cameron Reed.

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[171] Workpapers- Engineering Projects, Tab 120 (I15-510041).

The cost of the generators should be removed from the cost of the proposed project candidates. Table 6-E below shows the costs of the generators for each of the proposed project candidates. For the booster pump station (BPS) project candidates (**<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**), the generator costs shown in Table 6-E are construction costs. Cal Am calculates the direct project costs of the aforementioned booster pump station project candidates by including the design and project implementation phase costs to the generator construction costs.[172] In the proposed direct project cost estimates of the proposed project candidates, Cal Am shows that the individual components of the design ("project need phase") and the project implementation phase as a percentage of the construction costs. Table 6-E shows the design and project implementation phase projects as a total percentage of the construction cost. The design and project implementation phase cost for the generators was calculated by multiplying the generator construction cost by the total percentage cost (of the construction costs) used for the design and project implementation phase costs. After removing the cost of the generators, the revised total direct project costs for all of the project candidates planned for the 2021-2026 period is **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** $5,647,025.[173] Because the revised total direct project

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[172] The design costs include the cost for **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDETNIAL>>**. The project implementation phase costs include the cost for **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.

[173] The revised project cost for the projects planned is calculated as part of determining the annual recommended budget for 2021-2022 period. As stated earlier in this report, the Public Advocates Office does not take a position on the prudency or reasonableness of projects

(continued on next page)

costs for all of the project candidates planned for the 2021-2026 period, the revised direct project cost was divided by six to calculate the revised annual direct project budget or approximately $941,171 per year. After removing the costs of the generators, the Commission should only allow $1,882,342 for the 2021-2022 period for I15-510041.

Table 6-E. 2021-2026 I15-510041 Generator Direct Costs[174]

<<BEGIN CONFIDENTIAL>>

[redacted]

<<END CONFIDENTIAL>>

(c) Academy Turnout Rehabilitation (I15-510049)

The Commission should not allow $92,070 in 2022 to bring the Academy Turnout back into service because the current system capacity is able to meet the system demand adequately. The Ventura district has **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** interconnections in the

(continued from previous page)
scheduled for completion in 2023 (after 2022) in this rate case.

174 2018 Ventura Comprehensive Planning Study, Appendix B.

Thousand Oaks Main gradient with a combined capacity of **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** gpm.[175] According to the 2018 Ventura Comprehensive Planning Study, the current total interconnection capacity for the Thousand Oaks Main gradient could **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[176] The Las Posas gradient has **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** interconnection with a capacity of **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[177] The 2018 Ventura Comprehensive Planning Study also states that the current capacity for the Las Posas gradient **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[178] Because the current Ventura district has sufficient capacity, the proposed I15-510049 is not needed at this time.

(d) Standby Generator Improvement (I15-510055)

The Commission should not allow Cal Am's proposed 2022 budget of $511,500 for **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END**

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[175] 2018 Ventura Comprehensive Planning Study, p. 4-6.

[176] 2018 Ventura Comprehensive Planning Study, p. 4-6. The Academy Turnout has a capacity of **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** gpm. Excluding the capacity of the Academy Turnout, the Thousand Oaks Main Gradient has a combined capacity of **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** gpm.

[177] 2018 Ventura Comprehensive Planning Study, p. 4-6.

[178] 2018 Ventura Comprehensive Planning Study, p. 4-6.

CONFIDENTIAL>>[179] generators because the generators should not be installed at this time. Cal Am proposes funding to install permanent generators at the following booster pump stations: **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[180] The Commission should direct Cal Am to conduct a portable generator and power shutoff study as described in the testimony of the Public Advocates Office witness Cameron Reed.

2) Recurring Project Budget

The Commission should reduce the total proposed 2021-2022 recurring project budget from $7,338,424 to $6,546,304 due to a reduction in the Process Plant recurring project category for the main Ventura district (Thousand Oaks and Las Posas) and the Rio Plaza system. Refer to Chapter 1 of this report regarding the recurring project budget.

D. CONCLUSION

The Commission should make the following adjustments on Cal Am's requests for the Ventura district:

1. Allow $231,000 in 2022 for the Tank Rehabilitation and Seismic Upgrades project (I15-510054). Funding for the seismic upgrades should not be allowed until Cal Am completes the seismic study for its existing tanks to get a better understanding of the necessary upgrades for the tanks.
2. Allow $1,882,342 for 2021-2022 for the Pump Station Replacement and Rehabilitation Program (I15-510041).

[179] Workpapers- Engineering Projects, Tab 128 (I15-510055).

[180] Workpapers- Engineering Projects, Tab 128 (I15-510055).

3. Not allow $92,070 in 2022 for Academy Turnout Rehabilitation (I15-510049) since the current Ventura district has sufficient interconnection capacity.
4. Not allow $511,500 in 2022 for the Standby Generator Improvements Program (I15-510055) since the proposed generators should not be installed at this time.
5. Approve $6,546,304 for the 2021-2022 period for the recurring project budget.

CHAPTER 7: LOS ANGELES

A. INTRODUCTION

Cal Am's Los Angeles district is comprised of the following systems: Baldwin Hills, Duarte, and San Marino.[181] Cal Am has also filed an application (A.18-09-013) to acquire the Bellflower system from the Bellflower Municipal Water System.[182] The Los Angeles district is supplied through a combination of treated water, imported, and groundwater.[183] The Public Advocates Office reviewed Cal Am's testimony, application, work-papers, minimum data requirements, capital project justifications, Comprehensive Planning Study, Condition Based Assessment of Buried Infrastructure, cost estimates, and responses to the Public Advocates Office's data requests. The Public Advocates Office conducted a field investigation of the Los Angeles district's water system on October 16, 2019 before making its recommendations. This chapter presents the recommendations the Commission should adopt for the proposed Plant in Service for Cal Am's Los Angeles district.

B. SUMMARY OF RECOMMENDATIONS

Table 7-A and Table 7-B compares Cal Am's proposed capital investment project budget with the adjustments that the Commission should adopt as a result of the analysis and recommendations discussed in this report. The project costs shown in Table 7-A and Table 7-B are direct project costs (without add-on costs such as contingency and overhead).

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[181] Direct Testimony of Gary Hofer, p. 6.

[182] Direct Testimony of Gary Hofer, pp. 68-69.

[183] Direct Testimony of Gary Hofer, p. 7.

Table 7-A. Los Angeles Plant Additions, Including Carryovers, and Recurring Project

Los Angeles ($000)	2021	2022	Annual Average
Public Advocates Office Recommendation	$ 9,730.86	$ 10,951.90	$ 10,341.38
Cal Am's Proposed	$ 14,604.44	$ 16,211.84	$ 15,408.14
Cal Am> Public Advocates Office	$ 4,873.57	$ 5,259.94	$ 5,066.76
Public Advocates Office as % of Cal Am	67%	68%	67%

Table 7-B. Los Angeles Plant Comparison

2021	Project #	Project Description	Public Advocates Office Recommendation	Cal Am Proposed	Cal Am > Public Advocates Office	Public Advocates Office/ Cal Am
1	I15-500066	Main Replacement Program	$ 3,682,800	$ 3,682,800	$ -	100%
2	I15-500069	Pump Station Replacement and Rehabilitation	$ 1,023,000	$ 1,023,000	$ -	100%
3	I15-500068	SCADA Maintenance and Improvements Program	$ 383,625	$ 383,625	$ -	100%
4	I15-500070	Well Rehabilitation Program	$ 429,660	$ 429,660	$ -	100%
5	I15-500065	Standby Generator Improvement Program	$ -	$ 818,400	$ 818,400	0%
Proposed Total			**$ 5,519,085**	**$ 6,337,485**	**$ 818,400**	**87%**
Recurring Project Total			**$ 4,211,780**	**$ 4,329,669**	**$ 117,889**	**97%**
Carry-Overs			**$ -**	**$ 3,937,285**	**$ 3,937,285**	**0%**
TOTAL 2021			**$ 9,730,865**	**$ 14,604,439**	**$ 4,873,574**	**67%**

2022	Project #	Project Description	Public Advocates Office Recommendation	Cal Am Proposed	Cal Am > Public Advocates Office	Public Advocates Office/ Cal Am
1	I15-500066	Main Replacement Program	$ 3,682,800	$ 3,682,800	$ -	100%
2	I15-500069	Pump Station Replacement and Rehabilitation	$ 1,023,000	$ 1,023,000	$ -	100%
3	I15-500068	SCADA Maintenance and Improvements Program	$ 383,625	$ 383,625	$ -	100%
4	I15-500071	Tank Rehabilitation and Seismic Upgrades Program	$ -	$ 409,200	$ 409,200	0%
5	I15-500067	Well Installation and Replacement Program	$ -	$ 1,023,000	$ 1,023,000	0%
6	I15-500070	Well Rehabilitation Program	$ 429,660	$ 429,660	$ -	100%
7	I15-500073	Tank Replacement Program	$ 1,023,000	$ 1,023,000	$ -	100%
8	I15-500065	Standby Generator Improvement Program	$ -	$ 818,400	$ 818,400	0%
Proposed Total			**$ 6,542,085**	**$ 8,792,685**	**$ 2,250,600**	**74%**
Recurring Project Total			**$ 4,409,815**	**$ 4,530,622**	**$ 120,807**	**97%**
Carry-Overs			**$ -**	**$ 2,888,538**	**$ 2,888,538**	**0%**
TOTAL 2022			**$ 10,951,900**	**$ 16,211,844**	**$ 5,259,944**	**68%**

C. DISCUSSION

As discussed below, Cal Am's requested capital budget consists of proposed projects (Section 1), projects previously approved and funded in multiple rate cases but not providing a benefit to the ratepayers (Section 2), and recurring project budget (Section 3). Unless otherwise stated, the project costs listed below are direct project costs.[184]

1) Proposed Projects

(a) Well Installation and Replacement Program (I15-500067)

The Commission should not allow the proposed budget of $1,023,000 in 2022 because the project candidates being proposed are already being handled through previously approved carryover projects. Cal Am states that it intends to use the funding under this proposed project (I15-500067) to fund the drilling of

[184] The direct project costs are the cost of the project without add-on costs (e.g. overhead).

the Lamanda Well once a new site is secured.[185] However, Cal Am already has a project (I15-500006) to drill the Lamanda Well.

The Lamanda Well was originally approved in the 2010 rate case (A.10-07-007) for development costs[186] and the construction costs were approved in the 2013 rate case (A.13-07-002) to be completed in 2016.[187] Since the 2013 rate case, the ratepayers have financed the total cost of the Lamanda Well without receiving any benefit. The Public Advocates Office does not dispute the need of the Lamanda Well, however, ratepayers should only bear the cost of the Lamanda Well once it is in service and providing a benefit to the ratepayers. In the event Cal Am constructs the Lamanda Well, it may request to recover the cost of the project in a subsequent general rate case where the actual cost can be reviewed for prudency. Because Cal Am already has a project allocated for the Lamanda Well (I15-500006), the funding for I15-500067 in 2022 is not necessary.

(b) Tank Rehabilitation and Seismic Upgrades Program (I15-500071)

The Commission should not allow the proposed 2022 budget of $409,200 for seismic upgrades to the existing tanks. Funding for the seismic upgrades should not be allowed until Cal Am completes the seismic study for its existing tanks to get a better understanding of the necessary upgrades for the tanks. In

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[185] Direct Testimony of Ian Crooks, p. 44.

[186] A.10-07-007 Partial Settlement Agreement between the [Public Advocates Office], The Utility Reform Network, and California American Water Company on Revenue Requirement Issues, p. 140.

[187] A.13-07-002 Partial Settlement between California American Water, City of Pacific Grove, Las Palmas Wastewater Committee, Monterey Peninsula Water Management District and the [Public Advocates Office] in the General Rate Case, p. 184.

addition, the costs for the five-year anniversary tank maintenance should be handled as a deferred tank improvement cost rather than a capital cost.

Cal Am relied on the consultant firm **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** which prepared the 2019 Los Angeles Comprehensive Planning Study to estimate the seismic upgrades depending on the size of the tank (whether the storage volume of the tank is more or less than 1 million gallons).[188] Cal Am assumes the seismic upgrade cost of **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**.[189] Cal Am states that **<<BEGIN CONFDIENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** did not evaluate each tank individually and could not provide a detailed cost estimate to seismically upgrade each tank.[190] Therefore, funding for seismic upgrades should not be allowed until Cal Am completes the currently planned tank seismic study and Cal Am has a better understanding of the appropriate seismic upgrades at each tank. In 2021, Cal Am plans to conduct a seismic study for the existing storage tanks in the Los Angeles district. When the tank seismic study is completed, Cal Am will have enough information to present these costs in the next rate case in 2022, so the Commission can review them for prudency.

In addition, Cal Am requests approximately **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** for the five-year

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[188] Cal Am Response to Data Request A.19-07-004 JMI-004, Q. 4.b.

[189] Workpapers- Engineering Projects, Tab 34 (I15-500071).

[190] Cal Am Response to Data Request A.19-07-004 JMI-004, Q. 4.b.

anniversary tank maintenance in 2022.[191] Cal Am states that the five-year anniversary tank maintenance is related to routine tank inspections of existing tanks.[192] Cal Am states that the costs for the five-year anniversary tank maintenance should be included as a deferred maintenance expense, and, therefore, should not be included in the proposed capital project costs.[193] The proposed costs of the five-year anniversary tank maintenance should be removed from I15-500071. The Commission should not allow any funding in 2022 for I15-500071.

(c) Standby Generator Improvements Program (I15-500065)

The Commission should not allow Cal Am's proposed 2021-2022 budget of $1,636,800 for generators because the generators should not be installed at this time. The Commission should direct Cal Am to conduct a portable generator and power shutoff study as described in the testimony of the Public Advocates Office witness Cameron Reed.

2) Projects Previously Approved and Funded in Rates in Multiple Rate Cases but Not Yet Completed

The projects shown in Table 7-C below are projects that were approved and funded in a previous rate case. However, over the span of multiple rate cases, these projects are not yet completed. As a result, ratepayers continuously have had to bear the cost of projects for which they are not receiving any benefit.

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[191] Workpapers- Engineering Projects, Tab 34 (I15-500071). Cal Am proposes a 2022-2026 total of **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>** for five-year anniversary tank maintenance.

[192] Cal Am Response to Data Request A.19-07-004 JMI-007, Q. 2.c.1.

[193] Cal Am Response to Data Request A.19-07-004 JMI-007, Q. 2.c.2.

Table 7-C. Projects Previously Approved and Funded in Rates in Multiple Rate Cases but Not Yet Completed[194]

			A.10-07-007		A.13-07-002		A.16-07-002		A.19-07-004	
Project ID	Description	Original Rate Case Project Was Proposed	Completion Year	Estimated Completion Cost	Completion Year	Estimated Completion Cost	Completion Year	Estimated Completion Cost	Completion Year	Estimated Completion Cost
I15-500030 IP-0550-38	Oswego Well Replacement and Treatment	A.10-07-007	2013	$1,246,400	2014	$ 814,484	2018	$ 2,148,528	2021	$ 1,482,308
I15-500006 IP-0550-14	Redrill Lamanda Well	A.10-07-007 (development cost) A.13-07-002 (construction)	2014 Development phase only	$ 200,000	2016	$ 1,600,000	2017	$ 1,912,405	Cal Am wants to complete as part of proposed project I15-500067	
I15-500009 IP-0550-118	Santa Fe Well Treatment	A.10-07-007	2013	$1,164,000	2016	$ 1,777,658	2018	$ 1,889,506	2020	$ 2,080,000
I15-500036	Rehabilitate/Redrill Longden Well	A.13-07-002	--	--	2018	$ 1,964,000	2019	$ 4,737,246	2022	$ 3,565,113
I15-500032	Winston Well Redrill and Treatment	A.10-07-007	2014	$3,566,000	2014	$ 2,111,574	2019	$ 2,140,000	2022	$ 2,520,000

As shown in Table 7-C above, some of the projects previously approved and funded in rates extend back to the 2010 rate case (A.10-07-007).

The Public Advocates Office does not dispute the need for these projects. However, based upon ratepayers repeated funding of these projects that have either not started or have not been completed, the Commission should temporarily suspend funding of these projects until Cal Am can demonstrate that these projects are complete and providing service to ratepayers. The costs of the projects shown in Table 7-C should be removed for ratemaking purposes from Cal Am's proposed capital budgets for the period 2021-2022. Cal Am may request to recover the cost

[194] Project costs in the table are total project cost.

of these projects after the projects are completed and actual costs can be reviewed for reasonableness and prudency.

3) Recurring Project Budget

The Commission should reduce Cal Am's total proposed 2021-2022 recurring project budget from $8,860,291 to $8,621,595 due to a reduction in the Process Plant recurring project category for the Bellflower system. Refer to Chapter 1 of this report regarding the recurring project budget.

D. CONCLUSION

The Commission should make the following adjustments on Cal Am's requests for the Los Angeles district:

1. Not allow any funding in 2022 for the Well Installation and Replacement Program (I15-500067) because Cal Am is planning a project that was already approved and funded into rates.
2. Not allow any funding in 2022 for the Tank Rehabilitation and Seismic Upgrades Program (I15-500071). Funding for the seismic upgrades should not be allowed until Cal Am completes the seismic study for its existing tanks to get a better understanding of the necessary upgrades for the tanks.
3. Not allow $1,636,800 in the 2021-2022 period for the Standby Generator Improvements Program (I15-500065).
4. The following previously approved projects should be removed and Cal Am should not be able to recover the cost of these projects until they are completed and are providing a benefit to ratepayers: Oswego Well Replacement and Treatment (I15-500030), Redrill Lamanda Well (I15-500006), Santa Fe Well Treatment (I15-500009), Rehabilitate/Redrill Longden Well (I15-500036), and Winston Well Redrill and Treatment (I15-500032).

5. Approve $8,621,595 for the 2021-2022 period for the recurring project budget.

CHAPTER 8: SAN DIEGO

A. INTRODUCTION

Cal Am's San Diego district is supplied through purchased treated water from the City of San Diego.[195] The Public Advocates Office reviewed Cal Am's testimony, application, work-papers, minimum data requirements, capital project justifications, Comprehensive Planning Study, Condition Based Assessment of Buried Infrastructure, cost estimates, and responses to the Public Advocates Office's data requests. The Public Advocates Office conducted a field investigation of the San Diego district's water system on October 15, 2019 before making its recommendations. This chapter presents the recommendations the Commission should adopt for the proposed Plant in Service for Cal Am's San Diego district.

B. SUMMARY OF RECOMMENDATIONS

Table 8-A and Table 8-B compares Cal Am's proposed capital investment project budget with the adjustments that the Commission should adopt as a result of the analysis and recommendations discussed in this report. The project costs shown in Table 8-A and Table 8-B are direct project costs (without add-on costs such as contingency and overhead).

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[195] Direct Testimony of Gary Hofer, p. 8.

Table 8-A. San Diego Plant Additions, Including Carryovers, and Recurring Project

San Diego ($000)	2021	2022	Annual Average
Public Advocates Office Recommendation	$ 3,447.22	$ 3,574.41	$ 3,510.81
Cal Am's Proposed	$ 5,376.08	$ 7,174.41	$ 6,275.24
Cal Am> Public Advocates Office	$ 1,928.86	$ 3,600.00	$ 2,764.43
Public Advocates Office as % of Cal Am	64%	50%	56%

Table 8-B. San Diego Plant Comparison

2021	Project #	Project Description	Public Advocates Office Recommendation	Cal Am Proposed	Cal Am > Public Advocates Office	Public Advocates Office/ Cal Am
1	I15-300018	SCADA Maintenance and Improvements Program	$ 51,150	$ 51,150	$ -	100%
2	I15-300021	Strand Two-Way Pump Station	$ 51,150	$ 51,150	$ -	100%
3	I15-300024	Main Replacement Program	$ 1,023,000	$ 1,023,000	$ -	100%
Proposed Total			**$ 1,125,300**	**$ 1,125,300**	**$ -**	**100%**
Recurring Project Total			**$ 1,445,779**	**$ 1,445,779**	**$ -**	**100%**
Carry-Overs			**$ 876,140**	**$ 2,805,000**	**$ 1,928,860**	**31%**
TOTAL 2021			**$ 3,447,219**	**$ 5,376,079**	**$ 1,928,860**	**64%**

2022	Project #	Project Description	Public Advocates Office Recommendation	Cal Am Proposed	Cal Am > Public Advocates Office	Public Advocates Office/ Cal Am
1	I15-300018	SCADA Maintenance and Improvements Program	$ 296,670	$ 296,670	$ -	100%
2	I15-300021	Strand Two-Way Pump Station	$ 460,350	$ 460,350	$ -	100%
3	I15-300022	Remove NAB Abandoned PS Vault	$ 130,000	$ 130,000	$ -	100%
4	I15-300024	Main Replacement Program	$ 1,023,000	$ 1,023,000	$ -	100%
Proposed Total			**$ 1,910,020**	**$ 1,910,020**	**$ -**	**100%**
Recurring Project Total			**$ 1,524,388**	**$ 1,524,388**	**$ -**	**100%**
Carry-Overs			**$ 140,000**	**$ 3,740,000**	**$ 3,600,000**	**4%**
TOTAL 2022			**$ 3,574,408**	**$ 7,174,408**	**$ 3,600,000**	**50%**

C. DISCUSSION

As discussed below, Cal Am's requested capital budget consists of carryover projects. Unless otherwise stated, the project costs listed below are direct project costs.[196]

1) Carryover Projects

(a) Replace Transmission Main Along Silver Strand (I15-300010)

The Commission should reduce Cal Am's proposed 2021-2022 budget from $6,545,000 to $1,016,140 to replace a portion of the existing transmission main along the Silver Stand. When originally proposed in its 2013 rate case, Cal Am forecasted replacing approximately ten miles of transmission main over a ten year period (the equivalent of one mile per year).[197] In its 2016 rate case, Cal Am nearly doubled its forecasted replacement rate to approximately 5.7 miles in three years (the equivalent of 1.9 miles per year).[198] During the 2016 rate case, the Public Advocates Office demonstrated that Cal Am's updated replacement rate was not realistic due to the uncertainty in the project schedule and the location of the existing main.[199] Nevertheless, the Commission approved ratepayer funding

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[196] The direct project costs are the cost of the project without add-on costs (e.g. overhead).

[197] Capital Investment Project Workpapers, I15-300010 (from A.13-07-002), p. 3.

[198] Direct Testimony of Mark Schubert (from A.16-07-002), p. 110.

[199] Public Advocates Office Report on Proposed Utility Plant in Service (from A.16-07-002), pp. 44-46.

of Cal Am's revised replacement rates[200] allowing rate base to increase approximately $2,400,000 in 2018 and $5,500,000 in 2019.[201]

In its current rate case, Cal Am states that it forecasts spending only $2,371,140 during 2018 and 2019, or approximately 30% of the amount ratepayers will have actually funded during this same period.[202] With nearly a quarter of this anticipated spending for design and permitting, Cal Am now anticipates actually replacing just 5,950 feet of transmission main in 2019.[203] This represents just 19.77% of the total amount of main Cal Am had planned to replace during the 2018-2020 period. This means in order to maintain its initially forecasted schedule, Cal Am would have to replace 24,146 feet of main in 2020 (more than 4.5 times its initially anticipated replacement rate) for a capital project that Cal Am now admits will "present significant challenges during construction."[204] Cal Am acknowledges that the overall project schedule will not be completed by the end of this rate case cycle as previously planned.[205]

During the 2021-2022 period forecasted in the current rate case, Cal Am requests approximately $6,545,000 of ratepayer funding to start the second phase of the overall replacement project along the Silver Strand. While Cal Am acknowledges that it will likely spend just $2,371,140 in the 2018-2020 period, previous rate case authorizations have committed ratepayers to fund non-existent

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200 Decision (D).18-12-021, pp. 188-190.

201 Direct Testimony of Mark Schubert (from A.16-07-002), p. 107.

202 Direct Testimony of Ian Crooks, p. 111.

203 Direct Testimony of Ian Crooks, p. 112.

204 Direct Testimony of Ian Crooks, p. 114.

205 Direct Testimony of Ian Crooks, p. 114.

project costs totaling $7,900,000 during this same period. Given the recent history of this project, there is a credible possibility that the remaining 24,146 feet of main that Cal Am anticipates replacing at accelerated rates after 2019 is overly optimistic. Nevertheless, at a minimum, the Commission should reduce Cal Am's proposed funding by the difference between the 2018-2019 funding previously approved in rates and the amount Cal Am currently plans on spending in 2018-2019 or $5,528,860 ($7,900,000 - $2,371,140). The Commission should only allow $1,016,140 for the 2021-2022 period for I15-300010. All reasonable and prudently incurred costs in excess of those amounts the Commission approves for ratemaking purposes in the current rate case can and should be fully incorporated into Cal Am's rate base in a subsequent rate case when actual project costs can be reviewed by the Commission for reasonableness.

D. CONCLUSION

The Commission should make the following adjustments to Cal Am's requests for the San Diego district:

1. Allow $1,016,140 for the 2021-2022 period for the replacement of transmission main (project I15-300010).

CHAPTER 9: SPECIAL REQUEST #16

A. INTRODUCTION

In Special Request #16, Cal Am seeks approval to establish a Lead Service Line Replacement Program as part of its main replacement program.[206] Under the proposed Lead Service Line Replacement Program, Cal Am would replace the lead service on the customer side of the meter (if it contains lead) in addition to the service line owned by Cal Am when Cal Am discovers a lead service line in the system.[207] Although service lines replaced on the customer side of the meter will remain the property of the customer, Cal Am proposes to recover the cost of replacement through authorized rate base.[208]

B. SUMMARY OF RECOMMENDATIONS

Based upon the well-documented and significant health impacts of lead in drinking water, the Public Advocates Office does not oppose Cal Am's request.

C. DISCUSSION

According to the Environmental Protection Agency (EPA), lead can enter drinking water where the acidity or mineral content of water corrodes pipes and fixtures containing lead.[209] The EPA states that the most common sources of

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[206] Cal Am 2019 Final Application, p. 13.

[207] Cal Am 2019 Final Application, p. 13.

[208] In this rate case, Cal Am did not estimate how much funding the proposed Lead Service Line Replacement Program would impact rates.

[209] US EPA Website: Basic Information about Lead in Drinking Water (https://www.epa.gov/ground-water-and-drinking-water/basic-information-about-lead-drinking-

(continued on next page)

lead in drinking water are from lead pipes, faucets, and fixtures.[210] Lead can also occur in homes with lead service line that connect the home to the water main.[211]

Under the Lead Service Lines section of the California Health and Safety code, Section 116885, added by Senate Bill 1398 (2016) and amended by Senate Bill 427 (2017), all community water systems (CWS)[212] are required to compile an inventory of known, partial, or total lead user service lines in use by July 1, 2018.[213] The California State Water Resource Control Board keeps an inventory of the service lines in California that either contain lead or where the material of the service line is unknown. According to the California State Water Resources

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water#health). Accessed November 18, 2019.

[210] US EPA Website: Basic Information about Lead in Drinking Water (https://www.epa.gov/ground-water-and-drinking-water/basic-information-about-lead-drinking-water#health). Accessed November 18, 2019. Lead pipes are more likely to be found in older cities and homes built before 1986.

[211] US EPA Website: Basic Information about Lead in Drinking Water (https://www.epa.gov/ground-water-and-drinking-water/basic-information-about-lead-drinking-water#health). Accessed November 18, 2019. Lead is known to accumulate in people's bodies over time. Adults who have been exposed to lead can lead to cardiovascular effects (e.g. increased blood pressure, hypertension), decrease in kidney function, and reproductive problems. Lead is also known to be harmful to children, which is known to cause behavior and learning problems, lower IQ and hyperactivity, stunted growth, hearing problems, and anemia.

[212] A community water service is defined as a public water system that serves at least 15 service connections used by yearlong residents or regularly service at least 25 yearlong residents of the areas serviced by the system.

[213] California State Water Resources Control Board website: Lead Service Line Inventory Requirement for Public Water Systems (https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/lead_service_line_inventory_pws.html). Accessed November 18, 2019.

Control Board, Cal Am does not have any known service lines that contain lead.[214] However, Cal Am has service lines where the material of the service line is unknown in its Sacramento, Monterey, and Larkfield districts.[215]

In the event Cal Am discovers a service line containing lead on their side of the meter, Cal Am will contact the customer to seek approval to investigate whether the service line on the customer's side of the meter also contains lead.[216] If Cal Am discovers lead in the service line on the customer's side of the meter, Cal Am will request approval from the property owner to replace the service line.[217]

To estimate the potential rate impact of Cal Am's proposed Lead Service Line Replacement Program, some assumptions are necessary.[218] According to Cal Am, the service line replacement recurring project category (R15-xxH1) is for

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[214] The Service Line Inventory (SLI) Status map displays the SLI status based on the data collected in the 2018 Electronic Annual Report (EAR) Lead Service Line Replacement (LSLR) section. The law defines the lead fittings as anything that connects the main water line to individual water meters. In the Los Angeles district, Cal Am does have lead fittings on their main.

[215] The Sacramento district has approximately 43,795 service lines of unknown material. The Larkfield district has approximately 374 service lines of unknown material. The Monterey district has approximately 40,121 service lines of unknown material. The number of service lines of unknown material was taken from the SLI Status Map.

[216] Direct Testimony of Gary Hofer, pp. 31-32.

[217] Direct Testimony of Gary Hofer, pp. 31-32.

[218] The potential rate increase is not a recommendation on the number of services that should be replaced under this program nor is it a recommendation how much funding Cal Am should be granted for the proposed program. The potential rate increase is an educated guess on the financial impact of the proposed program on a customer's bill on a monthly basis and how it compares to a customer being fully responsible for the replacement cost of the lead service.

funding the scheduled and unscheduled replacement of service lines.[219] To calculate the potential worst case scenario in terms of rate impact, it is assumed that: 1) the material of all the service lines being replaced is unknown; 2) all of the services being replaced contain lead (on both Cal Am's and customer's side of the meter); and 3) all customers who are impacted agree to have their service line (on their side of the meter) replaced.[220] Therefore, the amount spent to replace service lines on the customer's side of the meter in the Sacramento, Larkfield, and Monterey districts is assumed to be the same as the amount spent for the service line replacement recurring project category.[221] Based on these assumptions, it is estimated that the proposed Lead Service Line Replacement Program would cost approximately $0.19 per service connection per month in the Larkfield district, $0.21 per service connection per month in the Monterey district, and $0.21 per service connection per month in the Sacramento district.[222] In the event that

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[219] Direct Testimony of Ian Crooks, p. 23.

[220] These assumptions are not a declaration of the number of lead service lines that will be replaced in this rate case cycle. These assumptions are made in order to estimate the potential rate impact.

[221] ALL_CH07_PLT_RO_Forecast, Tab Total CAPEX by Project WS-9. Cal Am is requesting $428,106 in 2021 and $429,302 in 2022 for the service line replacement recurring project category for the Sacramento district. Cal Am is requesting $15,698 in 2021 and $15,742 in 2022 for the service line replacement recurring project category for the Larkfield district. Cal Am is requesting $346,474 in 2021 and $347,441 in 2022 for the service line replacement recurring project category for the Monterey district. These assumptions are not a declaration of the amount of funding that should be allocated for the proposed program.

[222] The 2023 Annual Revenue Requirement for the Larkfield district is $6,515 /number of service lines (2,809)/12 months. The 2023 Annual Revenue Requirement for the Monterey district is $136,911 /number of service lines (53,271)/12 months. The 2023 Annual Revenue Requirement for the Sacramento district is $169,169 /number of service lines (68,691)/12 months.

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individual customers were solely responsible for funding the replacement of lead service lines on their side of the meter, the cost to replace the service line might deter customers from wanting to replace the service line on their side of the meter. Assuming a unit replacement cost of **<<BEGIN CONFIDENTIAL>>** [redacted] **<<END CONFIDENTIAL>>**[223] per service line based on a current Cal Am project (I15-610014), it would cost approximately $57 per month in the Larkfield district and $55 per month in the Sacramento and Monterey districts.[224]

American Water has similar programs that were implemented in other states. The Indiana American Water, New Jersey American Water, Missouri American Water, and Pennsylvania American Water have approved programs to replace lead service lines, which includes seeking authority to replace any potential lead service lines on the customer's side of the meter.[225] One distinction

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The 2023 Annual Revenue Requirement is calculated as the sum of (1) the product of the rate of return, the 2021-2023 capital cost for each district, and the net to gross ratio for each district; and (2) depreciation expense. The forecasted 2021-2023 capital cost and 2023 annual expense is calculated per the escalation and attrition process of the Rate Case Plan for Class A Water Utilities (D.07-05-062). Refer to Attachment 11.

[223] Workpapers- Engineering Projects, Tab 3 (I15-610014).

[224] The revenue requirement related to the service line replacement cost of $5,000 is calculated as the sum of (1) the product of the rate of return, unit cost of $5,000, and the net to gross ratio for each district and (2) depreciation expense. The depreciation rates, net to gross ratio, and rate of return used in this calculation is similar to the depreciation rates, net to gross ratio, and rate of return used in the potential estimated cost per service connection for the Lead Service Line Replacement Program as shown in Attachment 11.

[225] Indiana American Water Company: (https://amwater.com/inaw/news-community/rss-in/id/2394988). Accessed November 19, 2019. New Jersey American Water Company: (https://amwater.com/njaw/water-quality/service-line-replacement). Accessed November 19, 2019. In August 2019, the Pennsylvania Public Utilities Commission adopted Pennsylvania

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between Cal Am's proposed program and some of the programs implemented in other states is that in some of the other states, the companies have identified a number of service lines that are known to contain lead.[226]

It is possible that no lead service lines (on the customer's side of the meter) will need to be replaced during this rate case cycle because no lead service lines (on the utility's side of the meter) are uncovered during replacement. In the last six years (2013-2018), Cal Am did not replace any lead service lines.[227] Given the safety concerns regarding lead and the potential cost impact of individual customers solely being responsible for replacing a lead service line versus spreading the potential cost over Cal Am's customer base, the Public Advocates Office does not oppose Cal Am's proposed Lead Service Line Replacement Program.

Cal Am does not currently have an estimate on the number of lead service lines Cal Am intends to replace in this rate case or the financial impact of the replacement costs as a result of the proposed Lead Service Line Replacement Program. Since Cal Am is not aware of the magnitude of the how much the proposed Lead Service Line Replacement Program will impact rates, the best

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American Water Company's request to replace lead service lines on the customer's side of the meter (https://www.morganlewis.com/-/media/files/document/2019/papuc-order-approving-pawc-lead-service-line-replacement-plan_3oct19.ashx?la=en&hash=7F6346DE7B7B8CC4910CC797AF025D92AF0BD61C). Accessed November 21, 2019. Missouri American Water Company: (https://psc.mo.gov/WaterSewer/New_Water_and_Sewer_Rates_Filed_by_Missouri-American_Water_Company). Accessed November 21, 2019.

[226] Approximately 30,000 Missouri American Water customers have lead service lines. The Indiana American Water Company estimates that it has as much as 50,000 lead service lines.

[227] Cal Am Response to the Public Advocates Office Data Request JMI-002, Q. 3. During the 2013-2018 period, Cal Am only replaced 25 lead gooseneck fittings in the Los Angeles district.

method to handle the recorded prudent replacement costs (as either capital or an expense) is unknown. Therefore, the ratemaking treatment on how Cal Am should recover any prudent funding Cal Am spent on the proposed Lead Service Line Replacement Program should be considered in the next rate case where Cal Am should have information on the number of lead service lines replaced and the potential financial impact of the recorded replacement costs and the recorded costs can be reviewed for prudency. When Cal Am requests to recover the prudent costs of the replacement costs of the proposed Lead Service Line Replacement Program in the next and future rate cases, the Commission should require Cal Am to maintain detailed records pertaining to all lead service line replacements, including: 1) the location; 2) length; and 3) cost of each customer-owned service line replaced. Cal Am should also exhaust all measures to obtain both state and federal wide in order to help fund any potential replacement of lead service lines (on customer's side of the meter).

D. CONCLUSION

The Public Advocates Office does not oppose Cal Am's request to establish the Lead Service Line Replacement Program as part of its main replacement program. Contingent upon approving this request, the Commission should require Cal Am to maintain detailed records pertaining to all lead service line replacements, including the location, length, and cost of each customer-owned service line replaced. In addition, the rate treatment of the potential costs incurred from the proposed Lead Service Line Replacement Program should be handled in the next rate case when Cal Am has information on the potential cost spent due to the proposed program.

CHAPTER 10: DEPRECIATION

A. INTRODUCTION

Depreciation (in accounting terms) distributes the cost of the asset over the useful life of the asset.[228] Cal Am uses the straight-line, average life group remaining life depreciation system to calculate the annual and accrued depreciation.[229] This chapter presents the analyses and recommendations that the Commission should adopt for the depreciation reserve for Test Year 2022 and Escalation Year 2023.

B. SUMMARY OF RECOMMENDATIONS

The Public Advocates Office does not oppose Cal Am's proposed depreciation rates. Any differences between Cal Am and the Public Advocates's proposed depreciation expense is due to differences in forecasted depreciable plant in service, which is dependent on recommended plant additions (refer to the individual district chapters in this report).

C. DISCUSSION

Cal Am proposes to use the depreciation rates authorized in 2016 rate case decision (D.18-12-021).[230] Cal Am claims that due to the timing of D.18-12-

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[228] Any net salvage of the asset is removed from the cost of the asset.

[229] Direct Testimony of Mark Schubert (from A.16-07-002), p. 197. When a plant asset is retired, the cost of the depreciable asset (excluding any net salvage value) and is charged to the depreciation reserve.

[230] Direct Testimony of Bahman Pourtaherian, p. 19.

021,[231] it was unable to conduct a new depreciation study for this rate case.[232] The Public Advocates Office does not oppose the depreciation rates proposed by Cal Am. Cal Am plans to prepare a new depreciation study as part of its 2022 GRC.[233] In D.18-12-021, the Commission ordered Cal Am to provide additional information, including but not limited to: 1) analysis and explanation of the drivers and causes for the potential increases; 2) comparison and analysis of current and analysis of current and proposed depreciation rates, net salvage rates, and service lives of each asset group; and 3) computation of the annual depreciation rate.[234] When Cal Am provides a new depreciation study as part of its 2022 rate case, Cal Am should also provide the information requested in D.18-12-021.

D. CONCLUSION

Any difference in the depreciation expense proposed by Cal Am and the Public Advocates Office reflects only differences in forecasted depreciable plant in service.

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[231] The proposed decision for A.16-07-002 was mailed on November13, 2018.

[232] Direct Testimony of Bahman Pourtaherian, p. 19.

[233] Direct Testimony of Bahman Pourtaherian, p. 19.

[234] D.18-12-021, p. 198.

Attachment 1: Excerpt from Industrial Tank #2 TIC Inspection Report (from Cal Am's response to the Public Advocates Office Data Request JMI-001)

ECONOMIC FACTORS:

Item	Cost	Life in Years
Replacement of tank with a new one	$ 5,800,000[1]	75+

No repairs are recommended at this time.

[1] The replacement estimate includes costs associated with new tank fabrication and erection, foundation, painting, and engineering. The budget estimate given does not include costs associated with tank demolition, site acquisition, and distribution interruptions.

Tank Industry Consultants has no control over the cost of labor, materials, or equipment, or over the contractors' methods of determining prices, or over competitive bidding, or the market conditions. Opinions of probable cost, as provided for herein, are to be made on the basis of our experience and qualifications and represent our best judgment as design professionals familiar with the design, maintenance, and construction of concrete and steel plate structures. However, Tank Industry Consultants cannot and does not guarantee that proposals, bids, or the construction cost will not vary from opinions of probable cost prepared for the Owner.

Due to the numerous potential scopes of work which exist, the Owner should obtain an updated budget estimate once the final scope of work has been determined. This would enable the Owner to accurately budget monies for additional mobilization costs and damaged coating rehabilitation costs.

Engineering and resident observation costs are not included in the Total of the Engineer's Recommendations because these fees are dependent upon the scope of work to be performed. Tank Industry Consultants performs all facets of the engineering services which would be required for this project. Estimated fees for engineering and resident observation will be furnished upon request.

CLOSURE:

Brief Summation: California American Water owns and operates a 5,000,000 gallon in Thousand Oaks, California. The exterior and interior coating systems were in good condition as no significant areas of corrosion were noted. Proper maintenance after completing the recommendations herein would include periodic washouts and evaluations approximately every 3 to 5 years in accordance with AWWA recommendations.

Contractor Selection: The work should be performed by a competent bonded contractor, chosen from competitive bids taken on complete and concise specifications. The coatings used should be furnished by an experienced water tank coating manufacturer, supplying the field service required for application of technical coatings.

Standards for Repairs and Coatings: All work done and coatings applied should be applied in accordance with NACE, ANSI/NSF Standard 61, the manufacturer's recommendation, AWWA D100, and AWWA D102 (latest revisions), and the SSPC: The Society for Protective Coatings.

Observation of Work: Observation of the work in progress by experienced personnel will offer additional assurance of quality protective coating application. Observations can be performed on a continuous basis or spot (critical phase) basis. The actual cost of observation may be less using spot as opposed to full-time resident observation; however, with spot observation it is often necessary for work

Attachment 2: 2016 Cal Am Generator Master Plan, p. 2

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Attachment 3: Cal Am Response to the Public Advocates Office Data Request DG-004, Q.1

California-American Water Company

APPLICATION NO. A.19-07-004
DATA REQUEST RESPONSE

Response Provided By:	**Walter Sadler**
Title:	**Manager of Engineering - Project Delivery**
Address:	**4701 Beloit Drive, Sacramento, CA 95838**
ORA Request:	**A1907004 CAL PA DATA REQUEST #DG-04 RECORDED PLANT PROJECTS**
Company Number:	**Cal PA DG 04 Q001**
Date Received:	**July 24, 2019**
Date Response Due:	**August 7, 2019**
Subject Area:	**Recorded Plant Projects**

DATA REQUEST:

1. MDR II.D.0. lists the Project Code I15-600071 Sacramento Well Rehab (2015-17) project with an authorized amount of $4,500,000 and a completed cost of $4,779,040. Provide the following information about the project in the table below (add rows if necessary):

Name of Well Rehabilitated	Year Started	Year Completed	Winning bid Amount	Final Cost

   a. For each well rehabilitation project, was a competitive bidding process used? If not, explain the bidding process.

   b. Explain how the bidders in response 1.a. were contacted.

   c. Provide all the bids received and identify the winning bid.

   d. State all the criteria used to select the winning bid, if not lowest cost.

   e. For each project listed in the table above, identify the reason(s) for any final project cost increases/decreases from the original winning bid(s).

CAL-AM'S RESPONSE

California-American Water Company

APPLICATION NO. A.19-07-004
DATA REQUEST RESPONSE

1. MDR II.D.0. lists the Project Code I15-600071 Sacramento Well Rehab (2015-17) project with an authorized amount of $4,500,000 and a completed cost of $4,779,040. Provide the following information about the project in the table below (add rows if necessary):

Name of Well Rehabilitated	Year Started	Year Completed	Winning bid Amount	Final Cost
Auburn/Halifax	2015	2017	$ 213,905.00	$ 255,795.00
Tally Ho 1	2015	2017	$ 200,978.00	$ 246,572.00
Salmon Falls	2015	2017	$ 194,100.00	$ 226,381.00
Grove 1	2015	2017	$ 132,205.00	$ 142,605.00
Isleton H Street	2015	2017	$ 69,217.00	$ 69,217.00
Tally Ho 2	2015	2017	$ 56,550.00	$ 123,192.00
Parksite 2	2015	2017	$ 66,510.00	$ 74,552.00
Falcon View	2015	2017	$ 66,575.00	$ 100,790.00
Daly	2015	2017	$ 55,175.00	$ 101,734.00
Nut Plains	2015	2017	$ 37,950.00	$ 77,055.00
Hemingway	2015	2017	$ 63,850.00	$ 72,334.00
Andrea 2	2015	2017	$ 38,800.00	$ 123,525.00
Cook Riolo	2015	2017	$ 57,575.00	$ 108,627.00
Swansea	2015	2017	$ 37,700.00	$ 71,283.00
Fairlake 2	2016	2017	$ 171,192.00	$ 171,192.00

Don Julio	2016	2017	$ 77,591.00	$ 133,823.00
Rockhurst	2016	2017	$ 77,591.00	$ 123,894.00
Vintage 1	2016	2017	$ 77,241.00	$ 150,848.00
West La Loma	2016	2017	$ 81,441.00	$ 84,423.00
Parksite Well 1	2017	2017	$ 1,170.00	$ 1,170.00
Eagle Ridge	2016	2017	$ 280,416.00	$ 287,302.00
Carriage	2016	2017	$ 27,479.00	$ 28,124.00
Palmerson	2016	2016	$ 127,225.00	$ 127,225.00
Chipping	2016	2016	$ 46,500.00	$ 46,500.00
Roseville	2016	2016	$ 113,625.00	$ 113,625.00
Briggs	2016	2016	$ 54,125.00	$ 54,125.00
Summerplace	2016	2019	$ 320,110.00	$ 320,110.00
Rogue River	2016	2017	$ 199,100.00	$ 199,100.00

"Final Cost" information shown above is final construction cost to contractors and does not include overhead, direct CAW labor, design service, construction inspection services, SCADA programming, and startup services.

a. Yes, competitive bidding was used.
b. Via phone and/or email.
c. See Cal PA DG 04 Q001 Attachments 1 through 8.
d. Winning bid was awarded to the lowest bidder.
e. Reasons for project costs increase/decrease

Attachment 4: Larkfield District Tank Study, p. 7

During this scenario, the minimum residual pressure in the water system is below the typical engineering standard minimum residual pressure of 20 psi at the required fire flow, ranging from -2 to 152 psi. The residual pressures observed for fire flow simulation are shown in Figure 8.20. The available fire flow is in the range of 0 to 3,500 gpm.

Scenario 5)
Extended Period Simulation - North Wikiup Tank #2 and Lower Wikiup Tank #2 Out of Service

The 400,000 gallon North Wikiup Tank #2 and 300,000 gallon Lower Wikiup Tank #2 out of service condition was run using an extended period simulation (EPS) with peak day demands. Peak day average pressures observed during the last 24 hours of the EPS simulation are between 3 psi and 204 psi. The high pressures are due to the varying demands during the day and low pressures were observed near the tank sites due to the large elevation difference between the areas.

The water levels in the North Wikiup Tank #1 and Lower Wikiup Tank #1 fluctuate significantly and repeatedly drain to low levels (5 to 6 feet) under this scenario. This indicates that the system is stressed and cannot meet demands throughout the day as the tanks are being drained. There is not enough storage in the system with both the North Wikiup #2 and Lower Wikiup Tank #2 out of service.

Modeling Findings and Recommendations

1. Since high pressures are observed due to huge elevation difference, PRV's are required to regulate pressure and avoid pipe breaks.
2. During the EPSs, the active tanks are emptying the tanks to meet the demands. So it is not recommended to take the North Wikiup Tank #2 and Lower Wikiup Tank #2 out of service at the same time.
3. Due to new sloshing heights, the system does not have enough storage to meet the standard fire flow requirements. Its is recognized that the Larkfield system is not required to provide fire flow per the operating agreements.
4. In order to meet the peak hour demands, the system is utilizing the maximum flow from the aqueduct and wells.

SUMMARY AND COSTS

Table ES1 summarizes the pertinent tank information, sloshing heights (recommended overflow rehabilitation), recommended rehabilitation activities, condition ranking and estimated rehabilitation costs. The costs include construction, design, construction management fees, and contingencies. The costs do not include seismic retrofit costs as the revised sloshing heights meet the same objective. Alternate replacement costs are also presented for those tanks with higher unit rehabilitation costs.

Table ES2 presents a cost summary or each tank along with a target year for the improvements.

Table ES1: Tank Replacement Cost Summary

Tank/Reservoir Name	Rated Size (gallons)	Nominal Dimensions	Dia (feet)	Vol/ Foot of Height (gallons)	New Slosh Height (feet)	New Slosh Height Elev (feet)	New Effective Slosh Height Elev (feet)	New Effective Depth (feet)	New Usable Volume (gallons)	Rehab Cost	$/Gal	Alternative Replacement Cost	$/Gal
Lower Wikiup #1 (1)	168,000	Round 45' Dia x 14.5' Tall	45	11,900	8.33	303.33	303.33	8.33	99,127	$236,300	$2.38	$604,800	$3.60
Lower Wikiup #2	300,000	Round 51' Dia x 19' Tall	51	15,300	12.00	307.00	303.33	9.33	142,749	$149,400	$1.05	N/A	N/A
Upper Wikiup #1 (2)	48,000	Square 20' x20' x 16' Tall	20	3,000	11.33	561.33	559.42	9.42	28,260	N/A	N/A	$172,800	$3.60
Upper Wikiup #2	75,000	Round 28' Dia x 16' Tall	28	4,600	9.42	559.42	559.42	9.42	43,332	$129,600	$2.99	$270,000	$3.60
North Wikiup #1	250,000	Round 48' Dia x 20' Tall	48	13,550	12.67	312.67	312.67	12.17	164,904	$107,300	$0.65	N/A	N/A
North Wikiup #2	400,000	Round 61' Dia x 21'-6" Tall	61	21,850	14.00	314.00	312.67	9.67	211,290	$148,400	$0.70	N/A	N/A
Total Storage Volume	1,241,000								689,661				

* (1) Tank would be replaced with a 19 ft tall tank to match Lower Wikiup #2
* (2) Rehab cost not provided as tank was removed from service due to Tubbs Fire

Attachment 5: Larkfield District Tank Study,

Exhibit 4.2.

LOWER WIKIUP TANK #1: ENGINEER'S OPINION OF PROBABLE CONSTRUCTION AND SOFT COSTS

RECOMMENDATIONS FOR DESIGNING SEISMIC ENHANCEMENT				
Description	**Qty**	**Unit**	**Unit Price**	**Total Price**
Concrete Strength Testing (Non-Destructive Testing Methods)	1	LS	$ 2,500.00	$ 2,500.00
Steel Reinforcement Scanning, Location Testing, and X-Ray (Non-Destructive Testing Methods)	1	LS	$ 25,000.00	$ 25,000.00
Foundation Potholing and Investigation	1	LS	$ 2,500.00	$ 2,500.00
Concrete Structural Integrity Analysis (Retro-Fit Design Only)	1	LS	$ 10,000.00	$ 10,000.00
Analysis and Foundation Design (Retro-Fit Design Only)	1	LS	$ 10,000.00	$ 10,000.00
			Total	**$ 50,000.00**

MISCELLANEOUS RECOMMENDATIONS				
Description	**Qty**	**Unit**	**Unit Price**	**Total Price**
Stainless Steel Mesh Installation, Removal of Existing Vent Screens	1	LS	$ 12,500.00	$ 12,500.00
			Total	**$ 12,500.00**

COATING RECOMMENDATIONS				
Description	**Qty**	**Unit**	**Unit Price**	**Total Price**
Sand Blasting (Interior)	3,600	SF	$ 3.50	$ 12,600.00
Spot primer and application of two-coat epoxy coating (Interior Spots, 12-16 mils DFT)	5,200	SF	$ 5.00	$ 26,000.00
Pressure wash cleaning (Exterior)	3,600	SF	$ 1.00	$ 3,600.00
Preparation and application of epoxy coatings (Exterior Concrete Walls)	2,000	SF	$ 7.50	$ 15,000.00
Disinfection, Sampling, and Testing	1	LS	$ 1,500.00	$ 1,500.00
			Total	**$ 58,700.00**

SUMMARY		
Recommendations for Designing Seismic Enhancement	$	50,000.00
Miscellaneous Recommendations	$	12,500.00
Coating Recommendations	$	58,700.00
Sub-Total 1	**$**	**121,200.00**
Mobilization (Taxes, Bonds, Insurance, Start-Up) Costs at 20% of Sub-Total 1	$	24,200.00
Sub-Total 2	**$**	**145,400.00**
Contingency at 30% of Sub-Total 2	$	43,600.00
Total Construction Cost	**$**	**189,000.00**
Design & Construction Management (CM) Fee, 25% of Total Construction Cost	$	47,300.00
Total Project Cost	**$**	**236,300.00**

Attachment 6: Larkfield District Tank Study, Exhibit 3.2.

NORTH WIKIUP TANK #2: ENGINEER'S OPINION OF PROBABLE CONSTRUCTION AND SOFT COSTS

RECOMMENDATIONS FOR DESIGNING SEISMIC ENHANCEMENT				
Description	**Qty**	**Unit**	**Unit Price**	**Total Price**
Initial Screening Analysis for Welds (Non-Destructive Testing Methods)	1	LS	$ 2,500.00	$ 2,500.00
Analysis and Anchorage System Design (Retro-Fit Design Only)	1	LS	$ 10,000.00	$ 10,000.00
Analysis and Foundation Design (Retro-Fit Design Only)	1	LS	$ 15,000.00	$ 15,000.00
Analysis and Roof Framing System (Retro-Fit Design Only, Assumes Non-Compliant Operational Freeboard)	1	LS	$ -	$ -
			Total	**$ 27,500.00**

MISCELLANEOUS RECOMMENDATIONS				
Description	**Qty**	**Unit**	**Unit Price**	**Total Price**
Grout Injection at Voids Between Foundation and Tank	1	LS	$ 2,500.00	$ 2,500.00
			Total	**$ 2,500.00**

COATING RECOMMENDATIONS				
Description	**Qty**	**Unit**	**Unit Price**	**Total Price**
Pressure wash cleaning (Interior)	11,600	SF	$ 1.00	$ 11,600.00
Preparation, spot primer, and application of two-coat epoxy coating (Interior Spots, 12-16 mils DFT)	1	LS	$ 15,000.00	$ 15,000.00
Pressure wash cleaning (Exterior)	7,000	SF	$ 1.00	$ 7,000.00
SSPC-SP3: Power Tool Cleaning (Exterior Roof Spots)	1	LS	$ 2,500.00	$ 2,500.00
Preparation and application of epoxy and polyurethane coatings (Exterior Roof Spots Only, 6-8 mils DFT)	1	LS	$ 7,500.00	$ 7,500.00
Disinfection, Sampling, and Testing	1	LS	$ 2,500.00	$ 2,500.00
			Total	**$ 46,100.00**

SUMMARY		
Recommendations for Designing Seismic Enhancement	$	27,500.00
Miscellaneous Recommendations	$	2,500.00
Coating Recommendations	$	46,100.00
Sub-Total 1	**$**	**76,100.00**
Mobilization (Taxes, Bonds, Insurance, Start-Up) Costs at 20% of Sub-Total 1	$	15,200.00
Sub-Total 2	**$**	**91,300.00**
Contingency at 30% of Sub-Total 2	$	27,400.00
Total Construction Cost	**$**	**118,700.00**
Design & Construction Management (CM) Fee, 25% of Total Construction Cost	$	29,700.00
Total Project Cost	**$**	**148,400.00**

Attachment 7: Cal Am Response to the Public Advocates Office Data Request JMI-007

BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF CALIFORNIA

Application of California-American Water Company (U210W) for Authorization to Increase its Revenues for Water Service by $25,999,900 or 10.60% in the year 2021, by $9,752,500 or 3.59% in the year 2022, and by $10,754,500 or 3.82% in the year 2023.	Application 19-07-004 (Filed July 1, 2019)

CALIFORNIA-AMERICAN WATER COMPANY'S (U-210-W)
OBJECTIONS AND RESPONSES TO
PUBLIC ADVOCATES OFFICE'S
DATA REQUEST NO. JMI 07

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Attorneys for Applicant California-American Water Company

Dated: November 12, 2019

**CALIFORNIA-AMERICAN WATER COMPANY'S (U-210-W)
OBJECTIONS AND RESPONSES TO
PUBLIC ADVOCATES OFFICE'S
DATA REQUEST NO. JMI 06**

California-American Water Company (U-210- W; "California American Water," "CAW" or the "Company") hereby sets forth the following objections and responses to the Public Advocates Office's ("Cal PA") Data Request JMI 07 ("Data Requests") propounded on November 1, 2019, in A.19-07-004.

RESERVATION OF RIGHTS

1. California American Water's investigation into the Data Requests is ongoing. The Company reserves the right, without obligating itself to do so, to supplement or modify its responses and to present further information and produce additional documents as a result of its ongoing investigation.

2. Any information or materials provided in response to the Data Requests shall be without prejudice to California American Water's right to object to their admission into evidence or the record in this proceeding, their use as evidence or in the record, or the relevance of such information or materials. In addition, California American Water reserves its right to object to further discovery of documents, other information or materials relating to the same or similar subject matter upon any valid ground or grounds, including without limitation, the proprietary nature of the information, relevance, privilege, work product, overbreadth, burdensomeness, oppressiveness, or incompetence.

GENERAL OBJECTIONS

1. California American Water objects to the Data Requests as improper, overbroad, and unduly burdensome to the extent they purport to impose upon California American Water any obligations broader than those permitted by law.

2. California American Water objects to the Data Requests as improper, overbroad, and unduly burdensome to the extent they improperly seek the disclosure of information protected by the attorney-client privilege, the attorney work-product doctrine, or any other applicable privilege or doctrine, and/or the client confidentiality obligations mandated by Business and Professions Code Section 6068(e)(1) and Rule 3-100(A) of the California Rules of Professional Conduct. Such responses as may hereafter be given shall

not include information protected by such privileges or doctrines, and the inadvertent disclosure of such information shall not be deemed as a waiver of any such privilege or doctrine.

3. California American Water objects to the Data Requests to the extent that the requests are duplicative and overlapping, cumulative of one another, overly broad, and/or seek responses in a manner that is unduly burdensome, unreasonably expensive, oppressive, or excessively time consuming to California American Water.

4. California American Water objects to the Data Requests to the extent they seek documents that are and/or information that is neither relevant nor material to this proceeding nor reasonably calculated to lead to the discovery of admissible evidence.

5. California American Water objects to the Data Requests to the extent they seek an analysis, calculation, or compilation that has not previously been performed and that California American Water objects to performing.

6. California American Water objects to the Data Requests insofar as they request the production of documents or information that are publicly available or that are equally available to Cal PA because such requests subject California American Water to unreasonable and undue annoyance, oppression, burden and expense.

7. California American Water objects to the Data Requests to the extent the requests are vague, ambiguous, use terms that are subject to multiple interpretations but are not properly defined for purposes of the Data Request, or otherwise provide no basis from which California American Water can determine what information is sought.

8. The objections contained herein, and information and documents produced in response hereto, are not intended nor should they be construed to waive California American Water's right to object to the Data Requests, responses or documents produced in response hereto, or the subject matter of such Data Requests, responses or documents, as to their competency, relevancy, materiality, privilege and admissibility as evidence for any purpose, in or at any hearing of this or any other proceeding.

9. The objections contained herein are not intended nor should they be construed to waive California American Water's right to object to other discovery involving or relating to the subject matter of the Data Requests, responses or documents produced in response hereto.

California-American Water Company

APPLICATION NO. A.19-07-004
DATA REQUEST RESPONSE

Response Provided By:	**Steven Dutch**
Title:	**Senior Project Engineer**
Address:	**4701 Beloit Drive Sacramento, CA 95838**
ORA Request:	**A1907004 CAL PA JMI 07 LARKFIELD TANK REHABILITATION**
Company Number:	**CAL PA JMI 07 Q001.a-b**
Date Received:	**November 1, 2019**
Date Response Due:	**November 12, 2019**
Subject Area:	**Larkfield Tank Rehabilitation**

DATA REQUEST:

1. Regarding the Larkfield Tank Rehabilitation and Seismic Upgrades project (I15-610018):

   a. Page 1-15 of Tab 7 (I15-610018) of the Workpapers—Engineering Projects shows the cost estimate for I15-610018. The "Tank Condition Assessment Rehabilitation for Lower Wikiup Tank #1" line item shows the estimated cost for the proposed improvements for the Lower Wikiup Tank #1 as $604,800. Page 7 of the 2018 Larkfield District Tank Study (provided in response to data request A.19-07-004 JMI-004) shows on Table ES2 that the alternative replacement cost for Lower Wikiup Tank #1 is $604,800.

      i. Is it Cal Am's intention to replace the existing Lower Wikiup Tank #1?

      ii. Is it Cal Am's intention to make improvements to rehabilitate the existing Lower Wikiup Tank #1?

      iii. If it is Cal Am's intention to make improvements for the exisitng Lower Wikiup Tank #1 in response to question 1.a.i above, should the proposed rehab cost for Lower Wikiup be $236,300 be as shown in Exhibit 4.2 (Lower Wikiup Tank #1 Detailed Cost Estimate) for the 2018 Larkfield District Tank Study? If not, please provide the revised rehab cost and a cost breakdown of the revised rehab cost in a format similar to Exhibit 4.2 of the 2018 Larkfield District Tank Study.

iv. If it is Cal Am's intention to replace the existing Lower Wikiup Tank #1 in response to question 1.a.i above, please provide a cost breakdown of the

$604,800 estimate in a format similar to Exhibit 4.2 of the 2018

Larkfield District Tank Study.

v. Exhibit 4.2 (Lower Wikiup Tank #1 Detailed Cost Estimate) for the 2018 Larkfield District Tank Study shows that approximately $58,700 of the proposed $236,300 is for tank coating improvements. Please describe why the proposed tank improvements for Lower Wikiup Tank #1 is proposed as part of a capital project rather than as deferred tank improvments?

b. Page 260 of the Direct Testimony of Ian Crooks shows in Table XVII-F that Cal Am is proposing $236,300 in 2020 for deferred tank improvments for the Lower Wikiup Tank #1.

i. Please describe how the proposed deferred tank improvements for the Lower Wikiup Tank #1 is different than the proposed improvements for the Lower Wikiup Tank #1 for I15-610018?

ii. If it is Cal Am's intention to replace the Lower Wikiup Tank #1 in response to question 1.a, would the proposed $236,300 in deferred tank improvements still be necessary? If so, please explain.

CAL-AM'S RESPONSE

California American Water incorporates its General Objections as though each is submitted fully here. Subject to, but without waiving, those objections, California American Water responds as follows.

1.a.i. No, California American Water does not intend to replace Lower Wikiup Tank #1.

California-American Water Company

APPLICATION NO. A.19-07-004
DATA REQUEST RESPONSE

Response Provided By:	**Steven Dutch and Lacy Carothers**
Title:	**Senior Project Engineer**
	Project Manager
Address:	**4701 Beloit Drive Sacramento, CA 95838**
ORA Request:	**A1907004 CAL PA JMI 07 LARKFIELD TANK REHABILITATION**
Company Number:	**CAL PA JMI 07 Q001.c**
Date Received:	**November 1, 2019**
Date Response Due:	**November 12, 2019**
Subject Area:	**Larkfield Tank Rehabilitation**

DATA REQUEST:

2. Regarding the Larkfield Tank Rehabilitation and Seismic Upgrades project (I15-610018):
   c. Page 1-15 of Tab 7 (I15-610018) of the Workpapers—Engineering Projects shows the cost estimate for I15-610018. There is a line item for a "5th Year Anniversary Tank Maintenance" for five tanks.
      1. Is this line item related to routine tank inspection? If not, please describe the scope of this line item.
      2. If this line item is related to routine tank inspection in response to question 1.c.i above, please describe why Cal Am is proposing to capitalize the tank inspection report rather than how Cal Am normally funds tank inspection reports.

CAL-AM'S RESPONSE

California American Water incorporates its General Objections as though each is submitted fully here. Subject to, but without waiving, those objections, California American Water responds as follows.

1.c.1. The 5th Year Anniversary Tank Maintenance is the routine tank inspection.

1.c.2. This cost should be included as a deferred maintenance expense related to tank maintenance.

California-American Water Company

APPLICATION NO. A.19-07-004
DATA REQUEST RESPONSE

Response Provided By:	**Lacy Carothers**
Title:	**Project Manager**
Address:	**4701 Beloit Drive** **Sacramento, CA 95838**
ORA Request:	**A1907004 CAL PA JMI 07 LARKFIELD TANK REHABILITATION**
Company Number:	**CAL PA JMI 07 Q001**
Date Received:	**November 1, 2019**
Date Response Due:	**November 12, 2019**
Subject Area:	**Larkfield Tank Rehabilitation**

DATA REQUEST:

1. Regarding the Larkfield Tank Rehabilitation and Seismic Upgrades project (I15-610018):

   d. Page 1-15 of Tab 7 (I15-610018) of the Workpapers—Engineering Projects shows the cost estimate for I15-610018. The "Tank Condition Assessment Rehabilitation for North Wikiup Tank #2" line item shows the estimated cost for the proposed improvements for the North Wikiup Tank #2 as $148,400. Exhibit 3.2 (North Wikiup Tank #2 Detailed Cost Estimate) for the 2018 Larkfield District Tank Study shows that approximately $46,100 of the proposed $148,400 is for tank coating improvements. Please describe why the proposed tank improvements for North Wikiup Tank #2 is proposed as part of a capital project rather than as deferred tank improvements?

   e. Page 260 of the Direct Testimony of Ian Crooks shows in Table XVII-F that Cal Am is proposing $4,300 in 2022 for the Upper Wikiup Tank #1. On page 160 of the Direct Testimony of Ian Crooks, it states that the tank was removed from service due to the Tubbs Fire. Please explain the scope of the proposed deferred improvements for the Upper Wikiup Tank #1.

CAL-AM'S RESPONSE

California American Water incorporates its General Objections as though each is submitted fully here. Subject to, but without waiving, those objections, California American Water responds as follows.

1.d. The tank coating improvements for North Wikiup Tank #2 of approximately $46,100 should be included as a deferred maintenance expense.

1.e. There are no deferred improvements for the Upper Wikiup Tank #1 as it no longer exists. This estimate should be removed from forecasted deferred maintenance expense.

California-American Water Company

APPLICATION NO. A.19-07-004
DATA REQUEST RESPONSE

1.a.ii. Yes, California American Water intends to rehabilitate Lower Wikiup Tank #1.

1.a.iii. The proposed rehab cost of Lower Wikiup Tank #1 is $236,300 as shown in Exhibit 4.2 (Lower Wikiup Tank #1 Detailed Cost Estimate) for the 2018 Larkfield District Tank Study. However, as noted in response to item 1.a.v below, approximately $58,700 of this estimate is related to tank coating improvements and should be included in deferred maintenance expense.

1.a.iv. California American Water does not intend to replace Lower Wikiup Tank #1.

1.a.v. The tank coating improvements for Lower Wikiup Tank #1 of approximately $58,700 were inadvertently included in the proposed capital project and should have been apportioned to deferred tank improvements.

1.b.i. As referenced in Item 1.a.v above, deferred tank improvements for the Lower Wikiup Tank #1 should include only the tank coating. The proposed capital improvements are related to major structural changes that might be required to meet the 2016 updates to tank seismic codes. These changes in Larkfield are critical due to the proximity of several seismic fault lines.

1.b.ii. California American Water does not intend to replace Lower Wikiup Tank #1.

Attachment 8: Excerpts from TIC Inspection Reports (from Cal Am’s response to the Public Advocates Office Data Request JMI-001 and JMI-004)

ECONOMIC FACTORS:

Item	Cost	Life in Years
Replacement of tank with a new one	$ 350,000[1]	75+

The following economic factors include only those work items that the Engineer believes to be the minimum to properly maintain this tank from an operational standpoint. Other items related to safety and risk management should be evaluated by the Owner.

Item	< 1 Year	1 to 3 years	3 to 5 years
Clean and Paint Exterior:			
SP 6, Complete Clean, Epoxy/Polyurethane System		$ 50,000	
Containment		50,000	
[2]Heavy Metal Abatement & Disposal		15,000	
Clean and Paint Interior:			
SP 10, 3-Coat Epoxy System		80,000	
Miscellaneous Chipping and Grinding		5,000	
Roof Hole and Pit Repair		7,000	
Install Additional Shell Manhole		8,000	
Install Air Break & Overflow Pipe Elastomeric Check Valve		10,000	
Install Roof Safety Railing		4,000	
Install Additional Roof Manhole		5,000	
Enlarge Roof Manhole Cover Overlap		2,500	
Install Clog-Resistant Vent		10,000	
Remove Interior Access Rungs		4,000	
Modify Drain Pipe		8,000	
Contingency for Roof Support Structure Repairs		18,000	
Contingency Items		10,000	
Totals		**$286,500**	

Estimates are believed to be a high average of bids that would be received in 2016.

[1] The replacement estimate includes costs associated with new tank fabrication and erection, foundation, painting, and engineering. The budget estimate given does not include costs associated with tank demolition, site acquisition, and distribution interruptions.

[2] Heavy metal abatement is included in the economic factors; however, the hazardous disposal will not be required unless the abrasive residue is determined to be hazardous.

Tank Industry Consultants has no control over the cost of labor, materials, or equipment, or over the contractors' methods of determining prices, or over competitive bidding, or the market conditions. Opinions of probable cost, as provided for herein, are to be made on the basis of our experience and qualifications and represent our best judgment as design professionals familiar with the design, maintenance, and construction of concrete and steel plate structures. However, Tank Industry Consultants cannot and does not guarantee that proposals, bids, or the construction cost will not vary from opinions of probable cost prepared for the Owner.

Due to the numerous potential scopes of work which exist, the Owner should obtain an updated budget estimate once the final scope of work has been determined. This would enable the Owner to accurately budget monies for additional mobilization costs and damaged coating rehabilitation costs.

ECONOMIC FACTORS:

Item	Cost	Life in Years
Replacement of tank with a new one	$ 900,000[1]	75+

The following is a complete list of repairs and estimated costs for their respective recommendations found in the RECOMMENDATION section of this report.

Item	< 1 Year	1 to 3 years	3 to 5 years
Clean and Paint Exterior:			
Spot Repair and Topcoat		$ 85,000	
Containment		60,000	
Clean and Paint Interior:			
SP 10, Complete Clean, 100% Solids Epoxy System		245,000	
Seam Sealing		7,000	
Miscellaneous Chipping and Grinding		4,000	
Contingency for Pit Repair		4,000	
Fiberboard Repair		2,000	
Foundation Repair		3,000	
Contingency for Roof Support Structure Repairs		10,000	
Install Flexible Connections (2)	$ 10,000		
Lower Overflow Inlet	5,000		
Install Overflow Elastomeric Check Valve		8,000	
Remove Interior Ladder		1,000	
Install Exterior Ladder and Vandal Deterrents (2)		12,000	
Install Platform Self-Closing Gate		2,000	
Install Additional Roof Manhole		5,000	
Install Clog-Resistant Vent	10,000		
Contingency Items	10,000	10,000	
Totals	**$ 35,000**	**$ 458,000**	

Estimates are believed to be a high average of bids that would be received in 2018.

[1] The replacement estimate includes costs associated with new tank fabrication and erection, foundation, painting, and engineering. The budget estimate given does not include costs associated with tank demolition, site acquisition, and distribution interruptions.

Tank Industry Consultants has no control over the cost of labor, materials, or equipment, or over the contractors' methods of determining prices, or over competitive bidding, or the market conditions. Opinions of probable cost, as provided for herein, are to be made on the basis of our experience and qualifications and represent our best judgment as design professionals familiar with the design, maintenance, and construction of concrete and steel plate structures. However, Tank Industry Consultants cannot and does not guarantee that proposals, bids, or the construction cost will not vary from opinions of probable cost prepared for the Owner.

Due to the numerous potential scopes of work which exist, the Owner should obtain an updated budget estimate once the final scope of work has been determined. This would enable the Owner to accurately budget monies for additional mobilization costs and damaged coating rehabilitation costs.
Engineering and resident observation costs are not included in the Total of the Engineer's Recommendations because these fees are dependent upon the scope of work to be performed. Tank

ECONOMIC FACTORS:

Item	**Cost**	**Life in Years**
Replacement of tank with a new one	$ 400,000[1]	75+

The following is a complete list of repairs and estimated costs for their respective recommendations found in the RECOMMENDATION section of this report.

Item	< 1 Year	1 to 3 years	3 to 5 years
Clean and Paint Exterior:			
Complete Clean and Recoat		$ 75,000	
Containment		60,000	
Clean and Paint Interior:			
SP 10, Complete Clean, 100% Solids Epoxy System		70,000	
Seam Sealing		5,000	
Miscellaneous Chipping and Grinding		4,000	
Contingency for Pit Repair		5,000	
Contingency for Roof Support Structure Repairs		15,000	
Install Flexible Connection	$ 5,000		
Lower Overflow Inlet	5,000		
Remove Interior Ladder		1,000	
Install Exterior Ladder and Vandal Deterrents (2)		12,000	
Modify Roof Safety Railing and Install Self-Closing Gate		5,000	
Contingency Items	15,000	30,000	
Totals	**$ 25,000**	**$ 282,000**	

Estimates are believed to be a high average of bids that would be received in 2018.

[1] The replacement estimate includes costs associated with new tank fabrication and erection, foundation, painting, and engineering. The budget estimate given does not include costs associated with tank demolition, site acquisition, and distribution interruptions.

Tank Industry Consultants has no control over the cost of labor, materials, or equipment, or over the contractors' methods of determining prices, or over competitive bidding, or the market conditions. Opinions of probable cost, as provided for herein, are to be made on the basis of our experience and qualifications and represent our best judgment as design professionals familiar with the design, maintenance, and construction of concrete and steel plate structures. However, Tank Industry Consultants cannot and does not guarantee that proposals, bids, or the construction cost will not vary from opinions of probable cost prepared for the Owner.

Due to the numerous potential scopes of work which exist, the Owner should obtain an updated budget estimate once the final scope of work has been determined. This would enable the Owner to accurately budget monies for additional mobilization costs and damaged coating rehabilitation costs.
Engineering and resident observation costs are not included in the Total of the Engineer's Recommendations because these fees are dependent upon the scope of work to be performed. Tank Industry Consultants performs all facets of the engineering services which would be required for this project. Estimated fees for engineering and resident observation will be furnished upon request.

ECONOMIC FACTORS:

Item	Cost	Life in Years
Replacement of tank with a new one	$ 380,000[1]	75+

The following is a complete list of repairs and estimated costs for their respective recommendations found in the RECOMMENDATION section of this report.

Item	< 1 Year	1 to 3 years	3 to 5 years
Clean and Paint Exterior:			
Spot Repair and Topcoat		$ 40,000	
Containment		40,000	
Clean and Paint Interior:			
SP 10, Complete Clean, 100% Solids Epoxy System		70,000	
Seam Sealing		5,000	
Miscellaneous Chipping and Grinding		4,000	
Pit Repair		5,000	
Grout Repair		2,000	
Contingency for Roof Support Structure Repairs		10,000	
Install Flexible Connections (2)	$ 10,000		
New Anchor Bolts	80,000		
Lower Overflow Inlet	5,000		
Remove Interior Ladder		1,000	
Install Exterior Ladder and Vandal Deterrents (2)		12,000	
Modify Platform		2,000	
Install Additional Roof Manhole		5,000	
Install Clog-Resistant Vent	10,000		
Contingency Items	10,000	10,000	
Totals	**$ 115,000**	**$ 206,000**	

Estimates are believed to be a high average of bids that would be received in 2018.

[1] The replacement estimate includes costs associated with new tank fabrication and erection, foundation, painting, and engineering. The budget estimate given does not include costs associated with tank demolition, site acquisition, and distribution interruptions.

[2] Heavy metal abatement is included in the economic factors; however, the hazardous disposal will not be required unless the abrasive residue is determined to be hazardous.

Tank Industry Consultants has no control over the cost of labor, materials, or equipment, or over the contractors' methods of determining prices, or over competitive bidding, or the market conditions. Opinions of probable cost, as provided for herein, are to be made on the basis of our experience and qualifications and represent our best judgment as design professionals familiar with the design, maintenance, and construction of concrete and steel plate structures. However, Tank Industry Consultants cannot and does not guarantee that proposals, bids, or the construction cost will not vary from opinions of probable cost prepared for the Owner.

Due to the numerous potential scopes of work which exist, the Owner should obtain an updated budget estimate once the final scope of work has been determined. This would enable the Owner to accurately budget monies for additional mobilization costs and damaged coating rehabilitation costs.

ECONOMIC FACTORS:

Item	Cost	**Life in Years**
Replacement of tank with a new one	$ 1,600,000[1]	75+

The following economic factors include only those work items that the Engineer believes to be the minimum to properly maintain this tank from an operational standpoint. Other items related to safety and risk management should be evaluated by the Owner.

Item	< 1 Year	1 to 3 years	3 to 5 years
Clean and Paint Exterior:			
Spot Repair and Topcoat		$200,000	
Containment		80,000	
Clean and Paint Interior:			
SP 10, Complete Clean, I 00% Solids Epoxy System		400,000	
Miscellaneous Chipping and Grinding		8,000	
Pit Reoair		6,000	
Seam Sealing		12,000	
Contingency for Roof Support Structure Repairs		15,000	
Lower Overflow Inlet	$ 5,000		
Replace Patch Plate	12,000		
Install Additional Roof Safety Railings (2)		16,000	
Modify Existing Roof Safety Railing		5,000	
Enlarge Existing Roof Manhole Curbs (2)		4,000	
Clog-Resistant Vents (2)		20,000	
Install Exterior Ladder and Vandal Deterrents (2)		12,000	
Contingency Items	2,000	10,000	
Totals	**$19,000**	**$788,000**	

Estimates are believed to be a high average of bids that would be received in 2018.

[1] **The replacement estimate includes costs associated with new tank fabrication and erection, foundation, painting, and engineering. The budget estimate given does not include costs associated with tank demolition, site acquisition, and distribution interruptions.**

Tank Industry Consultants has no control over the cost of labor, materials, or equipment, or over the contractors' methods of determining prices, or over competitive bidding, or the market conditions. Opinions of probable cost, as provided for herein, are to be made on the basis of our experience and qualifications and represent our best judgment as design professionals familiar with the design, maintenance, and construction of concrete and steel plate structures. However, Tank Industry Consultants carmot and does not guarantee that proposals, bids, or the construction cost will not vary from opinions of probable cost prepared for the Owner.

Due to the numerous potential scopes of work which exist, the Owner should obtain an updated budget estimate once the final scope of work has been determined. This would enable the Owner to accurately budget monies for additional mobilization costs and damaged coating rehabilitationcosts.

Engineering and resident observation costs are not included in the Total of the Engineer's Recommendations because these fees are dependent upon the scope of work to be performed. Tank Industry Consultants performs all facets of the engineering services which would be required for this project. Estimated fees for engineering and resident observation will be furnished upon request.

ECONOMIC FACTORS:

Item	**Cost**	**Life in Years**
Replacement of tank with a new one	\$ 1,600,000[1]	75+

The following economic factors include only those work items that the Engineer believes to be the minimum to properly maintain this tank from an operational standpoint. Other items related to safety and risk management should be evaluated by the Owner.

Item	< 1 Year	1 to 3 years	3 to 5 years
Clean and Paint Exterior:			
Spot Repair and Topcoat		\$ 200,000	
Containment		80,000	
Clean and Paint Interior:			
SP 10, Complete Clean, 100% Solids Epoxy System		400,000	
Miscellaneous Chipping and Grinding		8,000	
Pit Repair		6,000	
Seam Sealing		12,000	
Contingency to Repair Roof Connections		12,000	
Contingency to Replace Rafters (30)		70,000	
Installation of Additional Purlins (30)		30,000	
Repair Chime		8,000	
Lower Overflow Inlet	\$ 5,000		
Lower Existing Roof Safety Railing Toe Bar		1,000	
Clog-Resistant Vents (2)		20,000	
Install Exterior Ladder and Vandal Deterrents (2)		12,000	
Contingency Items	5,000	5,000	
Totals	**\$ 10,000**	**\$ 864,000**	

Estimates are believed to be a high average of bids that would be received in 2018.

[1] The replacement estimate includes costs associated with new tank fabrication and erection, foundation, painting, and engineering. The budget estimate given does not include costs associated with tank demolition, site acquisition, and distribution interruptions.

Tank Industry Consultants has no control over the cost of labor, materials, or equipment, or over the contractors' methods of determining prices, or over competitive bidding, or the market conditions. Opinions of probable cost, as provided for herein, are to be made on the basis of our experience and qualifications and represent our best judgment as design professionals familiar with the design, maintenance, and construction of concrete and steel plate structures. However, Tank Industry Consultants cannot and does not guarantee that proposals, bids, or the construction cost will not vary from opinions of probable cost prepared for the Owner.

Due to the numerous potential scopes of work which exist, the Owner should obtain an updated budget estimate once the final scope of work has been determined. This would enable the Owner to accurately budget monies for additional mobilization costs and damaged coating rehabilitation costs.

Engineering and resident observation costs are not included in the Total of the Engineer's Recommendations because these fees are dependent upon the scope of work to be performed. Tank

ECONOMIC FACTORS:

Item	Cost	Life in Years
Replacement of tank with a new one	$ 380,000[1]	75+

The following economic factors include only those work items that the Engineer believes to be the minimum to properly maintain this tank from an operational standpoint. Other items related to safety and risk management should be evaluated by the Owner.

Item	< 1 Year	1 to 3 years	3 to 5 years
Clean and Paint Exterior:			
SP 6, Complete Clean, Epoxy/Polyurethane System	$ 60,000		
Containment	40,000		
[2]Heavy Metal Abatement & Disposal	10,000		
Clean and Paint Interior:			
SP 10, Complete Clean, 100% Solids Epoxy System	70,000		
Seam Sealing	5,000		
Miscellaneous Chipping and Grinding	4,000		
Pit Repair	5,000		
Lower Overflow Inlet	5,000		
Install Flexible Connection	5,000		
Contingency For Roof Support Structure Repairs and Rafter Replacement	20,000		
Contingency for Bottom Plate Metal Loss Repairs	5,000		
Install Shell Manhole	10,000		
Install Air Break and Overflow Pipe Elastomeric Check Valve	12,000		
Install Roof Safety Railing	6,000		
Install Exterior Ladder and Vandal Deterrents (2)	12,000		
Modify Existing Roof Manhole	4,000		
Install Additional Roof Manhole	5,000		
Remove Interior Ladder	1,000		
Contingency Items	10,000		
Totals	**$ 289,000**		

Estimates are believed to be a high average of bids that would be received in 2018.

[1] The replacement estimate includes costs associated with new tank fabrication and erection, foundation, painting, and engineering. The budget estimate given does not include costs associated with tank demolition, site acquisition, and distribution interruptions.

[2] Heavy metal abatement is included in the economic factors; however, the hazardous disposal will not be required unless the abrasive residue is determined to be hazardous.

Tank Industry Consultants has no control over the cost of labor, materials, or equipment, or over the contractors' methods of determining prices, or over competitive bidding, or the market conditions. Opinions of probable cost, as provided for herein, are to be made on the basis of our experience and qualifications and represent our best judgment as design professionals familiar with the design, maintenance, and construction of concrete and steel plate structures. However, Tank Industry Consultants cannot and does not guarantee that proposals, bids, or the construction cost will not vary from opinions of probable cost prepared for the Owner.

ECONOMIC FACTORS:

Item	Cost	Life in Years
Replacement of tank with a new one	$ 850,000[1]	75+

The following economic factors include only those work items that the Engineer believes to be the minimum to properly maintain this tank from an operational standpoint. Other items related to safety and risk management should be evaluated by the Owner.

Item	< 1 Year	1 to 3 years	3 to 5 years
Clean and Paint Exterior:			
SP 6, Complete Clean, Epoxy/Polyurethane System	$ 100,000		
Containment	40,000		
[2]Heavy Metal Abatement & Disposal	25,000		
Clean and Paint Interior:			
SP 10, 3-Coat Epoxy System	200,000		
Replace Cathodic Protection System	12,000		
Contingency For Roof Support Structure Repairs	10,000		
Miscellaneous Chipping and Grinding	2,000		
Pit Repair Contingency	8,000		
Foundation Repair	2,000		
Grout Repair	1,000		
Relocate Overflow Pipe and Install Elastomeric Check Valve	10,000		
Remove Interior Ladder and Safety Cage	3,000		
Enlarge Roof Manhole Cover Overlap	2,000		
Install Closure Chains on Roof Safety Railing	2,000		
Install Clog-Resistant Vent	10,000		
Contingency Items	12,000		
Totals	**$ 439,000**		

Estimates are believed to be a high average of bids that would be received in 2016.

[1] The replacement estimate includes costs associated with new tank fabrication and erection, foundation, painting, and engineering. The budget estimate given does not include costs associated with tank demolition, site acquisition, and distribution interruptions.

[2] Heavy metal abatement is included in the economic factors; however, the hazardous disposal will not be required unless the abrasive residue is determined to be hazardous.

Tank Industry Consultants has no control over the cost of labor, materials, or equipment, or over the contractors' methods of determining prices, or over competitive bidding, or the market conditions. Opinions of probable cost, as provided for herein, are to be made on the basis of our experience and qualifications and represent our best judgment as design professionals familiar with the design, maintenance, and construction of concrete and steel plate structures. However, Tank Industry Consultants cannot and does not guarantee that proposals, bids, or the construction cost will not vary from opinions of probable cost prepared for the Owner.

Due to the numerous potential scopes of work which exist, the Owner should obtain an updated budget estimate once the final scope of work has been determined. This would enable the Owner to accurately budget monies for additional mobilization costs and damaged coating rehabilitation costs.

ECONOMIC FACTORS:

Item	Cost	Life in Years
Replacement of tank with a new one	$ 600,000[1]	75+

The following economic factors include only those work items that the Engineer believes to be the minimum to properly maintain this tank from an operational standpoint. Other items related to safety and risk management should be evaluated by the Owner.

Item	< 1 Year	1 to 3 years	3 to 5 years
Clean and Paint Exterior:			
SP 6, Complete Clean, Epoxy/Polyurethane System		$ 115,000	
Containment		50,000	
[2]Heavy Metal Abatement & Disposal		10,000	
Clean and Paint Interior:			
SP 10, Complete Clean, 100% Solids Epoxy System		150,000	
Seam Sealing		5,000	
Miscellaneous Chipping and Grinding		5,000	
Pit Repair		7,000	
Contingency to Replace Rafters (15)		20,000	
Installation of Additional Purlins (21)		12,000	
Lower Overflow Inlet	$ 5,000		
Install Flexible Connection	5,000		
Install Exterior Ladder and Vandal Deterrents (2)		12,000	
Modify Existing Roof Safety Railing		4,000	
Replace Interior Ladder Safe-Climbing Device		1,000	
Install Additional Roof Manhole		5,000	
Contingency Items	5,000	10,000	
Totals	**$ 15,000**	**$ 406,000**	

Estimates are believed to be a high average of bids that would be received in 2018.

[1] The replacement estimate includes costs associated with new tank fabrication and erection, foundation, painting, and engineering. The budget estimate given does not include costs associated with tank demolition, site acquisition, and distribution interruptions.

[2] Heavy metal abatement is included in the economic factors; however, the hazardous disposal will not be required unless the abrasive residue is determined to be hazardous.

Tank Industry Consultants has no control over the cost of labor, materials, or equipment, or over the contractors' methods of determining prices, or over competitive bidding, or the market conditions. Opinions of probable cost, as provided for herein, are to be made on the basis of our experience and qualifications and represent our best judgment as design professionals familiar with the design, maintenance, and construction of concrete and steel plate structures. However, Tank Industry Consultants cannot and does not guarantee that proposals, bids, or the construction cost will not vary from opinions of probable cost prepared for the Owner.

Due to the numerous potential scopes of work which exist, the Owner should obtain an updated budget estimate once the final scope of work has been determined. This would enable the Owner to accurately budget monies for additional mobilization costs and damaged coating rehabilitation costs.

Attachment 9: Cal Am Response to the Public Advocates Office Data Request A.19-07-004 JMI-003, Q. 1.a.

California-American Water Company

APPLICATION NO. A.19-07-004
DATA REQUEST RESPONSE

Response Provided By:	**Tim O'Halloran**
Title:	**Manager Engineering- Project Delivery**
Address:	**511 Forest Lodge Road, Suite 100 Pacific Grove, CA 93950**
ORA Request:	**A1907004 CAL PA DATA REQUEST # JMI 03 HUCKLEBERRY HILL HYDROPNEUMATIC TANK AND RECENT MONTEREY PRESSURE EVENTS**
Company Number:	**Cal PA JMI 03 Q001**
Date Received:	**August 9, 2019**
Date Response Due:	**August 23, 2019**
Subject Area:	**Huckleberry Hill Hydropneumatic Tank and Recent Monterey Pressure Events**

DATA REQUEST:

1. Page 143 of the Direct Testimony of Ian Crooks discusses the Huckleberry Hill Hydropneumatic Tank Replacement project (I15-400124). Tab 54 of the Engineering Projects Workpapers also discusses project I15-400124.

a. Page 143 of the Direct Testimony of Ian Crooks states that the estimated project cost for I15-400124 is $1,260,000. Page 1-143 of Tab 54 of the Engineering Projects Workpapers shows the cost estimate for I15-400124. The cost estimate for this project is shown as a single line item with a lump sum of $1.26 million. Please provide a cost breakdown of the $1.26 million estimate. Please provide any supporting documentation used to calculate the cost breakdown of the $1.26 million estimate.

b. Page 1-144 of Tab 54 of the Engineering Project Workpapers references a tank inspection report prepared by TIC as supporting documentation. Please provide a copy of the aforementioned tank inspection report.

c. Page 1-144 of Tab 139 Monterey CPS Report indicates that pertaining to I15-400124, "No other projects are directly related to this project" and page B-274 discussing the need for a project to add two smaller service pumps at the same location is related. Please explain.

California-American Water Company

APPLICATION NO. A.19-07-004
DATA REQUEST RESPONSE

CAL-AM'S RESPONSE

California-American Water Company ("Cal Am") responds:

a. As is noted above, the figure provided for project costs was an estimate.. Cal Am hired Water Systems Consulting ("WSC") to prepare the Workpaper for the project. WSC mistakenly assumed the cost of this Hydropneumatic Tank Replacement to be similar to the cost of tank replacement for the Huckleberry Tank #2, which was recently replaced. A TIC inspection report prepared in March 2016 for Huckleberry Tank #2, an 800,000 gallon ground storage tank, estimated the cost of replacement for this tank to be $1,200,000, which was the figure used by WSC. Hydropneumatic tanks, however, are less costly to replace than tanks such as Huckleberry Tank #2.

   A hydropneumatic tank can be manufactured by a pressure vessel manufacturer at a cost of $10,000-$20,000. Additionally, this project will include replacement of approximately 200 feet of aboveground piping that has rusted significantly. The project will also necessitate a method of water distribution during the time the hydropneumatic tank is out of service, which will likely include installation of two smaller distribution pumps that can service the residential connections without the need for a surge tank. When approached for a preliminary proposal to demo and replace the hydropneumatic tank along with associated piping and hazardous waste disposal, the contractor estimated $170,000. The project estimate based on this information is therefore revised to be $399,000, with the following breakdown:

Contractor – Distribution Pumps	$100,000
Contractor- Tank Demo/Install	$170,000
30% Contingency	$81,000
TIC Tank Specifications	$25,000
Construction Inspection	$10,000
Operator Time	$4,000
Overhead	$9,000
Total	$399,000

   This revised estimate will be reflected in the 100-Day Update.

b. Please see tank inspection reports for both tanks attached as Cal PA JMI 03 Q001 Attachments 1 and 2.
c. As is noted below, the distribution pumps relate indirectly to the tanks. The Huckleberry site currently serves 116 residential connections with a peak hour

Attachment 10: Cal Am Response to the Public Advocates Office Data Request A.19-07-004 JMI-004, Q. 3 and 4.

California-American Water Company

APPLICATION NO. A.19-07-004
DATA REQUEST RESPONSE

Response Provided By:	**Mark Reifer**
Title:	**Engineering Manager – Project Delivery**
ORA Request:	**A1907004 CAL PA DATA REQUEST # JMI 04 TANK REHABILITATION**
Company Number:	**Cal PA JMI 04 Q003**
Date Received:	**August 13, 2019**
Date Response Due:	**August 27, 2019**
Subject Area:	**Tank Rehabilitation**

DATA REQUEST:

3. In regards to the Ventura Tank Rehabilitation and Seismic Upgrades Program (I15- 510054), pages 1-48 and 1-49 of Tab 126 of the Engineering Projects Workpapers lists the estimated tank rehabilitation cost for the Los Robles II Tank, Greenridge Tank, White Stallion Tank, Potrero I Tank, Shopping Center II Tank, Dos Vientos IIA Tank, Dos Vientos IIB Tank, Dos Vientos III Tank, Las Posas I Tank, and Las Posas II Tank.

   a. Please provide the most recent tank inspection report for the following tanks:
      i. Los Robles II Tank
      ii. Greenridge Tank
      iii. White Stallion Tank
      iv. Potrero I Tank
      v. Shopping Center II Tank
      vi. Dos Vientos IIA Tank
      vii. Dos Vientos IIB Tank
      viii. Dos Vientos III Tank
      ix. Las Posas I
      x. Las Posas II

   b. Pages 1-48 and 1-49 of Tab 126 of the Engineering Projects Workpapers estimated the seismic upgrade costs for each of the tanks listed in question 3.a above as $500,000 per tank. Please provide a cost breakdown for this portion of the project. Please provide any documentation used as the cost basis for any of the unit cost(s) used to calculate the $500,000 unit cost estimate.

c. For the unit cost of $500,000 per tank mentioned in question 3.b above, if the unit cost was calculated based on previously completed projects to provide seismic upgrades for tanks, please provide a list of the completed projects used to calculate the unit cost. For convience, please fill in the table below.

Tank	District	Year	Tank Volume	Recorded Cost

CAL-AM'S RESPONSE

a. Please see the attached tank inspection reports for the requested tanks, attached hereto as Cal PA JMI 04 Q003 Attachments 01-10.

b. The cost estimates for seismic rehabilitation were provided by Mott MacDonald as part of their work on the 2019 Ventura County District Comprehensive Planning Study. Without a thorough evaluation of each tank, Mott MacDonald could not provide a more detailed estimate of the seismic rehabilitation costs. Therefore, they recommended California American Water first complete a seismic study, Project A-4, Water Storage Tank Seismic Study, page 1-13 to 1-15 of Tab 174 in the Engineering Project Workpapers. Completion of this study in 2021 will produce detailed costs estimates for seismic upgrades to begin in 2022.

c. The budgetary cost estimates were not based on previous California American Water seismic tank upgrades. These unit costs were based upon two tanks in Oak Lodge Water District, another water service provider, that were seismically retrofitted in 2013.

California-American Water Company

APPLICATION NO. A.19-07-004
DATA REQUEST RESPONSE

Response Provided By:	**Mark Reifer**
Title:	**Engineering Manager – Project Delivery**
ORA Request:	**A1907004 CAL PA DATA REQUEST # JMI 04 TANK REHABILITATION**
Company Number:	**Cal PA JMI 04 Q004**
Date Received:	**August 13, 2019**
Date Response Due:	**August 27, 2019**
Subject Area:	**Tank Rehabilitation**

DATA REQUEST:

4. Page 1-27 of Tab 34 of the Engineering Project Workpapers shows the cost estimate for the proposed Tank Rehabilitation and Seismic Upgrades Program in the Los Angeles District (I15-500071).

   a. The cost estimate on page 1-27 of Tab 34 of the Engineering Project Workpapers estimates the cost to seismically upgrade a tank larger than 1 million gallons is approximately $350,000. Please provide a cost breakdown for this portion of the project. Please provide any documentation used as the cost basis for any of the unit cost(s) used to calculate the $350,000 unit cost estimate.

   b. The cost estimate on page 1-27 of Tab 34 of the Engineering Project Workpapers estimates the cost to seismically upgrade a tank less than 1 million gallons is approximately $150,000. Please provide a cost breakdown for this portion of the project. Please provide any documentation used as the cost basis for any of the unit cost(s) used to calculate the $150,000 unit cost estimate.

   c. For the unit costs of $350,000 per tank and $150,000 per tank mentioned in questions 4.a. and 4.b above respectively, if the unit costs were calculated based on previously completed projects to provide seismic upgrades for tanks, please provide a list of the completed projects used to calculate the aforementioned unit costs. For convenience, please fill in the table below.

Tank	District	Year	Tank Volume	Recorded

				Cost

CAL-AM'S RESPONSE

Cal Am objects to this Request as overbroad and unduly burdensome, particularly to the extent the Request seeks "any documents." Subject to, but without waiving, these objections, Cal Am responds:

a. The cost provided is a budgetary estimate that will need to be refined once the seismic study is complete. As a general planning level cost, a smaller than 1 million gallon tank is estimated to cost $150,000 while a tank larger than 1 million gallons is estimated to cost $350,000. The cost estimates for seismic rehabilitation were provided by Stantec as part of their work on the 2019 Los Angeles County District Comprehensive Planning Study. Without a thorough evaluation of each tank, Stantec could not provide a more detailed estimate of the seismic rehabilitation costs other than a budgetary estimate. Therefore, they recommended that California American Water first complete a seismic study, Project A-9, Tank Seismic Evaluations, pages 1-36 to 1-38 of Tab 045 in the Engineering Project Workpapers. Completion of this study in 2021 will produce detailed costs estimates for seismic upgrades to begin in 2022.

b. The cost provided is a budgetary estimate that will need to be refined once the seismic study is complete. As a general planning level cost a smaller than 1 million gallon tank is estimated to cost $150,000 while a tank larger than 1 million gallons is estimated to cost $350,000. The cost estimates for seismic rehabilitation were provided by Stantec as part of their work on the 2019 Los Angeles County District Comprehensive Planning Study. Without a thorough evaluation of each tank, Stantec could not provide a more detailed estimate of the seismic rehabilitation costs other than a budgetary estimate. Therefore, they recommended that California American Water first complete a seismic study, Project A-9, Tank Seismic Evaluations, pages 1-36 to 1-38 of Tab 045 in the Engineering Project Workpapers. Completion of this study in 2021 will produce detailed costs estimates for seismic upgrades to begin in 2022.

Attachment 11: Estimated Potential Service Cost Impact

General[235]

District	# Services of Unknown Material	Total # Services	Source
Sacramento	43795	68691	California State Water Resources Control Board: Lead Service Line Replacement Inventory Status
Larkfield	374	2809	
Monterey	40121	53271	

Estimated Capital[236]

District	2021	2022	2023	2021-2023
Sacramento (excl. Dunnigan WW and Meadowbrook)	$ 397,506	$ 398,616	$ 399,727	$ 1,195,849
Dunnigan WW	$ 5,100	$ 5,114	$ 5,129	$ 15,343
Meadowbrook	$ 25,500	$ 25,572	$ 25,643	$ 76,715
Sacramento (Total)	$ 428,106	$ 429,302	$ 430,498	$ 1,287,906
Larkfield	$ 15,698	$ 15,742	$ 15,786	$ 47,226
Monterey	$ 346,474	$ 347,441	$ 348,409	$ 1,042,324

Depreciation

Depreciation	Rate	Source:	2023
Sacramento (Total)	2.24%	ALL_CH08_DEPR_RO_ Forecast; Y_Depr Rates WS-3 Tab	$ 28,849
Larkfield	2.90%		$ 1,370
Monterey	2.24%		$ 23,348

Net to Gross (NTG)[237]

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235 California State Water Resources Control Board Website: Lead Service Line Replacement Inventory Status. (https://gispublic.waterboards.ca.gov/portal/apps/Cascade/index.html?appid=7adcfc6473614ada9c0b9c351362a656). Accessed November 18, 2019.

236 ALL_CH07_PLT_RO_Forecast, Tab Total CAPEX by Project WS-9.

237 Cal Am's workpapers only provides a net to gross ratio for their "Northern Division", but not an individual net to gross ratio for the Sacramento and Larkfield districts. Therefore, the "Northern Division" net to gross ratio was used for the Sacramento and Larkfield districts. Similarly, Cal Am provides a net to gross ratio for their "Central Division", but not an individual

(continued on next page)

NTG	2023	Source
Sacramento (Total)	1.43169	ALL_CH02_SE_RO; OUT_NTG Multiplier Tab
Larkfield	1.43169	
Monterey	1.43169	

Rate of Return (ROR)

ROR rate	Source
7.61%	D.18-03-035

Calculation

District	=ROR*NTG*2023	2023 Depreciation	2023 Revenue Requirement	Cost per Service	Cost per Service /month
Sacramento (Total)	$ 140,319	$ 28,849	$ 169,169	$ 2.46	$ 0.21
Larkfield	$ 5,145	$ 1,370	$ 6,515	$ 2.32	$ 0.19
Monterey	$ 113,563	$ 23,348	$ 136,911	$ 2.57	$ 0.21

(continued from previous page)
net to gross ratio for the individual Monterey service areas. The "Central Division" net to gross ratio was used for the Monterey district.

Attachment 12: Cal Am Response to the Public Advocates Office Data Request A.19-07-004 JMI-002, Q. 3.

California-American Water Company

APPLICATION NO. A.19-07-004
DATA REQUEST RESPONSE

Response Provided By:	**Garry Hofer and Chris Mattis**
Title:	**Vice President of Operations, Director of Southern Operations**
Address:	**8657 Grand Avenue, Rosemead, CA 91770 1025 Palm Avenue, Imperial Beach, CA 91932**
ORA Request:	**A1907004 CAL PA DATA REQUEST # JMI-02 LEAD SERVICE REPLACEMENT**
Company Number:	**Cal PA JMI 02 Q003**
Date Received:	**July 25, 2019**
Date Response Due:	**August 8, 2019**
Subject Area:	**Lead Service Replacement**

DATA REQUEST:

3. In the last six years (2013-2018), what is the number of company-owned lead service lines Cal Am replaced each year for each district. For convenience, please fill in the table below.

	# Lead Company-Owned Services Replaced					
District	2013	2014	2015	2016	2017	2018
Sacramento						
Larkfield						
Monterey County						
Monterey Wastewater						
Ventura						
Los Angeles						
San Diego						

CAL-AM'S RESPONSE

	# Lead Company-Owned Services Replaced					
District	2013	2014	2015	2016	2017	2018
Sacramento	0	0	0	0	0	0
Larkfield	0	0	0	0	0	0
Monterey County	0	0	0	0	0	0
Monterey Wastewater	0	0	0	0	0	0

Ventura	0	0	0	0	0	0
Los Angeles	0	0	0	0	25*	0
San Diego	0	0	0	0	0	0

* The 25 replacements were not lead service lines. They were lead goose neck fittings.

Attachment 13: Witness Qualifications

QUALIFICATIONS AND PREPARED TESTIMONY OF JUSTIN MENDA

Q.1 Please state your name and business address.

A.1 My name is Justin Menda and my business address is 505 Van Ness Ave, California 94102.

Q.2 By whom are you employed and in what capacity?

A.2 I am a Utilities Engineer in the Communication and Water Policy Branch of the Public Advocates Office of California Public Utilities Commission (Cal PA).

Q.3 Briefly describe your pertinent educational background.

A.3 I received a Bachelor of Science Degree and Master of Science Degree in Civil Engineering from the University of California Irvine.

Q.4 Briefly describe your professional experience.

A.4 I have been employed by the Public Advocates Office – Communications and Water Policy Branch since June 2012. Since that time, I prepared testimony on capital investment in serval GRCs: California Water Service Company's 2012, 2015 and 2018 GRCs; California-American Water's 2013 and 2016 GRCs; San Jose Water Company's 2015 GRC; and Golden State Water Company's 2017 GRC.

Q.5 What is your responsibility in this proceeding?

A.5 I am responsible for the testimony on Cal Am's Proposed Plant, Depreciation, and Special Request #16, presented in this report.

Q.6 Does that conclude your direct testimony?

A.6 Yes, it does.

ATTACHMENT 4

Docket:	:	A.15-07-015
Exhibit Number	:	ORA - ____
Commissioner	:	Catherine Sandoval
Administrative Law Judge	:	Jeanne McKinney
ORA Witnesses	:	Jenny Au
		Daphne Goldberg
		Pat Ma
		Justin Menda
		Susana Nasserie
		Brian Yu

ORA
OFFICE OF RATEPAYER ADVOCATES

OFFICE OF RATEPAYER ADVOCATES
CALIFORNIA PUBLIC UTILITIES COMMISSION

***** PUBLIC VERSION (redacted)*****

REPORT ON PLANT – COMMON ISSUES

California Water Service Company
Test Year 2017 General Rate Case
A.15-07-015

San Francisco, California
March 2016

In addition, the pipeline unit costs that CWS used in its budget estimate for the King City and the East Los Angeles Districts are based on incorrect unit costs. The workpapers that CWS provided do not support the unit costs used in the budget estimates for these two districts.[96]

d. ORA's Recommended Budget Estimates

While it may not always be possible for CWS to exactly match the cost data between proposed and historical pipeline projects, as described above, CWS's pipeline budget estimation approach produces overly generalized and non-representative unit costs. In instances described below, it results in over-inflated cost budgets. CWS presents a general annual budget estimate for each district by multiplying the total amount of pipeline requested by these questionable unit costs. Instead of extracting a unit cost from a limited set of sometimes very dissimilar pipeline projects, it is more reasonable for estimating purposes to consider the total historical expenditures and total length constructed recently – in this case, from 2009 to 2014. The total historical pipeline expenditures would capture the various costs of pipeline construction projects that CWS has constructed and would provide a better, more normalized indicator of average unit cost to estimate future projects' costs. To arrive at a unit cost, ORA escalates the 2009-2014 historical expenditures from each year to 2014 dollars, totals the escalated annual expenditures, and then divides the total pipeline lengths constructed in those years. ORA did not load the historical unit cost with a Contingency factor because contingency is typically needed for unforeseen events. Any unexpected/unforeseen expenditures associated with pipeline installation projects in the past six years would have already been captured in the historical data. Also, ORA did not include an overhead rate because historical unit cost already included this expense. This concept is used to estimate the unit cost in each district and to estimate the pipeline budget based on the amount of pipeline ORA recommended for replacement.

[96] Email from Paul Yang of CWS to Jenny Au of ORA (November 13, 2015, 9:49AM PT) (on file with author).

ATTACHMENT 5

Docket	:	A.18-07-001
Exhibit Number	:	Cal Advocates - ____
Commissioner	:	Liane Randolph
Administrative Law Judges	:	Eric Wildgrube, Charles Ferguson
Cal Advocates Witnesses	:	Brian Yu Alex Lau Justin Menda Kyle Graff Zaved Sarkar Cortney Sorensen

PUBLIC ADVOCATES OFFICE
CALIFORNIA PUBLIC UTILITIES COMMISSION

REPORT ON PLANT – COMMON ISSUES

California Water Service Company
Test Year 2020 General Rate Case
A.18-07-001

San Francisco, California
February 2019

Cal Water retained Blair, Church & Flynn Consulting Engineers (BCF) to analyze Cal Water's completed capital projects and cost overruns. BCF's report claims that a representative sample of projects whose cost estimates included a 10% contingency had a total cost overrun of 13.5%.[27] The report states that the contingency of 10% was inadequate when compared to industry standards.

According to Cal Water, BCF found gaps in Cal Water's capital project cost estimating practice and recommended several ways to improve cost estimates. These include the implementation of Contingency Factors,[28] Location Factors[29] and Risk Factors[30] to arrive at a Total Contingency factor.

Cal Water states that it also conducted an evaluation of completed projects from 2016 and tested various rates (10%, 0% and the BCF-recommended contingency).[31] Cal Water claims that the application of BCF-recommended contingency shows decreased cost discrepancy and improved cost estimates.[32]

Cal Water asserts that its proposal to implement the new contingency protocol will increase the accuracy of cost estimates for this GRC cycle.[33]

D. PUBLIC ADVOCATES OFFICE'S ANALYSIS

The use of contingency factors is an acceptable practice to account for unseen changes in scope or unexpected expenses of capital projects. However, Cal Water's proposal to

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[27] Cal Water Capital Project Justifications Common Plant, p. CP PJ-146.

[28] Cal Water Capital Project Justifications Common Plant, p. CP PJ-148. See section: *Contingency Factors.*

[29] Cal Water Capital Project Justifications Common Plant, pp. CP PJ-148-150. See section: *Location Factors.*

[30] Cal Water Capital Project Justifications Common Plant, pp. CP PJ-150-151. See section: *Risk Factors.*

[31] Cal Water Capital Project Justifications Common Plant, pp. CP PJ-152-153. See section: *Evaluation Methodology.*

[32] Cal Water Capital Project Justifications Common Plant, p. CP PJ-154.

[33] Cal Water Capital Project Justifications Common Plant, p. CP PJ-155.

ATTACHMENT 6

"Control of Project Risk for Owners"

Chris Carson, CCM, PMP, PSP
Director of Program and Project Controls, Arcadis U.S., Inc.

Executive Summary

Maximum and most effective control of Owner's project risk requires a risk planning and management culture integral to the project controls disciplines of cost and time management. There is no simple one-step process, but rather a proactive and planned effort. The approach includes special attention to specific high-risk areas of construction management including scope definition, type of contract, contractual language used in the contract, the choice of project delivery method, the change management process, the quality and experience of the CM team, the procurement process, an integrated cost and schedule management approach using risk workshops to provide high value input into the program. Success correlates with collaboration among the full construction team, and a strong integrated cost/schedule/risk approach improves collaboration.

Table of Contents

Background

Owner risk tolerance is a necessary discussion as an integral part of planning a project or program. Understanding the level of tolerance is vital to several of the tasks in the planning effort. Risk can and should be addressed in the scope definition, in the contract type, in the contractual language, in the choice of project delivery method, in the change management process, in the quality and experience of the management staff, in the procurement process, in the integrated risk/schedule and in the implementation of the plan. Types of risk run the gamut from cost to schedule to political to performance risk, and each can be dealt with differently in the planning effort to ensure the appropriate risk assignment and acceptance for each Owner.

The Construction Management Association of America (CMAA) notes that in the best interest of the project, risk should be assigned to the party most capable of managing the risk. This requires a constant evaluation of the ability of each party to manage the risk, and alignment with the risk under review.

Scope Definition

This is the first decision that should be made by any Owner but is routinely ignored or minimized, partly because it is driven by the investment in design services. The level of scope definition directly affects the level of risk for any given project. Therefore, professional and experienced estimators recommend contingencies that can be reduced as the maturity of the scope definition is improved. Weak contingency estimating and misuse account for a significant percentage of claims, which are failures in properly assigning and managing project risk. The reasons for these failures often relate to failure to understand the level of scope definition at the time of procurement. There is a wide range of levels of scope definition based on the contract with the designer, and again with the quality of the final design as disseminated to the Contractors at bid and procurement stages.

The Association for the Advancement of Cost Engineering (AACE) International, a project controls and cost engineering professional association, notes the maturity of scope definition is aligned with the level of accuracy of the cost estimate, as well as the appropriate usage of the schedule based on the degree of project definition.

The table below, Figure 1, shows the suggested Estimate Classes and the associated Maturity Level of Project Definition Deliverables aligned with the Methodology and Expected Accuracy Range. The accuracy range speaks directly to the risk associated with the cost estimate; the tighter the accuracy range, the lower the risk of meeting that cost. The accuracy range also demonstrates the benefits for probabilistic risk assessment that help ensure better understanding of the potential consequences of the decisions.[i]

When the culture accepts that an estimate provided at 30% scope definition cannot be accurate to within +/- 5%, the Owner is better protected recognizing that the budget estimate at 30% scope definition is more appropriately considered as a -10% / +40% range of accuracy. This ensures that the estimate aligns with the scope maturity and the ability of the estimator to use appropriate tools to estimate the work.

	Primary Characteristic	Secondary Characteristic			
ESTIMATE CLASS	MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES Expressed as % of complete definition	END USAGE Typical purpose of estimate	METHODOLOGY Typical estimating method	EXPECTED ACCURACY RANGE Typical +/- range relative to index of 1 (i.e. Class 1 estimate) [a]	PREPARATION EFFORT Typical degree of effort relative to least cost index of 1 [b]
Class 5	0% to 2%	Screening or feasibility	Stochastic (factors and/or models) or judgment	4 to 20	1
Class 4	1% to 15%	Concept study or feasibility	Primarily stochastic	3 to 12	2 to 4
Class 3	10% to 40%	Budget authorization or control	Mixed but primarily stochastic	2 to 6	3 to 10
Class 2	30% to 75%	Control or bid/tender	Primarily deterministic	1 to 3	5 to 20
Class 1	65% to 100%	Check estimate or bid/tender	Deterministic	1	10 to 100

Notes: [a] If the range index value of "1" represents +10/-5%, then an index value of 10 represents +100/-50%.
[b] If the cost index value of "1" represents 0.005% of project costs, then an index value of 100 represents 0.5%.

Figure 1 - Cost Estimate Classification Matrix for Construction from AACE RP No. 17R-03[ii]

	Primary Characteristic	Secondary Characteristic		
ESTIMATE CLASS	MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES Expressed as % of complete definition	END USAGE Typical purpose of estimate	METHODOLOGY Typical estimating method	EXPECTED ACCURACY RANGE Typical variation in low and high ranges
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Figure 2 - Cost Estimate Classification Matrix for Process Industries from AACE RP No. 18R-97[iii]

Capturing the full scope definition requires an appropriate and reasonable schedule and allows adequate time to support building in quality instead of inspecting quality. Finishing a project on time using the right schedule will help minimize risks and reduce cost overruns. This is part of the AACE's Total Cost Management philosophy and classifying schedules like cost estimates aligned with the typical Phases and Stage-Gates defines the project life-cycle.

AACE Recommended Practice No. 27R-03, “Schedule Classification System”, provides these schedule classes designations and shows how they align with project scope definition maturity. From this RP, Figure 2 below addresses how the scheduling methods achieve reasonable project duration and planning dates while covering scope definition maturity.

	Primary Characteristic	***Secondary Characteristic***	
SCHEDULE CLASS	**DEGREE OF PROJECT DEFINITION (Expressed as % of complete definition)** [1]	**END USAGE**	**SCHEDULING METHODS USED**
Class 5	0% to 2%	Concept screening	Top down planning using high level milestones and key project events.
Class 4	1% to 15%	Feasibility study	Top down planning using high level milestones and key project events. Semi-detailed.
Class 3	10% to 40%	Budget, authorization, or control	"Package" top down planning using key events. Semi-detailed.
Class 2	30% to 70%	Control or bid/tender	Bottom up planning. Detailed.
Class 1	70% to 100%	Bid/tender	Bottom up planning. Detailed.

Figure 3 - Schedule Classification Matrix - From AACE RP No. 27R-03[iv]

Lessons learned from forensic analysis of disputes and industry studies show that the largest risks to project success lie in the scheduling effort, the cost estimating effort, and the failure to use risk management processes to ensure appropriate budgets and project durations. In fact, risks from schedule, cost, and risk are twice as serious to project success as technical, design, and engineering issues.[v]

Contract Type

Contracts are primarily either Fixed Price (Stipulated Sum) or Cost Reimbursable formats. There are some variations such as Guaranteed Maximum Price (GMP), Cost Plus Fee, Unit Price, Fixed Price with Incentives, or combinations of these alternates. Allocation of risk is determined by the type of contract, with fixed price contracts shifting performance risk to the Contractor and cost reimbursable contracts accepting risk by the Owner.

With fixed price contracts, there must be adequate competition in order to make the proposals effective, and cost and pricing information must be available. The Contractor in a fixed price contract will accept a price which represents assumptions of a reasonable apportionment of risk. This means that the Contractor must be able to estimate uncertainties in contract performance, as well as fully understand the contract scope. Less than fully mature scope definition in drawings will increase costs at bid and increase change management efforts, resulting in higher change costs.

Cost reimbursable contracts are used when the uncertainties of performance do not allow accurate costs to be developed and use of a fixed price contract would yield very high bids. These contracts place the bulk of the risk on the Owner and should only be used in specific cases, especially since there is little incentive for the Contractor to control costs. When used, the Owner should recognize that minimizing cost and time overruns require careful documentation of actual cost and time, daily if possible. This approach will limit the ability of contractors to confuse time spent on original contract work with time spent on the additional T&M scope.

One of the places where Owners assume unintended risk is in the change management process during design and construction. The goal of change management should be to place the Owner and Contractor back in the same risk profile as the original contract dictated, however, when change management is not handled in a timely and effective way, the Owner often assumes additional risk. The solution to this is to prepare accurate estimates and time impact analyses that can be used to negotiate change orders, including, legitimate time extensions, as early as possible. This timely approach to change management reduces the owner assumption of performance risk, avoids claims such as constructive acceleration, and keeps the schedule as a good model of project status, capable of use in analysis of delays.

Contractual Language

There are a variety of approaches to limit or shift risk in the contract, regardless of the project delivery method or contract type. These approaches are defined in the contractual language and can affect risk for time and costs.

Time risk assignments occur with language to limit or assign ownership of project float, which is generally Total Float. Delays which would be compensable to the Contractor must occur on the Critical Path of activities which control the project duration, so these are typically zero float activities. Since it is possible to assign the ownership of float, the Owner can take this ownership and limit the ability of the Contractor to earn extensions of time. The quality of the schedule is a significant factor in management of float, and that requires a high level of technical schedule review, in the baseline and all updates.

When the contract is silent with respect to float ownership, in most states the float is owned by the project and shared by Owner and Contractor. The Owner must manage this issue by protecting against a Contractor using up all available float for an Owner to discover that there is a change order needed which would then be compensable. Careful schedule review and monitoring to ensure that float is accurately calculated and reported is essential in protecting against this risk.

Another place where Owners can protect themselves against performance risks is by using language to limit or prevent the possibility of a Contractor pursuing a compensable extension of time based on an early completion schedule. Case law suggests that a Contractor has a right to finish early, so if he bids a project and reduces the costs by planning to finish in less time than the contractual completion date (CCD), he could earn extended general conditions if the Owner causes a delay beyond the Contractor's early completion date and the CCD. There are a number of clauses that protect against the Contractor's early completion schedule and leave flexibility in the schedule for Owner needs. This is especially important if the Owner cannot take occupancy of the project earlier than the CCD, which can often be the case.

The subject of notice from the Contractor to the Owner about alleged delays is another place where risk can be controlled. Contract language requiring the Contractor to provide formal, written notice of any delay will limit the risk of large change orders that come as a surprise to the Owner with the late discovery limiting the ability of the Owner to participate in mitigation decisions and actions. This language often defines failure to provide sufficient or timely notice as a waiver of rights to make a claim. Waivers can show up in change order requests either as contractual language related to required processes to perfect a change request, and if the Contractor breeches those requirements, can lose entitlement to the additional costs and time involved in the change.

A risk shifting approach that Contractors often use is a reservation of rights provided with change orders. This is an attempt to keep options open for future claims of indirect, consequential and/or cumulative disruption costs and time impacts. This approach can alter change order language that otherwise notes that the change order settles all cost and time claims associated with the issue. If the goal is to maintain the assignment of performance risk to the Contractor in the original contract, reservation of rights can move the risk of performance over to the Owner during change order negotiations and resolution.

Another set of risk shifting language is that of exculpatory contract clauses, sometimes called disclaimers, which attempt to absolve responsibility for damages from future or unknown circumstances. This is a way to shift undetermined risk to the Contractor from issues like third-party uncontrolled risks. It also occurs in existing conditions such as geotechnical reports and Owner limitations for information only or differing site conditions. These can also be pay when paid or indemnity clauses, all of which require experienced legal support to provide maximum value in the use.

The last set of risk shifting language is that of the no damages for delay, and this limits delay entitlement to time only. It is important when using this type of language to ensure that no exemptions to no damages for delay are created by interference by the Owner, bad faith, or delays that just were not contemplated. But no damages for delay clauses shift risk to the Contractors who do not have the ability to control that risk, so the use of this approach tends to increase the costs and detracts from the collaborative construction team effort that is most effective.

Choice of Project Delivery Method

There are four basic project delivery methods, Design-Bid-Build (DBB), Design-Build (DB), Construction Management at Risk (CMAR), and Integrated Project Delivery (IPD), as well as several variations of these methods. Each method carries a different level of risk for the owner, and this is related to the amount of control that the Owner accepts over the project. Risk and control are inversely related so one way to reduce risk is to choose a project delivery method that lowers Owner's risk but also gives up more Owner's control.

This risk profile is illustrated in a CMAA chart shown in Figure 2 below, which lists the range for Public-Private-Partnerships (P3), a similar delivery method as DB except for financing and operations by the Contractor, DB, DBB, CMAR, and Multiple Prime contracts, which place the risk of contract coordination onto the Owner.

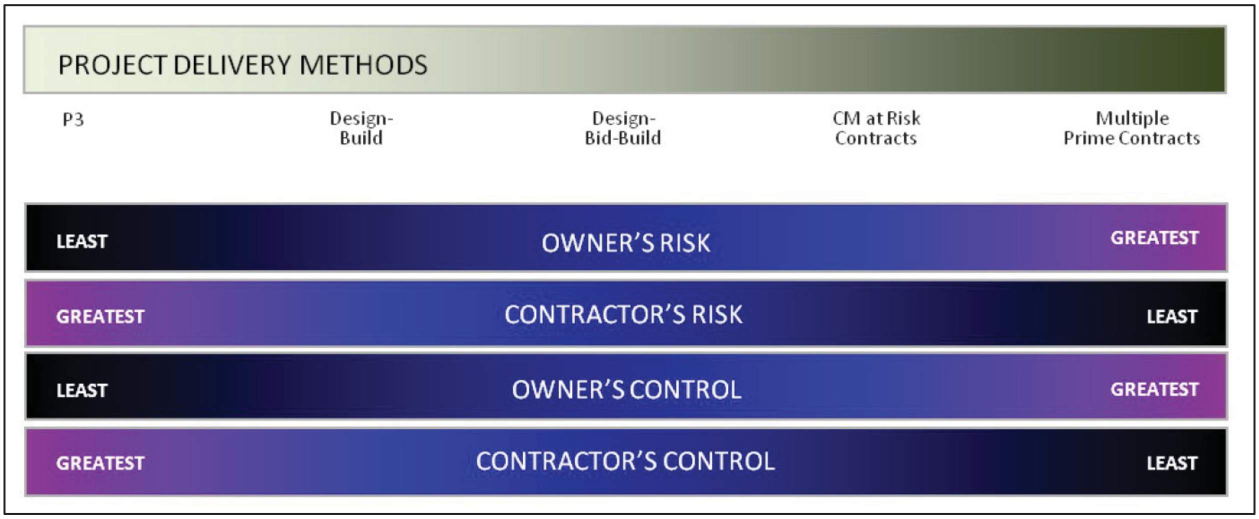

Figure 4 - Project Delivery Methods - Risk and Control[vi]

The choice of project delivery method also depends on the level of scope definition. A DBB project cannot be utilized if the scope definition is not very mature or change management will exceed contingencies for time and budget. On the other end of the scale, attempting to provide too complete of a scope definition for a PPP project will reduce flexibility and limit the innovation freedom to control risks that is at the very heart of this type of delivery.

Each type of project delivery method has risks that must be managed to ensure success. For example, in the CMAR delivery, establishing a detailed preliminary budget, a formal stage-gate approach to cost/schedule/risk during design development, and correlation with each evolving budget and the award letters to the preliminary budget, all promote the "design-to-cost" effort and allow for a reasonable and achievable final guaranteed maximum price when the CMAR becomes a General Contractor and takes on full performance risk. Without serious controls in place to evaluate the CMAR budgets and schedule, and without ensuring the competitiveness and accuracy of the award of subcontracts, the project can start out by draining the Owner's contingencies, only to discover that there are huge savings which might be split after final audits. That ties up contingency monies that should have been drawn down for the Owner's benefit and returns it too late for the project but ensures the Contractor makes their additional fee.

Change Management Process

A planned and well-managed change management process is very important to managing and minimizing risk for a successful project. Planning for change management starts with a careful definition of changes, establishing the types of change so appropriate funding planning can be provided. Some changes are issues that occur in most projects, such as unforeseen conditions, and some are issues that cannot be easily anticipated, such as scope changes by end-users. Planning for defined categories of changes allows alignment between categories and funding.

After all, that is the real root of the matter, if legitimate change happens and there is a fund set up to accommodate the change, there is no impact to the project. Once the categories of change are established (and many contracts as well as AACE RPs offer definitions), it is possible to plan for how to fund the changes when they occur. Looking at two broad funding approaches, Contingency and Management Reserves, the difference in the use is that Contingency is intended to be used for changes that are expected to happen even if the extent is not known, and Management Reserves are intended to fund scope requests that are not included in the original scope description, and hence the budget, from the Owner, End-User, A/E.

AACE defines Contingency, in the Cost Engineering Terminology RP, as "*An amount added to an estimate to allow for items, conditions, or events for which the state, occurrence, or effect is uncertain and that experience shows will likely result, in aggregate, in additional costs*."vii Contingency does not include major scope changes, Force Majeure events, management reserves, escalation and currency changes.

Contingency can be carried in the original budget, and during the Stage-Gate process of Project Controls, can be subdivided into specific categories such as Design Contingency, Estimating Contingency, Procurement Contingency, Construction Contingency. Note that not all contingency funding is due to specific risk events, some is needed for accommodating the standard of care in the construction process, from design to estimating to construction. There is some level of design errors and omissions that falls outside the industry standard of care which recognizes that scope definition in the way of plans and specifications cannot be perfect. This is part of the purpose of Contingency.

AACE defines Management Reserves, in the Cost Engineering Terminology RP, as "*An amount added to an estimate to allow for discretionary management purposes outside of the defined scope of the project, as otherwise estimated*." This is where an Owner would normally fund the items not included in Contingency, such as scope change. Management Reserves would typically be carried outside the project, and managed by the Program Manager or Owner, not the Project CM team. The better the definition of these terms, the easier it is to manage and account for change orders.

Estimating Management Reserves is more difficult than Contingency because this fund is designed to cover unknowns such as improvements in technology that might interest the end user to upgrade equipment that was specified in the original scope definition, is still sufficient, but not the most desired technology.

Contingency and Management Reserves cover the risks that can be planned, but a robust Change Management effort during design, procurement, and construction is important to control these risks. Use of a formal Stage-Gate process during the design phase is vital to supporting "design-to-budget" efforts. Use of a thorough review and evaluation of the procurement process improves the selection of contractors and suppliers and correlating the procurement basis to the budget and schedule helps ensure adequate time and money. Use of a robust Change Management effort during construction ensures that original contract scope is provided, that Contingency is drawn down appropriately and according to the relief of risks, and Management Reserves are used appropriately.

When it comes to change management for an existing project, providing accurate AACE Class 2 or Class 1 estimates for changed conditions is vital to evaluate the costs. Without the ability to discuss specific quantities and unit costs for changes, the Owner is at a huge disadvantage, and in negotiations, it is common to find that the subcontract portion of the general contractor's estimate that is poorly documented will be reduced in the face of a detailed check estimate. In addition, when there is a time impact from a changed condition or delay, the costs for the extended general conditions when the project is truly prolonged can be a large part of the total change order. This makes it imperative that a good process to develop independent Time Impact Analyses (TIA) in order to evaluate the contractor's TIAs, and armed with this independent evaluation, the negotiations are quicker and easier.

Once a delay or impact event has been identified, prior to absorbing the delay into the schedule and project, the goal should be to quickly move the Owner back to the original risk allocation strategy from the contract, which is usually assigning the cost and time performance to the contractor. This requires negotiating any extensions of time (EoT) that the contractor is entitled to received after careful analysis to validate the request or need. Issuing the proper EoT in a timely fashion fulfills the need to allocate the risk properly and eliminates the risk of constructive acceleration to the project. Owners are at risk of turning non-compensable time extensions into compensable acceleration efforts simply by not awarding legitimate EoTs as they are earned.

Control of risks from change is dependent on this full Change Management process being implemented competently in order to ensure scope is defined and the increasing maturity of scope definition is monitored to enable the ability to "design-to-budget".

CII (Construction Industry Institute) ran a research project "to evaluate the level of engineering **maturity** needed at Project Authorization, but also the **accuracy** of these engineering deliverables." This Front End Engineering Design process is shown in the graphic below, which indicates the Gate 3 which cannot be opened to release further design development until the process yields the appropriate maturity and accuracy of the design.

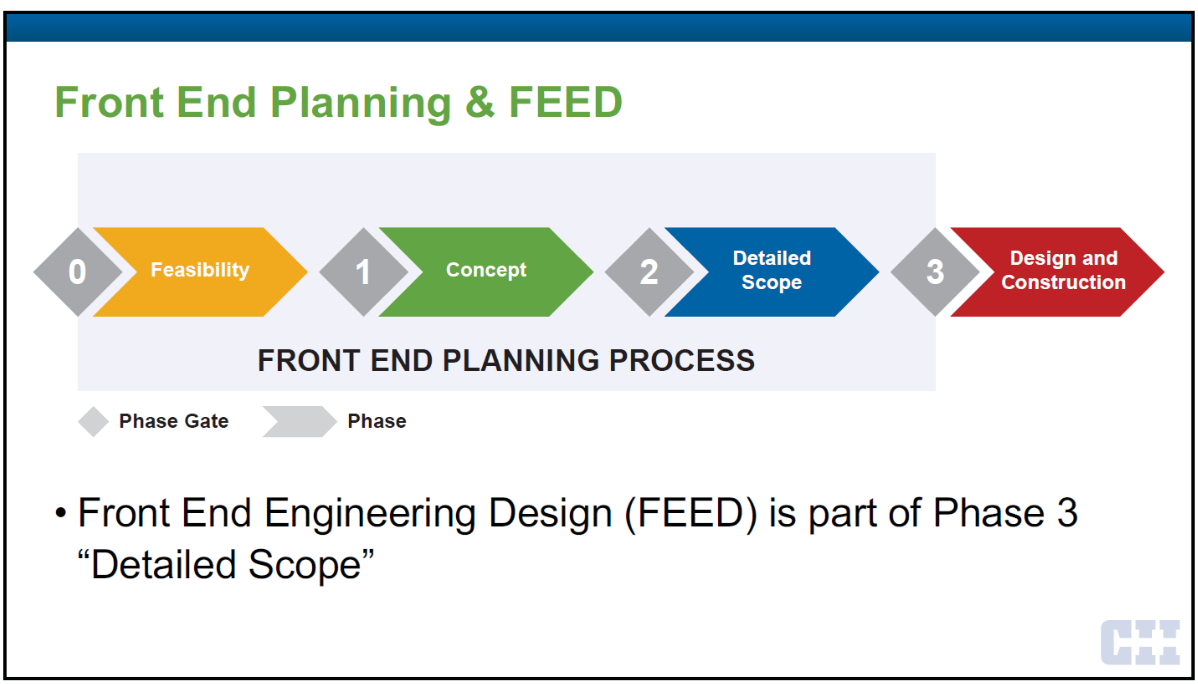

Figure 5 - Front End Engineering Design Process (CII)[viii]

With **maturity** addressing the degree of completeness and **accuracy** addressing the degree of confidence in the measure of maturity, the research project developed a tool to be used to assess the maturity vs. accuracy. found a 24% cost difference between "High Maturity High Accuracy and Low Maturity Low Accuracy Front End Engineering Design".

The tool was used to assess 11 projects of over $5.1B construction value in the survey, ranging from chemical plants to a storage facility, and yielded the 24% cost difference in the summary shown below:

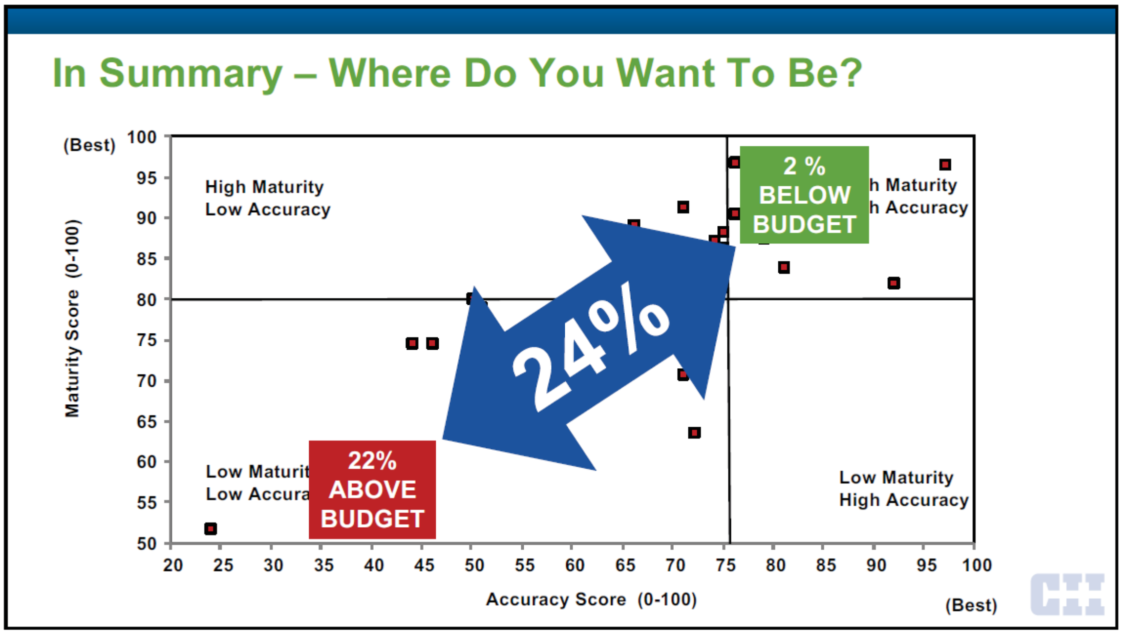

Figure 6 - Study Summary Cost Difference (CII)[ix]

Quality and Experience of the Construction Management Team

Managing risk starts with pre-planning and must be at the forefront of management throughout the construction project. Shallow efforts to develop initial risk management plans without a very experienced team to support and implement the plan will result in dusty risk management plans sitting on shelves providing no value.

While risk is a common buzzword, few stakeholders in projects have a strong depth of understanding of risk and the risk processes. Risk must be integrated into the construction management processes, and the CM staff should be well versed in risk principles and implementation.

Experience in risk management is very important to anticipate the typical problems that occur and bring the lessons learned from previous projects to the planning of each new project. Lessons learned can come from project experience but also from claims and dispute resolution experience. In fact, since claims result from failures in risk management, these lessons are often more valuable than project lessons. Engaging in forensic schedule and cost analysis requires a deep understanding of CPM scheduling, forensic analysis methodologies, negotiations skills, and cost and time legal principles. The experiences of reviewing schedules and documentation to determine what happened to cause delays, determine the quantum of delay, examine entitlement and liability, and place responsibility for delays, all contribute to a much better understanding of project risk and how to control it. This means that CM team members who have forensic analysis and dispute resolution are much more competent to manage risk during the project life-cycle. Involvement in Industry association publications such as the AACE's Recommended Practice 29R-03, "Forensic Schedule Analysis" is valuable, this is probably the best explanation and taxonomy of methodologies used to analysis and resolve disputes. Lessons learned during development of these types of industry best practices are invaluable in predicting risks and mitigating to avoid cost and time overruns.

While few academic programs include knowledge of risk management as a prerequisite for a professional degree, there are professional certifications that support understanding of risk. At the construction/project management level, the Project Management Institute (PMI) includes risk management as one of the knowledge areas, so a Project Management Professional (PMP) certification would indicate exposure to risk on project work, not specifically construction projects, but still project risk. The Construction Management Association of America (CMAA) offers the Certified Construction Manager (CCM) certification and the CMAA Standards of Practice as taught for the CCM fully integrate risk into the CM processes, and these are specifically for construction projects.

When it comes to specialization in risk management, there are two primary industry risk certifications; the Risk Management Professional (PMI-RMP) by PMI and the Decision and Risk Management Professional (DRMP) by AACE International. Once again, the PMI-RMP is not specifically designed for construction as is the DRMP but the general risk processes are the same regardless of industry. AACE believes that it is not possible to separate decision and risk so both need to be taught and certified.

Since control of risk to the Owner involves cost and time, it is important that an integrated effort of cost and schedule risk management is undertaken, which elevates the value of the cost and schedule certifications. For construction projects, the PMP is useful but the CCM is invaluable as it addresses these areas. Specialization in cost and time certifications is important for CM staff to support risk control for Owners, and AACE International is the best of the industry associations that issue these certifications. The Certified Cost Professional (CCP) is a generic certification which provides a good overview background in time, cost, and risk, offered by AACE. Cost estimators can earn the Cost Estimating Professional (CEP) and schedulers can earn the Planning & Scheduling Professional (PSP) certifications, both of which demonstrate a detailed understanding and experience in cost and time. The largest risks to project success are related to cost, time, and risk itself, as demonstrated below:

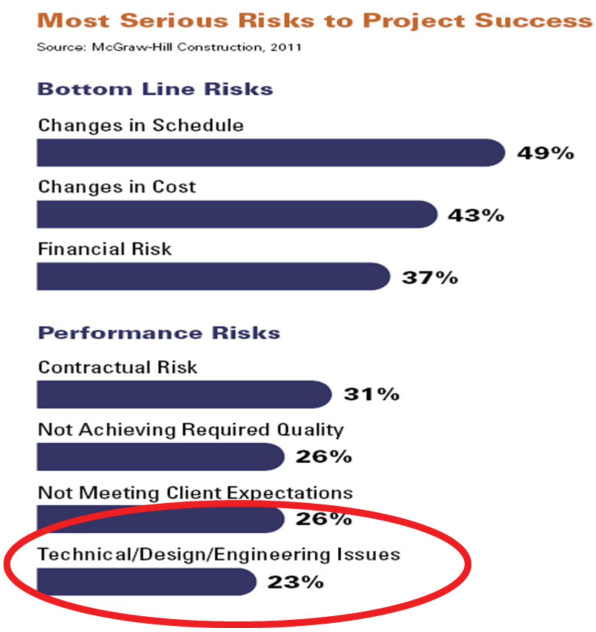

Figure 7 - Risks to Project Success[x]

While part of the value of industry professional associations includes CM professionals earning industry certifications, a greater part of the value is the engagement in these associations by writing and presenting papers on various cost, scheduling, and risk topics. This engagement takes a CM professional from an expert in these fields to an industry thought leader. At this level, the professional has taken the lead in innovative approaches to managing risk and has defended those approaches from industry constructive criticism, improving the approach.

Procurement Process

Once the contract type and project delivery methods are chosen, and the appropriate risk assignment language has been selected, it is vital that the procurement process is managed with an eye to limiting risk. Many disputes start with a breakdown in procurement.

A quality check on the procurement is to evaluate the number of questions or requests for information that result from Contractors starting their cost estimate. If there are large numbers of questions, the documents do not convey the appropriate scope definition and the project contingency is likely too low as the result will be an increase in change requests. A careful evaluation of the bidders, including trade and general conditions comparisons, is vital to ensure appropriate awards. Lessons learned from claims shows that a frequent problem with projects that had cost and time overruns was an inappropriate award to the “low” bidder. This can be due to insufficient general conditions, unbalanced subcontract trade bids, inappropriate project duration estimate, missing scope, and inadequate or lack of contingency.

Constructability reviews, value planning and engineering, along with better designer quality control of documents, are valuable mechanisms to reduce risk to the Owner. Owner risk is enhanced since these same defects in scope definition will generally raise the bids from the Contractors attempting to limit their risk.

Integrated Cost and Schedule Management

Risk control attempts to predominantly avoid cost and time losses, and while these are discussed separately, they should be managed in an integrated approach with risk management. Early risk assessment identifies project or program risk issues that can then be monitored and controlled. This can start with identifying cost and risk drivers during value planning and monitoring those drivers throughout the stages of cost and schedule development in conjunction with scope definition development. Risk-based approaches to determine appropriate contingency and management reserve are probabilistic and deterministic, and support risk control for an Owner. AACE has a number of excellent Recommended Practices for determination of cost and time contingency, from range estimating to expected value approaches, as well as those for integrated cost and schedule risk analysis.

Then as soon as a preliminary schedule is developed that shows a reasonable level of detail and full scope, an integrated cost and schedule risk management effort can be facilitated. From simple qualitative risk assessment of risk drivers to comprehensive quantitative risk assessment looking at risk drivers as well as uncertain durations and what-if scenarios for conditional branching risks (acceptance of one risk can cause new conditions that branch out into new risk directions), all risk approaches bring value to the process of managing Owner's risk.

While it is possible to provide schedule risk management as a stand-alone effort, it is not useful to attempt to provide cost risk management with considering the schedule as schedule is a significant risk driver for cost. The integrated cost-schedule approach to risk assessment provides the most valuable results.

Use of Risk Workshops to Identify and Manage Risk

Risk workshops range from simple one day efforts to multi-day, multi-meeting workshops, and all efforts add value to the process, improving the control of risk. A qualitative integrated cost-schedule risk workshop designed to identify and manage risk drivers will capture the combined experience and lessons learned of all the participants in the workshop. Facilitated properly, this workshop will allow the participants to identify all risks, prioritize the risks based on probability and consequence, and write response plans that have the effect of removing the highest priority risks from the schedule and project. These risk removal efforts include time-based practical steps developed by the CM team based on their experience. The deliverables from the workshop also start the risk monitoring effort which keeps risks and risk monitoring at the forefront of project discussions. Awareness of potential risks and review of them at the time of inception will allow proactive actions to minimize or mitigate the risk impacts.

In addition to the value from the risk management, these workshops help to establish a partnering or collaborative approach to construction management, which has proven to drastically improve performance and reduce claims.

Implementation of the Plan

The best way to manage Owner risk is to develop the risk management plan early in the pre-project phase looking at systemic risks and major risk drivers, update it during design phases developing and monitoring project risks, and allow it to evolve into the full integrated cost-schedule risk management plan, and use the output or deliverables from each stage to manage the next stage. Accurate cost estimates with appropriate contingencies, developed at the appropriate level of accuracy, integrated with the evolving schedules, starts the project with the right benchmarks to monitor. With preliminary schedules established, a strong risk workshop enables the CM team to identify the likely risks, eliminate the highest priority risks by the risk response plan, and then monitor the ongoing risks to avoid or mitigate those risks during the project.

This approach takes advantage of the combined experience of the CM team and embraces risk as an integral part of the CM process such that it informs the team and helps shape the approach to managing Owner risk. These project controls discipline tasks are represented in the table below, aligned with the project phases:

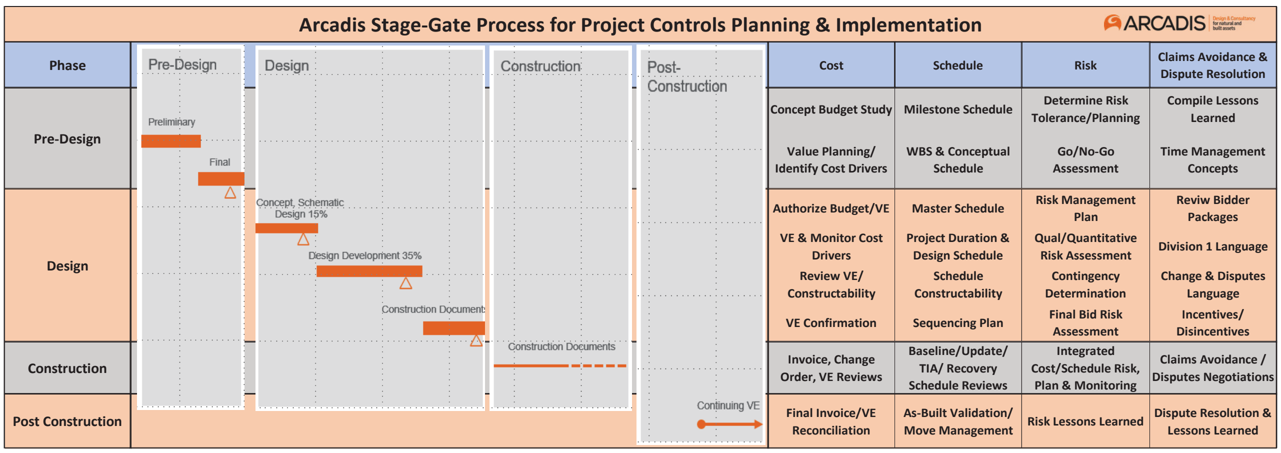

Figure 8 - Project Controls Discipline Stage-Gate Services Per Phase

Conclusion

Control of Owner risks is not a universal one-step panacea, but rather an integrated program of cost and schedule risk management that starts pre-project and does not end until all outstanding issues are resolved with the project complete. For the most effective control of Owner risk, the risk management process cannot be a one-time effort or a casual approach, but an integrated cost/schedule/risk culture embedded in the construction management process.

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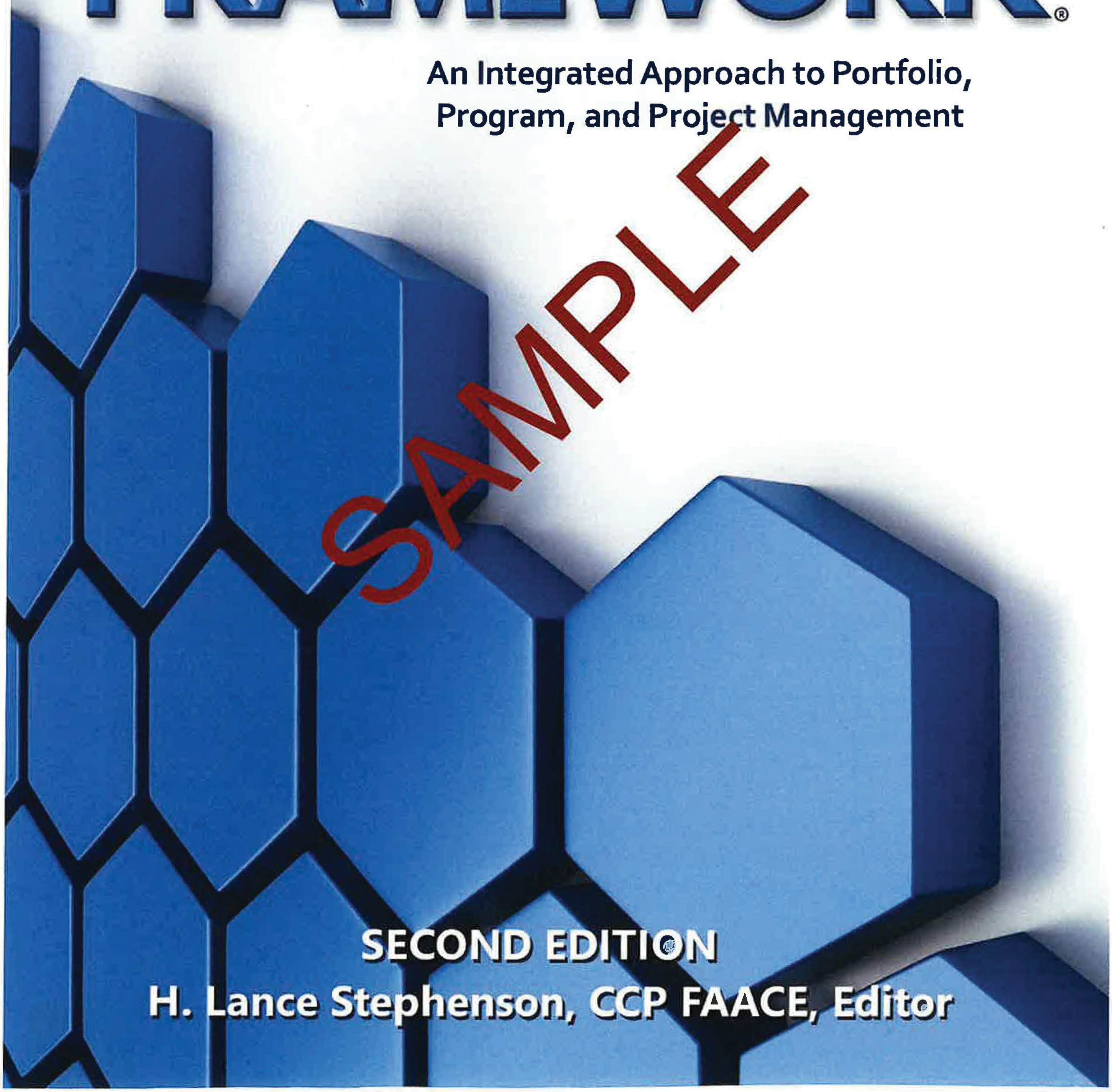
ATTACHMENT 7

AACE INTERNATIONAL

TOTAL COST MANAGEMENT FRAMEWORK®

An Integrated Approach to Portfolio, Program, and Project Management



SECOND EDITION

H. Lance Stephenson, CCP FAACE, Editor

Total Cost Management Framework

An Integrated Approach to Portfolio, Program, and Project Management

Second Edition

H. Lance Stephenson, CCP FAACE, Editor

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PREFACE

What Is the Total Cost Management (TCM) Framework?

Total cost management (TCM) is the effective application of professional and technical expertise to plan and control resources, costs, profitability and risk. Simply stated, TCM is a systematic approach to managing cost throughout the life cycle of any enterprise, program, facility, project, product or service. The *TCM Framework* is a representation of that systematic approach.

The *TCM Framework* is a structured, annotated process map that explains each practice area of the cost engineering field in the context of its relationship to the other practice areas including allied professions. It provides a process for applying the skills and knowledge of cost engineering. A key feature of the *TCM Framework* is that it highlights and differentiates the main cost management application areas: *project control* and *strategic asset management*.

Those working in the project management field will find similarities with the Project Management Institute's (PMI) *A Guide to the Project Management Body of Knowledge (PMBOK Guide)* as project control is a subset of the field of project management. With a greater focus on project control, the *TCM Framework* enhances many of the processes. More importantly, the *TCM Framework* addresses *strategic asset cost management* practices in business and capital planning, operations and maintenance, and product cost management, both upstream and downstream of the project processes. Asset owner companies will particularly appreciate the enhanced coverage of areas such as historical data management, cost modeling, economic and decision analysis, and value analysis.

The *TCM Framework* is a significant contribution to the cost management profession applicable to all industries. It is an AACE cornerstone technical document that joins the current body of knowledge for related fields such as project management, operations management and management accounting. It is also consistent with organizational and portfolio thinking which ties all practices and processes back to overall business strategies and objectives.

As a framework, this document is a conceptual representation that provides a structured, integrated overview of cost engineering. It will guide AACE International's development of more detailed technical products including the following:

- *Recommended Practices (RPs)*: original, peer-reviewed documents that define the specifics of particular methods or procedures outlined in the *TCM Framework*,
- *Professional Practice Guides (PPGs)*: a set of structured, edited compilations of selected AACE publications on specific areas of cost engineering,
- *Cost Engineer's Notebook* (*CEN*): a single structured, edited compilation of selected AACE publications that provides an overview of all the key fundamental areas of cost engineering.

The *TCM Framework's* structure provides consistency and supports development of AACE Education Board (e.g., *Skills and Knowledge of Cost Engineering* and certification study guides) and Certification Board (e.g., certification examinations) products.

The intent is that the *TCM Framework* will be studied, applied, and continuously improved by a worldwide audience from all industries, thereby advancing the profession of cost engineering and cost management.

The Value of the TCM Framework for Industry

Companies are continually looking for ways to tie everything they do to their strategic missions and objectives. As they strive for better strategic performance, they are frequently re-engineering their organizations. To find efficiencies and improve quality, they are documenting, benchmarking, analyzing and improving business and work processes. For the many enterprises seeking ISO certification a process focus is required.[1] TCM provides a strategic model that can help an organization design its own processes related to cost management.

Likewise, re-engineering increases the challenges for individual professionals as employers break down functional silos and increasingly expect staff and leaders to be competent in many different practices, while also being more knowledgeable of business processes. For individuals, the *TCM Framework* provides a map to help them understand all the practice areas while also helping guide their career planning.

In the academic arena, the *TCM Framework* provides a model for developing cost engineering education and training products and curricula that will serve those individuals and enterprises in need of a broader, more integrated perspective.

How to Use the TCM Framework

Because the *TCM Framework* process is based on broadly accepted first principles (i.e., the Deming/Shewhart cycle) and it applies to all industries. It can be used by all levels of practitioners and in all business, academic, and institutional environments (customers, subcontractors, government, prime contractors, construction managers, design-build, etc.) worldwide. It also applies to the entire life cycle of asset and project portfolios.

It is a *generic reference* process model or guideline. It is not intended to be used directly out-of-the-box in any specific application. Managers, practitioners, educators, and others will need to build their own processes and improve practices in the context of their business, asset, organization, culture, project systems, etc. As a generic reference model, the *TCM Framework* has been successfully tested in reengineering consulting and training.

The *TCM Framework* can be read and applied section-by-section at a sub-process or functional level. However, optimal effectiveness of a sub-process requires that it be developed in the context of and in relationship to associated sub-processes that share common strategies and objectives. In that respect, all readers with limited interest or time should understand the *Part 1* overview sections before focusing on the sections and sub-processes of interest.

TCM Online

An enhanced online edition of the TCM Framework incorporates additional key AACE resources such as recommended practices (RPs). In each section of the TCM Framework, there will be links to RPs that are applicable to that particular section. RPs provide additional detail that supplement key TCM concepts and processes. The online version is a living document that will change each time a new or revised RP is published.

The online edition of TCM is a product of the AACE Technical Board and is available on the AACE website at web.aacei.org.

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[1] International Organization for Standardization ISO 9000 and its family of related standards is focused on an enterprise having, maintaining, and following documented process and procedures.

Introduction to the First Edition

The *TCM Framework* had its beginnings in 1994 as an effort to develop a professional handbook to be called *AACE International's Total Cost Management Guide for the 21st Century* with Wes Querns as the editor. A significant and successful effort was made to enlist recognized leading professionals in their respective fields as contributing authors and a publisher was lined up.[2] However, as the *Guide's* scope was defined, it became apparent that a book with independent experts covering the traditional cost engineering topics in their own ways would not provide the required *systematic approach*. Therefore, in 1995, the *Guide* project was re-scoped as the *Framework* project.

In 1996, the high level TCM process was published in an article in *Cost Engineering* journal entitled "A New Look at Total Cost Management", authored by John Hollmann. At this time John became the lead author and editor for the Framework working in association with the Technical Board. The Technical Board solicited member comment via a special survey and we drafted the introductory chapters (now Part I). These overview chapters were subjected to considerable review and consensus building (during what may be called phase one) until 2002 when the introductory chapters were formally published.[3]

Completing the remaining 30 sections was not so much a traditional writing process as a process reengineering project for the editor and contributors. The effort consisted of taking common practice knowledge about cost engineering and allied fields, breaking it down into steps, connecting the steps based on a time honored management process model, and finishing it with consistent narrative using a *single voice*. Once again, the support of leading professionals was sought to assist in the development. The value of the resulting product is in *integration and structure,* not new practices, how-tos, or narrative.

The product was then reviewed by AACE's Technical Committees, the main and associate AACE Boards, and other subject matter experts. Comment was sought from related associations as well. The review and approval process used was the same stringent approach that AACE uses for its recommended practices. This multi-stage process requires formal requests for comment, documented comment disposition, and Technical Board approval to ensure that general consensus is achieved.

Introduction to the First Edition Revised

This revision included two completely rewritten sections; *3.3 Investment Decision Making* and *7.6 Risk Management*. These resulted from work to improve AACE's technical foundation for the Decision and Risk Management Professional (DRMP) Certification.

Introduction to the Second Edition

The second edition enhanced the process maps through the use of color to emphasize the plan-do-check-act (PDCA) steps integral to TCM. In addition, it incorporates minor edits to the process maps and associated narrative.

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[2] Many of these experts provided early outlines or draft chapters for the cancelled *Guide.* They are listed in the Contributors section. Some of these experts are also acknowledged as author/key contributors for *Framework*.

[3] Individuals that commented at that time are included among the contributors listed in the Contributors section.

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The Technical Board acknowledges the significant efforts by John Hollmann to guide the development of the *TCM Framework* from its inception in 1994 through completion in 2006. John served as lead editor and primary author for the First Edition. He contributed a substantial amount of his personal time and resources toward this very important effort.

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I. INTRODUCTION TO TOTAL COST MANAGEMENT

1.1 Definition of Total Cost Management

1.1.1 Total Cost Management and Related Terminology

The Constitution of AACE International provides the following definition of total cost management (TCM):

"Total cost management is the effective application of professional and technical expertise to plan and control resources, costs, profitability and risks. Simply stated, it is a systematic approach to managing cost throughout the life cycle of any enterprise, program, facility, project, product, or service. This is accomplished through the application of cost engineering and cost management principles, proven methodologies and the latest technology in support of the management process."

Put another way, total cost management is the sum of the practices and processes that an enterprise uses to manage the total life cycle cost investment in its portfolio of strategic assets.

For example, a real estate developer may build, maintain, renovate, and then demolish an office building during its life cycle—at each phase of the building life cycle the developer makes significant investments. To manage these investments, the building developer monitors building operating costs and profitability; evaluates alternative investment opportunities; and initiates, plans, and controls improvement projects. These activities are all within the scope of the TCM process.

Costs in TCM include any investment of resources in the enterprise's assets including time, monetary, human, and physical resources. *Total* refers to TCM's comprehensive approach to managing the total resource investment during the life cycle of the enterprise's strategic assets. The enterprise can be any endeavor, business, government, group, individual, or other entity that owns, controls, or operates strategic assets.

Strategic asset is shorthand for any unique physical or intellectual property that is of long term or ongoing value to the enterprise. For most cost engineers, strategic assets equate to capital assets; however, the term strategic asset is more inclusive (e.g., may include things that are considered expenses). The asset may be a building, an industrial plant, a software program, or a stage production. Strategic asset investments are made through the execution of projects or programs. Projects are temporary endeavors for creating, modifying, maintaining, or retiring strategic assets. Products and services may be considered strategic assets in that before a product can be made or a service performed, many investments must be made through the execution of projects for research, development, design, and so on.

As an example of where TCM fits within a company's undertakings, consider a company that designs and manufactures integrated circuits. The chip's design is a strategic asset of the company created through the execution of research and design projects. In order to fabricate a new chip, the company develops a unique manufacturing process or layout—that process design or layout is also a strategic asset developed through the execution of projects. Next, a project is performed to design, procure, and build the plant for fabricating the microchips—the physical plant is another strategic asset. Finally, workers are hired and trained to operate the plant. Worker skill and knowledge are strategic assets and their initial training and plant start-up are executed as projects. The new plant must be maintained and eventually decommissioned. Each component of the chip maker's strategic asset portfolio requires investments realized through the execution of projects whose cost must be managed. Each component of the company's asset portfolio has its own life cycle with cost investments to integrate over time. The complex interaction of the asset portfolio component costs over their various life cycles and during operations calls for a total cost management process.

One way that TCM adds value to the body of cost engineering knowledge is that it integrates areas of cost management that are too often treated as separate entities or fields. While AACE is not the subject-matter caretaker or custodian of all that is covered in the *TCM Framework*, it is important that cost engineers understand the relationships between the various fields of practice with which they are likely to interact ... be expected to perform.

1.1.2 Total Cost Management's Relationship to Other Fields

TCM is an integrating process that not only maps the fields of practice of cost engineering, but it also provides links to the fields of project management, resource management, and management accounting practice.[4] TCM provides a unique technical perspective that is often missing from financially focused approaches (hence the term cost engineering). Figure 1.1-1 illustrates how TCM, with roots and emphasis in project management and project control, has a balanced focus on product and capital costs, project and operational work processes, and resources of all types. In other words, it covers the total costs of the business.

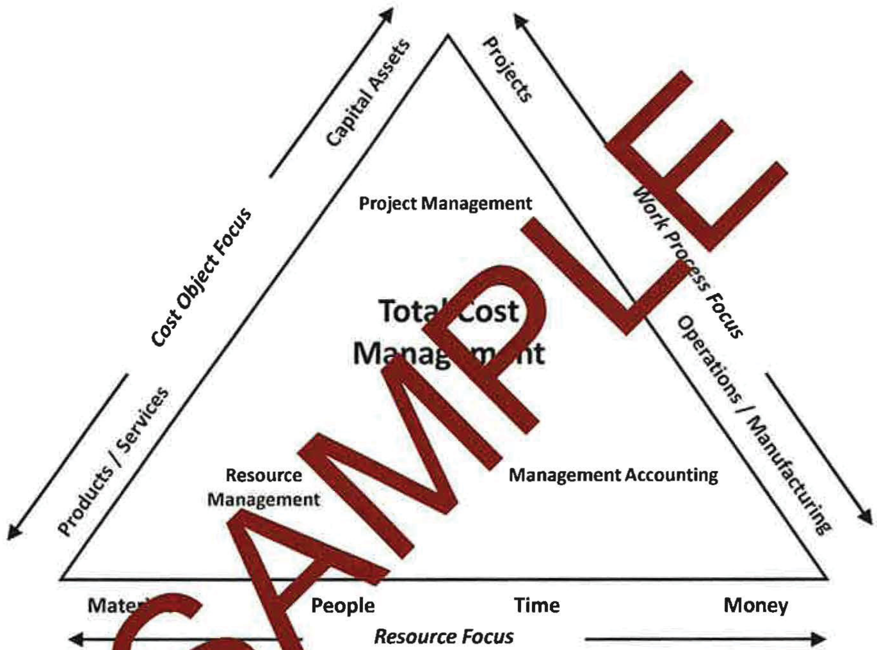

Figure 1.1-1 TCM's Place in the Cost Management Spectrum

Recently, project management models have been enhanced to better address pre-project processes, project portfolios, and consideration of overall business organization strategies. An example is the *Project Management Institute's Organizational Project Management Maturity Model (OPM3)*. However, these models still do not cover production and operation management and costs to the extent addressed by TCM.

Product and operations costs have been the focus of the resource management and management accounting fields. Resource management's developments in enterprise resource management (ERP) and management accounting's developments in activity-based-costing (ABC) are significant advancements that are incorporated in TCM. However, unlike TCM, those fields have focused on product costs and typically address capital project costs as an incidental cost (i.e., depreciation) as it affects products.

In summary, TCM is unique in that it integrates the best approaches from all the major fields that have cost management interests while emphasizing cost engineering's practices and major role in them all.

[4] See the Further Reading and Sources section for references to the organizations that are primary caretakers for the project management, resource management, and management accounting bodies of knowledge.

1.2 Purpose and Uses of the TCM Framework

The purpose of the *TCM Framework* is to provide an integrated and theoretically sound structure upon which AACE recommended practices (RPs) can be developed for those areas of TCM for which AACE is the primary caretaker.[5] The *Framework* achieves this objective by establishing an integrated process map of TCM. The process map helps ensure that RP products are consistent with each other and free of unnecessary duplication. As the structure for RP products, the *Framework,* by extension, also provides a technical framework that all AACE International educational and certification products and services can use.

Having achieved its primary purposes, there are many other possible uses of the *Framework*. For example, the *Framework* defines key concepts and terminology[6], and provides illustrations that can aid communication between cost engineering practitioners. This is particularly important because cost management is practiced in a myriad of enterprises such as construction, manufacturing, software development, real estate development, healthcare delivery, and so on. Also, practitioners striving for functional excellence may lose sight of overall cost management objectives.

In addition, students and newcomers to the cost management field can gain a broad understanding of the field from the *Framework*. For educators, the *Framework* can provide the structure for a course that can be enhanced with selected readings. Companies and skilled cost engineering practitioners that are looking for better ways to tie their disparate cost functions and asset management into an effective system will find that the *Framework* adds structure and value to their efforts. The *Framework* also provides a conceptual process model on which professionals can benchmark or pattern cost management work processes and practices within their enterprises.

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[5] AACE's Constitution defines the areas of association focus as follows: "Total Cost Management is that area of engineering practice where engineering judgment and experience are utilized in the application of scientific principles and techniques to problems of business and program planning; cost estimating; economic and financial analysis; cost engineering; program and project management; planning and scheduling; and cost and schedule performance measurement and change control." Furthermore, AACE's Recommended Practice 11R-88, "Required Skills and Knowledge of Cost Engineering" specifies cost engineering knowledge that is "core" (i.e., recommended that professional cost engineers know) and identifies skills that are recommended for individuals to put that core knowledge into practice.

[6] Where concept definitions are provided, they are consistent with AACE's primary terminology reference: Recommended Practice 10S-90, "Cost Engineering Terminology."

1.3 Organization of the TCM Framework

1.3.1 The TCM Framework Uses Process Management Conventions

Total cost management is a quality driven process model. As such, the *Framework* employs process management conventions. A process consists of a flow of inputs and outputs with mechanisms that transform the inputs to outputs. The *Framework* maps the process flows of TCM. The transforming mechanisms or activities are referred to as tools, techniques, or sub-processes. The inputs and outputs of TCM consist primarily of data and information.

1.3.2 The TCM Framework Uses a Standard Organization Structure

The *Framework* is organized into parts, chapters, and sections. The chapters correspond to the process elements (i.e., blocks) in the high level TCM process map that is illustrated and described later in Section 2.2. Figure 1.3-1 below illustrates how the chapters and key sections can be grouped by basic or overarching processes, functional or working processes, and enabling and supporting processes.

Figure 1.3-1 The Structure of the Framework's Parts and Chapters

The sections in each chapter correspond to the functional level process steps that are illustrated and described later in Sections 2.3 and 2.4. The process sections are organized as follows (for the enabling processes, maps, inputs, and outputs are not applicable and are excluded):

x.x.1 Description of the Process
x.x.2 Process Map
x.x.3 Inputs to the Process
x.x.4 Outputs of the Process
x.x.5 Key Concepts and Terminology for the Process

1.4 Key Introductory Concepts and Terminology for Total Cost Management

1.4.1 *Total Cost Management* - The sum of the practices and processes that an enterprise uses to manage the total life cycle cost investment in its portfolio of strategic assets. Describes the process employed in the profession of cost engineering.

1.4.2 *Resource Management* - (1) The effective planning, scheduling, execution, and control of all organizational resources to produce a good or a service that provides customer satisfaction and supports the organization's competitive edge and, ultimately, organizational goals. (2) An emerging field of study emphasizing the systems perspective, encompassing both the product and process life cycles, and focusing on the integration of organizational resources toward the effective realization of organizational goals. Resources include materials; maintenance, repair, and operating supplies; production and supporting equipment; facilities; direct and indirect employees; and capital.[7]

1.4.3 *Project Management* - The methodical application of management knowledge, skills, and practices to project activities in order to meet project objectives.

1.4.4 *Management Accounting* - The process of identification, measurement, accumulation, analysis, preparation, interpretation, and communication of financial information used by management to plan, evaluate, and control within an organization and to assure appropriate use of and accountability of its resources.

1.4.5 *Costs and Resources* - Any investment of time, money, human effort, or physical objects in the enterprise's products, services, and assets.

1.4.6 *Strategic Asset* - Any unique physical or intellectual property of some scope that is of long term or ongoing value to the enterprise.

1.4.7 *Enterprise* - Any endeavor, business, government entity, group, or individual that owns or controls strategic assets.

1.4.8 *Process* - A flow of inputs and outputs with mechanisms that transform the inputs to outputs.

1.4.9 *Projects* - A temporary endeavor to conceive, create, modify, or terminate a strategic asset.

1.4.10 *Operations* - Ongoing endeavors that use strategic assets.

1.4.11 *Life Cycle* - Describes the stages or phases that occur during the lifetime of an object or endeavor. A life cycle presumes a beginning and an end. The asset life cycle describes the stages of an asset's existence, and the project life cycle describes the phases of a project's endeavors.

1.4.12 *Life Cycle; Asset* - Describes the stages of asset existence from ideation through termination during the lifetime of an asset.

1.4.13 *Life Cycle; Project* - Describes the stages of project progress from ideation through closure during the lifetime of the project.

[7] *APICS Dictionary*, 9th ed., James F. Cox and John H. Blackstone (www.apics.org).

CHAPTER 2 - THE TOTAL COST MANAGEMENT PROCESS MAP

2.1 Basis of Total Cost Management Processes

This section describes the fundamental basis or foundation of the TCM process and defines the process mapping conventions used in the *Framework*. Sections 2.2, 2.3, and 2.4 further describe the respective processes of TCM, strategic asset management, and project control.

2.1.1 TCM Is Based on Process Management Principles

The pursuit of increased productivity and quality has been a driving force of worldwide business management for decades. Process management and process reengineering emphasize the need for enterprises to identify their work processes and continually improve them. Effective processes are needed to support continuous quality improvement while nurturing innovation and change without chaos.

TCM as described in the *Framework* is a process map that supports continuous process improvement while being flexible. It is not intended to be a set of rigid rules or work procedures. While each of the sub-process maps of TCM may look rigid when set on paper, users may chose to emphasize those process steps that are most critical to their situation. Steps can be skipped when they are not applicable and information flows can be modified to suit the needs of the enterprise. If the enterprise or market is growing, the emphasis can be placed on asset creation and scheduling aspects. On the other hand, if the enterprise or market is mature, the emphasis may be put on asset maintenance and cost aspects. In practice, the processes are quite flexible.

In addition, TCM supports cross-functional integration and multi-skilling. Few enterprises in a dynamic environment can afford to have cadres of functional specialists. However, multi-skilling may come at the price of having less experience, skill, and knowledge than dedicated in any one function. Weaknesses in individual skill and knowledge place a premium on having reliable, integrated processes like TCM.

2.1.2 The Basic TCM Process Model—Plan, Do, Check, and Act (PDCA)

The TCM process model is based upon the PDCA management or control cycle, which is also known as the Deming or Shewhart cycle. The PDCA cycle is a generally accepted, quality driven, continuous improvement management model. PDCA stands for plan, do, check, and act, with the word *check* being generally synonymous with *measure*. *Act* as in *to take corrective action* is sometimes substituted with the word *assess*. The PDCA cycle is the framework for TCM because (1) it is time-proven and widely accepted as a valid management model, (2) it is quality driven, and (3) it is highly applicable to cost management processes, which are cyclical by nature.

The PDCA cycle in TCM includes the following steps:

- **Plan** - plan asset solutions or project activities
- **Do** (i.e., execute) - initiate and perform the project or project activities in accordance with the plan
- **Check** (i.e., measure) - making measurements of asset, project, or activity performance, and
- **Act** (i.e., assess) - assessing performance variances from the plan and taking action to correct or improve performance to bring it in line with the plan or to improve the plan.

Throughout this book, colors are used to indicate the four steps of the PDCA cycle:

PLAN	DO	CHECK (MEASURE)	ACT (ASSESS)

These steps are repeated as activities and time progress until such time as the asset or project life cycle is complete. Figure 2.1-1 illustrates the PDCA process steps.

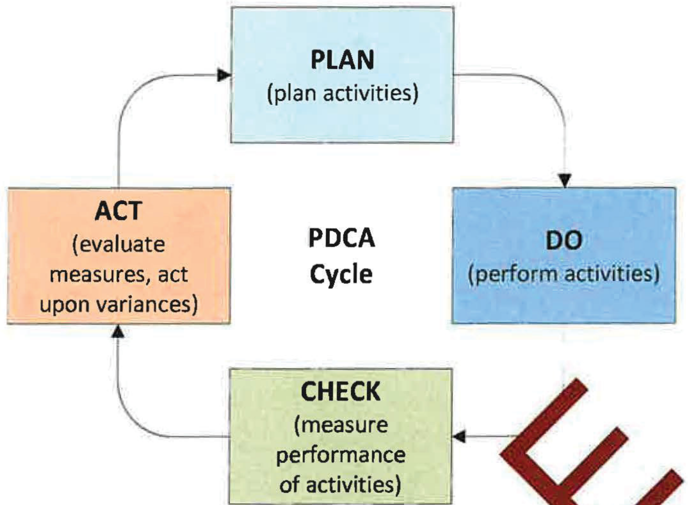

Figure 2.1-1 The Plan, Do, Check, Act Cycle

Two underlying tenets of the PDCA process cycle and process management in general are that:

- you can't manage what you can't measure
- whatever you measure tends to improve

Measurement is a key element that is often lacking in management systems that focus on planning. However, use caution in what and how you measure—"playing for score" is not the way to achieve the desired improved outcomes.

A cyclical process model is useful because strategic assets and the projects that create them each have an inherent life cycle. With each stage or phase of the asset or project life cycle, successive iterations of the cost management process are required. Each iteration of the cycle achieves a new or improved level of performance or progress for the asset or project.

2.1.3 The Asset Life Cycle

The PDCA control process takes place within the context of the asset and project life cycles. The life cycle describes the stages or phases that occur during the lifetime of an object or endeavor. The stages or phases are sequential groupings of processes that result in an intermediate deliverable or progress milestone.

While the life cycle for a given asset has a defined beginning and end, the process actions are not a straight line—an asset is usually modified and recycled many times with ongoing ideation leading to changes and improvements. The life cycle of a strategic asset can be summarized in five stages as follows:

1) **Ideation** - recognize an opportunity or need for a new or improved asset; evaluate, research, develop, and define optional asset solutions that address the opportunity; and select an optimum asset solution.
2) **Creation** - create or otherwise implement the asset solution through execution of a project or program.
3) **Operation** - deploy or put the new or modified asset into service, function, production, operation, or other use.
4) **Modification** - improve, modify, or otherwise change or recycle the asset through execution of a project or program.

Resource investments are made via the execution of projects during the asset ideation, creation, operation, modification, and termination phases. Figure 2.1-2 illustrates the asset life cycle of a factory as it passes through time.

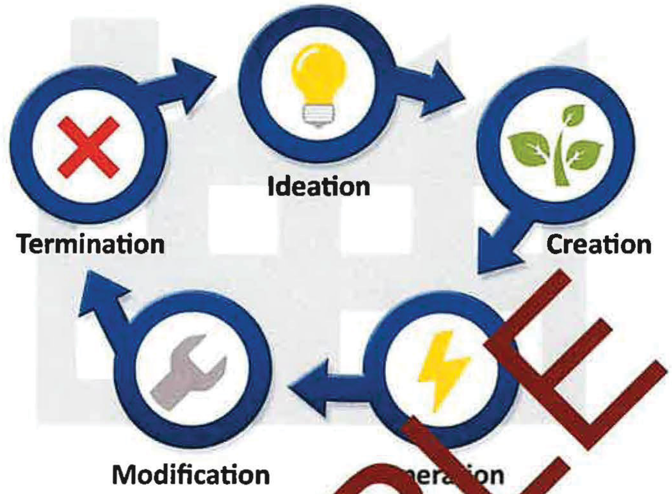

Figure 2.1-2 Asset Life Cycle of a Factory

2.1.4 The Project Life Cycle

Within the life cycle of an asset, projects are temporary endeavors for the ideation, creation, modification, or termination of assets. Projects have a defined beginning and end. In the asset life cycle, only operation is not generally considered a project endeavor. However, there may be many projects within the operation phase of an asset to maintain, relocate, modify, repair, enhance, or otherwise improve the utility of the asset. The elements of the project life cycle are often referred to as phases. Each phase yields one or more deliverables or outputs that become resources or inputs for the following phase. The deliverable may be a requirements document, a plan, a design document, a model, and so on. The life cycle of most projects can be summarized in four sequential phases as follows:

1) **Ideation** - given overall requirements of the project, the project team assesses alternative concepts for performing the project and selects an optimal performance strategy. Strategic performance requirements for the project are established.
2) **Planning -** project plans are developed that address the strategic requirements and selected performance strategy.
3) **Execution** - the plans are implemented through the execution of planned project activities.
4) **Closure** - the asset or deliverable is reviewed, tested, verified, validated, and turned over to the customer. Learnings for future use in ideation are documented.

These phases are recursive; this means that each phase may be a project in itself that produces a deliverable but not the final asset. For instance, the ideation phase has a life cycle including planning for ideation, executing the ideation process, and closure of the ideation phase (e.g., completion of a requirements document). At this recursive level, the closure of a phase usually represents a hand-off of a deliverable and achievement of a project milestone, decision point, or gate. If the deliverable does not pass the phase gate review, it is returned for correction or the project may be killed or terminated.

While the project phases discussed above are performed sequentially, they usually overlap to some extent. Fast tracking, concurrent engineering, and similar terms refer to project strategies that have highly overlapping phases to achieve faster cycle times.

2.1.5 Continuous Improvement During a Life Cycle

The two-dimensional PDCA cycle and traditional asset and project life cycle illustrations, such as Figures 2.2-1 and 2.2-2, do not adequately illustrate the concept of progress through time or continuous improvement. Two-dimensional illustrations infer that one is always returning to the starting point, or that work follows a sequential line from beginning to end. In fact, with each iteration of the PDCA cycle, the asset portfolio or project performance or state is continually improved—it does not return to its original state. An asset's life cycle may include scores of projects to modify the asset. Likewise, a project may go through many iterations of design. In addition, innovation may lead to discontinuous leaps in performance or progress.

There are many ways to illustrate the concept of continuous improvement or progress through time including cyclones, spirals, wheel and axle, and other diagrams. In each of these diagrams, the circular motion aspect illustrates some cyclical process (e.g., PDCA) while the axis or axle represents progress through time or phases. Figure 2.1-3 illustrates the TCM concept for a project life cycle with PDCA shown as a spiral. The axis represents the life cycle phases of a project from ideation through closure. The spiral attempts to show that the plan-do-check-act process is employed continually to achieve various milestones or deliverables at each phase of the project life cycle. The asset life cycle can be represented in the same way by substituting the asset life cycle phases along the axis.

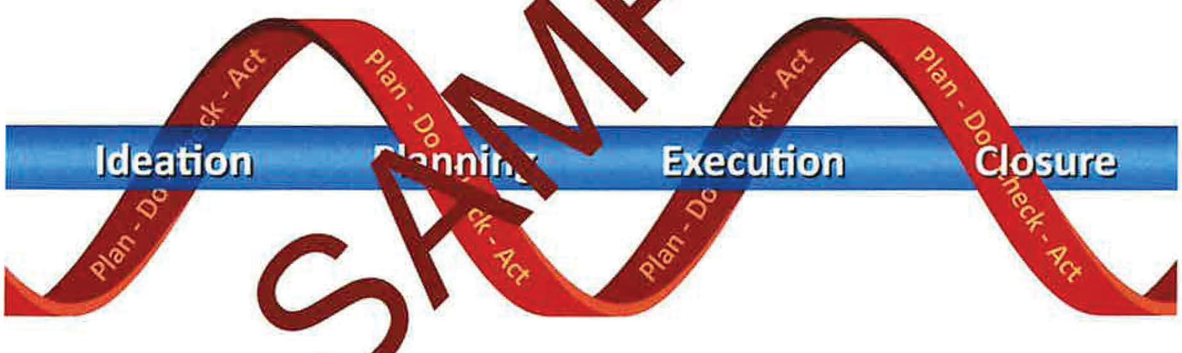

Figure 2.1-3 TCM Applies the PDCA Concept throughout the Project or Asset Life Cycle

2.1.6 General Process Mapping and Diagramming

As was discussed previously, TCM is a quality driven process. Processes represent real work with which to create and deliver value to customers. A process consists of inputs, outputs, and mechanisms that transform the input to meaningful outputs. Outputs of one process may be inputs to another. The transforming mechanisms are referred to in the *Framework* as tools, techniques, or sub-processes.

These processes are illustrated in the *Framework* with block diagrams (i.e., blocks connected with arrows). The blocks represent a transforming mechanism or tool, technique, or sub-process. The TCM processes are governing or directing processes that deal with information rather than physical objects; therefore, the arrows represent the input and output flow of information or information products rather than physical objects. The arrows may be double headed indicating two-way flow or feedback. Groups of blocks surrounded by a dashed outline indicate alternative tools, techniques, or sub-processes or those performed in conjunction with each other using the same inputs and outputs. Input and output arrows that tie to separate diagrams are labeled with the related *Framework* chapter or section numbers that they tie to. Figure 2.1-4 illustrates the basic diagramming conventions used in the *Framework*.

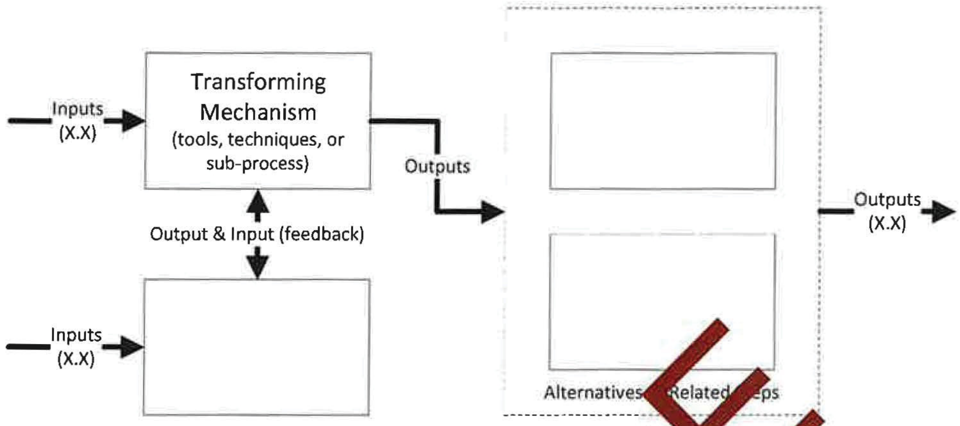

Figure 2.1-4 Process Map Representations as used in the TCM Framework

The *Framework* includes high-level, integrative process maps showing basic inter-relationships and sequencing of processes, and a rudimentary flow of information. The processes are mapped or diagrammed to the highest meaningful level of abstraction. These maps are not intended to be detailed data-flow, flow chart, procedural, logic, or other type of work definition diagrams. A process map does not show the way work is done—it attempts to balance the requirements of communication and content. A single block in a diagram may represent a complex process that would require an entire text to fully explain and document, and a single arrow may represent a large volume and variety of information and data products.

2.1.7 Key Concepts and Terminology for Processes

2.1.7.1 *Process* - A series of actions bringing about a result.

2.1.7.2 *Business Processes* - There are various types of business processes including governing, asset creating, value adding, and enabling. *TCM is a "governing" process*. Governing processes direct or control other processes. A project is an "asset creating" process in that its output is an asset. Value adding processes are those that provide enhanced outputs to the external customer. Enabling processes are those that establish or provide capabilities for the other processes.

2.1.7.3 *Process Map* - A diagram of a process that illustrates high level groupings of sub-processes and their interrelationships. A process map does not illustrate the way work is done at a detailed level.

2.1.7.4 *PDCA Cycle* (Shewhart or Deming cycle) - A basic management process first described in the 1930s. It is conducive to process management and control by inherently incorporating continuous improvement and measurement.

2.1.7.5 *Recursive Process* - A process model that repeats itself when one of the steps of the process is described at a lower level of detail. The project control sub-process of TCM is a recursive application of the PDCA process model (Section 2.2).

2.1.7.6 *Inputs and Outputs* - The inputs to projects are resources and the outputs are assets. An asset may be a resource to a downstream process. Internal to the process maps, inputs and outputs are information and information products that are produced or utilized by tools, techniques, and sub-processes.

2.1.7.7 *Tools, Techniques, and Sub-processes* - These are the transforming mechanisms and technologies that convert the inputs to outputs.

2.2 Total Cost Management Process Map

2.2.1 Description

2.2.1.1 Total Cost Management

This section builds on the information provided in the previous section by illustrating how the generic plan-do-check-act (PDCA) model is implemented in the total cost management process map.

As defined earlier, total cost management is the sum of the practices and processes that an enterprise uses to manage the total life cycle cost investment of resources in its portfolio of strategic assets. Furthermore, the maximum value of TCM can only be realized when the enterprises' practices are applied logically in an integrated process. The TCM process map is a generic outline of that integrated process.

Figure 2.2-1 shows the TCM process map (the numbers in parenthesis correspond to chapters and sections of the *Framework* that cover each step). The figure shows how the PDCA model is applied recursively (i.e., in a nested manner) in TCM—the basic process is applied for each asset and group or portfolio of assets, and then again for each project being performed to create, modify, maintain, or retire those assets.

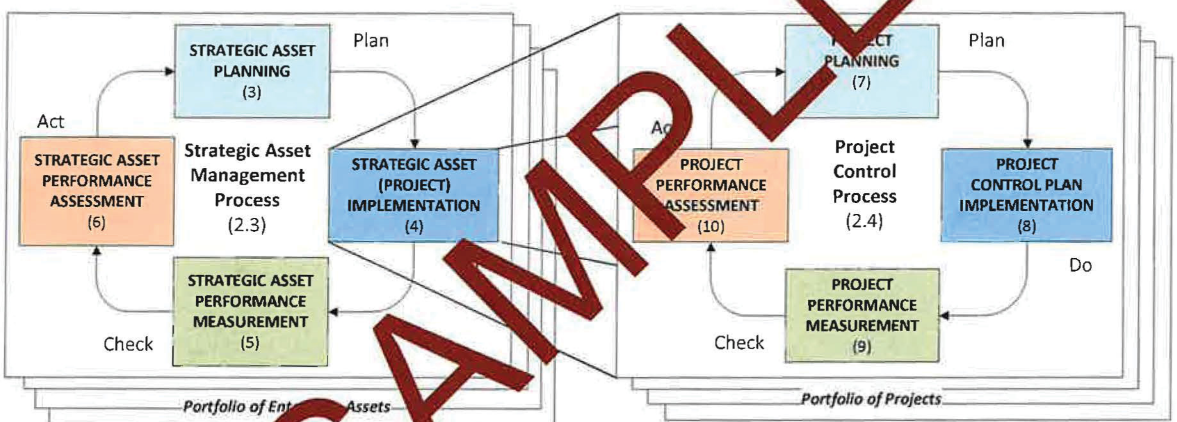

Figure 2.2-1 Total Cost Management Process Map

The two levels of the TCM process in Figure 2.2-1 are referred to respectively as the strategic asset management and project control processes. Project control is a recursive process nested within the "do" or project implementation step of the strategic asset management process. An enterprise will have a portfolio of assets in various stages of their life cycles, and during each asset's life cycle, many projects will be performed to create, modify, or terminate that asset.

2.2.1.2 The Strategic Asset Management Process Cycle

Strategic asset management (SAM) refers to the macro process of managing the total life cycle cost investment of resources in an enterprise's portfolio of strategic assets. The portfolio will contain many assets in various stages of their life cycles (including those assets that are nothing more than ideas). Although investments are made in an asset through the performance of a project or program, SAM is not concerned with day-to-day project tasks; SAM focuses instead on initiating and managing the overall portfolio of projects in a way that addresses the strategic objectives of the enterprise.

The PDCA steps of the strategic asset management process cycle include:

1) Strategic asset planning - converts asset portfolio improvement ideas into plans for investing resources in assets.
2) Project implementation - asset investment plans and requirements are communicated to and executed by project teams. Project teams request resources as needed and report on their performance.
3) Strategic asset performance measurement - includes measurement of both operational asset and project performance.
4) Strategic asset performance assessment – performance measurements are compared to the plan, and corrective, mitigating, or improvement actions are taken as may be determined.

Section 2.3 further defines the SAM process map and the specific steps in its process cycle.

2.2.1.3 The Project Control Process Cycle

Project control is the recursive process cycle nested within the "do" step of the strategic asset management process cycle. A project is a temporary endeavor an enterprise undertakes to create, modify, maintain, or retire an asset. During the life of a project, various resources are invested in the asset by the project team. Ultimately, a usable or operational asset is returned to the enterprise's asset portfolio at the completion of the project.

The PDCA steps of the project control process cycle include:

1) Project planning – converts project requirements or corrective action ideas into plans for investing resources in project activities.
2) Project activity implementation – project plans and requirements are communicated to and executed by project team members.
3) Project performance measurement – includes measurement of project activity progress and performance.
4) Project performance assessment – performance measurements are compared to the plan, and corrective, mitigating, or improvement actions are taken as may be determined.

Section 2.4 further defines the project control process map and the specific steps in its process cycle.

2.2.1.4 Parallels Between Strategic Asset Management and Project Control Process Cycles

Strategic asset management and project control are both recursive PDCA processes. Many of their sub-processes are the same as will be described in Sections 2.3 and 2.4. For example, cost estimating is a planning sub-process in strategic asset management with an emphasis on stochastic estimating methods, while in project control, cost estimating emphasizes deterministic methods. Decision analysis, value analysis and engineering, risk analysis, and resource planning are some other sub-processes that are practiced in both the strategic asset management and project control process cycles. In the *Framework*, these parallel sub-processes are described only one time for brevity (e.g., the value engineering process is grouped with project control processes).

2.2.1.5 Enterprise Organization for Total Cost Management

There is no one best organizational approach to achieve successful TCM implementation. Organizational approaches will be as varied as the strategic objectives of enterprises. However, all organizations should be focused on customer needs and on the entire life cycle of strategic assets rather than on short term functional considerations.

People are every enterprise's most important strategic asset. Organizational or human resource development can be viewed as a portfolio of projects undertaken to continually improve the work life and performance of each person in the enterprise. Narrow functional task training alone does not address the needs of TCM. For instance, a project control estimating methods will be a more valuable asset than a person who understands only one type of cost estimating approach.

2.2.2 Process Maps for Total Cost Management

The process map for total cost management was shown previously in Figure 2.2-1. At a more practical level, TCM is a combination of the process maps for strategic asset management and project control as described in Sections 2.3 and 2.4.

2.2.3 Inputs to Total Cost Management

2.2.3.1 *Investment of Costs or Resources* - Costs refer to any investment of resources in the enterprise's strategic assets. Resources may include time, monetary, human and physical resources. An alternate definition of costs is economic resources used in achieving an objective.

2.2.3.2 *Strategic Objectives and Requirements for Asset and Project Investments* - The TCM process takes place within the overarching context of the enterprise. Enterprise management establishes objectives and performance requirements for its assets and processes. TCM is concerned with the deployment of business strategy, not its formulation.

2.2.3.3 *Working Environment Considerations* - TCM processes are enabled or constrained by technologies such as information and communication management and organizational development management. Also, the enterprise exists and processes take place within society where concerns for culture, environment, health and safety must be addressed (Chapter 11).

2.2.4 Outputs from Total Cost Management

2.2.4.1 *Managed Asset Portfolio* - The end products of the TCM process are new, modified, maintained, or retired assets that achieve the enterprise's strategic performance objectives and requirements.

2.2.4.2 *Managed Project Portfolio* - For larger enterprises, projects will be in progress at all times. While individual projects have a beginning and end, the enterprise must consistently manage the project process to assure that all projects achieve the enterprise's objectives and requirements.

2.2.5 Key Concepts and Terminology for Total Cost Management

2.2.5.1 *Strategic Asset Management* - Refers to the TCM process as applied at an enterprise wide level to manage costs of the enterprise's entire strategic asset portfolio (Section 2.3).

2.2.5.2 *Project Control* - Refers to the TCM process as applied at an individual project level to manage costs of creating, modifying, maintaining, or retiring individual strategic assets (Section 2.4).

2.3 Strategic Asset Management Process Map

2.3.1 Description

2.3.1.1 Definition of Strategic Asset Management (SAM)

Strategic asset management refers to the macro process of managing the total life cycle cost investment of resources in an enterprise's portfolio of strategic assets. The portfolio will contain many assets in various stages of their life cycles (including those assets that are nothing more than ideas). Although investments are made in an asset through the performance of a project or program, SAM is not concerned with day-to-day project tasks; SAM focuses instead on initiating and managing the overall portfolio of projects in a way that addresses the strategic objectives of the enterprise.[8] To paraphrase an old saying, the SAM process is more concerned with doing the right projects than with doing the projects right.

The main financial objective of many enterprises is to maximize the total long-term economic return or profit from its asset investments.[9] The economic performance of existing and proposed assets is often difficult to measure, yet the pressure to improve performance is relentless. Resources available to invest in assets are often limited or scarce while various parts of the enterprise may be in competition for these resources. In addition, the business environment is dynamic and uncertain. The SAM process therefore attempts to balance opportunities and risks against demand and supply for resources in such a way that the enterprise's objectives are met.

As discussed in Section 2.1, SAM is built on the PDCA cycle steps of (1) plan—establishing resource investment plans in assets, (2) do—making measurements of asset and project performance, (3) check—comparing the measurements against the plan, and (4) act/assess—taking corrective, mitigating, or improvement action as may be determined. This section translates those overall steps into sub-processes that will be more generally recognizable by practitioners.

2.3.1.2 The Strategic Asset Management Process Cycle

Figure 2.3-1 in this section illustrates strategic asset management as a process. Each step or sub-process in the figure is covered in a section in the *Framework*. The SAM process starts with the established enterprise business strategy, goals, and objectives. From there, the needs and desires of customers and stakeholders are elicited, analyzed, and translated into asset performance requirements (Section 3.1). Considering the requirements and opportunities from performance assessment, asset investment options are identified and developed (Section 3.2), and then evaluated and decided upon (Section 3.3).[10] Asset investment plans and requirements are communicated to and executed by project teams (Section 4.1).

Asset performance is then measured, including cost accounting measurements (Section 5.1) and non-cost performance measurements such as quality (Section 5.2). Asset performance assessment (Section 6.1) includes techniques for determining if the profitability, cost of quality, and other parameters vary from established plans and benchmarks. Also, adverse or positive trends or changes in performance are evaluated. Benchmarking and other means are used to identify improvement opportunities for new or existing asset performance. If everything is according to plan, the process continues. If there are performance deviations noted in assessments, action should be taken to correct or improve the asset performance trend. If performance corrections or improvements will affect asset portfolio investment plans, or changes to stakeholder needs, requirements, or resource availability occur, then these changes must be managed using a change management process (Section 6.2). Finally, asset and

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[8] The SAM process assumes that the enterprise has developed its strategic objectives through a strategy formation process that is not part of TCM. TCM is focused on business strategy *deployment* in respect to cost management of its assets.

[9] Return on assets (ROA) or return on net assets (RONA) are common financial measures.

[10] Asset planning and investment decision making employ the planning processes covered in Chapter 7.

project performance, history, and lessons learned are captured in a historical database for use in future asset management (Section 6.3).

2.3.1.3 Organization for Strategic Asset Management

In smaller enterprises that have few and/or low value assets, the strategic asset management process may be managed by whoever controls or operates the asset, be it the proprietor, the facility operation manager, the financial manager, or so on. In larger enterprises, there may be a dedicated asset management organization that includes managers, strategic planners, cost estimators, financial and budget analysts, value specialists, cost accountants, and other specialists. In large enterprises, there may be a tiered organizational approach where major investments are managed centrally by a dedicated organization while minor investments are taken care of by the operators of the asset.

The asset management organization may also be responsible for development of project management personnel, processes, and procedures for the enterprise. This organization may also manage relationships with key resource providers.

2.3.2 Process Map for Strategic Asset Management

Figure 2.3-1 below maps the major steps or sub-processes of strategic asset management.

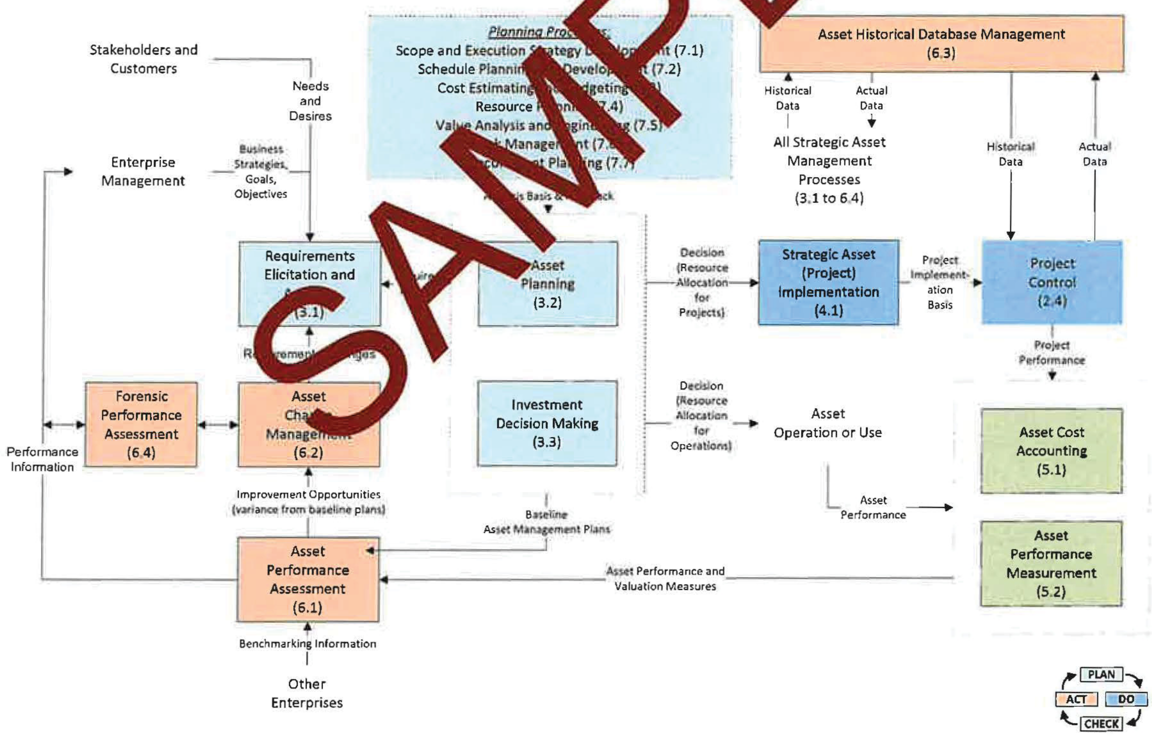


Figure 2.3-1. The Strategic Asset Management Process Map

The processes mapped conceptually above have each been diagrammed at a detail level in the sections noted.

2.3.3 Inputs to Strategic Asset Management

2.3.3.1 *Business Strategies, Goals, and Objectives* - Guiding information, directives, and imposed requirements are elicited for analysis and translation to asset requirements.

2.3.3.2 *Stakeholder and Customer Needs and Desires* - Information is elicited for analysis and translation to asset requirements.

2.3.3.3 *Asset and Project Performance* - Relevant physical and performance characteristics and behavior of each asset and project are described in a timely manner in sufficient detail to support strategic asset management.

2.3.3.4 *External Benchmarking Information* - Performance improvement ideas may be obtained through the benchmarking of practices and results for external enterprises and their assets and projects.

2.3.3.5 *Project Actual Data* - Information and data from projects are captured for use in future asset planning.

2.3.4 Outputs from Strategic Asset Management

2.3.4.1 *Project Implementation Basis* - The scope of asset solutions to be implemented in a project or program is described in sufficient detail to provide a basis for project scope and execution strategy development. The asset performance requirements are also conveyed so that the project team may address them in its project control planning. Cost, schedule, and resource requirements such as target costs, capital and maintenance budgets, schedule milestones, enterprise resource constraints, and other information is included (Section 3.1 and 7.1).

2.3.4.2 *Non-Project Decisions* - The investment decision may select a non-project solution (change to operation practice, expense, etc.) for implementation by the asset operator or user.

2.3.4.3 *Performance Information* - The performance of the enterprise's asset and project portfolio is reported to enterprise management for its consideration in business strategy formulation.

2.3.4.4 *Asset Historical Data* - Information and data from asset management may be used for project control purposes.

2.3.5 Key Concepts and Terminology for Strategic Asset Management

2.3.5.1 *Benchmarking* - A process that compares the processes and performance of an enterprise's endeavors to the processes and performance of the endeavors of a set of peers or competitors selected because they are considered to be the best in whatever endeavor is being assessed.

2.3.5.2 *Planning* - A management or control sub-process that consists of defining scope and establishing baselines or targets against which work performance can be measured. In strategic asset management, integrated asset project plans for cost, schedule, and resourcing are established. All plans should address risks.

2.3.5.3 *Economic Evaluation* - A set of financial analysis techniques that considers all the relevant income and costs associated with an asset or project investment during all or part of the asset or project life-cycle.

2.3.5.4 *Profitability* - A financial measure of the excess income over expenditure during a period of time. In terms of asset management, it is the net economic benefit resulting from an investment in an asset or a project.

2.3.5.5 *Decision Analysis* - A set of analysis techniques that considers all relevant performance and requirements data about a set of asset investment options and produces a decision to pursue or not pursue one or more of the options evaluated.

2.3.5.6 *Resource Allocation* - In terms of asset management, resource allocation is the end result of a decision when actions are taken to invest resources (human, time, or monetary) in an asset investment option to be realized through performance of a project.

AACE International Recommended Practices

The following AACE International recommended practices (RPs) are applicable to this section of the *TCM Framework*. All RPs listed here are published by AACE International, Morgantown, WV. Please be sure to refer to web.aacei.org for the latest revisions and additions.

- 85R-14, *Use of Decision Trees in Decision Making*

2.4 Project Control Process Map

2.4.1 Description

2.4.1.1 Definition of Project Control

Project control is a process for controlling the investment of resources in an asset. In TCM, project control is the recursive process cycle that is nested within the "do" step of the strategic asset management process cycle. A project is a temporary endeavor an enterprise undertakes to create, modify, maintain, or retire a unique asset. Being a temporary and therefore unique endeavor, projects are by nature uncertain and that element of risk puts a premium on control and discipline.

As discussed in Section 2.1, project control (or control of any process for that matter) is built on the PDCA cycle steps of (1) plan—establish a plan, (2) do—make measurements of performance, (3) check—compare the measurements against the plan, and (4) act/assess—take corrective, mitigating, or improvement action as may be determined. As a cycle, steps 2 through 4 are repeated periodically until the project is complete.

2.4.1.2 The Project Control Process Cycle

Figure 2.4-1 illustrates project control as a process. Each step or sub-process in the figure is covered in a section in the *Framework*. A project starts with project scope and execution strategy development, which translates the project implementation basis, i.e., asset scope, objectives, constraints, and assumptions (Section 4.1), into controllable project scope definition and an execution strategy (Section 7.1). From the work breakdown structure (WBS) and execution strategy, integrated plans for cost, schedule, and resource management are developed (Section 7.2, 7.3, and 7.4). The plans are time-phased baselines against which performance is measured. Value analysis and engineering (Section 7.5) ensures that the scope and plans consider functional importance of scope relative to costs. Risk management (Section 7.6) ensures that the scope and plans address uncertainty at that point in time. Procurement planning (Section 7.7) ensures the information about resources (e.g., labor, material, etc.) as required for project control is identified for, incorporated in, and obtained through the procurement process.

The project control plans are communicated to and implemented by the performing parties (Section 8.1). For work in progress, performance measurements include accounting for cost expenditures and commitments, as well as physical progressing, which includes measures of the work and resource quantities that have been completed (Section 9.1 and 9.2.)

Performance assessment includes evaluative techniques for determining if the expenditures and progress vary from the plans (Section 10.1). If everything is according to plan, the control process continues on with more measurements. If there are performance deviations or trends noted in assessments, action should be taken to correct or improve the performance trend. Forecasting techniques (scheduling, estimating, and resource planning) are used to determine if corrective actions will achieve plan targets (Section 10.2). If performance corrections will affect the project scope, or changes to the requirements or scope are initiated by the strategic asset or other stakeholder, the project baseline plans must be managed to incorporate the changes (Section 10.3). Finally, project performance, history, and lessons learned are captured in a historical database for use in future asset management and project control (Section 10.4).

2.4.1.3 Relationship of Project Control to Other Processes

Project control is essentially equivalent to the project management process stripped of its facilitating sub-processes for safety, quality, organizational, behavioral, and communications management. Project control may be considered the quantitative resource control subset of the project management process (or as the AACE International constitution states, where "...engineering judgment and experience are utilized").

Project control is also roughly analogous to the processes of manufacturing and enterprise resource planning (MRP/ERP) with the difference being that MRP/ERP is focused on ongoing operations rather than projects. The enterprise has a portfolio of operations, and MRP/ERP is a recursive process of controlling the investment of resources within those ongoing operations. MRP/ERP and project control processes share many of the same tools and techniques.

As was discussed in Section 2.2, many of the sub-processes in project controls are the same as in strategic asset management.

2.4.1.4 Organization for Project Control

On smaller projects or those with limited types and quantity of resources, the project control process may be managed by the project leader be they a project manager, engineer, architect, systems analyst, cost engineer, or whoever. On larger projects, with many resources to deal with (such as major construction projects), there may be planners, schedulers, estimators, cost/schedule controllers, value specialists, cost accountants, and other specialists involved. Project control on large teams may be coordinated by a lead cost/schedule or resource manager, quantity surveyor, project controls manager, or project manager. For certain techniques, the individual performing the project tasks (i.e., turning the wrench) may be responsible for control tasks such as progress measurement.

A central project management organization may be responsible for development of project personnel, processes, and procedures for all projects in an enterprise (i.e., a project system). That organization may also manage relationships with project resource providers. All of the project control steps require experience and skills in which an enterprise should develop organizational excellence.

2.4.2 Process Map for Project Control

Figure 2.4-1 below maps the major steps or sub-processes of project control.

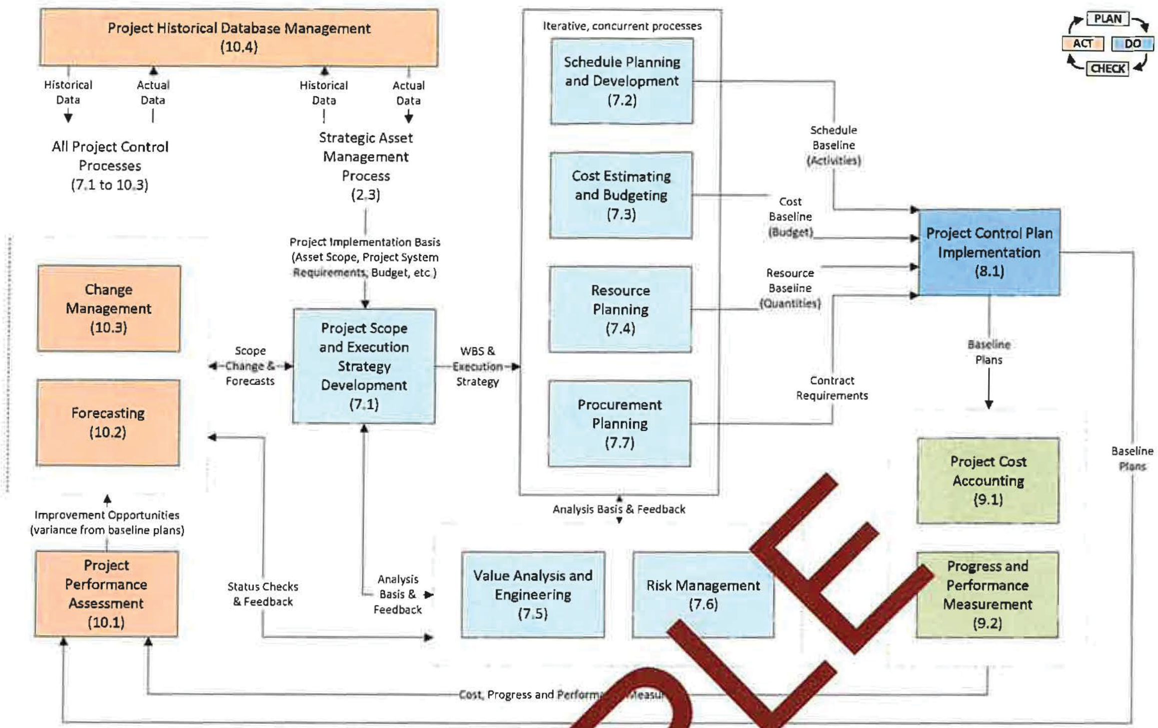


Figure 2.4-1 The Project Control Process Map

The process blocks or steps mapped above have each been diagrammed at a detailed level in the sections noted.

2.4.3 Inputs to Project Control

2.4.3.1 *Project Implementation Basis* - The basis includes objectives, constraints, and assumptions to be addressed in project control planning. The enterprise may establish requirements for schedule planning and development such as completion milestones, constraints, or limitations on the use of resources, and other criteria. The basis also includes the scope description of the asset solution in sufficient detail to provide a basis for planning. (Section 4.1)

2.4.3.2 *Asset Historical Data* - Information and data from strategic asset management (e.g., relevant asset performance metrics) may be useful for project control planning purposes.

2.4.4 Outputs from Project Control

2.4.4.1 *Asset* - The end product of the project process (of which project control is a subset) is the new, modified, maintained, or retired asset along with any information products defining or related to the asset. The overall output of project control is information needed for strategic asset management.

2.4.4.2 *Project Performance Information* - Project performance information is conveyed to the enterprise level for strategic assessment and financial analysis and reporting.

2.4.4.3 *Project Actual Data* - Information and data from projects may be used in strategic asset management.

2.4.5 Key Concepts and Terminology for Project Control

2.4.5.1 *Project* - A temporary endeavor undertaken to create, modify, maintain, or retire a unique asset (product or service). Control of ongoing endeavors producing non-unique assets (e.g., factories) is not covered by project controls but is covered by processes such as manufacturing resource planning. Given their temporary nature, an important characteristic of projects to address is risk and uncertainty.

2.4.5.2 *Planning* - The management or control sub-process of defining scope and establishing baselines or targets against which work performance can be measured. For project control, integrated plans for cost, schedule, and resourcing are established (some refer to planning as the activity definition and sequencing steps in the scheduling process). All plans should address risks.

2.4.5.3 *Control* - A process to ensure that an endeavor produces a desired end result. The process includes identification of the desired end result, measurements and assessment of intermediate results, and identification of actions needed to ensure that the end result is achieved. Project controls then is a control process applied to a project to ensure a desired asset investment result.

2.4.5.4 *Requirements* - An established requisite characteristic of an asset, product, process, or service.

2.4.5.5 *Scope* - The sum or end result of all resources and activities to be invested in an asset or project. Scope definition is a process to decompose the scope into manageable elements.

2.4.5.6 *Scheduling* - A predictive process of estimating and assigning the duration of activities based on available resources and planned means and methods and iteratively refining the planned activity logic in a way that achieves asset investment and project time objectives. A schedule is the output of the planning and scheduling process that documents planned activities and their start and finish times in a way that is logically sequenced; achieves asset investment, operating, project or other time objectives; and addresses available resources, investment objectives, and constraints. A schedule may be used for projects, operations, maintenance, business planning and other purposes.

2.4.5.7 *Estimating* - A process to predict or approximate the cost of or price for scope. Estimating quantification techniques are also used to predict or approximate resource quantities and schedule durations.

2.4.5.8 *Budgeting* - A process to develop a cost plan by allocating estimated costs or prices to controllable *cost accounts* or activities and time phasing the cost in accordance with the schedule.

2.4.5.9 *Resource Planning* - A process of defining resource types and quantities needed to achieve the scope and time phasing the resourcing in accordance with the schedule.

2.4.5.10 *Cost Accounting* - A process of measuring and reporting actual costs for financial reporting and project control purposes. For control, costs are collected in cost accounts that correspond to the budget accounts.

2.4.5.11 *Baseline* - A plan or target against which performance is measured. Analogous to baseline targets in statistical process control.

2.4.5.12 *Value Analysis and Engineering* - A process to analyze the functional value of a process, asset, product, or service where value is defined as the ratio of importance to cost. Increasing value is not synonymous with decreasing cost because value takes into consideration measures of functional importance.

2.4.5.13 *Risk Management* - A process to identify, quantify, manage, and communicate risks or uncertainties that may impact an asset investment or project. Also includes steps to find ways to mitigate risk factors; to continuously monitor the project or asset for the occurrence of risk factors; and to continue to identify, quantify, manage, and close out risks throughout the life cycle of the project or asset.

7.6.1 Description

Risk management is a systematic and iterative process comprising four steps:

1. **Plan** - *to establish risk management objectives;*
2. **Assess** - *to identify and analyze risk;*
3. **Treat** - *by planning and implementing risk responses; and*
4. **Control** - *by monitoring, communicating and enhancing risk management effectiveness.*

The goal of risk management is to increase the probability that a planned asset, project or portfolio achieves its objectives. In total cost management (TCM), potential deviations from plans are all considered potentially adverse to overall performance. In this sense, perceived opportunities may also pose a threat. However, if properly managed, the project or asset management team may be able to capitalize on opportune uncertainties.

The risk management process is applied in conjunction with the other asset and project control planning processes such as scope development, cost estimating, schedule planning, schedule development, resource planning, procurement planning and financial systems integration. In the context of TCM's strategic asset management process, the term enterprise risk management (ERM) recognizes that the risk management process should be applied to overall enterprise, portfolio and program level objectives, not to just a single business unit, asset or project.

Every organization manages risk but, depending on their level of risk management maturity, this might not be done in a visible, repeatable or consistent way. Risk management is an essential facet of enterprise governance that provides a disciplined environment for proactive decision making.

7.6.1.1 The Definition Debate

Risk is typically recognized as something that is harmful, adverse and negative. This view is supported by a commonplace dictionary definition of risk, however, when reviewing the details of a risk management process or seeking to develop, manage and maintain risk data, some essential concepts must be made clear and readily understood. The commonplace dictionary definitions will not support all the viable risk management processes in use that are evolving, or that which is included in TCM. In recent years risk practitioners and professionals have been actively debating the precise scope of the word.

To be an effective facilitator of the risk management process, professionals should be aware of the two major issues on which this debate centers.

First is the issue of risk versus uncertainty. The controversy here concerns how far we should be trying to manage uncertainty or whether we must restrict our efforts to managing risk. The economist Frank H. Knight in his work *Risk, Uncertainty, and Profit* (1921), made a distinction between risk and uncertainty when he argued that "...measurable uncertainties do not introduce into business any uncertainty whatever." For Knight, measurable uncertainty was not true uncertainty. To describe measurable uncertainty he assigned the term risk.

Knight's view should be balanced against the views held by mathematicians long before him such as Poisson, Bernoulli and Bayes. They referred to uncertainty as measurable in terms of quantified probabilities and did not distinguish between uncertainty and risk. This can help explain why economists may choose to define uncertainty and risk differently from mathematical purists.

Since AACE chooses to frame risk in terms of its effect on business goals or project objectives, we are not concerned with non-quantitative uncertainty but simply risk that matters.

Second is the question of positive or upside risk, commonly ...
downside risk, commonly called threats). Traditionally, risk was considered to only have an adverse, harmful or negative impact on objectives (and it still has in many quarters). In the 1960s, risk management began to be recognized as an essential management skill but at that time organizations tended to focus on insurance management, seeking to maintain financial capacity following the negative effects of adverse events. A broader view began to emerge in the 1970s as organizations developed a better understanding of the nature of risks and sought alternatives to insurance, however, the focus remained on overcoming negative effects. In recent years, more and more organizations have spoken of risk management in a broader sense where the intent is to proactively reduce the impact of negative threats and increase the probability of positive opportunities.

When ushering stakeholders through the risk management process, the risk practitioner needs to be aware of and prepared for potential differences in opinion. Listed below is a selection of definitions to help appreciate the differing views currently held by some of the more renowned professional groups who are shaping best practice in this discipline:

1. *"An ambiguous term that can mean any of the following: 1) all uncertainty (threats and opportunities); 2) undesirable outcomes (uncertainty = risks + opportunities); or 3) the net impact or effect of uncertainty (threats - opportunities). The convention used in any work should be clearly stated to avoid misunderstandings".*
   [Ref. AACE Risk Management Dictionary, 1995]

2. *"Combination of the probability of an event and its consequence."*
   Note: 3.1.1-1, The term "risk" is generally used only when there is at least the possibility of negative consequences.
   Note: 3.1.2-2, Consequences can range from positive to negative. However, consequences are always negative for safety aspects.
   [Ref. PD ISO/IEC Guide 73:2002].

3. *"The chance of something happening that will have an impact on objectives."*
   Note 1: A risk is often specified in terms of an event or circumstance and the consequences that may flow from it.
   Note 2: Risk is measured in terms of a combination of the consequences of an event and their likelihood.
   Note 3: Risk may have a positive or negative impact.
   [Ref. AS/NZS 4360:2004]

4. *"Uncertainty inherent in plans and the possibility of something happening (i.e. a contingency) that can affect the prospects of achieving business or project goals."*
   [Ref. BS 6079-3:2000].

5. *"An uncertain event or set of circumstances that, should it occur, will have an effect on achievement of one or more of the project's objectives."*
   [Ref. APM PRAM Guide 2004].

6. *"Uncertainty presents both risk and opportunity, with the potential to erode or enhance value."*
   [Ref. The Committee of Sponsoring Organizations of the Treadway Commission's (COSO's) Enterprise Risk Management - Integrated Framework, 2004].

7. *"An uncertain event or condition that, if it occurs, has a positive or negative effect on a project objective."*
   [Ref. PMI® PMBoK® Third Edition, 2004].

8. *An uncertain event or set of circumstances that, should it occur, will have an effect on achievement of one or more of the project's objectives.*
   [Ref. Management of Risk: Guidance for Practitioners (Published by TSO (The Stationery Office – UK Office of Government Commerce)].

[Ref. National Research Council (US), The Owner's Role in Project Risk Management, The National Academies Press, 2005].

10. *Risk refers to uncertainty of outcome, whether positive opportunity or negative threat, of actions and events. It is the combination of likelihood and impact, including perceived importance.*
    [Ref. Risk: Improving government's capability to handle risk and uncertainty, Strategy Unit Report, November 2002 (UK Cabinet Office)].

11. *A measure of future uncertainties in achieving program performance goals within defined cost and schedule constraints. It has three components: a future root cause, a likelihood assessed at the present time of that future root cause occurring, and the consequence of that future occurrence.*
    [Ref. Risk Management Guide for DOD Acquisition, Sixth Edition (Version 1.0) August, 2006].

12. *Risk = f(hazard, safeguard)*
    [Ref. Project Management: A Systems Approach to Planning, Scheduling, and Controlling, Harold Kerzner, Ph.D., John Wiley and Sons Tenth Edition, 2009].
    Also *"Future events (or outcomes) that are favorable are called opportunities, whereas unfavorable events are called risks."*
    [Ref. Project Management, Harold Kerzner, Ph.D., Fifth Edition 1995, Van Nostrand Reinhold].

13. *The probability and magnitude of a loss, disaster or other undesirable event.*
    [Ref. The Failure of Risk Management: Why It's Broken and How to Fix It, Douglas W. Hubbard, John Wiley and Sons, 2009].

14. *The chance of things not turning out as expected.*
    [Ref. http://www.economist.com/research 201[illegible]].

15. *The potential for realization of unwanted, adverse consequences to human life, health, property, or the environment.*
    [Ref. The Society for Risk Analysis, www.sra.org].

The AACE definition of risk is provided in Section 7.6.1.2. It may be noted that it is neutral in respect to threat and opportunity. This neutral position embodies a broader concept of risk derived from its Latin root, *risicare* or *to dare*. However, with this in mind, the risk professional should be aware that, although it may be tempting to consider the treatment of threat and opportunity as separate activities, in practice they are seldom independent. The AACE recommended risk management processes adopt a progressive interpretation of this definition by managing both threats and opportunities in parallel.

Hillson and Simon (2007) also acknowledge the increasing popularity of the wider application of risk management. They cite the following benefits to be gained from adopting a process that manages both threats and opportunities:

- *Proactive opportunity management* – a common process reduces the potential for opportunities to be overlooked.
- *Familiar techniques* – only following minor changes to the techniques used for managing threats can organizations deal with opportunities.
- *Minimal additional training* – the common process uses familiar processes, tools and techniques.
- *Maximum efficiency* – no need for a separate opportunity management process.
- *Cost effectiveness* – one process that can both minimize threats and maximize opportunities.

- *More realistic contingency management* – by intrinsically including both potential upside and downside impacts.
- *Increased team motivation* – by encouraging people to come together and think creatively about ways to work better, simpler, faster and more effectively.
- *Improved chances of project success* – by providing a familiar means to realize benefits.

7.6.1.2 Definition of Risk

For the purpose of the risk management process within the TCM process, risk can be defined as follows;

An uncertain event or condition that could affect a project objective or business goal.

In recognition of the "definition debate", some users may choose (during risk planning) to expound this definition so that it expressly underpins their specific stakeholder's needs.

7.6.1.3 Decision and Risk Analysis

The full risk management process, as mapped in this section, is designed for addressing uncertainty in project outcomes (from a project control context). However, the process generally applies and is critical to addressing uncertainty in the outcomes of any decision, including enterprise risk management. As discussed in Section 3.3, a key challenge in strategic asset planning and investment decision-making is bringing an awareness of risk and probability concepts to those processes regardless of whether or not they result in an implemented portfolio or project. If this is not achieved, traditional economic analysis used in investment decision-making may become meaningless when there are significant risks.

7.6.1.4 Risk Management versus Value Management and Value Improving Practices

As defined in Section 11.5, value management in TCM is a process employed by an enterprise to help ensure that its assets provide or maintain the usefulness and/or value required by the stakeholders.

Risk management is considered a value improving practice because it helps increase the probability that a planned asset or project achieves its optimum potential (as stakeholders would require). As discussed in Section 7.6.1.1, it is recommended that risk management processes manage both threats and opportunities in parallel. One way to accomplish this is have separate but integrated risk and value management processes to ensure that both threats and opportunities get all due attention.

7.6.2 Process Map for Risk Management

The risk management process is iterative, centering on steps that establish objectives, identify risk drivers occurring throughout the project or asset life-cycle, and essentially manage that risk by continually seeking to assess, treat and control their impacts. The primary outputs of the risk management process are: the risk management plan; the risk register; risk analyses (including contingency allowances for cost and schedule); risk response plans; and the baseline project scope definition. Figure 7.6-1 is the TCM process map for risk management.

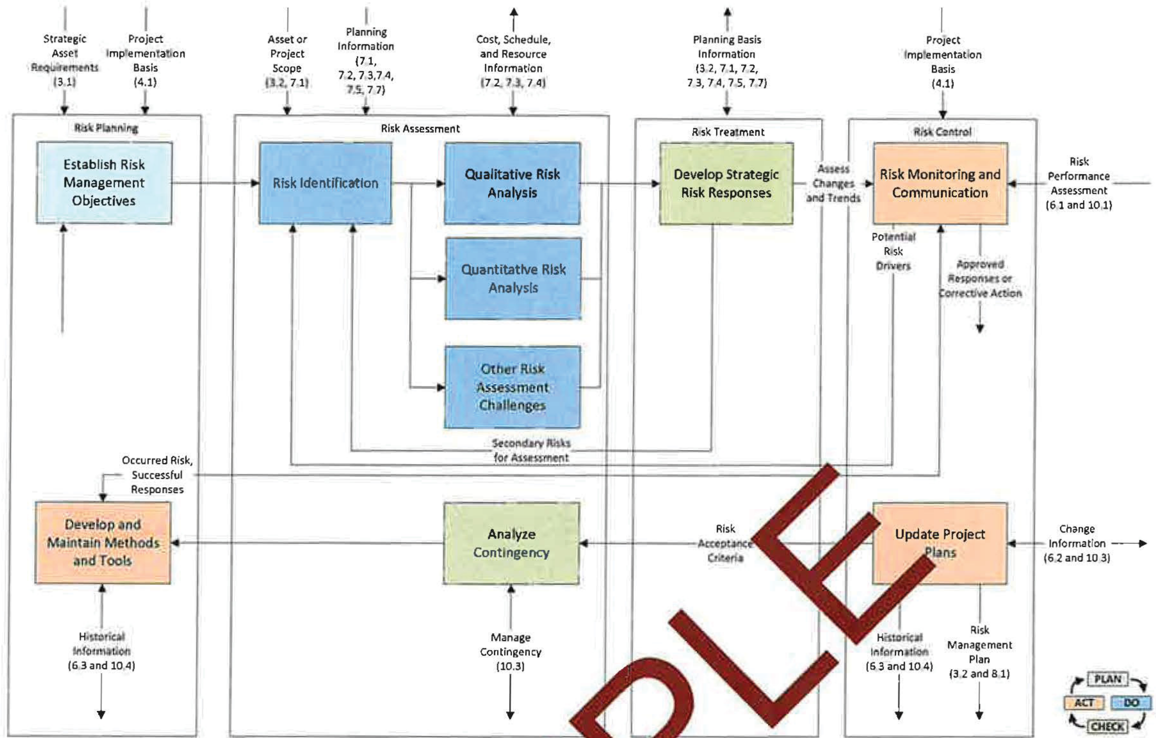


Figure 7.6-1 Process Map for Risk Management

The following sections briefly describe the steps in the risk management process.

7.6.2.1 Risk Planning

At the start of the process, risk management leadership is appointed with the responsibility to plan and prepare for the risk assessment, risk treatment and risk control efforts that will take place throughout the project life-cycle. Depending on the scope, size and/or complexity of the project, this leadership role may be performed by an individual or group of competent personnel.

Leadership must liaise with stakeholders at all levels and use the risk management plan to establish the scope of risk management. This will help clarify expectations and ensure all parties are aligned. For example:

- Are there any preferred methods or practices?
- Are there preferred metrics and/or report formats?
- Does the operational definition of risk support the specific process and methods being used?
- How frequently will the team be expected to meet and update their qualitative analyses? Each month or at different periodic intervals?
- How frequently are cost and/or schedule risk analyses to be run? Each quarter or at agreed milestones?
- Is there a predetermined budget or an estimated number of hours that can be expended in support of the risk management process?
- Alternatively, is this venture unique requiring special consideration?
- Are there any assumptions that need to be formalized? (E.g. the entire contractual chain may, at some point, be expected to support the implementation of risk response plans).

Roles and responsibilities should also be identified; this may include a risk champion to lead the risk management initiative at project level, a risk study team to complete the initial risk identification and a review committee to complete periodic monitoring and risk control. Such review committees are typically at the project level but, more frequently, organizations are utilizing independent groups to fulfill an additional parallel oversight and/or audit function.

Ultimately, the risk management plan must describe what the project or asset management team recognizes as being the risk management objective so that it may be incorporated within the overall project execution plan and/or project charter. The objective may be expressed in terms of risk appetite and risk tolerance. Risk appetite can be described in terms of a confidence interval or confidence level e.g., percentage confidence of underrun or P value (Section 7.6.2.2). Risk tolerance for example, could be described by using a simple threshold or range of +/- number of days and/or range expressed using the agreed project currency (or currencies). Depending on client needs or expectations it may, for example, be necessary to consider other risk consequences such as a reasonable number of safety and/or environmental incidents.

The scope must be aligned with the strategic asset requirements and project implementation basis (Section 3.1 and 4.1) and with the current asset or project scope definition (Section 3.2 and 7.1).

Planning for risk management is better facilitated when the enterprise has achieved a certain level of risk management maturity. A mature organization will provide a supportive culture and a support structure that offers capabilities for the successful implementation of the risk management process (i.e., methods, tools, and resources). As a consequence, the organization should have in place a policy or procedure document detailing when and how risk management is to be applied. In the context of enterprise risk management, these guidelines will be integrated across the enterprise.

Risk management is applicable to all enterprises and all asset or project life cycle stages. The four iterative steps, planning, assessment, treatment and control are initially applied in a phased manner consistent with the project scope development phases described in Section 7.1.

During planning, it is especially important to understand the synergies between value engineering (Section 7.5) and risk management. Changes to plans to address value issues may affect risk, and vice versa. Therefore, as indicated in the process map in Section 2.4, the value engineering and risk management processes generally need to be revisited together.

Many individuals on the strategic asset or project team may be involved in the risk management process. Diversity of the risk management team is strongly encouraged, with participation by all stakeholders and end users. However, risk management success is so closely linked to the other strategic asset and project processes that it is best facilitated by having experienced management personnel coordinate it.

Essential to effective risk management is experience coupled with good judgment that can be supported by sound historical data. In addition, senior management support of the risk management process is vital to ensure that all the necessary resources are made available, not just initially, but on an ongoing basis that supports periodic review and risk control. An organization's leadership team must convey the need for risk management to be embedded in all business processes. Only then can the risk management process described here be most effective.

7.6.2.2 Risk Assessment

Once the risk management process has been planned and informal agreement or formal approval obtained from all stakeholders, the team can start working through the next step of risk assessment. Risk assessment is typically comprised of three distinct tasks:

1. Risk identification.
2. Qualitative risk analysis.

3. Quantitative risk analysis.

These tasks, as well as other issues concerning the risk assessment process step, are outlined below.

1. Risk Identification

All members of the team should work together to identify asset or project risk drivers for analysis. Risk drivers are events or circumstances that may influence or drive uncertainty in asset or project performance. In this sense, risk drivers can also be considered the 'cause' of risk. They may be inherent characteristics or conditions of the asset or project, perhaps external influences, events, or environmental conditions ranging from climatic to economic.

Checklists or a knowledge base of common risk drivers may be developed and used to facilitate this risk identification step. Checklists and similar tools such as a risk breakdown structure (RBS) are generally based on project historical data and can serve as invaluable prompts during risk identification brainstorming.

Risk drivers can be general or systemic in nature. Empirical research of past project experience is generally required to understand these drivers. For example, research of historical industry data has shown that one of the most significant project risk drivers is having a poor level of project scope definition and planning. However, other risk drivers may be unique to the asset or project; therefore, input from the entire project team should be obtained using creative processes such as brainstorming workshops or other facilitated risk assessment meetings in order to reveal the full spectrum of risk perception i.e. systemic, project-specific, or varying combinations of both.

Initially, the output of this step is a list of potential risks, essentially it is the first draft risk register. The list should employ a three part risk metalanguage to describe each risk event.

These structured descriptions will separate cause, risk and effect. An example of a typical risk description using metalanguage follows: "Due to <*cause*>, there is a threat / opportunity that <*risk*> may occur, which may lead to <*effect*>.

Ensuring each risk is explicitly described in this way helps minimize confusion and can aid the identification process. For example, brainstorming may reveal that there are multiple causes behind one risk and vice versa. In addition, having delineated cause and effect, this will aid risk response planning and the assignment of the most competent or qualified risk owner.

It is during the initial risk identification forums that the team may invest their peak level of effort for this step, however, it is important to note that this is an ongoing process. Every team member should be empowered to bring for review a new risk driver, at any stage in the project or asset life-cycle. Periodic risk control meetings can facilitate ongoing risk identification. In addition, it is important to remember that risk identification efforts must focus on risks that matter i.e. those that can influence project objectives, irrespective of their probability of occurrence or severity of impact.

To clarify once more, risks that matter are essentially areas of uncertainty that can be quantified and, if they were to occur, could have a positive or negative impact on business goals or project objectives.

Whenever a risk is identified, care should be exercised to ensure it is assessed in its original state i.e. prior to qualification, mitigation or any other form of treatment.

One last important aspect of risk identification that must be given appropriate consideration, when identifying risk drivers and populating a risk register, the risk practitioner must be careful that the following elements are not mistaken to be risks:

- *Issues or problems*,

For example, an issue is generally a risk that has already occurred. A proactive risk management process should have permitted the creation of an appropriate risk response ahead of time and a good risk register should acquire a number of occurred risks as the project evolves but, if for some reason this does not happen, it is more appropriate to record and manage such problems in an issue log. Failure to do so will unnecessarily burden the process, curtailing the potential benefits that could have otherwise been enjoyed as a consequence of a more proactive approach.

To further illustrate what a risk is not, let us consider poorly defined scope. This is not a risk per se but a cause. Such a cause will drive numerous risks and effects that, ideally, should be individually isolated, explicitly defined and quantified.

In the case of systemic risks, such as poorly defined scope, it is worth noting that because the resulting risks are unlikely to be individually identifiable, it is likely that the risk(s) may only be defined in general terms, and the subsequent effect only quantifiable at the bottom line.

Finally, late delivery and schedule overrun is not, for example, a risk but an effect. The effect is often what team's have in mind when they enter a workshop so the risk practitioner can perhaps seize on this and use it to their benefit. When brainstorming, it is often useful to build off an effect that is widely appreciated and work backwards by seeking to elicit every potential risk driving the effect in question (e.g. risk of delayed procurement), subsequently asking the team to identify all potential causes of the identified risk (e.g. poorly defined scope).

These examples of what risk is not should further underscore the benefits of employing a metalanguage to describe risk.

2. Qualitative Risk Analysis

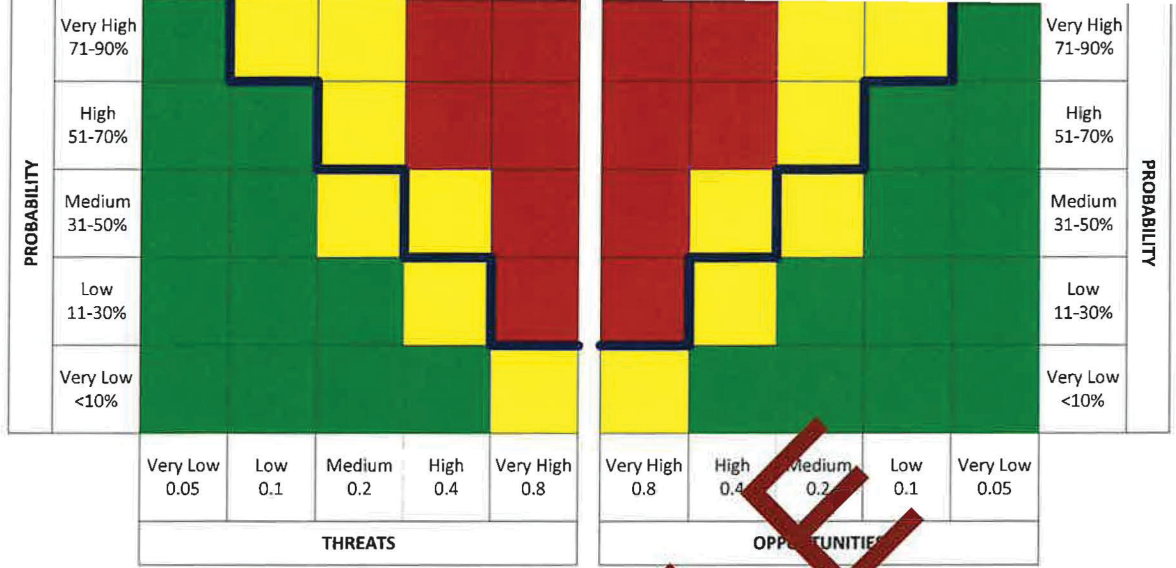
Entries in the risk register are typically classified by their source using the RBS. The team may further categorize or organize their risk data using qualitative methods that help rank risks in terms of criticality and significance to the enterprise objectives. These qualitative methods are subjective in nature and assign, for example, a score from one to five to reflect probability and each identified effect, consequence or impact.

A five point scale is generally preferred. Although a three point scale is common, it can sometimes prevent the desired level of analysis. Conversely, anything beyond a five point qualitative scale (or attempting to provide more quantitative values at this stage) can lead to what is affectionately termed analysis paralysis.

Risks are dynamic. What may appear to be a significant risk at one point in time could later evolve to become one that is critical. Additionally, what may pose a schedule risk at the start of the project may, for example, manifest itself as a safety risk at a later time. For this reason, it is recommended that the team establish a baseline for each risk, scoring them before any responses have been implemented, then periodically reviewing and updating their qualitative risk analysis if necessary, enabling them to monitor for any adverse trends (Section 7.6.2.4).

The content of the scoring matrix used for this exercise should have been agreed with all stakeholders during risk planning.

The output of the qualitative risk analysis is typically reported using a matrix where risk impact or consequence is plotted against probability. An indicative example of a five by five matrix is provided in Figure 7.6-2. An organization that has a mature risk aware culture would, for example, use two matrices to report on both threats and opportunities. The majority of organizations, however, typically focus solely on threats and the left hand matrix is commonly used in isolation.



Legend:

Red zone highlights major risks that require immediate action (in this example, those that score more than 0.2).

Yellow zone highlights moderate risks that require heightened attention (in this example, scoring between 0.08 and 0.2).

Green zone highlights minor risks that are "business as usual" (in this example, scoring less than 0.08).

Risk threshold line

Figure 7.6-2. Double Probability vs. Impact Matrix

3. Quantitative Risk Analysis

Once the risks have been identified and ranked, their quantitative impact on the asset or project plans can, with the support of the project team, be analyzed in an objective way by a professional risk practitioner. This may be a person that is already among the risk management leadership team, it may be someone working from within organization's specialist support services pool or it may be external consultant contracted in especially for this effort.

For each risk selected by the team for quantitative risk analysis, a probabilistic estimate of its impact will be prepared. The chosen methodology will have been specified during the risk planning phase. One of the following three methods or a hybrid of the three is commonly employed: expected value, range estimating, or parametric modeling.

When using the expected value method, estimates of the probability of occurrence and potential impact of the risks are prepared. These probability and impact ranges typically take the form of "three point estimates" and portray the team's optimistic and pessimistic view, where the most likely value frequently, but not always, aligns with the estimated value.

With range estimating, the impacts (usually three points) are estimated while risks and their probabilities are addressed by the team based upon their experience and knowledge as appropriate when determining impact ranges.

With parametric methods, the risk-to-impact estimating relationship is implicit and the probabilistic outcomes are inherent to the algorithm.

Expected value and parametric values are sometimes called risk driver approaches because they start with and focus directly on the risk drivers.

The estimated value is referred to as the base estimate, point estimate or the deterministic value. In expected value and range estimating methods, computer simulations using Monte Carlo, or similar statistical sampling processes, compute thousands of different outcomes or probabilistic values. These probabilistic values can be used for sensitivity analysis (i.e. identifying which variables are most influential) and also to produce a probability distribution for total cost, completion date or other measure of interest.

Parametric models can output distributions directly. The probability distribution is commonly used to derive the confidence level percentage values that support estimation of the appropriate contingency depending on management's risk appetite or tolerance.

Any qualifications, assumptions, or exclusions used in the quantitative risk analysis need to be clearly stated and accepted by all key stakeholders. Done properly, the risk analysis will address cost and schedule risks in an integrated manner. At a minimum, the cost and schedule impacts must reflect consistent assumptions that appropriately account for residual risk.

The first quantitative risk analysis is typically performed to help set an appropriate level of contingency. For the risk management process to be most effective, and resources permitting, it is good practice to repeat this exercise at periodic intervals and/or milestones as agreed in the risk management plan.

Contingency

Contingency is an amount added to an estimate (of cost, time, or other planned resource) to allow for items, conditions, or events for which the state, occurrence, and/or effect is uncertain and that experience shows will likely result, in aggregate, in additional cost.

The change management process (Section 10.3) is used to incorporate changes in the project scope definition and baseline plans. Contingency management is part of that process. In change management, if a project team takes an approved corrective action (within the project scope) that will cost more or less than the amount budgeted for in the affected cost accounts, or will take more or less time than planned for against the affected activities, then budgeted funds or float may be approved for transfer from or to the contingency as appropriate.

Contingency analysis, a sub-step of risk assessment, quantifies the risk impacts after all treatment efforts are complete, also known as residual risk. The team should guard against assumptions that the treatment efforts will be entirely successful, or not successful at all. Following treatment, more often than not, risk cannot be completely eliminated and there will be some degree of residual risk. In addition, many treatment efforts can introduce, inadvertently or knowingly, subsequent variation or secondary risks.

Successful contingency analysis will account for all residual risk and secondary risk that cannot be treated in some way. In this sense, it should be appreciated that appropriate contingency analysis is mutually dependent on the other two iterative process steps: risk treatment and risk control.

The amount of contingency depends in part on an organization's risk appetite or willingness to accept risk or avoid risk. The greater the appetite, the more risk the organization is willing to accept that the project may either exceed or under achieve its objectives.

Since the perception of risk varies from person to person, the risk management plan must document an organization's risk appetite. This will help the team become aligned as to whether their actions are to be risk seeking or risk averse. If modeling techniques that produce probabilistic outcomes are used to quantify risk impacts, then an organization's willingness to accept risk can be expressed simply as organization's desired percentage confidence (a.k.a. percentile or P value) that the project will not overrun its budget or schedule. For example, an aggressive contracting organization with a large risk appetite may choose not to accept a contingency value at a P70 confidence level but instead P50. Here they are fifty percent confident that they will meet their project objectives and have chosen to bid a lower price at the risk of losing their profit if their contingency later proves insufficient.

Contingency is normally controlled by the project manager or equivalent team leader because experience shows that contingency will likely be required by the project. However, the organization may decide that additional funds, time or other values at risk be considered for risks that are beyond the control of the project team. These amounts, typically controlled by senior management, are known as the funded liability or management reserves.

Other Risk Assessment Challenges

There are two additional key challenges for risk analysis. First, the impacts of some risks are difficult to imagine or estimate, even for the most experienced project teams. Second, even if individual risk drivers are understood, it is difficult to understand the interaction of risks. For example, does the occurrence of one risk influence the occurrence or consequence of others? Are the impacts of associated risks added or compounded?

Parametric modeling is one method that helps address interaction and complexity challenges. Parametric models are typically multi-variable regressions of historical, quantified risk drivers versus actual project outcomes. Regression empirically quantifies the impact while allowing the dependency of risks to be examined. Regression models also provide useful probabilistic outputs, and results are replicable. There are also proprietary commercial project risk analysis systems available that also address these risk analysis challenges.

Sensitivity analysis is another way to address risk complexity and interaction. Sensitivity analysis examines risk drivers (or cost or schedule drivers) by developing a model relating the drivers to impacts (can be a parametric or another model type), and then changing the driver variable values to examine the impact of each driver or combination of drivers on the impact. This helps prioritize the risk drivers for later risk treatment.

Not every project may warrant the level of effort required to undertake quantitative modeling. Alternatively, and in terms of their overall life-cycle, some projects may have insufficient data available to support cost and/or schedule analysis because they are in an early stage of implementation. That said, the most robust risk analysis methods tend to combine subjective team judgment and expert objective, empirical based modeling. Here then perhaps lies a paradox; the ability to influence the project outcome is strongest during the earliest stages of the project lifecycle, yet the full extent of inherent risk may not become apparent until the completion of design or commencement of execution.

7.6.2.3 Risk Treatment

As the risk assessment phase draws to a close and the team searches for ways to effectively treat risk, the team must assign risk ownership. It is a good practice for every risk to have a risk owner.

The risk owner is responsible for devising and implementing risk response plans on behalf of the project, monitoring and reporting on both the status of their identified risks and response plan. Such reporting should encompass the identification of secondary risks as response plans are implemented. For clarity, risk response plans simply aim to either maximize opportunities or minimize threats, optimizing the chances of project success. In addition, the risk owner should be one individual and not a department or group. Having a single point of responsibility aids effective communication and helps maintain accountability.

Although it is good practice to have in place risk response plans for every risk, it is often prudent to prioritize this effort based on the severity or qualitative ranking of the risks. Figure 7.6-2 illustrates a common type of matrix used for screening identified risks. Depending on the approach cited in the risk management plan, risk treatment may be focused on those risks with both very high impact and probability (i.e. those that are the worst threats and the best opportunities). In this example, the major risks score more than 0.2 and are shown in the central red zone.

Key actions performed during the risk treatment phase include:

- Evaluating all appropriate response strategies.
- Selecting an appropriate risk response plan strategy (or combination of strategies).
- Developing action items in support of the selected response.
- Validating proposed actions with assigned actionees, including dates for implementation.
- Ascertaining post-response targets and gains.
- Ascertaining response plan resource requirements.
- Updating project schedule or budget if the anticipated treatment value gain is positive.
- Identifying any secondary threats or opportunities that may arise from the response.

Response strategies for threats, listed in order of preference are:

- *Avoid* – involves eliminating either the probability or impact. Can be done by either clarifying requirements, acquiring expertise or changing the project management plan.
- *Reduce* – involves mitigating key drivers to reduce probability and/or impact.
- *Transfer* – involves transferring the threat to a competent third party who is better able. Could be through insurance or contractual transfer (via indemnity, exclusion or hold harmless clauses).
- *Accept* – no proactive action is to be taken because cost either outweighs benefit or there is already an adequate contingency provision that will protect the project objectives.

Response strategies for opportunities, listed in order of preference are:

- *Exploit* – involves taking steps that guarantee the opportunity will arise (e.g. changing specification, scope or supplier).
- *Share* – involves sharing the risk with a third party better able to manage it (perhaps by applying a pain/gain formula).
- *Enhance* – involves increasing the probability and/or impact of key risk drivers.
- *Accept* – no proactive action is to be taken because cost either outweighs benefit or there is already an adequate contingency provision that will protect the project objectives.

7.6.2.4 Risk Control

The risk management process will be worth nothing if all that has been discussed and planned during the earlier steps is not implemented. For this reason, monitoring is an essential component of risk control. Each response strategy and any associated actions must be monitored by both the risk owner and review committee to ensure that they are executed in a timely manner, and above all, with the intended effect.

The review committee must decide if response planning must end prematurely and, guided by the risk owners, they must make the final decision as to when it is appropriate to close a risk. Conversely, they must decide if it is appropriate to add any new risks to the register.

After a new risk has been clearly described and coded by RBS, benefit can also be gained by categorizing the affected areas of the project by work breakdown structure (WBS). By comparing the most common causes of risk by RBS, against the most commonly affected areas by WBS, it is possible to identify hot spots. Such information can be invaluable when prioritizing effective risk responses. Visibility of an initiative's hot spots may also influence the overall management of the project.

The probability versus impact matrix (Figure 7.6-2) can also be used to support timely risk control. The bold line in the figure represents a risk tolerance line. It illustrates the overall level of risk that the organization is willing to tolerate in the depicted situation. Risks that are plotted above the line are consequently regarded as unacceptable and require immediate or prompt action. Risks below the tolerance line are considered to be acceptable and should be monitored on a periodic basis.

For there to be tangible risk control after the project control plan has been implemented (Section 8.1), risk owners should, at a minimum, periodically update their qualitative risk analyses. Periodic risk control meetings can facilitate ongoing risk identification and analysis. Using such data, the team can determine if risk treatment is effective or if additional corrective action is required. If an identified risk is shown to have occurred but the original qualitative impact scores are seen to be underestimated, then contingency or fallback plans may be implemented. These changes are managed using the change management process (Section 10.3). In some cases, further risk planning, assessment, treatment, and control may be required to cover these changes, such as when performance trends may worsen, or if new risk drivers arise.

The review committee must be satisfied with the quality of data available to them. Before reporting risk data, they must also be satisfied with the content so there may be occasions where their consensus of opinion differs from that of the individual risk owner. When communicating risk, it is important to remember that, owing to the nature of uncertainty, data is often subjective and circumstantial. Risk perception differs from person to person and, invariably, this can be an emotive subject. For these reasons, it is important that no one individual sanctions a report. A review committee of four to six key stakeholders should ensure that it is their consensus of opinion that is communicated. Reports may take the form of the probability versus impact matrix, they may simply highlight the trends of the 'headline' risks or highlight areas of the scope that give rise for concern or show promise. Reporting requirements are variable so benefit can be gained if these are clearly prescribed in the risk management plan.

Outputs from the risk control process steps will help inform contingency analysis. In contingency analysis, the estimated cost and schedule impacts derived from quantitative risk analysis for residual risks must reflect an assumed contingent response where applicable. For example, if the project has a schedule-driven objective, a delay risk may be responded to by spending money to salvage the schedule; alternatively, a cost-driven project may allow the schedule to slip and incur nominal increases in time-driven costs. Few significant risks are passively accepted so one of the products of the contingency estimate is a list of assumed contingent responses or contingency plans for each risk. There are always cost-schedule tradeoffs associated with responses. It is therefore essential that the project team clearly understand the project objectives captured when risk planning then monitor and control their risk responses to help ensure contingency funds are adequate.

Even with the best risk management infrastructure, the ultimate success of the risk management process is due to the ongoing engagement of the entire team. This will not be a problem for an organization that actively promotes a risk aware culture and operates with a high level of risk management maturity. In other organizations that struggle to recognize the benefits of risk management, or believe that it is nothing more than a cursory bolt-on activity that is solely the preserve of a back-room specialist, there will exist cultural barriers to effective risk control. In these instances, such cultural barriers could be overcome after, for example, training campaigns, incentive programs and risk management audits.

An organization that strives to achieve the highest level of risk management maturity will work towards continual improvement. At the close of the project, one key action will be to capture historical data regarding risk drivers and their impacts in the project database (Section 10.4).

7.6.2.5 Develop and Maintain Methods and Tools

Risk management uses a variety of methods (e.g. parametric or simulation models) and tools (e.g. risk breakdown structures, risk driver checklists, report templates, etc.) that are enterprise specific and must therefore be developed and maintained by each entity. Historical risk occurrence, associated consequences, along with successful risk response plans are all key resources that can be used by an organization to create effective risk management methods and tools.

7.6.3 Inputs to Risk Management

7.6.3.1 *Strategic Asset Requirements and Project Implementation Basis* - These define the basis asset scope, objectives, constraints, and assumptions, including basic assumptions about risks.

7.6.3.2 *Asset or Project Scope* - Deliverables (asset options, work breakdown structure, work packages, and execution strategy) that define the current asset or project scope. Risk factors may be inherent characteristics or conditions of the asset or project scope. Scope changes for which risk assessment and analysis will be applied also channel through the scope development process (Section 3.2, 7.1, and 10.3).

7.6.3.3 *Planning Information* - All planning components may be subject to risk factors that must be assessed. Also, alternate plans may be considered to mitigate risk factor impacts. Results from value engineering are particularly important to assess (Section 3.2, 3.3, 7.1, 7.2, 7.3, 7.4, 7.5, and 7.7).

7.6.3.4 *Cost, Schedule, and Resource Information* - The quantification of risk factor impacts employs the methods and tools of the respective planning processes. Risk analysis is iterative with the other planning processes (Section 7.2, 7.3, and 7.4).

7.6.3.5 *Risk Performance Assessment* - In the performance assessment processes, the asset or project status is monitored for the occurrence of risk factors. New risk factors identified during asset operation or project execution may require updated risk management planning (Section 6.1 and 10.1).

7.6.3.6 *Change Information and Contingency Management* - During project execution, changes to the baseline scope definition and plans are identified in the change management process. In some cases, further risk assessment and analysis may be required for changes and trends. Additional contingency may be required to address changes and performance trends (Section 10.3).

7.6.3.7 *Historical Information* - Past risk factor occurrence and impacts, risk management approaches, and results are key resources for understanding asset and project uncertainty and for creating risk management methods and tools (Section 6.3 and 10.4).

7.6.4 Outputs from Risk Management

7.6.4.1 *Cost, Schedule, and Resource Information* (including contingency) - The quantification of risk factor impacts employs the methods and tools of the respective planning processes. Contingency is incorporated in project plans as appropriate (Section 7.2, 7.3, and 7.4).

7.6.4.2 *Planning Basis Information* - Alternate concepts and plans may be considered to mitigate risk factor impacts. Ultimately, one alternative is selected as the asset or project planning basis. It is particularly important to determine the extent that alternate concepts may affect value (Section 3.2, 3.3, 7.1, 7.2, 7.3, 7.4, 7.5, and 7.7).

7.6.4.3 *Risk Management Plan* - This plan becomes part of the overall project control plan that is implemented. A risk management plan may also be developed for non-project asset investment decision actions. The risk register is a key deliverable of the plan that serves as the bedrock for all subsequent risk management process steps (Section 3.3 and 8.1).

7.6.4.4 *Change Information and Contingency Management* - Findings from risk assessment and analysis may influence the management of changes and contingency (Section 6.2 and 10.3).

7.6.4.3 *Historical Information* - Risk management approaches are key resources for future planning and methods development. Historical risk outcomes are reported from the asset and project performance assessment processes (Section 6.3 and 10.4).

7.6.5 Key Concepts and Terminology for Risk Management

7.6.5.1 *Base or Point Estimate or Deterministic Value* – Section 7.6.2.2
7.6.5.2 *Confidence Level, Percentile or P Value* - Section 7.6.2.2
7.6.5.3 *Contingency* - Section 7.6.2.2
7.6.5.4 *Contingent Response* - Section 7.6.2.2
7.6.5.5 *Enterprise Risk Management (ERM)* - Section 7.6.1
7.6.5.6 *Opportunities* - Section 7.6.1.1
7.6.5.7 *Probabilistic Value* - Section 7.6.2.2
7.6.5.8 *Probability Distribution* - Section 7.6.2.2
7.6.5.9 *Probability vs. Impact Matrix* - Section 7.6.2.2
7.6.5.10 *Qualitative Risk Analysis* - Section 7.6.2.2
7.6.5.11 *Quantitative Risk Analysis* - Section 7.6.2.2
7.6.5.12 *Residual Risk* - Section *7.6.2.2*
7.6.5.13 *Response Strategies* - Section 7.6.2.3
7.6.5.14 *Risk* - Section 7.6.1.1
7.6.5.15 *Risk Assessment* - Section 7.6.2.2
7.6.5.16 *Risk Breakdown Structure* - Section 7.6.2.2
7.6.5.17 *Risk Control* - Section 7.6.2.4
7.6.5.18 *Risk Drivers* - Section 7.6.2.2
7.6.5.19 *Risk Identification* - Section 7.6.2.2
7.6.5.20 *Risk Management Maturity* - Section 7.6.2.[illegible] and 7.6.2.4
7.6.5.21 *Risk Management Plan* - Section [illegible].1
7.6.5.22 *Risk Metalanguage* - Section 7.6.2.2
7.6.5.23 *Risk Owner* - Section 7.6.2[illegible]
7.6.5.24 *Risk Planning* - Section 7.6.[illegible].1
7.6.5.25 *Risk Register* - Section 7.6.2.[illegible]
7.6.5.26 *Risk Response Plan* - Section 7.6.2.3
7.6.5.27 *Risk Screening* - Section 7.6.2.3
7.6.5.28 *Risk Tolerance* - Section 7.6.2.4
7.6.5.29 *Risk Treatment* - Section 7.6.2.3
7.6.5.30 *Secondary Risk* - Section 7.6.2.2
7.6.5.31 *Scenario Analysis* - Section 7.6.2.2
7.6.5.32 *Simulation and Modeling* - Section 7.6.2.2
7.6.5.33 *Stakeholders* - Section 7.6.2.1
7.6.5.34 *Threats* - Section 7.6.1.1

AACE International Recommended Practices

The following AACE International recommended practices (RPs) are applicable to this section of the *TCM Framework*. All RPs listed here are published by AACE International, Morgantown, WV. Please be sure to refer to web.aacei.org for the latest revisions and additions.

- 39R-06, *Project Planning – As Applied in Engineering and Construction for Capital Projects.*
- 40R-08, *Contingency Estimating – General Principles.*
- 41R-08, *Risk Analysis and Contingency Determination Using Range Estimating.*
- 42R-08, *Risk Analysis and Contingency Determination Using Parametric Estimating.*

- 43R-08, *Risk Analysis and Contingency Determination Using Parametric Estimating – Example Models as Applied for the Process Industries.*
- 44R-08, *Risk Analysis and Contingency Determination Using Expected Value.*
- 57R-09, *Integrated Cost and Schedule Risk Analysis Using Monte Carlo Simulation of a CPM Model.*
- 58R-10, *Escalation Estimating Principles and Methods Using Indices.*
- 61R-10, *Schedule Design – As Applied in Engineering, Procurement, and Construction.*
- 62R-11, *Risk Assessment: Identification and Qualitative Analysis.*
- 63R-11, *Risk Treatment.*
- 64R-11, *CPM Schedule Risk Modeling and Analysis: Special Considerations.*
- 65R-11, *Integrated Cost and Schedule Risk Analysis and Contingency Determination Using Expected Value.*
- 66R-11, *Selecting Probability Distribution Functions for use in Cost and Schedule Risk Simulation Models.*
- 67R-11, *Contract Risk Allocation – As Applied in Engineering, Procurement, and Construction.*
- 68R-11, *Escalation Estimating Using Indices and Monte Carlo Simulation*
- 70R-12, *Principles of Schedule Contingency Management – As Applied in Engineering, Procurement and Construction.*
- 72R-12, *Developing a Project Risk Management Plan*
- 75R-13, *Schedule and Cost Reserves within the Framework of ANSI/EIA-748*
- 77R-15, *Quality Assurance/Quality Control for Risk Management*
- 80R-13, *Estimate at Completion (EAC)*
- 82R-13, *Earned Value Management (EVM) Overview and Recommended Practices Consistent with EIA-748-C.*
- 85R-14, *Use of Decision Trees in Decision Making.*

ATTACHMENT 8

CECW-EC

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, DC 20314-1000

Regulation
No. 1110-2-1302

30 June 2016

Engineering and Design
CIVIL WORKS COST ENGINEERING

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Regulation
No. 1110-2-1302 30 June 2016

Engineering and Design
CIVIL WORKS COST ENGINEERING

1. Purpose. This engineer regulation (ER) provides policy, guidance, and procedures for cost engineering responsibilities for all Civil Works projects assigned to the U.S. Army Corps of Engineers (USACE).

2. Applicability. This regulation is applicable to all Headquarters USACE (HQUSACE) elements, divisions and major subordinate commands (MSCs), districts, laboratories, and field operating activities involved in the Civil Works program. It is applicable to cost products prepared by USACE representatives or others, Federal or non-Federal, in support of all authorization, appropriations, decision, and implementation reports and documents for all Civil Works projects that invest Federal dollars.

3. Distribution Statement. Approved for public release; distribution is unlimited.

4. References. References are in Appendix A.

5. Definitions. Various acronyms and terms are commonly used in this regulation to describe phases, types, and parts of cost products. For commonality, and to ensure understanding, definitions used in this regulation are described in the Glossary.

6. Policy. All cost engineering products required to support USACE managed Civil Works projects must be prepared in accordance with this regulation and all referenced regulations, policy and guidance, including engineering manuals, pamphlets and USACE memoranda. Cost engineering products are defined as those cost-related products performed and provided by the cost engineering office, including quantities, estimates, schedules, risk analyses, total project costs and cost-related reports.

a. By 33 U.S.C. 622, the Secretary of the Army, acting through the Chief of Engineers, will contract for improvements to the rivers and harbors in the manner most economical and advantageous to the United States. Contracts will be used for this work if private industry has the capability and the work can be done at reasonable prices and in a timely manner. All construction cost estimates are to be prepared in accordance

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This engineer regulation supersedes ER 1110-2-1302, dated 15 September 2008 with 33 U.S.C. 624, in as much detail as though the Government were competing for the award. Therefore, all costs that a prudent and experienced contractor would expect to incur shall be included in the cost estimate. Civil Works projects originate when a state or city (local sponsor) requests assistance from USACE for an improvement to a national river or harbor. These projects are investigated and developed under the requirements of ER 1105-2-100 and ER 1110-2-1150. Congressional authorization and appropriations are required to start design or construction of most Civil Works projects.

b. Civil Works projects are planned and approved in accordance with ER 1105-2-100, Planning Guidance Notebook, and are designed in accordance with ER 1110-2-1150, Engineering and Design for Civil Works Projects. Civil Works projects specific to Dam Safety should also adhere to ER 1110-2-1156, Safety of Dams – Policy and Procedures, as well as these regulations. Cost development within these regulations must continue to adhere to this regulation (ER 1110-2-1302).

c. Budget Estimates and Independent Government Estimates. Cost estimates are categorized into two types: budget estimates or Independent Government estimates (IGEs). The budget estimate supports funding requests as well as comparisons made to current available funding. Updated costs during project execution and comparisons to the available funding are also referred to as current working estimates (CWE). IGE's are estimates that are prepared to support a contract award. The IGE consists of a title page, signature page, and price schedule, submitted to the Contracting Officer under protective sealed For Official Use Only (FOUO) envelope. The Government estimate back-up data is the detailed cost data, which includes production and crew development methodology, labor, equipment, and crew backup files, subcontractor quotes and all other data identified as detail sheets. The backup data is FOUO and is not to be released. Supporting documents that are publicly available as parts of the solicitation (such as plans, specifications, and project descriptions) are not part of the Government estimate.

(1) In accordance with Federal Acquisition Regulation (FAR) 36.203, Independent Government Estimates must be prepared in as much detail as though the Government were competing for award. All IGEs must be developed as complete and as accurately as possible based upon the latest available information. The cost estimate will represent the "fair and reasonable" cost to the Government.

d. All estimates should include within the cost estimate all allowable costs, which a prudent and experienced contractor would expect to incur. Design (if applicable) and construction efforts needed for project completion must be included in the cost estimate. These costs might address such items as performance specifications, deliveries, site preparation, access, cleanup, and other such items not included in the plans and specifications but would be part of the costs a prudent contractor would expect to incur.

e. Cost estimates must be defensible documents that include description of project scope, major assumptions, sufficient rationale, and basis of costs presented within the estimate. Cost estimates are to be developed in as much detail as practical for the work involved for the specific design phase. At a minimum, the detail included in the cost estimate will make it a standalone and defendable document. Estimate data that includes unit prices, lump sums, and allowances must contain a basis for cost.

f. Detailed preparation requirements and the format of the cost engineering products must follow policy and guidance.

g. Cost engineering products developed by architect-engineer (A-E) contractors or by other offices (i.e., Area Offices, Resident Offices, etc.) must conform to all cost ERs, EMs, and other applicable regulations (shown at Appendix A).

h. Quality control reviews must occur on all cost engineering products (e.g., quantities, estimates, schedules, risk analyses, total project costs, cost-related reports and appendixes, etc.), whether prepared by the cost engineering office, by other authorized offices (i.e., Area offices, Resident Offices, A-E Firms, etc.), or by contract, as prescribed by the specific review procedures in this regulation and those referenced. Reviews will be performed by qualified government personnel in the cost engineering office, which have not participated in the development of the cost product. Cost engineering products must be reviewed to confirm that each estimate meets the project scope and associated USACE regulations and that the assumptions and logic used are valid in estimating the cost of all features.

i. Cost engineering products used to support decision documents for the MSC, HQUSACE and/or Congressional authorization/appropriation must undergo an agency technical review (ATR). HQUSACE mandates that the Review Management Organization (RMO), including National Planning Centers of Expertise (PCX), coordinate with the Civil Works Cost Engineering and Agency Technical Review Mandatory Center of Expertise (Cost MCX) currently located at the Walla Walla District.

7. Function of the Project Delivery Team.

a. USACE is committed to effective management of the scope, quality, cost, and schedule of each project by using project delivery teams (PDTs). ER 5-1-11 presents the requirements for establishing a PDT for all projects. A project manager (PM) leads each PDT, which is comprised of everyone necessary for successful development and execution of all phases of the project. The PDT may consist of individuals from more than one USACE district and may include specialists, consultants/contractors, stakeholders, or representatives from other Federal and state agencies. Team members are chosen for their skills and abilities to successfully execute a quality project.

b. A member of the cost engineering office must be an integral PDT participant, supporting the PM in developing, monitoring, and management of cost engineering products from the study phase through project completion.

c. The coordinated efforts of all PDT members must provide sufficient project information for development of all cost engineering products at the established project development level required within ER 1110-2-1150.

8. Responsibilities.

a. Project Manager (PM)/Planner. The assigned PM/planner provides support to the cost engineering element with sufficient funding and time to produce quality products in accordance with Federal law, Federal Acquisition Regulations, and USACE regulations, guidance, and policies. In support of cost engineering product development, the project team lead is responsible for the following:

(1) Ensure cost engineering representation is included as a full and active PDT member in the development and update of cost engineering products at all project phases and milestones from inception to completion.

(2) Provide PDT leadership and facilitation with responsibility for assuring that the project stays focused on the public interest and on the customer's needs with resulting clarity in project scoping that supports cost engineering product development.

(3) Ensure the PDT provides the cost engineer with all necessary data and information within their respective areas of responsibility to support development of quality cost products.

(4) Support cost engineering principles and applications relative to project scope development and management, quantity development, estimates, schedules, risk analyses, value engineering, cost updates, and cost management.

(5) Coordinate with and rely on cost engineering approved data when reporting costs, schedules and risks internally and externally.

(6) Develop a Risk Management Plan (RMP) which identifies planned measures for risk identification, and risk reduction actions utilizing the construction estimates, schedules and risk analyses to effectively manage the risk throughout implementation of the project; the RMP is a living document that is updated in coordination with the PDT and cost engineer as the project progresses through all phases of project execution.

(7) Coordinate the project schedule and risk analysis within the PDT structure to develop the risk management plan and establish and justify chosen project contingencies with corresponding confidence levels as applicable.

(8) Assure each project has received a formal Cost ATR on the project cost products, cost changes when required.

(9) Coordinate and consult with the Cost MCX technical experts and engage their services as early as possible in the planning, design, and agency technical review (ATR) processes. Communicate with the Cost MCX on high visibility projects or as required.

(10) Provide district project review board technical support on project costs as required.

(11) Ensure the Total Project Cost Summary (TPCS), Justification (J)-Sheet and all reports correctly reflect the costs developed within the cost engineering office, respective work breakdown structure and features and cost-sharing agreements. Ensure the TPCS also includes the cost data from the PDT and other appropriate offices, including any sunk or spent costs to ensure a complete TPCS. PDT involvement must include spent and forecast real estate, PED and construction management costs.

(12) Review, approve, sign, and date all TPCS documents.

(13) Ensure timely coordination and collaboration with programmer, economist, and project cost engineer at critical milestones.

(14) Assure the cost PDT member communicates with the PM, on the requirements concerning update of cost engineering products.

(15) Ensure cost engineering receives annual funding to support cost management practices and controls, program updates for review and concurrence. For mega-projects (see para. 26 g.), ensure the allocation of appropriate resources for project controls and earned-value management practices as required.

b. Project Delivery Team. The Project Delivery Team (PDT) carries critical responsibilities in supporting the cost engineering functions and cost engineering product development. The PDT must:

(1) Develop scope and technical information for delivery of a complete usable project. Develop sufficient design documents to support the cost engineering products at the various project development phases. Coordinate with the cost engineer to determine the appropriate level of project details. The PDT and design personnel must work with the cost engineer to determine the design level required for function, safety and risk reduction.

(2) Must establish a project acquisition plan at Feasibility phase to reduce acquisition risks and improve estimate assumptions and quality.

(3) Participate in risk meetings throughout the project life to develop and maintain the project risk register. Also, the PDT members must help identify the cost and schedule threshold levels associated with the identified risks.

(4) Support the cost engineer in development of the total project cost by providing the associated scope and estimated costs of non-construction elements within the CW-WBS. This includes the 01-Lands and Damages, 02-Relocations, 22-Feasibility, 30-Planning, Engineering and Design, 31-Construction Management and spent cost accounts.

(5) Responsible for defining confidence/risk levels associated with their office products. See information under “Risk Identification for Determining Uncertainties and Contingencies” for details regarding PDT participation in risk development and management.

c. Chief, Cost Engineering. The Chief of the Cost Engineering Office is responsible for the development of all cost engineering products including cost estimate, construction schedule and risk analysis for the construction CW-WBS features as a member of the PDT and in accordance with HQUSACE regulations, guidance, and policies. Responsibilities include:

(1) Responsible for adhering to the latest cost engineering regulations, manuals, and guidance. The chief manages the overall workload, which is subject to funding, ensuring a capable workforce by hiring adequate resources, and providing necessary training and software tools. Software includes the mandatory Microcomputer Aided Cost Estimating System (MCACES), Cost Engineering Dredge Estimating Program, quantity take-off, scheduling programs, and risk analysis (Crystal Ball).

(2) Responsible for assuring a cost engineering PDT member is actively engaged in the planning and execution of projects.

(3) Responsible for the quality of cost engineering products during all phases of development. Quality responsibilities include those cost engineering products prepared by self or others, whether in-district, other districts, architect-engineer (A-E) community, or other organizations where Federal design and construction dollars are USACE managed.

(4) When cost engineering products are to be prepared by others (AE's, local sponsor, etc.), ensure that cost products developed comply with USACE cost engineering regulations, policies and guidance, including the support of ATRs.

(5) Responsible for ensuring that cost engineering products prepared by A-E firms or others are reviewed and validated within the district cost engineering office. This will be evidenced by the chief of the cost engineering elements signature on the cost estimate before release or submission.

(6) Ensure resource needs for all appropriate estimating activities, including site visits prior to and during construction, are properly communicated to the PM to facilitate the provision of adequate funding and scheduling for cost engineering requirements within the Project Management Plan (PMP).

(7) Ensure cost engineering products are updated, reviewed, approved and signed by the cost engineering chief in accordance with applicable sections of this and other applicable regulations.

(8) Document and review bid data and results, protests, and mistakes in bids. Analyze, evaluate, and make recommendations on proposed district actions for bid protests and mistakes in bid.

(9) Support HQUSACE Cost Engineering initiatives that include but are not limited to cost engineering database development, usage, historical recording of cost estimate data, bid data results, and construction feature unit pricing.

(10) Support USACE, contracting, and PDT processes including bid schedule development, bid and proposal evaluations, source selection boards, project review boards, value engineering, quality management, quality reviews, ATRs, and independent external peer reviews.

(11) Foster and develop qualified cost engineers to support ATR cost product reviews.

(12) Support the PM and PDT members in the total cost management processes.

d. Cost Engineer. The cost engineer is responsible for development of the cost engineering products as defined within this regulation. Responsibilities include:

(1) Support and coordinate with project management, program management, and economists at key milestones of study and cost reporting. The cost engineer must support the PM in the development of the PMP scope as pertains to cost engineering products associated with project execution. The cost engineer will provide the labor estimate for cost engineering services.

(2) Work with all PDT members and local interests to sufficiently define and confidently include project scopes and construction, designs, drawings, quantities, pertinent environmental and permitting restrictions, project schedules and risks in preparing sound budget estimates.

(3) Responsible for the development of all cost engineering products as a member of the PDT and in accordance with HQUSACE regulations, policies and guidance. Non-construction costs (real estate, 30 PED, Construction Management, etc.) will be developed by the responsible PDT members but the cost engineer will support the project manager as the PDT member for gathering the data and ensuring adequate documentation for costs identified in the TPCS.

(4) Quantity development (take-offs) for lump sum project features, CW-WBS estimates, construction schedules, risk analyses, life cycle cost analyses, TPC, cost product narratives and reports, a documented record of quality control checks and documentation supporting the contract negotiation process.

(5) Confirming quantities provided by the PDT and developing sub-quantities for items requiring additional documentation.

(6) Performing quantity, cost, schedule and risk updates as required to support design changes, acquisition strategy changes, budget estimate requests and IGEs.

(7) Identification to the project manager a budget allowance for Management Control activities within the TPC to assure cost, schedule, and risk are living documents and are used as a tool throughout the project life.

(8) Provide cost engineering support in the development of Operations, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) costs in support of construction estimates and economic calculations.

(9) Provide cost estimating support to the value engineer in conducting value engineering studies.

e. Cost engineering services by Non-USACE or Engineering Firms. Preparation of budget estimates, Independent Government Estimates and associated cost engineering products are inherently the responsibility of the Government when Federal funds are to be requested, received or spent. When others develop cost engineering products for USACE projects, the tasking and product development are the responsibility of the USACE Cost Engineering Office. These services must be provided by personnel experienced in cost engineering, scheduling, and cost risk analysis. Cost products developed Non-USACE will be provided to the Cost Engineering office for review and subsequent approval. The Cost Engineering office will assume ownership of the products for proper use of the cost information.

f. Civil Works Cost Engineering Mandatory Center of Expertise. The MCX has certain USACE responsibilities to support the civil works mission. Responsibilities include:

(1) Assisting HQUSACE with policy development, policy/guidance review and enforcement, for Cost and Schedule Risk Analysis (CSRA), agency technical reviews, and Cost Engineering Dredge Estimating Program (CEDEP).

(2) Maintaining technical expertise related to current cost engineering regulations and guidance.

(3) Provide technical support to HQUSACE on development, upgrade, maintenance, and implementation of MCACES and related supporting databases.

(4) Provide technical assistance and resources to HQUSACE, division command, or MSC and/or district command on cost engineering issues and product development including quality control and technical reviews.

(5) Serve as the proponent for the CSRA development and policy.

(6) Serving as a quality assurance, and quality review agent as required by current USACE policies on cost related products. Ensure that the Cost ATR reviewers are qualified and technically competent with the necessary technical experience to perform the Cost ATR and maintain a database of qualified personnel.

(7) Receiving, interpreting, disseminating, and implementing cost engineering guidance, direction, and correspondence from higher authority in a timely manner.

(8) Participating in HQUSACE Cost Engineering Steering Committee and lead subcommittee efforts.

(9) Developing and providing cost engineering instructors at the national level to help develop and mentor the cost engineering community.

(10) Serve as Technical Center of Expertise for the Construction Equipment / Civil Works Cost Index Database. This includes all research, development and communication.

g. Division or MSC Cost Engineer.

(1) Serve as division or MSC point of contact in communicating with HQUSACE cost engineering offices.

(2) Receive, disseminate, and implement cost engineering guidance, direction, and correspondence from higher authority in a timely manner.

(3) Establish and maintain a cost engineering quality assurance program overseeing the district's quality control to ensure the accuracy and completeness of project cost engineering products prepared either in-house or by A-E firms.

(4) Conduct periodic field reviews of district commands' execution of cost quality management and recommend necessary corrective actions when warranted.

(5) Support and encourage technical development and training of USACE cost engineers in performing ATRs of cost engineering products.

(6) Review proposed project reports requiring approval above the authority delegated to district commanders. Where policy/guidance dictates, assure districts have obtained the required ATR certifications.

(7) Participate in HQUSACE Cost Engineering Steering Committee and lead subcommittee efforts.

(8) Conduct and lead annual regional cost engineering meetings that include cost engineering supervisors and senior engineers. Meetings should address current regulations, cost related programs, issues, findings, recommendations, resolutions, and progress.

(9) Provide technical assistance to districts and MSC elements on cost engineering issues. Consolidate and disseminate MSC-wide historical cost data.

(10) Provide technical support to HQUSACE on development, upgrade, maintenance, and implementation of MCACES and related supporting databases.

(11) Support the Department of Defense (DoD) Tri-Service Cost Engineering Certification Board by encouraging cost estimators within the division or MSC area of responsibility to obtain certification and assist the board with proctoring tests for candidates. At a minimum, certification as a Certified Cost Consultant or Certified Cost Engineer must be obtained and maintained.

9. Cost Engineering Products and Updates. Cost engineering products include quantities, estimates, schedules and escalation, risk analyses and contingencies, and

cost reports. These products are critical management tools used for establishing and monitoring costs, schedule, and risks over the project life cycle.

a. Cost engineering involvement in the project's cost estimate development and updates are continuous. The level of estimating intensity varies with progression through the different phases of project development and implementation. The five typical project phases are:

(1) Federal Interest Determination (Alternative Studies).

(2) Feasibility phase.

(3) Preconstruction, engineering, and design (PED) phase.

(4) Construction phase.

(5) O&M, Repair, Replacement, and Rehabilitation phase.

In some cases, such as Continuing Authorities Program (CAP) projects, phases are combined into Feasibility and Implementation.

b. Update of the cost products are a key component to project management controls. Cost engineering products must be updated to reflect project scoping changes, clarifying technical information, acquisition strategy identification or changes, construction element changes and current commodity cost (labor, equipment, materials, etc.). Update of construction schedule and cost and schedule risk update.

(1) Regular updates (annually or sooner) must be performed to ensure the total project cost estimate is based on current information. The cost PDT member is required to evaluate changes on the project for the above items to determine appropriate methods for updating the cost products. Full updates (requiring updated cost pricing based on the above factors must occur within a two-year timeframe measured from the previous estimate preparation date. Escalation of cost (if deemed appropriate by the cost development responsible personnel) may occur within the two-year period.

(2) Total project cost estimates presented for budget or funding requests must have an estimate preparation date within two years of the date of submission.

(3) Total project cost estimates presented in Chief of Engineer's reports must have an estimate preparation date within two years of the report date

(4) For active authorized total project costs, the cost products must be updated annually as identified above and include spent costs within TPCS. For projects that are currently not active and are attempting to seek funds to become active, the product submittal must follow the requirements from above. HQUSACE reserves the right to require estimate product updates regardless of timelines. Refer specific update requirements including review requirements to the Cost MCX.

c. The Civil Works Construction Cost Index System (CWCCIS), EM 1110-2-1304, must be used to update unit prices and various project cost features to current or future price levels. CWCCIS indices used for future projections are developed directly from the escalation factors provided to the Federal agencies by the Office of Management and Budget (OMB). The OMB factors are published by HQUSACE, Programs Division, in the Engineer Circular (EC) for the Annual Program and Budget Request for Civil Works Activities.

10. Cost Engineering Software Tools. The USACE approved estimating software programs, Microcomputer Aided Cost Engineering System (MCACES) and the Cost Engineering Dredge Estimating Program (CEDEP), are the required software programs for the preparation of Civil Works cost estimates throughout USACE. HQUSACE may mandate other industry software for applications in quantity development, project scheduling, and risk analyses. Construction schedules must be developed using standard industry recognized scheduling software. A statistically based Monte Carlo risk analysis software must be used for TPCS values greater than $40 million. Current mandated software systems should be confirmed from the latest guidance provided by HQUSACE, Cost Engineering office.

a. MCACES is a cost estimating program used by cost engineering to develop and prepare all Civil Works cost estimates. Using this system, estimates are prepared uniformly allowing cost engineering throughout USACE and the A-E community to function as one virtual cost engineering team. The latest HQUSACE approved version of MCACES is mandatory beginning at the feasibility phase for the Federal recommended plan.

(1) MCACES software is supported by the following cost-related databases:

(a) Equipment Library - Engineer Pamphlet (EP) 1110-1-8 presents construction equipment hourly ownership and operating costs. These hourly rates are one of the supporting databases in MCACES software and must be used in the preparation of all cost estimates. Public Law requires fair and reasonable costs are to be determined from Government estimates prepared as though the Government were a well-equipped contractor; as such, pamphlet hourly rates are based on ownership and operating costs, and are not rental rates. Rental costs typically found in modifications and claims are determined from the contractor's rental agreement.

(b) Labor Library. Labor market research including the minimum by law, Davis Bacon wage determinations establish the prevailing hourly wage and fringe rate estimates for the supporting MCACES labor library local to each project location.

(c) Unit Cost Book Library. The Unit Cost Book Library is a generic composition of construction tasks including associated crews (equipment and labor), materials, and assumed productivities. In general, these costs are presented at in national average pricing and require localizing through (1) published adjustment factors, (2) re-pricing of labor, equipment, and materials through local market research, or (3) a combination of methodologies as appropriate.

11. Quantity Development. Project scope, design documents, and associated assumptions are the basis of quantity take-offs and calculations. They are an important aspect of cost estimate development and serve as a critical basis of estimate data. Regardless of the source, the cost engineer must ensure quantities are supported by a defensible, documented source that reflects the project scope and design level that is traceable and can reasonably support an independent quality review. Design uncertainty and quantity variation must be considered within the cost and schedule risk analysis study.

12. Civil Works Work Breakdown Structure. All project cost estimates must be organized according to the CW-WBS format (Appendix B). As a minimum, each cost estimate must be developed to the sub-feature level of the CW-WBS. The TPCS and budget forms (for example, PB-3) used for budgeting and programming purposes are required to be developed to at least the WBS feature level. The lower CW-WBS estimate structure should be developed to reflect the required activity elements and the anticipated sequencing that logically support project schedule development and respective risks within a risk analyses.

13. Cost Estimate Classifications.

a. To support the Civil Works missions addressed in ER 1105-2-100, cost estimates are required for all phases of a project. Detailed cost estimates should be considered For Official Use Only (FOUO) and managed in accordance with AR 25-55 and FAR 36.203. In a typical project life, cost estimates can be divided into two types: budget estimates or IGEs. The budget estimate supports funding requests as well as comparisons made to current available funding. IGE's are estimates that are prepared to support a contract award. The basis of an estimate can range from no technical information (very high cost risk and contingencies for uncertainties, considered Class 5) to complete plans and specifications (very low cost risk and lower contingencies for uncertainties, Class 1). Level of estimate, schedule, and risk quality correspond directly to scope quality and many estimates can be a combination of quality, depending upon level of technical information for certain project construction elements. Class 3 estimates to Class 5 estimates (very limited technical information) carry greater risk in scope and estimate assumptions and details and fall into the category of budget estimates. The goal of any estimate is to develop to the greatest degree of confidence and accuracy for the given level of technical information. This can be accomplished through several estimating approaches such as parametric processes of various cost sources, using quotes, detailed calculations, crew-based unit pricing, cost books, or historical data supported by sufficient explanation. All scope, technical information, and cost estimates must be prepared, as a minimum, in accordance with the classes as prescribed in Table 1. Technical information quality, confidence and completion level must reflect requirements for project scope as the basis for estimate development. There can be circumstances, criteria or programs that require a greater degree of project development and cost product accuracy. Estimates must include not only costs, but also sufficient narrative and notes that clearly describe the estimated scope, anticipated acquisition strategy, estimate assumptions, methodology and intentions of constructing the major elements.

b. Estimate Class is a reflection of the technical information. Quality and confidence are based upon the provided project information, developed scope and ability to estimate quantities and make reasonable or confident assumptions in estimate preparation. Lesser confidence equals greater risks and resulting higher contingencies. Estimates of a Class 3 to Class 1 must be developed using MCACES software. Estimates developed to support funding requests must be developed in MCACES software, regardless of the cost value or the program.

(1) Class 5 – Preliminary technical information (0-5%). These estimates are commonly referred to as "Rough Order of Magnitude (ROM)." There is considerable risk and uncertainty inherent in a Class 5 estimate, resulting in high contingencies. These estimates are NOT recommended in reports because the extremely limited information and high risk poses credibility issues in quality and accuracy. Project designs, methods, and quantity development are unclear or uncertain. There is great reliance on broad-based assumptions, costs from comparable projects and data, cost book, cost engineering judgment and parametric cost data. Development may consist of lump sum cost. Detailed cost items are not required or captured. Each PDT must identify areas of risk and uncertainty in the project and describe them clearly in an effort to improve quality and confidence to a Class 4 estimate level for external reporting purposes. Establishing a credible contingency with qualifications is necessary. Typical Contingency Range could be 40% to 200%.

(2) Class 4 – Early concept technical information (5-10%). There is still substantial lack of technical information and scope clarity resulting in major estimate assumptions in technical information and quantities, heavy reliance on cost engineering judgment, cost book, parametric, historical, and little specific crew-based costs. While certain construction elements can be estimated in detail, there is still a great deal of uncertainty relative to major construction components. Although Class 4 estimates may be more accurate than Class 5 estimates, they are based on a very limited technical information. The PDT must identify areas of risk and uncertainty in the project and describe them to determine the amount of contingency that must be added to a cost estimate to reduce the uncertainty to an acceptable level of cost confidence. Typical Contingency Range could be 30% to 100%.

(3) Class 3 – Technical information (including designs) are approaching a 10-60% quality of project definition. There is greater confidence in project planning and scope, construction elements and quantity development. The estimates rely less on generic cost book items, greater reliance on quotes, recent historical and site-specific crew based details. Class 3 estimates are a reflection of improved technical documents. The estimates must be supported by a technical information (scope, design, acquisition and construction methods, etc.) discussion within the estimate and the uncertainties associated with each major cost item in the estimate. Special attention must be given to large construction elements and items that are sensitive to technical information change. Typical Contingency Range could be 20% to 50%.

(4) Class 2 – Technical information (including designs) quality and confidence approaching 60-80% definition. There is a confident plan and quantity development with fewer broad-based assumptions. There is minor reliance on cost book for low value items, major reliance on quotes, detailed quantities and site-specific crew based details. A Class 2 estimate may include a PDT project evaluation to determine if additional investigations or studies are necessary to reduce the uncertainties and refine the cost estimate. The evaluation must be accomplished as a joint analysis between the cost engineer and the designers or appropriate PDT members that have specific knowledge and expertise on all possible project risks. A risk analysis is recommended as it better defines PDT project path forward regarding risks and basis for determining contingencies. Typical Contingency Range could be 15% to 30%.

(5) Class 1 – Technical information (including scope & design) quality and confidence approaching 80-100%. The estimate is near IGE level. Quantity and installation confidence is strong. There is minimal reliance on generic cost book items, heavy reliance on quotes, heavy reliance on site-specific crew based details. Class 1 does not imply that all unknowns and risks are eliminated. Some estimates prepared to this level should include risk analysis to the degree described in Class 2 above. Results of the risk analysis will be the basis for determining contingencies which are used for the budgetary basis or special contract types. Typical Contingency Range could be 5% to 15%.

Table 1. Civil Works Estimates – Class Level Designation

Project Phase	Scope and Technical Definition		Risk Level	Minimum Estimate Class
Pre-Budget Development (not recommended for reports)	Extremely Limited		Extremely High	**5***
	Pre-Authorization			
Initial Alternatives	Very Limited		Very High	4*
Feasibility Alternatives	Very Limited		High	4*
Feasibility – Federal Recommended Plan	Limited-Fair		Moderate	3
National Economic Decision (NED)	Limited-Fair		Moderate	3
Locally Preferred Plan (LPP)	Limited-Fair		Moderate	3
Funding Request Decision Documents	Limited-Fair		Moderate	3
	Authorization			
Continuing Authorities Program	Limited		Moderate to High	3-4
Civil Emergency Management Program	Limited		Moderate to High	3-4
Alternative Studies	Limited		Moderate to High	3-4
General Re-Evaluation Report	Limited-Fair		Moderate	3
Limited Re-Evaluation Report	Limited-Fair		Moderate	3
Design Documentation Report	Limited-Fair		Moderate	3
Engineering Decision Report	Limited-Fair		Moderate	3
Post Authorization Change Reports	Fair		Moderate	2-3
Other Funding Decision Documents	Limited-Fair		Moderate	3
	Preconstruction, Engineering & Design (working estimates)			
PED 30%	Fair		Moderate	3
PED 60%	Fair-Good		Moderate to Low	2
PED 90%	Very Good		Low	1
IGE <100% Design	Fair-Good		Moderate to Low	2
IGE 100% Design	Very Good		Low	1
	Construction / Post Award			
Budgets (modifications / claims)	Fair-Good		Moderate to Low	2
IGEs (modifications / claims)	Very Good		Low	1

* Do not use in formal/Chief of Engineer's Reports

14. Cost Products by Phase.

a. Studies. For all studies during pre-authorization and post-authorization.

(1) Planning Stage – Alternative Formulation

(a) Federal Interest Determination. During this phase, many alternatives can be considered. Class 5 and 4 alternative cost estimates for this phase may be developed by applying parametric processes of various cost sources, using quotes, calculations, unit prices, cost books, or historical data as backup. Use of MCACES software tools is recommended but not required. The costs of the Planning, Engineering, and Design feature (30 account) and the Construction Management feature (31 account) are obtained through the PDT and may be percentage based upon historical cost data. The costs for the Lands and Damages feature are obtained through the PDT from the real estate office. Alternatives are developed to the same constant dollar basis for fair comparison. Project specific risk-based contingencies are identified for each alternative under comparison.

(b) Tentatively Selected Plan (TSP). During the alternative formulation stage, a final group of potential alternatives are identified for further study and comparison. For comparison purposes, this group of alternatives, including the resulting TSP must be minimum Class 4 cost estimates and supported by a risk analysis to include reasonable contingencies as part of the comparison and formulation. At the alternative formulation stage, use of MCACES software tools is recommended but not required. Estimates are developed to the same constant dollar basis. This screening process will likely determine the TSP, which the District will present to the vertical team for decision. Cost Engineering judgment with support from Parametric processes, properly escalated historical bid cost data, properly escalated corollaries and cost models, demonstrated experience, and/or unit prices adjusted to expected project conditions are acceptable methods of developing project costs for these alternatives. The cost estimate for each viable alternative must sufficiently describe the construction features and elements, the cost basis, type, and method of construction. Cost presentation must include all features at a consistent effective price level and risk-based contingencies. The TSP is an alternative, equal in development for comparison to the other alternatives. Use of MCACES software tools is required for the TSP. Once that TSP is approved by the vertical team, the TSP becomes the Federal Recommended Plan.

(2) Feasibility Phase. Federal and Local Plans. The feasibility level, Federal recommended plan supports funding requests within a Chief of Engineer's Report. The Federal recommended plan will identify a National Economic Development (NED) and the National Ecosystem Restoration (NER) plan. In the civil works project planning context, NED analysis can be generally defined as economic benefit-cost analysis for plan formulation, evaluation, and selection that is used to evaluate the federal interest in pursuing a prospective project plan. The estimate(s) used to develop the total project cost must be a minimum Class 3 estimate supported by sufficient scoping documents. PDT involvement in establishing and communicating project construction scope and features for confident quantity development is necessary. The estimate(s) must be prepared using the MCACES tools and the established CW-WBS to at least the sub-feature level of detail. When the non-Federal sponsor requests a plan different from the Federally recommended plan, it is referred to as a "locally preferred" plan (LPP). Cost engineering products for both plans must be prepared of equal quality by using the required software and processes for estimates, schedules, and risk-based contingencies for inclusion in the feasibility report. In general and preferred, the unit costs for the major construction features will be computed by estimating the equipment, labor, material, and production rates suitable for the element being estimated. At feasibility stage, key construction elements may not be sufficiently designed to support a full crew-based estimate. With PDT support in defining project scope, alternate estimate approaches for less developed construction elements can include parametric, corollaries and models, quotes and comparisons, and historic data so long as the sources and assumptions are well documented and as recent as possible. If the Federal recommended plan is not the locally preferred plan then a separate TPCS is required for each of these plans. Both plans are updated as required for comparison and reimbursement.

(3) Estimates Submitted for Congressional Re-Authorization. All cost estimates submitted for Congressional reauthorization must be minimum Class 3. If the authorization bill does not pass in that year, the total estimated cost, reflecting the Constant Dollar estimate, must be updated for the next authorization opportunity. Refer to the requirements for updating cost engineering products.

(4) Authorized Projects. Authorized projects that are funded receive further study, more confident design, improved cost engineering products, and resulting lower risk. Projects that are authorized may not yet have the needed funding for project execution and in some cases are subject to appropriations that incrementally fund the project. In

these cases, formal funding requests or decision documents are still required for submission to the MSC and/or HQUSACE.

(5) Smaller projects destined for approval and funding at the MSC or Division, such as CAP, emergency management program and special programs, must be developed to a minimum Class 3 estimate using the MCACES software because they serve as the Federal Recommended Plan.

(6) Preconstruction, Engineering, and Design. As design refinements are made, reflective estimates of an appropriate class quality must also be developed to establish the current total project cost. These are referred to as a Current Working Estimate (CWE). The most recent CWE serves as a comparison check to the Baseline Cost Estimate (BCE). The CWE estimate must be prepared using the MCACES tools and the TPCS form. This is included as a part of any report submitted for reevaluation. A new cost risk analysis must be conducted upon major changes in acquisition strategy, design, and each update in the total project cost. A cost risk analysis report must be included as part of any post authorization report that presents a total project cost to MSC or HQ. The cost engineering product documentation for project submissions to MSC or HQUSACE will be the same as estimate products for the feasibility phase.

(7) Construction Phase. Federal and Local Plans Construction / Post Award Phase Estimates. This refers to estimates for authorized projects that have gone through the solicitation process and have received an initial construction contract award. During the project construction phase, multiple construction contracts and modifications may be required.

b. Operations and Maintenance (O&M). Development requirements for O&M estimates follow the same direction as "Authorized Projects" (see para. 14.a(4)).

(1) Independent Government Estimate. Initial IGEs may fall into two categories: less than 100 percent design and fully 100 percent design. Less than 100 percent design includes those such as design-build that vary in range of design detail and resulting risks and reflect a Class 3 estimate. The fully 100 percent design includes those such as design-bid-build and has lesser risk; it therefore must be developed as a Class 1 estimate. The IGE becomes the standard by which the Government determines whether contractor bid proposals appear fair and reasonable. The IGE is a representation of the best detailed level of design information at time of contract solicitation. The awarded contract becomes the construction contractor baseline in monitoring and management of the construction cost and schedule.

(a) Each IGE is based upon a defined set of plans and specifications and represents the cost of performing the work in the time allocated by determining the necessary labor, equipment, and materials. The bid schedule must be structured for the specific contract in coordination with the cost engineer. Each bid item on the bid schedule must be identified by the appropriate CW-WBS that will allow tracking of the cost needs and expenditures reflecting the appropriations and TPCS.

(b) An IGE of costs must be prepared and provided to the contracting officer prior to receipt of contractor proposals. The contracting officer may require an estimate when the cost of required work is anticipated to be less than the SAT. The estimate must be prepared in as much detail as though the Government were competing for award (FAR 36.203). Prior to opening of bids, access to information concerning the IGE must be limited to Government personnel whose official duties require knowledge of the estimate.

15. Dredging Estimates.

a. Dredging estimates using floating plants must utilize the CEDEP to prepare the estimate (see paragraph 14.c. below for special allowances). The CEDEP program contains proprietary data and NOT to be released to non-Government entities. Due to the proprietary nature of CEDEP tools, when an A-E is involved with developing estimates for projects that include dredging costs, the responsible district cost engineering office must develop all of the dredging unit costs that are CEDEP-based.

b. CEDEP is a supporting estimate for budget estimates and IGE. Most projects have a mixture of non-dredging construction and dredging. For these mixed construction projects, CEDEP must be used to develop the dredging cost, and this cost must be included in the MCACES estimate to calculate total construction cost estimate.

c. Dredging estimates using land-based equipment installed on a floating plant (e.g., crawler dragline on floating platform used for dredging) may use MCACES instead of CEDEP, with the floating plant rates developed using chapter 4 of EP 1110-1-8.

d. Regional Dredge Teams. The use of regional dredge team members is recommended for consultation or the development of dredge cost estimates. Members of regional dredge teams can be contacted for guidance on production rates, effective times, cost data, or other pertinent information. The regional dredge teams can be a valuable resource for estimate development, value engineering studies, and ATRs on projects requiring dredge estimating. Coordination and information can be made through the Cost MCX.

16. Estimating for Performance Specifications Contracts. This includes solicitations for Design-Build Contracting.

a. The selection of design-build or any other contracting method to acquire facilities is the responsibility of the contracting agency. USACE, as a Department of Defense construction agent, is responsible for selecting such methods. One of the requirements for proceeding with design-build contracting is that the project be fully defined, functionally and technically, by performance specifications as described in ER 1180-1-9.

b. For all design-build projects, district commanders will ensure that adequate funding and time are provided for all PDT members to fully develop both performance specifications and the design-build IGE.

c. PDT members must participate in assessing the functional and technical requirements of the project to determine and establish the physical components that comprise the project. The engineering assessment of project components must be based upon knowledge of standard analyses, operating experience, and sound engineering judgment. Senior engineering staff must be involved to provide experienced judgment in establishing the project scope and characteristics. Appropriate outside specialists should be consulted whenever the in-house engineering staff is not sufficiently trained or lacks experience in the type of work and components being considered. All members of the PDT must have input in the decision process for establishing the assumed physical properties to be used in preparing the cost estimate. These properties include size, dimensions, weights, amounts, and materials.

d. Project cost estimates and schedules should include cost and schedule risk-based assessment to address cost of work elements that could impact cost of project execution and construction. Preparation of a Monte Carlo simulated risk analysis is recommended for design-build projects that are deemed high risk, complex, or exceeding the project dollar limit established by USACE policy. A complete risk analysis must be conducted on the performance specifications, project physical properties, and schedule.

17. Profit.

a. Profit is defined as a return on investment and provides the contractor with an incentive to perform the work as efficiently as possible. Profit is applied for civil works budget estimates. Civil works IGE estimates do not include profit unless required to support a negotiated procurement.

b. For early design stage estimates such as feasibility, profit can be estimated as a percentage based on experience. For budget estimates of better developed projects, profit must be developed using an alternate structured approach, specifically the weighted guideline method, which considers the contractor's degree of risk, the relative difficulty of work, the monetary size of the job, the period of performance, the contractor's investment, assistance by the Government, and the amount of subcontracting.

c. Application of Profit. 33 U.S.C. section 624 provides that projects for river and harbor improvement not be performed by private contract if the contract price is more than 25 percent in excess of the estimated comparable cost of doing the work by Government plant or a fair and reasonable estimated cost (without profit) of a well-equipped contractor doing the work. The legislative history indicates profit is not included in the IGE. Profit is applied to negotiated procurement IGEs.

(1) Civil works construction contracts typically do not include profit. Refer to the contracting officer for recommendation of profit information.

(2) Non construction contracts should have profit included or as directed by contracting officer.

(3) For negotiated procurements, refer to the contracting officer.

18. Schedules.

a. Project and construction schedules are considered an integral part of cost development and the cost estimate is instrumental in defining the schedules. Simply stated, time is money relative to duration, escalation/inflation, delays, material lead-time, project acceleration and risks. As projects evolve, schedules become more critical in providing a clearer picture of anticipated events and expenditures. In early project development stages such as feasibility level, the schedule must be sufficiently developed to confidently present project duration to decision makers and partners, establish escalation/inflation, and support a Cost and Schedule Risk Analysis (CSRA).

As the project further evolves, the schedules must be sufficient to establish contract duration for contract solicitations. When projects are in construction phase, schedules should be well developed, possibly resource loaded, to support contractor schedule baselines, contractor progress payments, modifications, claims, project acceleration studies, and any further Federal funding needs.

b. The cost engineer must prepare reasonable construction schedules that reflect the construction estimates and timeframes used in the escalation/inflation calculations for the TPCS. The construction schedules must reflect the major construction elements and represent the MCACES estimate(s) including notice to proceed date, material lead-times, assumed productivities, work window limitations, etc. The schedules must be sufficiently developed using standard industry-recognized scheduling software, depicting major milestones, concurrent and sequential activities, predecessors, successors, and durations within a developed calendar and identifying a critical path. For projects requiring a Monte Carlo risk analysis, the schedule must be sufficiently developed to support the risk analysis related to seasonal risks, productivity assumptions, major construction elements, resourcing, acquisition strategy, environmental constraints, and assumed annual construction cost placement.

c. The PM may request the cost engineer to prepare the project schedule based on data developed by the PDT. Likely scheduling phases could include planning, receipt of funding, investigations and design, contract(s) acquisition, construction of project contracts.

19. Project Escalation and Inflation.

a. The CWCCIS must be used to update unit prices and various project cost features to specific price levels. Indexes used to escalate costs from the past to the present are developed from actual historic data. Indexes for future escalation are developed using the "Updating Factors" in Table 1, of the EC, Corps of Engineers Civil Works Direct Program – Program Development Guidance which are based on the current annual Office of Management and Budget (OMB) inflation factors. The CWCCIS presents a table that depicts the historic construction escalation and the projected OMB escalation rates measured from the date of the most current table. It reflects the CW-WBS construction elements. It is updated every March and September depicting current OMB annual escalation and semi-annual realized construction escalation.

20. Risk Identification for Determining Uncertainties and Contingencies.

a. Risk analyses will be performed during all project phases, appropriate to the level of available information.

b. Risk is broadly defined as a situation or event where something of value is at stake and the outcome is uncertain. Risk is typically expressed as a combination of the likelihood or probability of an event occurring, and attendant consequences should the event unfold, although it is too often used in actuality as a probability of an event occurring. Consequences are measured in terms of safety, cost, time, environmental harm, property damage and other metrics. Choosing the appropriate risk metrics and actively using them in decision making is critical to effective risk management in support of a vibrant economy, thriving ecosystems, and sustainable communities.

c. Risk Framework Components. The three components of the Civil Works Risk Framework are risk assessment, risk communication and risk management. As the life cycle of a project unfolds, risks must be continually assessed, then periodically updated and communicated in order to ensure the actual risks are accurately understood and properly applied as project conditions change. Key activities within each element are summarized in the diagram below.

(1) Risk Assessment is a systematic approach for describing the nature of the risk, including the likelihood and severity of consequences. Risk assessments are quantitative whenever possible; however, qualitative assessments may be appropriate for some activities. A risk register will be utilized to identify potential risk events. The PDT will support the cost facilitator in identifying the risk events. The risk register will identify probability of occurrence and severity of impact as relating to impacts on cost variance and schedule variance. The Cost MCX CSRA risk template will be utilized to assure consistency (or approved equal, by the chief Cost MCX). The risk register will also be the basis for identification of risk management decisions.

(2) Risk Communication is a two-way exchange of information between risk assessors and those who will use the risk assessment results or those who are affected by the risks and risk management actions. Open communication improves the understanding of the risks by all parties, and leads to improved risk assessments and risk management decisions and outcomes. Communication must occur early and repetitively throughout a project life cycle to ensure proper risk understanding and application.

(3) Risk Management is a decision-making process in which risk reduction actions are identified, evaluated, implemented, and monitored. The purpose of risk management is to take actions to effectively reduce and manage risks identified in the risk assessment. In simplest terms, there are four ways of adjudicating identified risks and often some combination of them is used for any given risk:

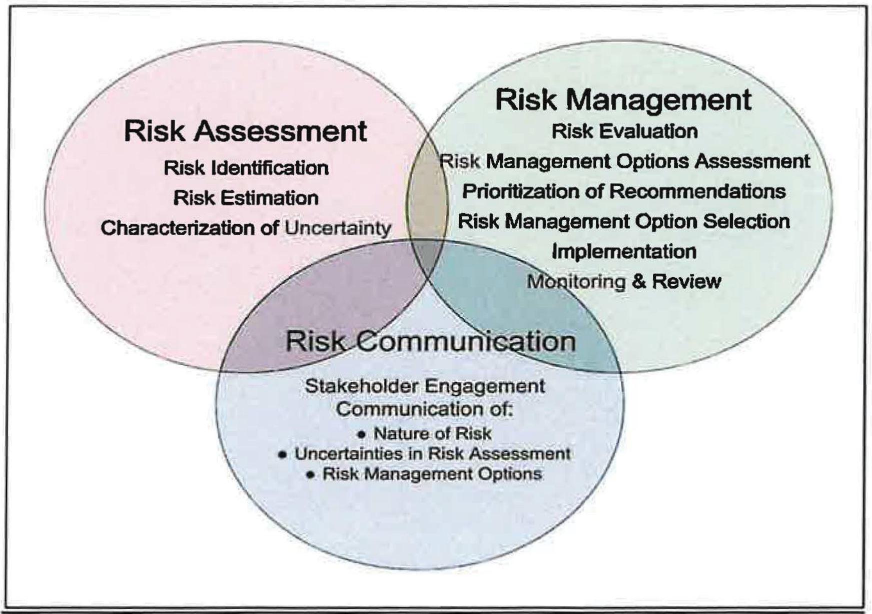
(a) Avoid the Risk. This may require a change in project scope or in program direction.

(b) Take Actions to Reduce (mitigate) the Risk. These actions would reduce the likelihood that the risk event occurs or the severity of impacts if the event does occur.

(c) Transfer the Risk Openly to Other Parties. Insurance is a common risk transfer mechanism for financial or hazard risks. Contracts are sometimes used to manage project risks, but a cost is typically incurred.

(d) Accept the Risk. This may be appropriate when consequences are not severe. Acceptance does not necessarily correlate to a lack of action. A response plan can be prepared and kept in hand, should the risk event occur.

Figure 1 - Risk Framework



d. HQUSACE requires using a cost risk analysis to determine contingency amounts for decision documents or in support of needed funding outside of the district funding authority. These include, but are not limited to, feasibility studies, design document reports, engineering documentation reports, general reevaluation reports, limited reevaluation reports, and post authorization change reports. A CSRA report and a risk management plan are required for all decision documents, regardless of project size.

e. Contingencies of cost and time must be included in the estimate and schedule to cover unknowns, uncertainties, and/or unanticipated conditions that are not possible to evaluate from the data on hand at the time the cost estimate is prepared but must be represented by a sufficient cost to cover the identified risks within the defined project scope. Added contingencies are not to be applied to project budgets as a means of replacing scope clarity of projects that fail to meet the required development stage or milestones.

f. Contingency values vary based on project phase and scope development. Limited information results in greater risks and higher contingencies. As projects evolve in scope and clarity, respective risks and contingencies will be typically reduced (Table 1, Civil Works Estimates – Class Level Designation). At construction contract award, a minimum contingency allowance of at least five percent of the contract amount must be available at the project level. Construction contracts with less than 100% design should be even greater, possibly supported by a risk analysis. As a project nears completion, this contingency allowance must be reduced accordingly. A cost and schedule risk analysis (CSRA) is the process of identifying, measuring, and forecasting the potential cost and time impacts of project uncertainties on the estimated total project cost during project delivery. Key components include record of PDT involvement, all cost features, a quality risk register, estimated contingencies and resulting report. As a minimum, a cost risk analysis is a formal process required for all Civil Works projects during the planning phase, regardless of project size or estimated cost value. It must be accomplished as a joint analysis between the cost engineer, PM or planner, real estate, contracting, engineering, construction, and other critical or appropriate PDT members that have specific knowledge and expertise on all possible project costs and risks. The risk analysis must consider all project features of the CW-WBS and four major project periods: funding, design and investigations, acquisition, and construction to complete. As a minimum, risks must include consideration for available or anticipated funding, known project scope and potential growth, acquisition strategy, construction complexity, volatile commodities, quantity development, special equipment, cost estimating methods and assumptions, and external risk factors.

g. Risk analysis processes and details will vary depending upon the complexity and size of the project. At the lowest extreme, the risk analysis may result in a single contingency value based on a simplified qualitative risk-based method, also referred to as an "Abbreviated" method. The abbreviated method does not address schedule, generally because the smaller dollar amounts are less dependent on schedule impacts in the form of cost. For projects where the total project cost including inflation is $40 million or greater, or for complex smaller projects having numerous work elements with differing unknown conditions and uncertainties, a "Detailed" risk analysis will be performed in accordance with current USACE requirements. This "Detailed" method includes risk identification, quantitative and qualitative study, and sensitivity analysis using a Monte Carlo simulation method. The risk analysis identifies and documents the conditions, uncertainties, and the evaluation methodology used to determine the assignment of contingency. Product results include CSRA report which includes PDT identifications, a risk register, risk model.

h. As project development progresses into design and construction, contingencies must be developed based upon the risks related to the uncertainties or unanticipated conditions identified by the investigation data and design detail available at the time the estimate is prepared (ER 1110-2-1150). In risk analysis studies using the Monte Carlo process for the larger, more complex projects, the contingencies should be presented with confidence levels and associated contingencies and confidence levels (10 percent confidence increments as a minimum). For cost product development, the contingencies reflecting an 80 percent confidence level will be reported. Management does have flexibility to use a different confidence level (higher or lower) with detailed justification documenting the rationale for variance from the 80 percent confidence level. Items to consider in the confidence level chosen could be life safety, project complexity, national priority, and/or likelihood of mitigating risks. In any case, the chosen value should be justified within the risk analysis and main reports.

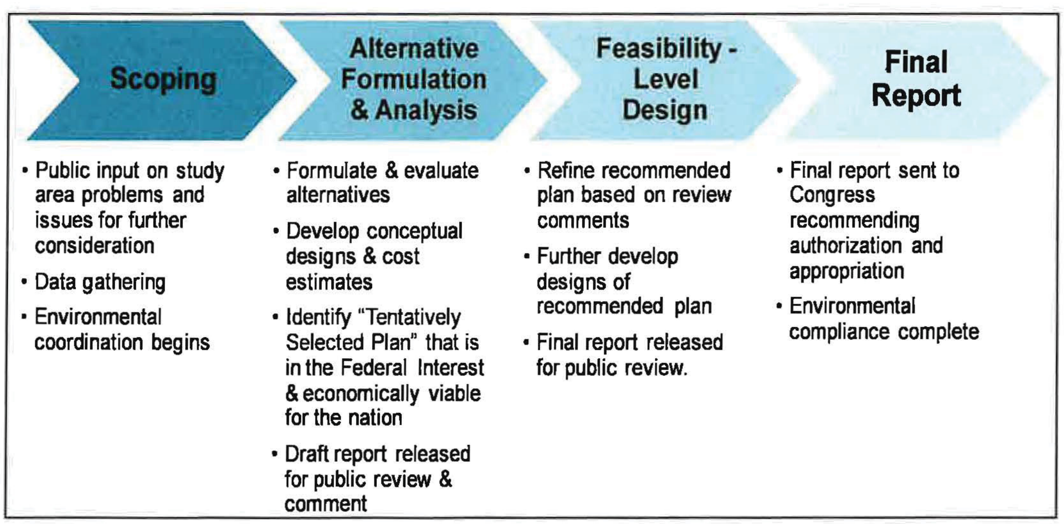
i. Estimates used for benefit-to-cost ratio calculation. The cost engineer will communicate with the economist to assure the economist understands the basis of the cost estimate and the corresponding confidence level. The goal is to assure the basis for the cost identification is comparable to the basis of the benefits.

(1) A CSRA and resulting report are not intended to serve as a risk management plan (RMP). Rather, the report serves as part of the RMP. The RMP must present the plan to manage, monitor, and mitigate risks accordingly; assigning responsibilities to PDT members to ensure the RMP is used as a living document and management tool.

j. Risk Analyses for Feasibility Phase.

(1) During the feasibility phase, a cost risk analysis approach and resulting contingencies must be applied to the final array of alternatives under a comparison study that establishes the tentatively selected or recommended plan. That final array is considered part of a decision document for the vertical team in establishing a Federal recommended plan. At this stage, a detailed Monte Carlo statistical method is not expected, but could be warranted for complex and large cost and schedule alternatives. The "Abbreviated" risk-based method is the recommended means to establish project alternative risks and contingencies for study comparison. For the Federal Plan, abbreviated processes can also be applied for projects where total project cost is less than the established $40 million threshold.

Figure 2 - Feasibility Process



(2) For the larger projects (greater than $40 million), the Federal recommended plan and the LPP, a Monte Carlo statistical method is required, addressing costs and schedules. The risk analysis must be performed, commensurate with project size and project complexity. The risk analysis must include a report that identifies the risk analysis processes, PDT member involvement, record of discussions, risk register, key assumptions, major concerns, justified contingencies, and recommended risk mitigation plans. The report will serve as part of the PDT's Risk Management Plan.

k. Risk Analyses for PED and Construction Phases. During the PED and construction phases, a risk analysis and updates must be conducted upon the remaining costs, major construction elements, further funding requests, major milestones, major changes in design scope, acquisition strategy, quantities, and contract acquisition strategy and for each update in the cost estimate. This is to satisfy the annual cost update requirements. The established project cost thresholds still apply for risk analyses processes during these phases relative to an abbreviated method or a Monte Carlo analysis. A cost risk analysis report must be included as part of any post authorization change report to support the revised authorized cost.

l. Risk Management. The project execution will be evaluated during the life of the project. The risk identified during the initial CSRA development will be monitored and responded to. In addition the PDT will identify potential new risk events during the various stages of development. The new risk events will be incorporated into the CSRA and analyzed for impact of likelihood of occurrence. The cost engineer will evaluate the cost risk model to communicate to the PM and PDT members the overall impact to the total project cost to decide response actions.

21. Total Project Cost Summary.

a. The TPCS is the product that is certified by the Cost MCX, because it presents the total project costs developed by the PDT rolled up into a single summary page. When the TPCS is updated, the update must include consideration for scope, current acquisition strategy, quantities, updated costs, schedules, inflation, risks, and contingencies.

b. The TPCS is prepared by the cost engineer with support from the PDT. The TPCS reflects all applicable project feature costs, contingencies, escalation and inflation to project completion and presents the Federal and non-Federal cost share (the cost share information is required for CAP projects, optional for Non-Cap). It includes spent and future costs. While the cost engineer prepares the basic construction cost elements of the form, the PM, Real Estate, and Construction offices play a major role in establishing program year presentation and Federal and non-Federal share, spent costs, 01 Lands and Damages, 30 PED, and 31 Construction Management. The Cost engineering will work closely with the PM to identify the breakout of the total project cost including cost per feature and contingency development. The Project First Cost and the Constant Dollar are required to be displayed in the feasibility report.

(1) Constant Dollar Cost (Price Level). Constant dollar analyses are utilized to determine an equivalent cost in the future or in the past by price indexing using CWCCIS data. Constant dollar cost is the estimated cost BROUGHT TO THE EFFECTIVE PRICE LEVEL. Constant dollar cost at current price levels is the cost estimate used in decision documents and chief's reports. The constant dollar cost does not include inflation to midpoint design and construction.

c. Project First Cost (Price Level). The cost estimate that will serve as the basis for providing the cost of the project for which authorization is sought. The cost estimate to be used in Chief's Reports and other decision documents is Estimated Cost represented at the current price level. The current price level is the current FY based on the submittal date. Certain costs that are excluded from the TPCS include (Appendix D):

a. The annualized estimate of Operations, Maintenance, Repair, Replacement, and Rehabilitation.

b. Associated financial costs that are not part of the recommended Federal project but are a necessary non-Federal responsibility.

c. Local service facilities that are for Commercial Navigation Only.

d. For decision documents and budget submissions, typically the TPCS must be completed no later than 31 May of the submitting year. The Project First Cost (Constant Dollar in the second column set) must be presented in program year 1 Oct 20XX in order to support the economic analysis and the budget request. The TPCS Project First Cost is be used for the programming Form PB-3.

22. Cost Product Report Submittals.

a. Formal project reports and supporting documents are required for decision documents that are processed through the vertical team, i.e., district commander, MSC/divisions, HQ, Assistant Secretary of the Army, and Congress. The cost reports are a subset of the main report and should at least address cost, schedule and risks.

The formal reports occur at various stages of project development or as directed. These include, but are not limited to, feasibility studies (alternatives, Federal recommended plan, locally preferred plan), design document reports, design deficiency reports, engineering documentation reports, general reevaluation reports, limited reevaluation reports, and post authorization change reports.

b. The cost engineering product submission includes a project narrative or introduction: level of design information, major project construction features, acquisition assumptions, general cost assumptions and qualifications. It also includes summary level costs (alternatives, Federal recommended plan and LPP where applicable), project and construction schedule, risk-based contingency presentation, and TPCS. These documents are also required to support the ATRs and external reviews.

(1) For the MCACES estimate, summary sheets must be provided for direct costs, indirect costs, and project (owner) costs to the CW-WBS feature account level. The estimate prepared (utilizing the latest approved MCACES software) must contain a narrative that presents the level of design information, acquisition and market assumptions, the major project construction features, key construction assumptions, contractor assignments and markups, quantity confidence and unknowns, and identified risks or uncertainties used in the development of contingencies utilizing risk analysis processes. For the MCACES estimate presentation, multiple CW-WBS folder levels may be necessary to present the project scope and cost of construction elements in the project. However, certain cost information is considered sensitive and AR 25-55 and FAR 36.203 govern its release. Release under the Freedom of Information Act (FOIA) should be coordinated with the FOIA officer.

(2) For public release reports and documents, a high level WBS summary shall be used. Cost sensitive data, such as quantities, unit costs, quotes and productivity rates, and CEDEP must be protected from public disclosure since they may serve as a basis for the IGE. Sensitive cost data must be removed from public documents or presentations.

(3) In presenting the project schedules, address the major components related to design phase, contracting solicitation, major construction components and their time relationships.

(4) In addressing the risks for the abbreviated risk method, the report should include a brief discussion of major construction elements, major risks, input and results, risk register and risk matrix. For the Monte Carlo risk method, a standalone risk report,

as part of the risk management plan, should provide an executive summary, brief report purpose and project scope, applied methodology, identified PDT members involved, key assumptions, risk register, sensitivity charts, contingency tables, and confidence curves, cost and schedule contingency presentation, major findings, and mitigation recommendations.

23. Cost Estimate Confidentiality.

a. Mature or well developed cost estimate data that is likely to be used in support of bid estimates must be considered as confidential, sensitive, and proprietary, and marked as For Official Use Only (FOUO), and so managed (reference AR 25-55). Typically, this occurs near the 90% design phase; however, earlier well developed detailed cost estimates can also include sensitive cost and pricing data regardless of design phase. Sharing of this data must be restricted since disclosure may easily compromise the integrity of competitive bidding processes. Sensitive data includes detailed quantities, detailed unit prices, crew or equipment productivity, and supplier and material quotes. This data must be restricted to within the USACE community shared only on an "as need to know basis" within the district and USACE cost community in support of estimate development and ATRs. Need to know basis is determined by the Contracting office and district command structure. Pre-Bid and IGE cost information must be protected, dissemination made carefully. Cost Data Sharing in and outside districts should only include higher level cost information related to project scope and features in use for programming and budget purposes. IGEs and cost data therein must remain restricted and marked as "For Official Use Only" (FOUO). The FOUO marking shall also be applied to any physical electronic storage media such as CDs. Any deviation must require a signed non-disclosure agreement with parties on a clear "need to know" basis. After contract award, ordinarily, only the title page, signature page, and price schedule are disclosed outside the Government. The IGE backup data should not be released since it contains sensitive cost data (e.g. contractor quotes, crews, and productivity) that are proprietary or might compromise costs for future similar procurement.

b. Non-IGE data may be shared within the USACE cost community to support cost development.

c. Detailed estimate data and its distribution must be submitted directly to the needed USACE parties through a secure means.

24. Cost Quality Management. Cost engineering offices must follow the established USACE Quality Management Regulation, ER 1110-1-12. Only qualified cost engineers, preferably certified estimators, must provide documented quality control reviews.

a. Accuracy and completeness of project scope and cost engineering products, including the necessary cost product updates, must be emphasized throughout the project life. Even in early phases, cost estimates should represent as complete and accurate a picture as is practicable. This is necessary for Federal and non-Federal planning, budgeting and management processes.

b. The division cost engineer is responsible for quality assurance of division cost engineering products. Part of the quality assurance process is to review a sampling of estimating products to ensure they comply with guiding policy. The division cost engineer, as a minimum, must sponsor an annual meeting with each constituent district's cost engineering chiefs and senior estimators to ensure the quality of the division estimating procedures complies with current USACE policy.

25. Technical Reviews for Cost Products.

In accordance with ER 1110-2-1150 and the Civil Works Review Policy, technical reviews are required and/or recommended during various phases of project development through the life of the project. Technical reviews consist of three levels of review: a District Quality Control (DQC), Agency Technical Review (ATR), and Independent External Peer Review (IEPR). The Design Review and Checking System (DrChecks) must be used throughout USACE as the formal system for ATR and IEPR. Cost comments are to be treated as For Official Use Only (FOUO). Refer specific update requirements including review requirements to the Cost MCX.

a. District Quality Control: A DQC review is a district responsibility, which is a documented review by a technical element as a quality control measure on decision documents. The DQC is a critical element in confirming district PDT acceptance of product presentation, quality, completeness, and readiness to support the ATR and IEPR. The Cost DQC, including comment and resolution, must be formally documented and performed by a technically qualified senior cost engineer; all cost products must be addressed: quantities, estimate(s), schedules, risk analyses, total project cost and cost report.

b. Agency Technical Review: All qualified Cost ATR reviewers must be senior cost engineers, trained and certified by the Cost MCX. For decision documents all reviewers will be assigned by the Cost MCX. Review comments must be addressed by qualified district cost personnel knowledgeable of the specific cost engineering products. Closure of critical comments or comments that cause a necessary change to the cost engineering products related to quality, cost, schedule, and contingencies must rely upon verification of the necessary revisions prior to comment closure by the cost reviewer.

(1) The Cost MCX has the responsibility for the quality performance of the Cost ATR[1] and for issuing a cost certification of the project cost products as identified by current regulations and policies. The RMO is required to coordinate with the Cost MCX for cost reviewer assignments and ATR of cost products. Review consideration is given to the project reports, investigations and design, DQC records, quantities, estimates, construction schedules, contingencies, and resulting total project cost. A Cost ATR is intended to confirm that such work is performed in accordance with established regulations and policies, professional principles, practices, codes, and criteria that result in a confident TPC. Regardless of product author (USACE, A-E, sponsor, or others), any report that is presenting or requesting Federal funds from higher authority such as MSC, divisions, HQ or Congress, must receive a Cost ATR and a Cost MCX Cost Certification. Other project milestone submissions may require a Cost ATR as defined by current HQ guidance or as specifically requested by HQ, MSC, or division offices. A Cost ATR Certification and its validity are based upon age of the estimate products as discussed in Section 11 – Cost Engineering Products and Updates. Cost ATRs and resulting Cost MCX Certifications should be current for budget requests.

(2) The Cost ATR(s) for the feasibility phase, as a minimum, must verify that the level of engineering is sufficient to substantiate both the screening level alternative or comparative cost estimates and the BCE with contingencies to support selection of the recommended plan and to establish the baseline schedule and cost estimate with contingencies. To accomplish this, each project submittal by the respective district must include with the submittal the draft main report, engineering products such as photos, design, drawings, and engineering appendices. The submission must also include native electronic files for the comparative estimates, MCACES estimates, project schedule depicting design, acquisition and construction, risk based contingency development, and the TPCS worksheets. Cost ATR for a PED stage of project

[1] Cost ATR – includes requirement for providing Cost Certification unless as otherwise identified.

development must still address the same products: scope definition, designs, quality controls, quantity development, estimates, construction schedules, risk analyses, and contingencies.

c. Independent External Peer Review: An IEPR is an independent review of the technical efficacy of a decision document by a review organization external to USACE. The term "external" implies non-USACE or non-governmental review. IEPR is conducted on projects that meet mandatory or discretionary triggers outlined in current HQ guidance similar to the ATR process, and a formalized comment resolution process must take place. Note this process may come under scrutiny through Freedom of Information Act requests. Document submittal requirements of section 21 also apply to IEPRs. Often times, the IEPR occurs at the same time as an ATR. IEPR coordination is critical regarding timeliness and funding, because funding the IEPR commonly requires a contractual process.

d. Types of Cost Certifications. The Cost MCX uses a certification method to communicate analysis of project cost development. The Cost MCX and respective reviewers take into consideration many key factors that contribute to accurately identification of cost, schedule and risk. Project Scope, technical information (design, acquisition methods, unique construction methods, etc.) and quality of development are reviewed. The Cost MCX has the authority assignment of certification level. Since many unique combinations of product development may occur, the Cost MCX assignment is based on the overarching goal of "Does the process used by the district produce accurate cost products which provide the district a high probability of execution within the authorization limits and is the risk level (Contingencies) appropriate?"

(1) Cost Certification Statement. Project Scope has been identified to accurately estimate project cost and schedule. Technical information is sufficient to allow for cost development combined with risk identification to appropriately account for cost and schedule. Product has been developed in accordance with quality standards as identified within current cost regulations and policy.

(2) Conditional Cost Certification Statement. Portions of the project scope, technical information or product quality are deemed at an insufficient level in accordance with regulations and policy, however not to the level where project cost cannot be identified with inclusion of risk identification. The Conditional Certification Statement will highlight basis for the Conditional Certification. This will allow the district to focus future resources on improvement. Projects will not be allowed multiple conditional cost certifications, without HQUSACE PM and HQUSACE Cost approval.

(3) Cost Non-Certification Statement. In cases where the project scope, technical information or quality of product are deemed to be at such an insufficient level where cost and/or schedule cannot be accurately identified. Rationale for Cost Non-Certification will be identified on the statement. Cost products assigned the Cost Non-Certification Statement are generally not acceptable for final planning reports, funding requests, or other circumstances for which the Cost Certification Statement is required. The non-certification letter and all comments will be forwarded to the MSC for review and evaluation. The MSC will forward its recommendations to HQUSACE for a final determination on subsequent action.

26. Total Cost Management.

a. Total cost management is the effective application of professional and technical expertise to plan and control resources, costs, schedules, and risk throughout all project phases. Total cost management is a systematic approach to manage and forecast costs, schedules and risks throughout the life cycle of any project, product, or service. A major tool in this application is the development and update of the total project cost and then updating and managing the cost products that support the total project cost comparison to the BCE. Applicable terms include project management, project controls and earned value management.

b. DFAR 234.201 presents the Department of Defense Policy regarding Earned Value Management System (EVMS) requirements in contracts. EVMS is another way of referring to Total Cost Management and should be considered/incorporated within the day to day business practices and management of USACE projects. A total project cost estimate, (reference TPCS forms), is required for documents supporting a funding request. This includes feasibility studies, design document reports, design deficiency report, engineering documentation reports, general reevaluation reports, limited reevaluation reports, and post authorization change reports.

c. During any phase of the project, as the PDT becomes aware of information that impacts project cost, schedule, or risks, the cost engineering office must update the cost engineering products. For total project cost development and updates, cost engineering products must include current project scope, reflect current acquisition strategy, quantities, labor, equipment, materials, escalation, schedules and risks. For cost engineering products older than 2 years, escalation application is not appropriate.

d. During the construction phase, the authorized BCE sets the target for managing and controlling project costs. As the design is refined, the uncertainties are reduced, and the costs associated with each feature become more specific towards satisfying the scope requirements. To identify these changing costs, a total project cost must be updated at each planning phase or milestone in the project development.

e. Project development can span multiple years. To ensure the project is still within the authorized or appropriated cost, annual total project cost estimates must be updated and compared with the BCE, current authorization, or appropriation. Subsequent to a Congressionally approved BCE (Section 902 of the Water Resources Development Act of 1986, Public Law 99-662), all total project costs must document the current computed total project cost at the appropriate price level, the total project cost escalated to the current programming year (constant dollar estimate), and the total project cost escalated through the construction periods based on a current project schedule. Estimate product updates must address current scope, current acquisition strategy, quantities, costs, schedules, and risks. The estimate must include re-pricing using current labor rates, equipment data, material rates, and use the appropriate cost indices found in EM 1110-2-1304.

f. For significant, ongoing construction projects that span multiple years, the cost engineering office must support in the monitoring, preparation, and update of quantities, Government cost estimates, schedules, and risk products. This is intended to support the project controls and monitoring of construction progress, invoice payments, potential modifications, negotiations, claims, and settlements.

g. Certain large projects that are greater than $300 million over a span of three years or more that are unique, higher acquisition risk, of national significance, multiple contractors and stakeholders may be qualified as "mega projects." Management of these projects require greater oversight that includes Project Control teams utilizing experienced personnel responsible for managing project and integrated program schedules, project and program budgets, and document and communication controls. The team must include capable expertise in cost and schedule risk analysis, cost estimating and network scheduling. An independent Government estimate and related risks are still required to protect the Government's interest in monitoring and reporting contractor progress, defending against contract modifications and claims and to support fair and reasonable invoice payments.

h. Cost and schedule metrics must use earned value processes to analyze and compare scheduled project progress and construction placement to contractor actuals, invoice validation, current TPC, authorizations and appropriations.

i. Reasonable separation must be made within the cost products regarding work breakdown structure, spent costs, ongoing efforts/contracts, and remaining efforts in order to identify specific risks and calculate the differing contingencies between the three phases of design, advertising, and construction. During the construction phase, greater consideration should be given to known, project-specific data, cost changes, and trends.

j. Value engineering is a mandatory method that supports cost management objectives. It can be performed during any phase of project development and execution. Refer to ER 11-1-321, Army Program Value Engineering.

FOR THE COMMANDER:

6 Appendixes
(See Table of Contents)

D. PETER HELMLINGER
COL., EN
Chief of Staff

APPENDIX A

References

Public Law No. 95-269 (91 Stat. 218-1-219)
Pertains to preparation of construction cost estimates as though the Government were a prudent and well-equipped contractor.

Public Law No. 99-662 (H.R.6)
The Water Resources Development Act of 1986.

Title 33 United States Code Section 624
Section 624 provides that projects for river and harbor improvement shall be performed by private contract if the contract price is less than 25 percent in excess of the estimated comparable cost of doing the work by Government plant or less than 25 percent in excess of a fair and reasonable estimated cost of a well-equipped contractor doing the work. The legislative history indicates the IGE shall not include profit.

5 U.S.C. 552, as amended by Public Law No. 104-231, 110 Stat. 3048
The Freedom of Information Act

AR 25-55 The Department of the Army Freedom of Information Act Program

33 Code of Federal Regulations Parts 209 and 335-338
Operations and Maintenance Regulations for Activities Involving the Discharge of Dredged or Fill Material in Waters of the United States and Ocean Waters.

Davis – Bacon Act

Federal Acquisition Regulation (FAR), Subpart 36.203
Construction and Architect-Engineer Contracts.

FAR, Subpart 15.404-4
Profit.

FAR, Subpart 36
Construction and Architect-Engineer Contracts.

FAR, Subpart 1.602
Contracting Officers.

USACE Acquisition Instruction (UAI)

Engineer Regulation (ER) 5-1-11
U.S. Army Corps of Engineers Business Process.

ER 11-1-321
Army Programs Value Engineering.

ER 1105-2-100
Planning Guidance Notebook.

ER 1110-1-12
Engineering and Design Quality Management.

ER 1110-1-1300
Cost Engineering Policy and General Requirements.

ER 1110-2-1150
Engineering and Design for Civil Works Projects.

ER 1180-1-9
Design-Build Contracting.

Engineer Manual (EM) 1110-2-1304
Civil Works Construction Cost Index System.

Engineer Pamphlet 1110-1-8
Construction Equipment Ownership and Operating Expense Schedule.

ASTM E 2516-06
Standard Classification for Cost Estimate Classification System, Reprinted, with permission, from the Annual Book of ASTM Standards, copyright ASTM International,

100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM, www.astm.org.

Project Management Institute, Inc. A Guide to the Project Management Body of Knowledge. PMBOK® guide, 3rd ed, 2004.

WATER RESOURCES DEVELOPMENT ACT (WRDA) (various years)

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(Feature and Subfeature Levels)

CW-WBS Number		Description of Item
01	**--**	**LANDS AND DAMAGES**
01	18	GENERAL REVALUATION REPORT (GRR)
01	19	LIMITED REVALUATION REPORT (LRR)
01	20	PROJECT DESIGN MEMORANDUM
01	21	FEATURE DESIGN MEMORANDUM
01	23	CONSTRUCTION CONTRACT(S) DOCUMENTS
02	**--**	**RELOCATIONS**
02	01	ROADS, Construction Activities
02	02	RAILROADS, Construction Activities
02	03	CEMETERIES, UTILITIES, AND STRUCTURES, Construction Activities
03	**--**	**RESERVOIRS**
04	**--**	**DAMS**
04	01	MAIN DAM
04	02	SPILLWAY
04	03	OUTLET WORKS
04	04	POWER INTAKE WORKS
04	05	AUXILIARY DAMS
04	06	MUNICIPAL AND INDUSTRIAL WATER DELIVERY FACILITIES
05	**--**	**LOCKS**
06	**---**	**FISH AND WILDLIFE FACILITIES**
06	01	FISH FACILITIES AT DAMS
06	02	FISH HATCHERY, (Including Trapping and Release Facilities)
06	03	WILDLIFE FACILITIES AND SANCTUARIES
07	**--**	**POWER PLANT**
07	01	POWERHOUSE
07	02	TURBINES AND GENERATORS
07	03	ACCESSORY ELECTRICAL EQUIPMENT
07	04	MISCELLANEOUS POWER PLANT EQUIPMENT
07	05	TAILRACE
07	06	SWITCHYARD
08	**--**	**ROADS, RAILROADS, AND BRIDGES**

(Feature and Subfeature Levels)		
08	01	ROADS
08	02	RAILROADS
09	**--**	**CHANNELS AND CANALS (Except Navigation Ports and Harbors)**
09	01	CHANNELS
09	02	CANALS
10	**--**	**BREAKWATERS AND SEAWALLS**
11	**--**	**LEVEES AND FLOODWALLS**
11	01	LEVEES
11	02	FLOODWALLS
12	**--**	**NAVIGATION, PORTS AND HARBORS**
12	01	PORTS
12	02	HARBORS
13	**--**	**PUMPING PLANT**
14	**--**	**RECREATION FACILITIES**
15	**--**	**FLOODWAY CONTROL AND DIVERSION STRUCTURES**
16	**--**	**BANK STABILIZATION**
17	**--**	**BEACH REPLENISHMENT**
18	**--**	**CULTURAL RESOURCE PRESERVATION**
19	**--**	**BUILDINGS, GROUNDS, AND UTILITIES**
20	**--**	**PERMANENT OPERATING EQUIPMENT**
30	**--**	**PLANNING, ENGINEERING, AND DESIGN**
30	11	PROJECT COOPERATION AGREEMENT
30	12	PROJECT MANAGEMENT PLAN
30	18	GENERAL REEVALUATION REPORT (GRR)
30	19	LIMITED REEVALUATION REPORT (LRR)
30	20	PROJECT DESIGN MEMORANDUM
30	21	FEATURE DESIGN MEMORANDUM
30	23	CONSTRUCTION CONTRACT(S) DOCUMENTS
30	24	VALUE ENGINEERING ANALYSIS DOCUMENTS
30	25	PROJECT OR FUNCTIONAL ELEMENT CLOSEOUT
30	26	PROGRAMS AND PROJECT MANAGEMENT DOCUMENTS
31	**--**	**CONSTRUCTION MANAGEMENT**
31	12	PROJECT MANAGEMENT PLAN
31	23	CONSTRUCTION CONTRACT(S) DOCUMENTS
31	26	PROGRAMS AND PROJECT MANAGEMENT DOCUMENTS
33	**--**	**HAZARDOUS AND TOXIC WASTE**

		(Feature and Subfeature Levels)
33	01	MOB, DEMOB & PREPARATORY WORK
33	02	SYSTEMS STARTUP/OPERATIONS/MAINTENANCE
33	03	INSTITUTIONAL ACTIONS
33	04	SURFACE WATER CONTROL
33	05	COLLECTION & INJECTION OF GROUND WATER
33	06	COLLECTION & DISPOSAL OF WASTES
33	07	CONTAIN & RESTORE CONTAMINATED GROUND WATER
33	08	CONTAINMENT FOR WASTES
33	10	TREAT-WASTES/CONTAMINATED SOIL & WATER
33	11	AIR POLLUTION AND LANDFILL GAS CONTROL
33	12	INNOVATIVE TECHNOLOGIES
33	13	SUPPORTING FACILITIES
33	14	PRIME CONTRACTOR'S INDIRECT COST

01. Lands and Damages. This feature includes all costs of acquiring for the project (by purchase or condemnation) real property or permanent interests therein, including Government costs, damages, and costs of disposal of real estate. Government costs include planning expenses for the real estate portion of the General Design Memo and for the detailed Real Estate Memo; and project real estate office administration, surveys, and marking for land acquisition purposes and appraisals.

For projects which require that costs be incurred on real estate activities, i.e., for records search, appraisals, and field inspection to assure compliance by local interests in the provision of local requirements on projects where no Federal land acquisition is involved, a memorandum statement will be provided with the PB-3 indicating the estimated costs of such real estate activities. These costs will be charged to feature 30, Engineering and Design and that feature will be properly footnoted to show the amount of such costs. A similar footnote will be shown on the PB-1s and PB-2a's for all such projects. This feature is credited with disposal receipts from sale of such items as standing crops, standing timber, structures, and improvements in place and acquired with the land. Disposal receipts from sale of excess land not turned in to the U.S. Treasury as miscellaneous receipts are credited to this feature. Lands or interests purchased for relocations and conveyed to others are included in the feature "Relocations." Temporary interests such as leases are included in the feature or distributive item benefited thereby.

02. Relocations. This feature includes removing and relocating, or reconstructing property of others, such as roads, railroads, cemeteries, utilities, buildings, and other structures; and lands or interests purchased for such relocations and conveyed to others, including real estate planning and acquisition expenses. The cost of removal of improvements from the reservoir area for disposal is included in the feature "Reservoirs." All alterations of railroad bridges in accordance with Section 3 of the 1946 Flood Control Act (22 USC 701p) are also included in this feature.

03. Reservoirs. This feature includes clearing lands in reservoirs and pools of debris, brush, trees, improvements, and structures. Any salvage, obtained by sale or disposal by the Government, of material removed in clearing operations is credited to this feature. This feature also includes bank stabilization, shoreline improvement, firebreaks, fencing, boundary line survey and marking of land which has been acquired or is to be acquired, rehabilitation of natural resources, erosion control, drainage, and rim grouting and mine sealing, etc., to prevent leakage. Site clearing, grouting, etc.,

incidental to and required for specific construction features is included as part of the construction features.

04. Dams. This feature includes dams and all other water collecting and storage facilities, whether man-made or natural, together with appurtenant diversion, regulation, and delivery facilities and spillways, outlet works, and power intake works, whether separate from the dam or not. In the case where the powerhouse is an integral part of the intake dam, the cost of the power intake dam is included in the feature "Power Plant." Any auxiliary dams or spillways detached from the main structures and floating trash and drift booms and barriers are included in this feature. The power intake works include such power items as forebay, penstocks, tunnels, surge tank, gates, operating equipment, and appurtenances. Service roads and service railroads on the dam are included in this feature. The additional cost of relocating highways and railroads across the dam is included in the feature "Relocations."

05. Locks. This feature includes facilities to provide for passage of waterborne traffic, including gates, valves, operating mechanisms, cribs, fills, lock walls, guide and guard walls, operating buildings, and excavation therefore. The lock structure is considered that part of the work within the limit lines extending from the upper end of the upper guide or guard walls to the lower end of the lower guide or guard walls, including dolphins within the lock approaches for tie up, guard, or guide purposes. Excavation or dredging· required in approaches outside of the limits defined above for the lock structure is included in the feature "Channels and Canals." The cost of a cofferdam or the properly allocable amount thereof, if required, is charged to this feature. Locks provided in connection with facilities for the prevention of encroachment of salt water are included in this feature. Locks in connection with fish facilities are included in the feature "Fish and Wildlife Facilities."

06. Fish and Wildlife Facilities. This feature includes items such as ladders, elevators, locks and related facilities for passage of fish at dams and navigation locks and maintenance of fish runs; and provision for wildlife preservation. In support of wildlife, this feature includes environmental mitigation and monitoring costs.

07. Power Plant. This feature includes those facilities specifically required for the production of power other than those included in the feature "Dams," and consists of the following: powerhouse, turbines and governors, generators, accessory electrical equipment, miscellaneous power plant equipment, switchyard, and tailrace improvement for power. In the case where the powerhouse is an integral part of the

power intake dam, the cost of the power intake dam is included in this feature. Where the structure of a dam also forms the foundation of the powerhouse, such foundation is considered a part of the dam. Units for production of power for the operation only of power, for the operation only of navigation, flood control, or other purpose projects (excluding those projects with power as a feature) are included in other than this feature. The cost of a cofferdam or appropriate part is charged to this feature.

08. Roads, Railroads, and Bridges. This feature includes permanent roads, railroads, and bridges required for access and other purposes in connection with the construction and operation of the project. This feature does not include roads, railroads, and bridges chargeable to the feature "Relocations," access roads to recreation facilities and areas, which will be charged to the feature "14. Recreation Facilities," and service roads and service railroads on structures.

09. Channels and Canals. This feature includes all forms of excavation (including dredging, preparation of spoil disposal area, and attendant facilities) necessary for the development and construction of channels, harbors, and canals for navigation purposes; and deepening, providing new, or improving existing watercourses for flood control and major drainage. Excavation of natural watercourse to provide adequate depths for navigation is included. Excavation for specific structures, such as dams and locks used in the development of waterways and conservation of water resources, is included with such structures. The removal of trees, brush, accumulated snags, drift, debris, water hyacinths and other aquatic growths from canals, harbors, and channels in navigable streams and tributaries thereof for navigational included in this feature. Excavation, clearing, and removal of accumulated snags, drifts, debris, and vegetable growth from streams for flood control and major drainage purposes also is included. Included in this feature are revetments, linings, dikes, and bulkheads constructed as channel improvement works for flood control or navigation, as against such items constructed for bank stabilization only. Also included are jetties constructed in connection with flood control channel improvements.

10. Breakwaters and Seawalls. This feature includes breakwaters, seawalls, piers, and like improvements constructed in connection with the protection of beaches, harbors, shores, and port facilities against the force of waves and encroachment of seas or lakes by direct wave action. Jetties, groins, and like structures provided in seas, lakes, tidewater reaches of rivers and canals, and harbors to control water flow and current, to maintain depth of channels, and to provide protection, are included in this feature.

11. Levees and Floodwalls. This feature includes embankments and walls constructed to protect areas from inundation by overflow from creeks, rivers, lakes, canals, and other bodies of water. This feature consists of such items as: service roads on levee crown or landside berms, road ramps, closure structures, seepage control measures, erosion protection measures on levee slopes and on berms and bank slops when an integral part of the levees or floodwalls; and drainage facilities, constructed to provide means for the passage of accumulated drainage and seepage water and sewage from the protected area over or through levees and floodwalls, comprising such items as interceptor and collection sewers and ditches, and pressurized sewers and drainage structures, including outfalls through levees or floodwalls. Pumping plants are included in the feature "Pumping Plants." Levees locally called dikes are included in this feature.

12. Navigation Ports and Harbors. This feature includes all forms of excavation (including dredging, preparation of spoil disposal area, and attendant facilities) necessary for the development and construction of coastal ports and harbors for navigation purposes. This includes bulkheads, jetties, piers, and docks constructed in connection with navigation improvements and basins or water areas for vessel maneuvering, turning, passing, mooring, or anchoring incidental to the navigation improvements. It also includes dredged material disposal areas (except those for the inland navigation system, the Atlantic Intracoastal Waterway, and the Gulf Intracoastal Waterway), and sediment basins. These are eligible for development as general navigation features of harbor or waterway projects. The removal of trees, brush, accumulated snags, drift, aquatic, and vegetable growths, and debris from harbors, and ports for navigation are included in this feature.

13. Pumping Plants. This feature includes pumping plants construction to pass accumulated drainage and seepage water and sewage from the protected area over or through levees and floodwalls.

14. Recreation Facilities. This feature includes access roads; parking areas; public camping and picnicking areas, including tables and fireplaces; water supply; sanitary facilities; boat launching ramps; directional signs; and other facilities constructed primarily for public recreational use, including essential safety measures in connection therewith. The latter includes, as appropriate, sheltered anchorage areas for small craft, bathing areas readily accessible and reasonably safe, and safety provisions for visitors and fishermen in the project area. (Boat launching ramps, anchorage areas and beaches should be provided during construction to the extent they will definitely be needed and can be accomplished more economically than at a later date.)

15. Floodway Control and Diversion Structures. This feature includes floodway control and diversion structures to provide for the release of flood waters from streams where discharges exceed flood capacity of the stream, including items such as diversion dams, gated or ungated discharge structures, training walls, stilling basin, and those adjacent embankment sections forming part of the control structure. Construction of channels and levees not forming part of the main control structure, but necessary for operation of such structures is included in the appropriate feature "Channels and Canals" or "Levees and Floodwalls."

16. Bank Stabilization. This feature includes revetments, linings, training dikes, and bulkheads for stabilization of banks of watercourses to prevent erosion, sloughing, or meandering. Bank stabilization constructed in navigation channels or in connection with flood control channel improvement is included in the feature "Channels and Canals."

17. Beach Replenishment. This feature includes replacement of eroded beaches, for purposes of recreation and shore protection, by direct deposit of materials obtained by dredging or land excavation.

19. Buildings, Grounds, and Utilities. This feature includes permanent facilities such as operators' quarters, administration and shop buildings, storage buildings and areas, garage buildings and areas, community buildings, local streets and sidewalks, landscaping, and electric, gas, water, and sewage facilities. Where space in a dam, powerhouse, or other basic structure is used in lieu of construction of any of the above-mentioned buildings, such allocated space is not separated from the basic structure. Communication systems are included in the feature "Permanent Operating Equipment."

20. Permanent Operating Equipment. This feature includes all project-owned operation and maintenance tools and equipment, such as laboratory, shop, warehousing, communications, and transportation equipment, and office furniture and equipment. The cost of installing sedimentation and degradation measuring facilities, including the surveys requisite to locating and monumenting range layouts, is charged to this feature. The cost of planning the installation of sedimentation and degradation ranges is charged to the feature "Engineering and Design."

30. Planning, Engineering and Design. This feature includes all engineering, design, surveys, preparation of detailed plans and specifications, and related work required for the construction of the project, including relocations. Surveys and planning required in connection with land acquisition are charged to the features "Lands and Damages" or

"Relocations," as applicable. Engineering and design performed by hired labor or as a pay item under a contract is included in this feature.

31. Supervision and Administration. This feature includes such functions as inspection, supervision, project office administration, and distributive costs of area office and general overhead charged to the project. Costs for Office of the Chief of Engineers CE and Division Office Executive Direction and Management are not charged to Construction, General but to the General Expenses appropriation title.

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APPENDIX C

Total Project Cost Summary

Total Project Cost Summary

Project:	Example Project (Non-CAP)	P2:	101010
Location:	Walla Walla River	Report Type:	Feas Stdy
District:	NWW -Walla Walla District	Contingency Development:	Crystal Ball
POC:	Callan	CWCCIS Issue:	9/1/2015
Authority:	Section 1135	TPCS Preparation Date:	27-Oct-15
FY:	2016		

Scope Synopsis: Flood Control along upper reach of the Walla Walla River.

WBS		ESTIMATED COST				PROJECT FIRST COST CONSTANT DOLLAR BASIS				TOTAL PROJECT COST (FULLY FUNDED)			
	Civil Works	Risk Based				Program Price Level Date: 2016-1Q							
WBS	Feature Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	INFLATED (%)	COST ($K)	CNTG ($K)	TOTAL ($K)
02	RELOCATIONS	500	125	25%	625		500	125	625	6%	531	133	664
06	FISH & WILDLIFE FACILITIES	41.525	8,381	20%	49,906		41,525	8,381	49,906	4%	43,267	8,734	52,000
	S/T	42,025	8,506	20%	50,531		42,025	8,506	50,531	4%	43,798	8,866	52,664
01	LANDS AND DAMAGES	50	13	25%	63		50	13	63	6%	53	13	66
	S/T	50	13	25%	63		50	13	63	6%	53	13	66
30	PLANNING ENGINEERING AND DESIGN	10.716	2,170	20%	12,886		10,716	2,170	12,886	9%	11,673	2,364	14,038
	S/T	10,716	2,170	20%	12,886		10,716	2,170	12,886	9%	11,673	2,364	14,038
31	CONSTRUCTION MANAGEMENT	6.386	1,289	20%	7,675		6,386	1,289	7,675	9%	6,959	1,405	8,364
	S/T	6,386	1,289	20%	7,675		6,386	1,289	7,675	9%	6,959	1,405	8,364
	Totals	59,178	11,977	20%	71,155		59,178	11,977	71,155	6%	62,484	12,648	75,132

CHIEF, COST ENGINEERING

PROJECT MANAGER

CHIEF, REAL ESTATE

CHIEF, PLANNING

CHIEF, ENGINEERING

CHIEF, OPERATIONS

CHIEF, CONSTRUCTION

CHIEF, CONTRACTING

CHIEF, PM-PB

CHIEF, DPM

	Cost ($k)	Contingency ($k)	Totals ($k)
Project First Cost for Report:	$59,178	$11,977	$71,155
Total Project Cost used to provide Sponsor information	$62,484	$12,648	$75,132

Project: *Example Project (Non-CAP)* Page 1 of 4 27-Oct-15

Contract Summary

WBS		ESTIMATED COST Estimate Class Level: *Class 3*				PROJECT FIRST COST *CONSTANT DOLLAR BASIS*				TOTAL PROJECT COST (FULLY FUNDED)				
Contract: **Phase I**		Est Preparation Date: 27-Oct-15				Program Yr: 2016								
		Est Price Level: 2016-1Q				Prog Level Date: 2016-1Q								
Location: Walla Walla River				Risk Based										
District: NWW -Walla Walla District		COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	MID-PT (DATE)	INFLATED (%)	COST ($K)	CNTG ($K)	TOTAL ($K)
02 RELOCATIONS		500	125	25.0%	625	.%	500	125	625	2019-2Q	6.2%	531	133	664
06 FISH & WILDLIFE FACILITIES		25	6	25.0%	31	.%	25	6	31	2019-2Q	6.2%	27	7	33
Construction **Activities**	Total	525	131		656		525	131	656			558	139	697
01 LANDS AND DAMAGES		50	13	25.0%	63	.%	50	13	63	2019-2Q	6.2%	59	13	66
Lands and **Damages**	Total	50	13		63		50	13	63			53	13	66
30 Planning Engineering and Design														
Project Management	*2.5%*	13	3	25.0%	16	.%	13	3	16	2019-2Q	13.1%	15	4	19
Planning & Environmental Compliance	*1.0%*	5	1	25.0%	7	.%	5	1	7	2019-2Q	13.1%	6	1	7
Engineering & Design	*15.0%*	79	20	25.0%	98	.%	79	20	98	2019-2Q	13.1%	89	22	111
Engineering Tech Review ATR & VE	*1.0%*	5	1	25.0%	7	.%	5	1	7	2019-2Q	13.1%	6	1	7
Contracting	*1.0%*	5	1	25.0%	7	.%	5	1	7	2019-2Q	13.1%	6	1	7
Engineering During Construction	*3.0%*	16	4	25.0%	20	.%	16	4	20	2019-2Q	13.1%	18	4	22
Planning During Construction	*2.0%*	11	3	25.0%	13	.%	11	3	13	2019-2Q	13.1%	12	3	15
Planning Engineering and **Design**	Total	134	33		167		134	33	167			151	38	189
Construction Management	*10.0%*	53	13	25.0%	66	.%	53	13	66	2019-2Q	13.1%	59	15	74
Project Operation:	*15.0%*	79	12	15.0%	91	.%	79	12	91	2019-2Q	13.1%	89	13	102
Construction **Management**	Total	131	25		156		131	25	156			149	28	177
Phase I	Total	840	202		1,042		840	202	1,042			911	219	1,130

Contract Footnote: For Example Only

Project: *Example Project (Non-CAP)* Page 2 of 4 27-Oct-15

Contract Summary

WBS		ESTIMATED COST Estimate Class Level: *Class 3*				PROJECT FIRST COST *CONSTANT DOLLAR BASIS*				TOTAL PROJECT COST (FULLY FUNDED)				
Contract: Phase II		Est Preparation Date: 27-Oct-15				Program Yr: 2016								
		Est Price Level: 2016-1Q				Prog Level Date: 2016-1Q								
			Risk Based											
Location: Walla Walla River		COST	CNTG	CNTG	TOTAL	ESC	COST	CNTG	TOTAL	MID-PT	INFLATED	COST	CNTG	TOTAL
District: NWW - Walla Walla District		($K)	($K)	(%)	($K)	(%)	($K)	($K)	($K)	(DATE)	(%)	($K)	($K)	($K)
06 FISH & WILDLIFE FACILITIES		40,000	8,000	20.0%	48,000	.%	40,000	8,000	48,000	2018-2Q	4.2%	41,663	8,333	49,995
Construction Activities	Total	40,000	8,000		48,000		40,000	8,000	48,000			41,663	8,333	49,995
30 Planning Engineering and Design														
Project Management	*2.5%*	1,000	200	20.0%	1,200	.%	1,000	200	1,200	2018-2Q	8.8%	1,088	218	1,306
Planning & Environmental Compliance	*1.0%*	400	80	20.0%	480	.%	400	80	480	2018-2Q	8.8%	435	87	522
Engineering & Design	*15.0%*	6,000	1,200	20.0%	7,200	.%	6,000	1,200	7,200	2018-2Q	8.8%	6,528	1,306	7,833
Engineering Tech Review ATR & VE	*1.0%*	400	80	20.0%	480	.%	400	80	480	2018-2Q	8.8%	435	87	522
Contracting	*1.0%*	400	80	20.0%	480	.%	400	80	480	2018-2Q	8.8%	435	87	522
Engineering During Construction	*3.0%*	1,200	240	20.0%	1,440	.%	1,200	240	1,440	2018-2Q	8.8%	1,306	261	1,567
Planning During Construction	*2.0%*	800	160	20.0%	960	.%	800	160	960	2018-2Q	8.8%	870	174	1,044
Planning Engineering and Design	Total	10,200	2,040		12,240		10,200	2,040	12,240			11,097	2,219	13,317
Construction Management	*10.0%*	4,000	800	20.0%	4,800	.%	4,000	800	4,800	2018-2Q	8.8%	4,352	870	5,222
Project Operation:	*5.0%*	2,000	400	20.0%	2,400	.%	2,000	400	2,400	2018-2Q	8.8%	2,176	435	2,611
Construction Management	Total	6,000	1,200		7,200		6,000	1,200	7,200			6,528	1,306	7,833
Phase II	Total	56,200	11,240		67,440		56,200	11,240	67,440			59,288	11,858	71,146

Contract Footnote: For Example Only

Contract Summary

WBS		ESTIMATED COST Estimate Class Level: *Class 3*				PROJECT FIRST COST *CONSTANT DOLLAR BASIS*				TOTAL PROJECT COST (FULLY FUNDED)				
Contract: **Phase III**		Est Preparation Date: 27-Oct-15 Est Price Level: 2016-1Q				Program Yr: 2016 Prog Level Date: 2016-1Q								
Location: Walla Walla River District: NWW -Walla Walla District		COST ($K)	CNTG ($K)	Risk Based CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	MID-PT (DATE)	INFLATED (%)	COST ($K)	CNTG ($K)	TOTAL ($K)
06 FISH & WILDLIFE FACILITIES		1,500	375	25.0%	1,875	.%	1,500	375	1,875	2018-4Q	5.1%	1,577	394	1,972
Construction Activities	Total	1,500	375		1,875		1,500	375	1,875			1,577	394	1,972
30 Planning Engineering and Design														
Project Management	2.5%	38	9	25.0%	47	.%	38	9	47	2018-4Q	11.%	42	10	52
Planning & Environmental Compliance	1.0%	15	5	30.0%	20	.%	15	5	20	2018-4Q	11.%	17	5	22
Engineering & Design	15.0%	225	56	25.0%	281	.%	225	56	281	2018-4Q	11.%	250	62	312
Engineering Tech Review ATR & VE	1.0%	15	4	25.0%	19	.%	15	4	19	2018-4Q	11.%	17	4	21
Contracting	1.0%	15	4	25.0%	19	.%	15	4	19	2018-4Q	11.%	17	4	21
Engineering During Construction	3.0%	45	11	25.0%	56	.%	45	11	56	2018-4Q	11.%	50	12	62
Planning During Construction	2.0%	30	8	25.0%	38	.%	30	8	38	2018-4Q	11.%	33	8	42
Planning Engineering and Design	Total	383	96		479		383	96	479			424	107	531
Construction Management	10.0%	150	38	25.0%	188	.%	150	38	188	2018-4Q	11.%	166	42	208
Project Operation:	7.0%	105	26	25.0%	131	.%	105	26	131	2018-4Q	11.%	117	29	146
Construction Management	Total	255	64		319		255	64	319			283	71	354
Phase III	Total	2,138	535		2,673		2,138	535	2,673			2,285	572	2,857

Contract Footnote: For Example Only

Project: *Example Project (Non-CAP)* Page 4 of 4 27-Oct-15

Total Project Cost Summary

Continuing Authorities Program

In addition to specifically authorized projects, Congress recognized a need to address small water resources and ecosystem restoration projects of limited scope and complexity.

1. The continuing authorities program (CAP) provides the authority for the Secretary of the Army, acting through the Chief of Engineers, to plan, design, and construct projects of limited size, scope, cost, and complexity without additional specific Congressional authority.

2. Congress provides annual appropriations for legislative CAP authorities up to the annual program limit.

3. CAP projects must be implemented in two phases: Feasibility, and Design and Implementation. Each phase is carried out under a separate cost-sharing agreement.

4. Feasibility study costs are NOT included in the Project First Costs or the Total Project Costs of the WBS table. Check current CAP guidance for further information. In most cases the study cost is not part of the "total project cost" but IS included in the federal spending limit/ceiling. The cost share percentage may vary-often the first 100K is fully federally funded.

The following pages are an example of a CAP TPCS.

****** TOTAL PROJECT COST SUMMARY ******

Printed:10/28/2015
Page 1 of 2

PROJECT: **Washout Creek Bridge Protection - Section 14**
PROJECT NO: **P2 172233**
LOCATION: **Somewhere, WA**

DISTRICT: **NWW WALLA WALLA** PREPARED **4/1/2014**

POC: **CHIEF, COST ENGINEERING, xxx**

This Estimate reflects the scope and schedule in report: CAP Feasibility STUDY - WASHOUT CREEK

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC): 2016 Effective Price Level Date: 1-Oct- 15									
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	REMAINING COST ($K)	Spent Thru: 10/1/2013 ($K)	TOTAL FIRST COST ($K)	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
09	CHANNELS & CANALS	$3,221	$741	23%	$3,962	1.3%	$3,263	$750	$4,013		$4,013	1.4%	$3,309	$761	$4,06[illegible]
16	BANK STABILIZATION	$458	$165	36%	$623	1.8%	$466	$168	$634		$634	1.4%	$473	$170	$64[illegible]
	CONSTRUCTION ESTIMATE TOTALS:	$3,679	$906		$4,585	1.4%	$3,729	$918	$4,647		$4,647	1.4%	$3,781	$931	$4,71[illegible]
01	LANDS AND DAMAGES	$5	$2	30%	$7	0.6%	$5	$2	$7		$7		$5	$2	$7
30	PLANNING, ENGINEERING & DESIGN	$1,050	$227	22%	$1,277	2.3%	$1,074	$232	$1,306		$1,306	3.3%	$1,110	$240	$1,35[illegible]
31	CONSTRUCTION MANAGEMENT	$534	$94	18%	$628	1.6%	$543	$95	$638		$638	3.3%	$560	$99	$66[illegible]
	PROJECT COST TOTALS:	$5,268	$1,228	23%	$6,496		$5,351	$1,247	$6,598		$6,598	2.0%	$5,456	$1,271	$6,727

ESTIMATED TOTAL PROJECT COST:		**$6,727**
ESTIMATED FEDERAL COST:	65%	$4,373
ESTIMATED NON-FEDERAL COST:	35%	$2,354
22 - FEASIBILITY STUDY (CAP studies):		**$200**
ESTIMATED FEDERAL COST:		$165
ESTIMATED NON-FEDERAL COST:		$35
ESTIMATED FEDERAL COST OF PROJECT		**$4,538**

________________ CHIEF, COST ENGINEERING, xxx

________________ PROJECT MANAGER, xxx

________________ CHIEF, REAL ESTATE, xxx

________________ CHIEF, PLANNING, xxx

________________ CHIEF, ENGINEERING, xxx

________________ CHIEF, OPERATIONS, xxx

________________ CHIEF, CONSTRUCTION, xxx

________________ CHIEF, CONTRACTING, xxx

________________ CHIEF, PM-PB, xxxx

________________ CHIEF, DPM, xxx

Filename: CAP Example TPCS Sep 2015 r0.xlsx
TPCS

****** TOTAL PROJECT COST SUMMARY ******

Printed: 10/28/2015
Page 2 of 2

****** CONTRACT COST SUMMARY ******

PROJECT: Washout Creek Bridge Protection - Section 14
LOCATION: Somewhere, WA
This Estimate reflects the scope and schedule in report; CAP Feasibility STUDY - WASHOUT CREEK

DISTRICT: NWW WALLA WALLA
POC: CHIEF, COST ENGINEERING, xxx

PREPARED: 4/1/2014

WBS Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 3/15/2014 Estimate Price Level: 41913				Program Year (Budget EC): 2016 Effective Price Level Date: 1-Oct-15								
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	PHASE 1 or CONTRACT 1													
09	CHANNELS & CANALS	$3,221	$741	23.0%	$3,962	1.3%	$3,263	$750	$4,013	2016Q4	1.4%	$3,308	$761	$4,069
16	BANK STABILIZATION	$458	$165	36.0%	$623	1.8%	$466	$168	$634	2016Q4	1.4%	$473	$170	$643
	CONSTRUCTION ESTIMATE TOTALS:	$3,679	$906	24.6%	$4,585		$3,729	$918	$4,647			$3,781	$931	$4,712
01	LANDS AND DAMAGES	$5	$2	30.0%	$7	0.6%	$5	$2	$7	2016Q1		$5	$2	$7
30	PLANNING, ENGINEERING & DESIGN													
0.025	Project Management	$92	$20	21.6%	$112	2.3%	$94	$20	$114	2016Q4	2.6%	$97	$21	$117
0.02	Planning & Environmental Compliance	$74	$16	21.6%	$90	2.3%	$76	$16	$92	2016Q4	2.6%	$78	$17	$94
0.15	Engineering & Design	$552	$119	21.6%	$671	2.3%	$565	$122	$687	2016Q4	2.6%	$579	$125	$705
0.01	Engineering Tech Review ITR & VE	$37	$8	21.6%	$45	2.3%	$38	$8	$46	2016Q4	2.6%	$39	$8	$47
0.01	Contracting & Reprographics	$37	$8	21.6%	$45	2.3%	$38	$8	$46	2016Q4	2.6%	$39	$8	$47
0.03	Engineering During Construction	$110	$24	21.6%	$134	2.3%	$113	$24	$137	2017Q4	6.7%	$120	$26	$146
0.02	Planning During Construction	$74	$16	21.6%	$90	2.3%	$76	$16	$92	2017Q4	6.7%	$81	$17	$98
0.02	Project Operations	$74	$16	21.6%	$90	2.3%	$76	$16	$92	2016Q4	2.6%	$78	$17	$94
31	CONSTRUCTION MANAGEMENT													
0.1	Construction Management	$368	$65	17.6%	$433	1.6%	$374	$66	$440	2017Q4	3.3%	$386	$68	$454
0.02	Project Operation:	$74	$13	17.6%	$87	1.6%	$75	$13	$88	2017Q4	3.3%	$78	$14	$91
0.025	Project Management	$92	$16	17.6%	$108	1.6%	$93	$16	$110	2017Q4	3.3%	$97	$17	$113
	CONTRACT COST TOTALS:	$5,268	$1,228		$6,496		$5,351	$1,247	$6,598			$5,456	$1,271	$6,727

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TPCS

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Cost Engineering Within the Planning Modernization Paradigm

1. Objective: The objective of preparing a feasibility report is to identify the recommended plan within the prescribed 3x3x3: project scope, economic benefit, and an accurate cost and schedule baseline identified with potential project risks. Analysis of specific design alternatives, selection of a final recommended technical design solution, and development of confident cost estimates, schedule products, and risk identification are part of project formulation, and are critical elements that enable informed decision making.

2. Guidance: For all Civil Works studies utilizing the new Planning paradigm as directed must consider the Uncertainty and Level of Detail, ensure Vertical Team Integration, determine Federal Interest, perform Alternative Comparison and Selection, and ensure necessary Funding and Resources.

   a. Uncertainty and Level of Detail. The new paradigm will require increased use of critical thinking (i.e. engineering judgment) in the analysis and cost estimates supporting plan formulation and selection for both alternative level as well as final recommendation. The Project Development Team (PDT) must analyze minimum design/technical information requirements to assure functionality and life safety for the project. The PDT must also determine minimum design/technical information requirements needed to develop accurate cost and schedule information (cost, schedule and risk). The appropriate level of detail must be determined with design personnel as the lead for determining design/technical information levels for function and safety, and cost personnel as the lead for the design/technical detail requirements pertaining to cost and schedule development. Based on the previous requirements corresponding PDT members will support cost personnel for defining technical assumptions where needed. Within the design effort in feasibility, the PDT will develop a work breakdown structure, which sufficiently identifies the project scope, features, and tasks to a level necessary to develop an accurate baseline cost and schedule, and enables identification and management of cost and schedule risks. Each project will utilize a "risk register" organized by project features to assess their likelihood of impacting cost, schedule and/or function/safety. The planning study risk register will be utilized for efforts required for the study execution. Risk Events identified within planning study risk identification process which could have an impact on cost and/or schedule will be included in the cost and schedule risk register. The goal is to minimize data collection and analysis for low impact features during the feasibility phase. High impact features should be carefully scoped such that data collection and analysis is commensurate with risk and adds value to the decision making process, accuracy to the cost and schedule, or reduces risk. The Project manager along with PDT must work closely with the cost engineer to identify areas where clarifying/modification of design/technical information details would be beneficial to reduce uncertainty. For items with significant cost and schedule risk, mitigation strategies shall be identified and discussed in the project's Risk Management Plan. While this approach must not lead us to accept additional life safety risk in projects, it may be appropriate to make a risk informed decision to defer some details or analysis to the Preconstruction Engineering and Design (PED) phase, provided that proper plan formulation can be accomplished.

APPENDIX E

Release of Government Estimates under Freedom of Information Act (FOIA)

1. This guidance establishes procedures for responding to FOIA requests for *Government estimates* and *Government estimate back-up data*. The *Government estimate* and *Government estimate back-up data,* prepared for construction contracts and modifications, are sensitive procurement information and should in many cases be withheld under the FOIA exemptions. FAR 36-203(c) states "Access to information concerning the Government estimate shall be limited to Government personnel whose official duties require knowledge of the estimate. An exception to this rule may be made during contract negotiations to allow the contracting officer to identify a specialized task and disclose the associated cost breakdown figures in the Government estimate, but only to the extent deemed necessary to arrive at a fair and reasonable price. The overall amount of the Government's estimate shall not be disclosed except as permitted by agency regulations."

2. Definitions:

a. Government estimate. The Government estimate consists of a title page, signature page and bid schedule.

b. Government estimate back-up data. The Government estimate back-up data is the detailed cost data, which includes production and crew development methodology, labor, equipment and crew back-up files, subcontractor quotes and all other data identified on MCACES software as detail sheets.

c. Fair market price determinations, under the Small Business Program (FAR 19.202 6), will be treated as Government estimates for purposes of this guidance.

d. Supporting documents that are publicly available, as part of the solicitation, such as plans, specifications and project description, or that contain no cost information, such as sketches, soil borings and material classifications, are not part of the Government estimate or back-up.

3. Government estimates and Government estimate back-up data are intra-agency memoranda which may be withheld under FOIA Exemption 4 and 5,

"confidential commercial information" and "deliberative process" privileges. Proper use of FOIA Exemption requires a showing that release of information will harm the Government's interests. Therefore, requests for Government estimates and back-up data will be reviewed on a case-by-case basis, based on the following guidance, to determine whether release will harm the Corps' interests. In reviewing requests the FOIA Officer will seek the assistance of the cost engineer. If the FOIA Officer determines that release will harm the Corps' interests, the information will be withheld.

a. Before Contract Award.

(1) When sealed bidding is used, neither the Government estimate nor the Government estimate back-up data should be released prior to bid opening, in accordance with FAR 36.203 and 36.204. It is well established that release of Government estimates and back-up data before contract award would harm the interests of the Government.

(2) The Government estimate will normally be released when bids are opened. In some instances, however, the *Government estimate* will not be released at that time, such as when all bids received are non-responsive and a re-procurement is envisioned.

(3) In negotiated procurement for construction under FAR Parts 15 and 36, the Government estimate should not be released prior to contract award, except that Government negotiators may disclose portions of the Government estimate in negotiating a fair and reasonable price, see FAR 36-203(c).

(4) Government estimate back-up data should not be released.

b. After Contract Award Through Contract Completion.

(1) The Government estimate may be released.

(2) The Government estimate back-up data should not be released. Release of Government estimate back-up data after contract award and before completion of a construction contract may also result in harm to the Government. The Government estimate back-up data is used to develop cost estimates for modifications and claims. Release of the back-up data prior to contract completion provides the contractor with the details of the Government's position and would

allow the contractor to develop a biased price proposal. This could harm the Government's ability to negotiate a fair and reasonable price for the modification or claim, putting the Government at a serious commercial disadvantage. Moreover, knowledge of the construction methods contemplated by the Government might reduce the contractor's incentive to discover less expensive methods. This could also reduce the contractor's incentive to locate and charge out materials at a lower cost, or to achieve project goals using less labor and equipment.

c. After Contract Completion (and after all claims have been resolved).

(1) Generally, the Government estimate back-up data may be released after the contract is completed. All sensitive information such as actual quotes and contractor reference shall be redacted from the data. Situations where the information should not be released include multiple-phased projects where a series of similar contracts are awarded in sequence and frequently recurring contracts (for example: dredging contracts). In those cases, each Government estimate is based upon the same or similar back-up data and the same or similar analysis of how to perform the work.

4. Bid Protests and Litigation. This guidance should be considered when the Corps is involved in bid protests or litigation. If appropriate and to the extent possible, Counsel should have the Government estimate and the Government estimate back-up data placed under a "protective order." There are valid reasons for not releasing the back-up data supporting the Government estimate to the contractors. In the case of a bid protest, there is a possibility that the contract could be re-advertised or converted to a negotiated procurement . Release of the back-up data would provide bidders with the detailed cost data that supports the Government estimate. If, however, the apparent low bidder protests the reasonableness of the Government estimate, the Command may provide the details of the Government estimate and Government estimate back-up data, to the protester only, upon receipt of complete details of the protester's estimate.

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Terms and Abbreviations

GLOSSARY

Term	Definition
Architect-Engineer (A-E)	Architectural/engineering firms that provide services such as planning, architecture, engineering, estimating, surveying, and other technical services related to planning, designing, and construction.
Agency Technical Review (ATR)	A mandatory effort to improve and ensure the quality and credibility of U.S. Army Corps of Engineers decision and implementation documents by employing an independent review from subject matter experts outside the home district.
Baseline Cost Estimate (BCE)	The cost estimate based on constant dollars is used for authorization/appropriation purposes. The congressionally authorized amount becomes the baseline cost estimate and may differ from the total project cost.
Budget Estimate	The budget estimate supports funding requests as well as comparisons made to current available funding. Comparisons to the available funding are also referred to as current working estimates (CWE).
Continuing Authorities Program (CAP)	Congress has given the U.S. Army Corps of Engineers the authority to plan, design, and construct certain flood risk management and navigation improvements without specific congressional authorization. The basic objective of this program is to allow the Corps to respond more quickly to problems or needs where the apparent project scope and costs are small. The amount of federal participation is limited by congress, and varies for each individual authority.
Cost Engineering Dredge Estimating Program (CEDEP)	A U.S. Army Corps of Engineers program that allows the user to estimate dredging projects using mechanical, pipeline, and hopper dredge plant.

Term	**Definition**
	The center is established to develop new cost database items that represent the current construction practices and technologies, to maintain and biennially update EP 1110-1-8, Construction Equipment Ownership and Operating Expense Schedule, and to semiannually update EM 1110-2-1304, Civil Works Construction Cost Index System (CWCCIS).
Civil Works Cost Engineering and Agency Technical Review Mandatory Center of Expertise (Cost MCX)	Walla Walla District's Cost Engineering Branch has been established as the Mandatory Center of Cost Engineering for Civil Works Review. The Cost MCX serves a critical role in all Civil Works and Support for Others Program cost support activities for the USACE cost community. The Cost MCX provides the cost community estimating services for the construction features on all projects from the planning phases through construction, maintenance, and rehabilitation of facilities. Walla Walla's diversified cost team strives to provide expert technical support for all customers, both Corps and other governmental agencies.
Constant Dollar Cost (Price Level)	Constant dollar analyses are utilized to determine an equivalent cost in the future or in the past by price indexing using CWCCIS data. Constant dollar cost is the estimated cost BROUGHT TO THE EFFECTIVE PRICE LEVEL. Constant dollar cost at current price levels is the cost estimate used in decision documents and chief's reports. The constant dollar cost does not include inflation to midpoint design and construction.
Cost and Schedule Risk Analysis (CSRA)	A risk analysis is the process of identifying and measuring the cost and time impacts of project uncertainties on the estimated TPC. The risk analysis results in two main products: Identified risks and contingency dollars to fund risk occurrence.
Civil Works Work Breakdown Structure (CW-WBS)	A hierarchical structure that defines tasks that can be completed independently of other tasks, facilitating resource allocation, assignment of responsibilities, and measurement and control of the project.
Civil Works Construction Cost Index System (CWCCIS)	Historical and forecasted cost indexes for use in escalating U.S. Army Corps of Engineers civil works project costs.

Term	**Definition**
Current Working Estimate (CWE)	An update comparison to the appropriated amount or BCE. Commonly referred to as total project cost, the update reflects the total project scope and estimated cost with current effective date pricing plus spent cost from authorization amount. The CWE reflects the associated project costs in quantities, estimates and supporting databases, duration, and risk at any point in time within the funded project's life.
DrChecks^{SM}	"Design Review and Checking System." Enables an actionable collaboration among the reviewers and design team of capital improvement projects.
District Quality Control (DQC)	All work products and reports, evaluations, and assessments shall undergo necessary and appropriate district quality control/quality assurance.
Economic Cost	Monetary equivalent cost used by the economist in determining the benefit-to-cost ratio (BCR). The economic cost includes all of the opportunity costs, both explicit (out of pocket to realize project benefits) and implicit (noncash), of using the resource and is expressed in average annual equivalent terms. It is also referred to as the constant dollar cost. The economic cost should not be confused with the financial cost and should be clearly and separately described in reports.
Effective Price Level (EPL)	Date of the point in time of the pricing used in the cost estimate.
Estimated Cost (Price Level)	Initially developed cost estimate which includes contingencies. The effective price level date for estimated cost is usually the date of preparation of the cost estimate.

Term	Definition
Financial Cost	Monetary outlay, both federal and non-federal, of constructing a project. It includes design and construction outlays, transfer payments such as replacement housing payments as specified in 42 United States Code 4623 and 4624, and the value of lands, easements, rights-of-way, relocations, and dredged or excavated material disposal areas (LERRD) and work in kind provided by non-federal sponsors. This cost is developed by cost engineering, in close coordination with the economist and other members of the PDT, and is typically presented in the TPCS.
Independent External Peer Review (IEPR)	Most independent level of review and is applied in cases that meet certain criteria where the risk and magnitude of the proposed project are such that a critical examination by a qualified team outside of USACE is warranted.
Independent Government Estimate (IGE)	Formal, approved cost estimate prepared to support a contract award, which is signed by the chief of cost engineering.
Independent technical review (ITR)	A review by a qualified person or team not involved in the day-to-day production of a project/product, for the purpose of confirming the proper application of clearly established criteria, regulations, laws, codes, principles and professional practices. Predecessor to agency technical review on civil works .
Microcomputer Aided Cost Estimating System (MCACES)	Mandatory U.S. Army Corps of Engineers estimating software.
MII	MCACES second generation
National Economic Development (NED)	In the civil works project planning context, NED analysis can be generally defined as economic benefit-cost analysis for plan formulation, evaluation, and selection that is used to evaluate the federal interest in pursuing a prospective project plan.

Term	Definition
Peer Review	The process of subjecting research, assumptions, analyses, and conclusions to the scrutiny of others who are experts in the same field. Peer review requires a community of experts in a given (and often narrowly defined) field, who are qualified and able to perform impartial review.
Project	Each project is a temporary endeavor undertaken to create a unique product, service, or result. Internal services are discrete projects when they are unique and non-recurring (ER 5-1-11).
Project Delivery Team (PDT)	An interdisciplinary group formed from the resources of the implementing agencies, which develops the products necessary to deliver the project.
Project Manager (PM)	Responsible for the planning, execution, and closing of any project, typically relating to construction.
Project Management Plan (PMP)	A formal, approved document used to guide both project execution and project control.
Project First Cost (Price Level)	The cost estimate that will serve as the basis for providing the cost of the project for which authorization is sought. The cost estimate to be used in chief's reports and other decision documents is estimated cost represented at the current price level. The current price level is the current FY based on the submittal date.
Risk management plan (RMP)	A document that a project manager prepares to foresee risks, estimate impacts, and define responses to issues.
Simplified acquisition threshold (SAT)	As defined in FAR 2.101
Total Cost Management	The effective application of professional and technical expertise to plan and control resources, costs, schedules, and risk. A systematic approach to managing cost throughout the life cycle of any project, product, or service.

Term	Definition
Total Project Cost	The constant dollar cost FULLY FUNDED WITH ESCALATION to the estimated midpoint of construction. Total project cost (or total cost of construction of GNFs when discussing navigation projects) is the cost estimate used in project partnership agreements and integral determination reports. Total project cost is the cost estimate provided non-federal sponsors for their use in financial planning as it provides information regarding the overall non-federal cost sharing obligation.
Total Project Cost Summary (TPCS)	The required cost estimate document to be submitted with all projects sent for either division or HQUSACE approval. Since it addresses all project features, it is considered a PDT product. Both the PM and chief of the cost engineering office must review, approve, sign, and date all TPCS documents. Real estate estimates included in the TPCS must be reviewed, approved, and the TPCS signed by the chief, or their designee, of the real estate office.

ATTACHMENT 9

NOT MEASUREMENT SENSITIVE

DOE G 413.3-21
5-9-2011

Cost Estimating Guide

[*This Guide describes suggested non-mandatory approaches for meeting requirements. Guides are not requirements documents and are not to be construed as requirements in any audit or appraisal for compliance with the parent Policy, Order, Notice, or Manual.*]

U.S. Department of Energy
Washington, D.C. 20585

AVAILABLE ONLINE AT:
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Office of Management

FOREWORD

This Department of Energy (DOE) Guide may be used by all DOE elements. This Guide provides uniform guidance and best practices that describe the methods and procedures that could be used in all programs and projects at DOE for preparing cost estimates. This guidance applies to all phases of the Department's acquisition of capital asset life-cycle management activities. Life-cycle costs (LCCs) are the sum total of the direct, indirect, recurring, nonrecurring, and other costs incurred or estimated to be incurred in the design, development, production, operation, maintenance, support, and final disposition of a system over its anticipated useful life span. This includes costs from pre-operations through operations to the end of the project/program life-cycle, or to the end of the alternative. DOE programs may use alternate methodologies or tailored approaches more suitable to their types of projects and technologies.

DOE Guides are not requirement documents and should not be construed as requirements. Guides are part of the DOE Directives Program and provide suggested ways of implementing Orders, Manuals, and other regulatory documents.

TABLE OF CONTENTS

1.0 PURPOSE

The purpose of the DOE *Cost Estimating Guide* is to provide uniform guidance and best practices that describe the methods and procedures recommended for use at DOE in preparing cost estimates that is specific to all work including but not limited to construction projects and/or programs. This guidance is applicable to all phases of the Department's acquisition of capital asset management activities. Practices relative to estimating life-cycle cost (LCC) are described. LCCs include all the anticipated costs associated with a project or program alternative throughout its life; i.e., from authorization through operations to the end of the facility/system life cycle (see Figure 3-3 in Section 3.2).

This Guide does not impose new requirements or constitute DOE policy, nor is this Guide intended to instruct Federal employees in *how* to prepare cost estimates (see Appendix C, Summary of Federal Requirements, and Appendix D, Summary of DOE Requirements). Rather, it may be used to provide information based on accepted standard industry estimating best practices and processes—including practices promulgated by the GAO Cost Estimating and Assessment Guide (GAO-09-3SP)—to meet Federal and DOE requirements and facilitate the development of local or site-specific cost estimating requirements. The GAO has specifically recommended that DOE cost estimating guidance be provided following the GAO Twelve Steps of a High-Quality Cost Estimating Process to improve the quality of its cost estimates (see GAO-10-199, Table 1, page 10).

2.0 GUIDANCE OVERVIEW

High quality cost estimates provide an essential element for *successful project and program management*. The main objective of the Guide is to provide guidance that should improve the quality of cost estimates supporting execution of projects and programs. The cost estimating principles and processes provided herein may be used to meet or adhere to Federal and DOE requirements while utilizing industry standards and best practices.

High-quality estimates should satisfy four characteristics as established by industry best practices—they should be credible, well-documented, accurate and comprehensive.[1] An estimate should be

- <u>credible</u> when the assumptions and estimates are realistic. It has been cross-checked and reconciled with independent cost estimates, the level of confidence associated with the point estimate has been identified,[2] and a sensitivity analysis (i.e., an examination of the

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1 *GAO Cost Estimating and Assessment Gui*de, GAO-09-3SP (Washington, D.C., March 2009)

2 A point estimate is the best guess or most likely value for the cost estimate, given the underlying data. The level of confidence for the point estimate is the probability that the point estimate will actually be met.

effect of changing one variable relative to the cost estimate while all other variables are held constant in order to identify which variable most affects the cost estimate) has been conducted;

- well-documented when supporting documentation includes a narrative explaining the process, sources, and methods used to create the estimate and identifies the underlying data and assumptions used to develop the estimate;
- accurate when actual costs deviate little from the assessment of costs likely to be incurred; and
- comprehensive when it accounts for all possible costs associated with a project, is structured in sufficient detail to insure that costs are neither omitted nor duplicated, and has been formulated by an estimating team with composition commensurate with the assignment.

From the GAO Cost Estimating and Assessment Guide, there are 12 key steps that are essential to producing high quality cost estimates:[3]

1. Define the estimate's purpose
2. Develop an estimating plan
3. Define the Project (or Program) characteristics
4. Determine the estimating structure [e.g., Work Breakdown Structure (WBS)]
5. Identify ground rules and assumptions
6. Obtain data
7. Develop a point estimate and compare to an independent cost estimate
8. Conduct sensitivity analysis
9. Conduct risk and uncertainty analysis
10. Document the estimate
11. Present the estimate for management approval
12. Update the estimate to reflect actual costs and changes

This guide contains industry best practices for carrying out these steps. Appendix L comprises a suggested crosswalk of the 12 key GAO estimating steps and their implementing tasks to the sections of this Guide wherein guidance for accomplishing those steps within the DOE project environment is addressed and discussed.

DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets,* dated 11-29-10, promotes the development of a well-defined and managed project performance baseline (defined by scope, schedule, cost and key performance parameters). The guidance provided in this document highlights the importance of three closely interrelated processes to

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[3] GAO-09-3SP

help define the project baseline: development of a Work Breakdown Structure (WBS) for scope definition, cost estimating, and schedule development.

- **The Work Breakdown Structure process provides:**
    - A complete decomposition of the project into the discreet products and activities needed to accomplish the desired project scope (the WBS dictionary should contain in a narrative format what each activity includes);
    - Compatibility with how the work will be done and how costs and schedules will be managed;
    - The visibility to all important project elements, especially those areas of higher risk, or which warrant additional attention during execution;
    - The mapping of requirements, plans, testing, and deliverables;
    - A clear ownership by managers and task leaders;
    - Organization of data for performance measurement and historical databases; and
    - Information that is the basic building block for the planning of all authorized work.
- **The Cost Estimate process provides:**
    - Documented assumptions and basis of estimate that provide further project definition;
    - The activity quantities that make up the scope of work;
    - The cost element data (labor and non-labor) needed to complete the products/deliverables;
    - The estimated resource hours and non-labor values that make up the work;
    - The component elements (labor, materials, equipment, etc.) required to complete activities and work packages; and
    - Additional WBS elements mined during the detailed take-off.
- **The Schedule process provides:**
    - The activity durations based on the "crew" production rates per quantity and other work influences, i.e. hold points, space restrictions, cure time, etc.;
    - Logical relationships of all schedule activities;
    - Critical path that represents the longest duration for the project and the sequence of work with the least margin for deviation or flexibility;
    - The time phasing of activities that identify new activities or costs, i.e. winter work, escalation needs, etc.; and
    - The milestones and activity relationships that define possible impacts, i.e. overtime needed to complete activities.

2.1 Purpose of the Cost Estimate

The purpose of a cost estimate is determined by its intended use (e.g., studies, budgeting, proposals, etc.), and its intended use determines its scope and detail. Cost estimates should have general purposes such as:

- Help the DOE and its managers evaluate and select alternative solutions;

- Support the budget process by providing estimates of the annual funding and phased budget requirements required to efficiently execute work for a project or program;
- Establish cost and schedule ranges during the project development phases;
- Establish a Project Performance Baseline to obtain Critical Decision-2 (CD-2) approval and to measure progress following the CD-2 approval (see Figures 3-1 and 3-2 for a pictorial description of the DOE Critical Decision Process);
- Support Acquisition Executive approval for acquisition of supplies, services, and contracts; and
- Provide data for value engineering studies, independent reviews, and baseline changes.

2.2 Overview of the Cost Estimating Process Model

Traditionally, cost estimates are produced by gathering input, developing the cost estimate and its documentation, and generating necessary output. Figure 2-1 depicts the cost estimating process model, which should be similar for cost estimates at various points within the project life cycle. The scope of work, schedule, risk management plan, and peer review interact to influence the cost estimating process and techniques used to develop the output. These process interactions—inputs, processes (tools and techniques), and outputs—are used by the Project Management Institute and others to depict the transfer of information between steps in a knowledge area such as cost estimating.

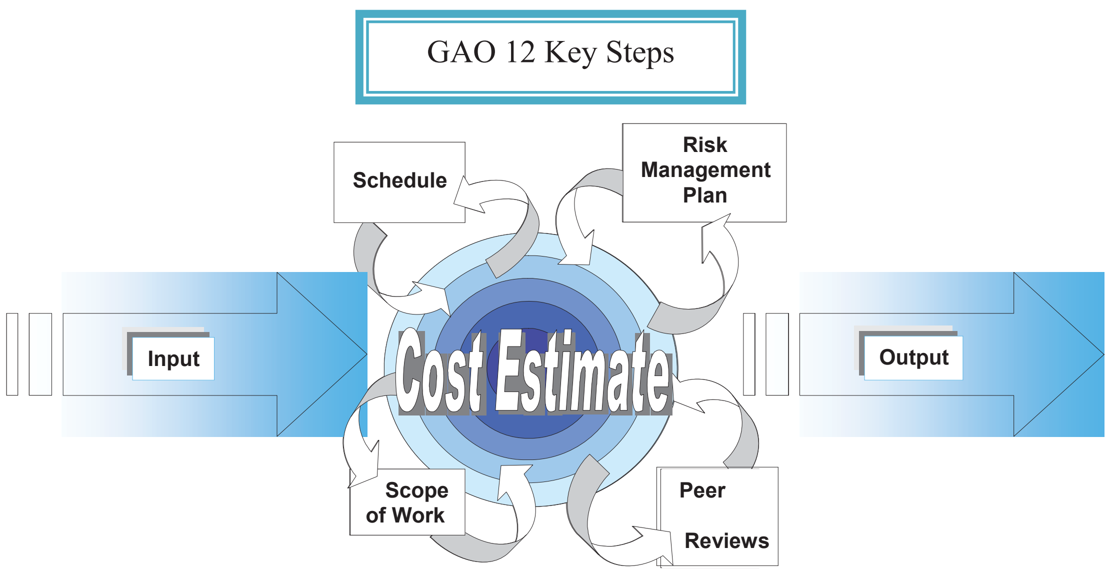

Figure 2–1. The Cost Estimating Process Model

3.0 COST ESTIMATING INPUTS

Cost estimate development is initiated by *inputs* to the process. These inputs are process elements that can be either one-time or iterative in nature as illustrated in the above process model. One-time inputs may include project/program requirements, the mission need statement, and the acquisition strategy or acquisition plan. Iterative inputs may include the technical/scope development, the schedule development, and the risk management plan with associated risk identification and mitigation strategies. The peer review results in the process may also identify the need to revisit various process elements to improve the quality of the cost estimate. Cost estimates that are developed early in a project's life may not be derived from detailed engineering designs and specifications (may not be a point estimate but a high/low range project estimate), but they should be sufficiently developed to support budget requests for the remainder of the project definition phase. Over the life of the project, cost estimates become increasingly more definitive, and reflect the scope and schedule of work packages and planning packages defined for the project.

3.1 Project/Program Requirements

Appendixes C and D provide summaries of the Federal and DOE requirements for cost estimates, respectively. Each DOE program or project may have more specific, detailed requirements. Examples include the National Environmental Policy Act (NEPA); safety and health; site security requirement; and local requirements that may be specified in contracts, labor agreements, etc. Many of these requirements are implemented through the DOE annual budget formulation and execution process, and may add cost to projects. The primary requirement for developing cost estimates for capital asset projects is DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets,* dated 11-29-10. During the life cycle of a project (see Figures 3-1 and 3-2), various cost estimates and related documents are required to support the Critical Decision process, the project reviews process, and the annual budget formulation and execution process.

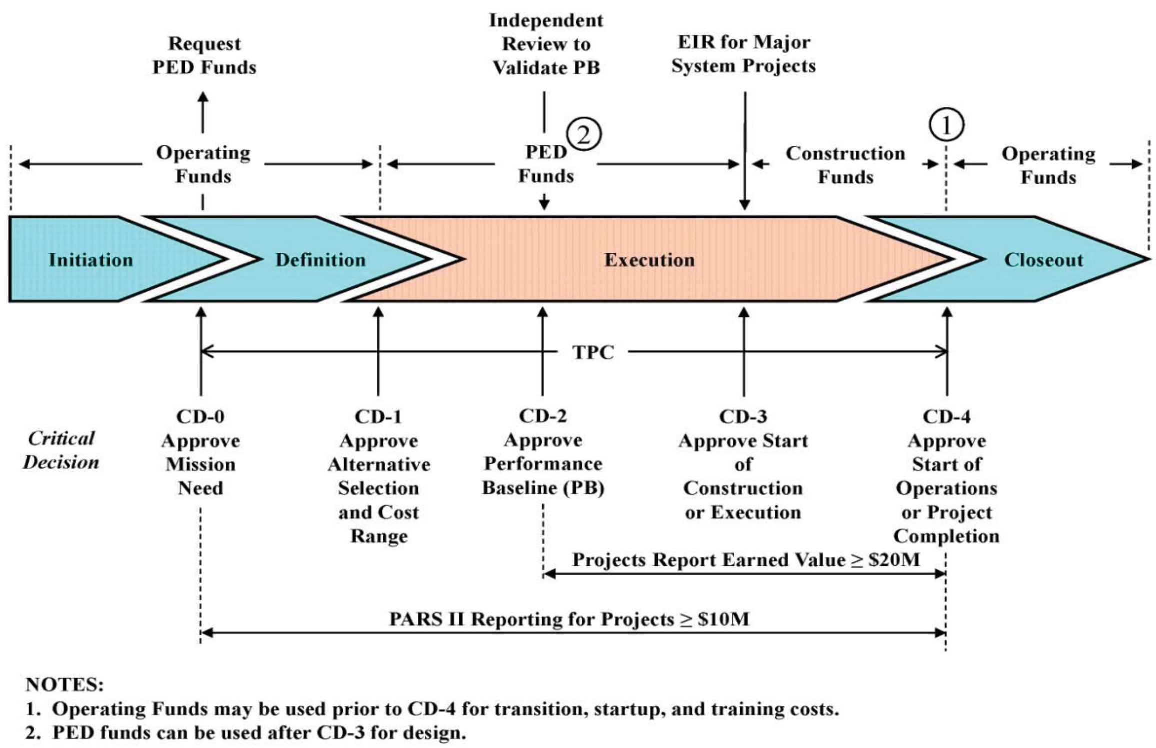

Figure 3-1. Typical DOE Acquisition Management System for Line Item Capital Asset Projects[4]

CD = Critical Decision
EIR = External Independent Review
PARS = Project Assessment and Reporting System
PB = Performance Baseline
PED = Project Engineering and Design
TPC = Total Project Cost

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4 DOE O 413.3B

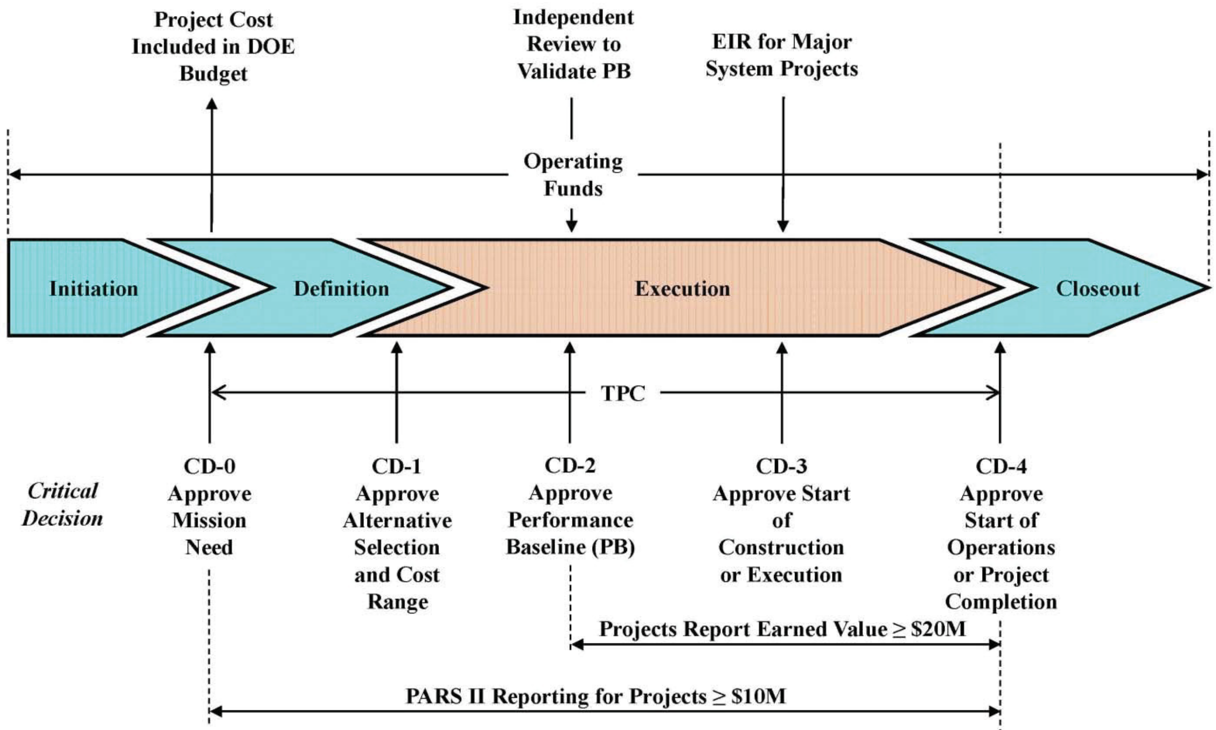

Figure 3-2. Typical DOE Acquisition Management System for Other Capital Asset Projects (i.e., Major Items of Equipment and Operating Expense Projects)[5]

3.2 Documentation Requirements

Common cost estimating outputs are shown in Figure 3-3. As this figure depicts, cost estimates must be developed, updated, and managed over the total life-cycle of any asset and are an important element for total life-cycle asset management within the DOE. Furthermore, project cost estimates are an integral element and key input into the management of programs over their life-cycle. Thus the concepts for cost estimate development described in this Guide should be applied to all instances when cost estimates are required to support both project and program management objectives.

As described by the DOE O 413.3B and other DOE directives, cost estimates and LCC analyses may be produced for a variety of purposes. As discussed below, these may include:

- The critical decision process within programs/projects (DOE O 430.1B Chg 1, *Real Property Asset Management,* and DOE O 413.3B).

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[5] DOE O 413.3B

- The DOE annual budget guidance document.
- Contract actions specifying requirements.
- Other project/program management purposes (various Federal regulations, DOE Orders, and industry practices).

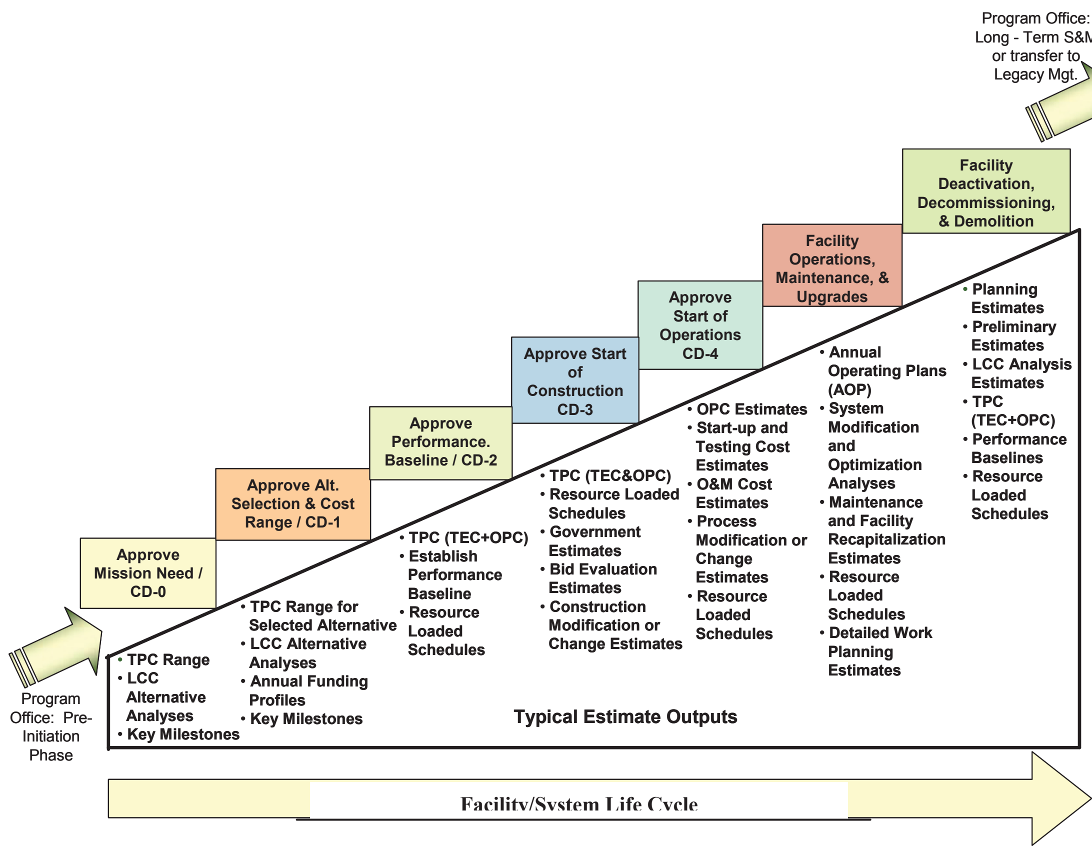

Figure 3-3. Facility/System Estimate Outputs as Compared to Life-Cycle Major Milestones

3.2.1 DOE Critical Decisions for Project Management and the Supporting Cost Estimates

- **Critical Decision (CD)-0, Approve Mission Need** — Generally, a cost estimate range is prepared to support CD-0. Assumptions developed by the project team generally will drive the project scope and bound both the project scope and costs. There will likely be very little detail to support these cost estimates, so it is important that scope assumptions be well-documented. A project cost magnitude range should be established based on potential project alternatives and major areas of risk, with appropriate consideration of the accuracy range of any supporting estimates or analyses. The proposed range should be sufficiently broad such that it fully bounds all possible project cost outcomes, understanding the very limited design basis that exists at the time and the more imprecise methodologies used at this stage of the project. This estimate assists in establishing the Acquisition Authority Level for CD-0. In addition, an estimate of the costs to be incurred prior to CD-1 which is for developing the Conceptual Design for the project, could also be required to support resource planning and near-term schedules.

- **CD-1, Approve Alternative Selection and Cost Range**—There are three cost estimates needed for CD-1.
  1. Prior to the approval of CD-1, the project team should develop a definitive estimate of the near term preliminary design cost, which is needed for the project engineering and design (PED) funding request (if needed for project execution). An estimate may also be used to support PED funding for use in preliminary design, final design and baseline development.
  2. As part of the CD-1 requirement, the project team should perform analyses of the most likely project alternatives. Thus, the second cost estimate needed at CD-1 is the LCC of the likely alternatives that are being considered. A risk adjusted LCC estimate should be prepared for each alternative under consideration to ensure the alternative with the best cost/benefit ratio (and generally the lowest life-cycle cost) to the government is considered. Full LCCs, including all direct and indirect costs for planning, procurement, operations and maintenance (operational analysis should be used to evaluate condition and any negative trends on cost projections for assets in use), and disposal costs must be considered for each alternative being evaluated (OMB A-11).
  3. After selecting the alternative that best meets the mission, the project team develops the third estimate, the total project cost (TPC) range, a schedule range with key milestones and events, and annual funding profiles. The TPC range should consider identified project risks and estimate uncertainty and encompass the full range of potentially required resources necessary to successfully execute the planned work associated with the preferred/recommended alternative. The TPC range also assists in establishing the Critical Decision Authority Thresholds.

- **CD-2, Approve Performance Baseline**—Cost estimates supporting CD-2 should utilize more definitive cost estimating techniques (see Section 5.0). For CD-2, since available information will be more developed, the range should be collapsed to a point estimate. A single cost estimate will represent the entire project, utilizing the current scope and associated design parameters. The estimate will include appropriate allowances for risk and estimate uncertainty, i.e., Management Reserve and Contingency (see Section 6.4.5). This estimate is the basis for the cost estimate of the project's Performance Baseline and the Performance Measurement Baseline used for earned value reporting as required for projects with a TPC greater than $20 million.[6]

- **CD-3, Approve Start of Construction**–Cost estimates based on the Final Design may incorporate some actual bids received from contractors used to establish the project's requirements for construction or execution. Cost estimates for Other Project Costs and Operational phases of the asset being acquired are finalized. These updated estimates

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[6] DOE O 413.3B

support authorization to commit resources necessary, within funds provided, to execute the project.

- **CD-4, Approve Start of Operations or Project Completion**—Establishes when the project is ready for turnover or transition to operations, if applicable. Determines the final Estimate at Completion (EAC) and provides final project cost and performance reports developed in accordance with the project's approved WBS. Cost and performance reports are necessary to document the TPC for the asset acquired, as well as assisting in the capture of historical cost information.

3.2.2 Annual Budget Process

Project or program budgets are sometimes adjusted to accommodate appropriations and allocations that are more or less than expected. Some situations may require development of alternative budget scenarios that can mitigate the risk of project funding uncertainty. When actual funding differs from planned budgets, baselines and estimates for current-period work (work packages) should be adjusted accordingly. Timing changes of actual funding versus planned budgets may not change the technical scope for which an estimate has been developed. However, those timing changes (extending work into the future from planned schedules) can cause changes to programmatic scope, project duration, and efficiencies, which affect overall project costs (such changes are subject to change control – scope, schedule and cost).

3.2.3 Contract Actions

During the normal course of project execution, contract actions occur. These commonly entail developing a government cost estimate, a proposed estimate, and a final estimate. Depending on contract types and other factors, varying levels of information will be available to facilitate the cost estimating process.

Before determining the content of an estimate, it is relevant to understand the contract types that will be used to execute the work. Types of contracts include firm-fixed price, fixed-price incentive, and cost reimbursable with a variety of fee structures, including fixed fee, award fee, and performance-incentive fee. Understanding the contract that will be used can influence the assumed government risks, contractor risks, productivity, and overhead and profit rates used in the estimate. The contract type should be defined in the Acquisition Strategy/Plan.

Independent Government Cost Estimates (IGCEs) are required before most acquisitions and may become either the basis for contract negotiations or settling claims. The purpose of the IGCE is to establish a basis for reserving funds for a contract during acquisition planning, comparing costs or prices subject proposed by offerors, and providing an objective basis for assisting in determining price reasonableness, and to assist in establishing the Government's negotiation position and strategy.

NOTE

Performance-based contracting could be a preferred contracting method that would require discrete, quantifiable, and measurable objectives tied to an incentive for which the development of discrete quantifiable estimates tied to the measurable objectives would be required. A project baseline (established at CD-2) and near-term contracts, or work packages, should also have characteristics that are discrete, quantifiable, and measurable.

Fee is normally associated with reimbursable cost contracts and is determined on the basis of pre-established performance objectives (e.g., meeting target dates, achieving target unit costs, etc.) Once the contract is in place, it will stipulate the fee structure and must be considered when developing or updating the cost estimate.

Profit is normally associated with a fixed-price contract and is unknown until all costs have been incurred. Cost estimates developed for this type of contract should assume a reasonable amount of profit based on market conditions and risks involved.

DEARS 915.404-4 provide guidance for estimating profit/fees for DOE contracts. Under DEARS 915.404-4-70 it is notable that construction and construction management contracts are subject to fee/profit limits which can only be exceeded after review and approval by the Senior Procurement Executive – important consideration when estimating the full contract price.

3.2.4 Other Project/Program Management Actions

Various other project or program management actions, such as development of LCC analyses, cost-benefit analyses, value engineering (VE) studies, earned value analyses, and change requests may require development of cost estimates.

LCC estimates may be required for many purposes. As a part of alternative selection, LCC analysis may point to the alternative with the lowest LCC but other analyses and considerations may need to be considered in the decision process. In cases where benefits can be quantified, LCC analyses can support more formal cost-benefit analysis for alternative evaluation and selection. Any time a change in the project is contemplated, or an alternative must be evaluated, LCC analysis should be considered. (Appendix G presents a simplified example of a LCC analysis)

Cost estimates are also required to support day-to-day project management decisions. In many cases, alternatives (e.g., changes in the work flow) are considered that do not affect the entire project, but do affect the day-to-day details of managing a project. A design detail change that does not exceed a cost or schedule threshold for management approval is an example.

Comparisons of government estimates to other results (e.g., bid opening prices) may require a reconciliation of the figures. Generally, the differences are due to the estimates not being based on consistent, current information, such as weather delay assumptions, productivity assumptions, market conditions for commodities, etc. The reconciliation should clearly state the differences and the rationale for the differences.

4.0 COST ESTIMATING CHARACTERISTICS AND CLASSIFICATIONS

4.1 Planning the Cost Estimates

Table 4-1 describes the elements of planning required to produce credible cost estimates.[7] In a 2006 survey to identify the characteristics of a good estimate, participants from a wide variety of industries– including aerospace, automotive, energy, consulting firms, the Navy, and the Marine Corps–concurred that the characteristics listed in the table are valid (GAO-09-3SP, Chapter 1, page 7). The Government Accountability Office (GAO) also found that despite the fact that these characteristics have been published and known for decades, many agencies still lack the ability to develop cost estimates that can satisfy these basic characteristics.

Planning Step	Description
Clear Identification of Task	Estimator must be provided with the scope description, ground rules and assumptions, and technical and performance characteristics.
	The estimate's constraints and conditions must be clearly identified to ensure the preparation of a well-documented estimate.
Broad Participation in Preparing Estimates	The Integrated Project Team and the Integrated Acquisition Team should be involved in determining requirements based on the mission need and in defining parameters and other scope characteristics.
	Data should be independently verified for accuracy, completeness, and reliability.
Availability of Valid Data	Use numerous sources of suitable, relevant, and available data.
	Use relevant, historical data from similar work to project costs of the new work. The historical data should be directly related to the scope's performance characteristics.
Standardized Structure for the Estimate	Use of a standard WBS that is as detailed as possible, continually refining it as the maturity of the scope develops and the work becomes more defined. The WBS elements should ultimately drill down to the lowest level, the work package.
	The WBS ensures that no portions of the estimate (and schedule) are omitted or duplicated. This makes it easier to make comparisons to similar work.
Provision for	Identify the confidence level (e.g., 80 percent) needed to establish a successful planning process. Identify uncertainties and develop an allowance to mitigate cost

[7] GAO-09-3SP

Planning Step	Description
Uncertainties and Risk	effects of the uncertainties.
	Include known costs and allow for historically likely but specifically unknown costs. (Reference: DOE G 413.3-7A, *Risk Management Guide*)
Recognition of Escalation	Ensure that economic escalation is properly and realistically reflected in the cost estimate. Escalation is schedule driven, and scheduling assumptions need to be clearly noted. NOTE: Project teams may use specific rates relative to the site when available. In any case, the source of escalation information used should be identified and the applicability of the rates should be explained/justified.
Recognition of Excluded Costs	Include all costs associated with the scope of work; if any cost has been excluded, disclose and include a rationale.
Independent Review of Estimates	Conducting an independent review of an estimate is crucial to establishing confidence in the estimate. The independent reviewer should verify, modify, and correct an estimate to ensure realism, completeness, and consistency.
Revision of Estimates for Significant Changes	Update estimates to reflect changes in the design requirements. Large changes that affect costs can significantly influence decisions.

Table 4-1. Basic Characteristics of Credible Cost Estimates

4.2 Cost Estimate Classifications

Most cost estimates have common characteristics, regardless of whether the technical scope is traditional (capital funded, construction, equipment purchases, etc.) or nontraditional (expense funded, research and development, operations, etc.). The most common characteristics are levels of definition, requirements (end usage/purpose), and techniques used. These characteristic levels are generally grouped into cost estimate classifications. Cost estimate classifications may be used with any type of traditional or nontraditional project or work and may include consideration of (1) where a project stands in its life cycle, (2) level of definition (amount of information available), (3) techniques to be used in estimation (e.g., parametric vs. definitive), and/or (4) time constraints and other estimating variables.

Typically, as a project evolves, it becomes more definitive. Cost estimates depicting evolving projects or work also become more definitive over time. Determination of cost estimate classifications helps ensure that the cost estimate quality is appropriately considered. Classifications may also help determine the appropriate application of contingency, escalation, use of direct/indirect costs (as determined by cost estimate techniques), etc.

Widely accepted cost estimate classifications are found in the Association for Advancement of Cost Engineering International (AACEI), Recommended Practice (RP) No. 17R-97 and RP No. 18R-97; see Appendix H). Appendix H includes a complete description of AACEI's classifications. The five suggested cost estimate classifications are listed in Table 4-2 along with their primary characteristics. Table 4-3 lists the secondary characteristic and the estimate uncertainty range, as a function of the estimate class; that could be *u*sed for contingency evaluations (estimate uncertainty contributes to both cost and schedule contingency) as part of the risk analysis for the project.[8] DOE's cost estimate classifications generally follow these recommended practices, although historically the more common cost estimate classifications are order of magnitude, preliminary, and definitive, which approximately equate to the AACEI's Classes 5, 3 and 1, respectively. Table 4.4 provides an example of the typical suggested types of cost estimates for each DOE Critical Decision as compared with the AACEI classification. Figure 4.1 provides an example of the variability in uncertainty ranges for a process industry estimate versus the level of project/scope definition. (Reference: AACEI RP No. 18R-97)

A project cost estimate may comprise separate estimates of differing classifications. Certain portions of the design or work scope may be well defined, and therefore warrant more detailed cost estimating techniques and approaches, while other areas are relatively immature and therefore appropriately estimated using parametric or other less definitive techniques.

Cost Estimate Classification	Primary Characteristics	
	Level of Definition (% of Complete Definition)	Cost Estimating Description (Techniques)
Class 5, Concept Screening	0% to 2%	Stochastic, most parametric, judgment (parametric, specific analogy, expert opinion, trend analysis)
Class 4, Study or Feasibility	1% to 15%	Various, more parametric (parametric, specific analogy, expert opinion, trend analysis)
Class 3, Preliminary, Budget Authorization	10% to 40%	Various, including combinations (detailed, unit-cost, or activity-based; parametric; specific analogy; expert opinion; trend analysis)
Class 2, Control or Bid/Tender	30% to 70%	Various, more definitive (detailed, unit-cost, or activity-based; expert opinion; learning curve)
Class 1, Check Estimate or Bid/Tender	50% to 100%	Deterministic, most definitive (detailed, unit-cost, or activity-based; expert opinion; learning curve)

Table 4-2. Generic Cost Estimate Classifications and Primary Characteristics

[8] **DOE G 413.3-7A,** *Risk Management Guide,* dated January 2011.

	Primary Characteristic	*Secondary Characteristic*		
ESTIMATE CLASS	**DEGREE OF PROJECT DEFINITION** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low and high ranges [a]
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 70%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	70% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Notes: [a] The state of process technology and availability of applicable reference cost data affect the range markedly. The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for given scope.

Table 4.3 – Cost Estimate Classification for Process Industries

Critical Decision	Suggested Estimate	AACEI Estimate Classification
CD-0	Cost estimate range	Class 5
	Estimate of costs to be incurred prior to CD-1	Class 3
CD-1	Estimate of near term preliminary design cost	Class 3
	LCC of likely alternatives that are being considered	Class 5
	TPC range	Class 4
CD-2	Single point estimate representing entire project:	
	Low risk projects	Class 3
	High risk projects	Class 2
CD-3	Cost estimate based on Final Design [or sufficiently mature to start construction]:	
	Low risk and final design complete	Class 1
	Low risk and final design not complete	Class 2
	High risk (final design or not)	Class 2
CD-4		N/A

Table 4.4 – Generic Suggested Types of Estimates for DOE Critical Decisions

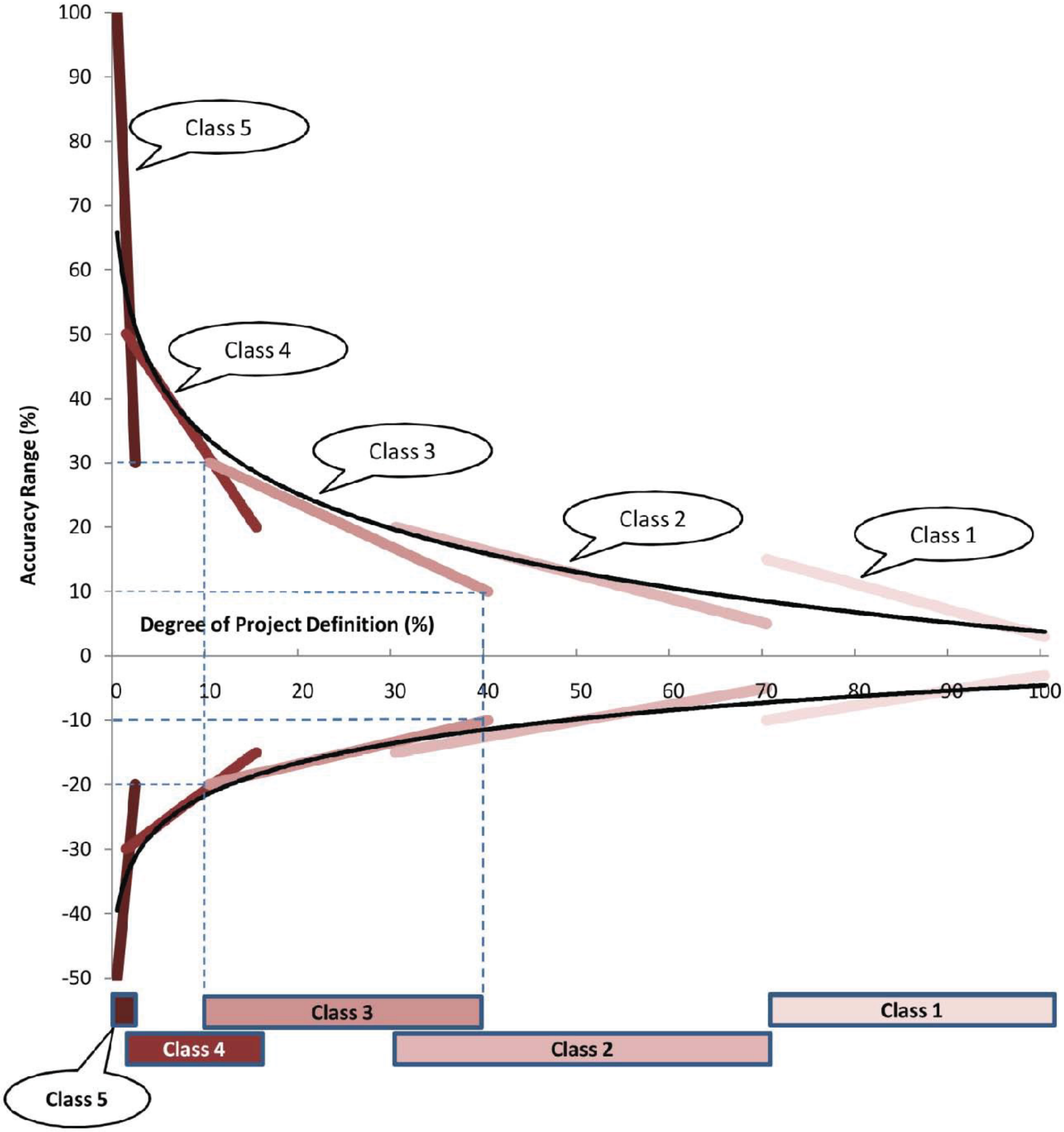

Figure 4.1 – Example of the Variability in Accuracy/Uncertainty Ranges for a Process Industry Estimate

As a general rule, particularly for projects that are in the early stages of development, a combination of estimate classifications must be used to develop the entire estimate. In these situations, estimators should use a combination of detailed unit cost estimating (Class 1) techniques for work that will be executed in the near future, preliminary estimating (Class 3) techniques for work that is currently in the planning stages but less defined, and order of magnitude estimating (Class 5) techniques for future work that has not been well defined. As a project progresses through the Acquisition Management System (initiation, definition, execution, and transition/closeout phases) and the project development and planning matures, the life-cycle cost estimate becomes more definitive. This may be referred to as **"rolling-wave"** planning, where detailed planning of future work is done in increments, or waves as the project progresses through phases.

4.3 Cost Estimate Ranges

The Department's Acquisition Management System includes Critical Decisions (CDs) that define exit points from one phase of project development and entry into the succeeding project phase. Prior to CD-2 approval, DOE O 413.3B requires the use of ranges to express project cost estimates. These ranges should depict TPCs in the early stage, even at CD-0. Ranges may be determined or based upon various project alternatives, project identified risks, and confidence levels.

LCC estimates that are developed early in a project's life may not be derived from detailed engineering, but must be sufficiently developed to support budget requests for the remainder of the project definition phase. In addition, ranges should include all anticipated resources, using appropriate estimating techniques that are necessary to acquire or meet the identified capability.

During the project definition phase, at the conclusion of the concept exploration process, the alternative selected as the best solution to a mission need is presented for approval. The solution presented includes the TPC range, a schedule range with key milestones and events, and annual funding profiles that are risk-adjusted and define all required resources necessary to successfully execute the planned work.

The estimate range (lower and upper bounds) as defined in DOE G 413.3-13, *U.S. Department of Energy*, *Acquisition Strategy Guide for Capital Asset Projects*, dated 7-22-08, is determined by independently assessing the lower and upper cost estimate range for each of the major WBS elements. In some situations, the range may in part be a function of scope variability; e.g., if a decision to add five or 10 glove-boxes is pending. The range can also be established by the project team considering the cost and schedule estimate uncertainties as part of the risk analysis. A risk analysis is analytical in nature and, although simulation tools aid the analyst in assessing impact and consequences, no simulation tool can substitute for a thorough logical deterministic process. The risks are identified by the likelihood of occurrence and the probable impact.

The lower bound of the cost range may represent a scenario where the project team has determined a low likelihood of occurrence and low impact of the identified risks, and a higher likelihood of opportunities occurrence. The risks may be accepted; therefore it is not necessary to include resources to mitigate them.

The upper bound of the cost range may represent a scenario where the project team has determined a low likelihood of occurrence, but the impact is significant of the identified impact risks. The risks will be managed and appropriate resources identified to mitigate each risk.[9]

5.0 COST ESTIMATING METHODS

Many cost estimating methods/techniques are available to facilitate the cost estimating process. Depending on project scope, estimate purpose, project maturity, and availability of cost estimating resources, the estimator may use one, or a combination, of these techniques. As shown in Table 4.3, as the level of project definition increases, the estimating methodology tends to progress from conceptual (stochastic/parametric) techniques to deterministic/definitive techniques. The following sub-sections include techniques that may be employed in developing cost estimates.

5.1 Detailed Estimating Method

Activity-based, detailed or unit cost estimates are typically the most definitive of the estimating techniques and use information down to the lowest level of detail available. They are also the most commonly understood and utilized estimating techniques.

The accuracy of activity-based detailed or unit cost techniques depends on the accuracy of available information, resources spent to develop the cost estimate and the validity of the bases of the estimate. A work statement and set of drawings or specifications may be used to identify activities that make up the project. Nontraditional estimates may use the WBS, team input and the work statement to identify the activities that make up the work.

Each activity is further decomposed into detailed items so that labor hours, material costs, equipment costs, and subcontract costs are itemized and quantified. Good estimating practice is to use a verb as the first word in an activity description. Use of verbs provides a definitive description and clear communication of the work that is to be accomplished. Subtotaled, the detailed items comprise the direct costs. Indirect costs, overhead costs, contingencies and escalation are then added as necessary. The estimate may be revised as known details are refined. The activity-based detailed or unit cost estimating techniques are used mostly for Class 1 and Class 2 estimates, and they should always be used for proposal or execution estimates.

Activity-based detailed cost estimates imply that activities, tasks, work packages, or planning packages are well-defined, quantifiable, and are to be monitored, so that performance can be reported accurately. Quantities should be objective, discrete, and measurable. These quantities provide the basis for an earned value measurement of the work within the activities and the WBS.

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9 A more thorough discussion on the risk management process can be found in **DOE G 413.3-7A,** *Risk Management Guide,* January 2011.

Advantages in using activity-based detailed or unit cost estimating methods include:

- a greater level of confidence
- more detail that can be used for better monitoring, change control, etc.
- enhanced scope and individual activity definition
- detailed quantities to establish more accurate metrics
- better resource basis for the schedule

Disadvantages include:
- more time needed to develop the estimate
- more costly to develop than relationship estimating

5.2 Parametric Estimating Techniques

A parametric model is a useful tool for preparing early conceptual estimates when there is little technical data or engineering deliverables to provide a basis for using more detailed estimating methods.[10] A parametric estimate comprises cost estimating relationships and other cost estimating functions that provide logical and repeatable relationships between independent variables, such as design parameters or physical characteristics and cost, the dependent variable. Capacity factor and equipment factor are simple examples of parametric estimates; however, sophisticated parametric models typically involve several independent variables or cost drivers. Parametric estimating is reliant on the collection and analysis of previous project cost data in order to develop the cost estimating relationships.

5.2.1 Cost Estimating Relationships

Cost estimating relationships (CERs), also known as cost models, composites, or assemblies/subassemblies, are developed from historical data for similar systems or subsystems. A CER is used to estimate a particular cost or price by using an established relationship with an independent variable. For example, a CER of design hours per drawing may be applied to the estimated number of drawings to determine total design hours. Identifying an independent variable (driver) that demonstrates a measurable relationship with contract cost or price develops a CER. That CER may be mathematically simple in nature (e.g., a simple ratio), or it may involve a complex equation.

Parametric estimates are commonly used in conceptual and check estimates. A limitation to the use of CERs is that to be most effective, one must understand completely how the CER was developed and where and how indirect costs, overhead costs, contingency, and escalation are applicable. The parametric estimating technique is most appropriate for Class 5, 4, and 3 cost

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[10] It is recommended that when using these cost estimating models that they should be verified and validated by recognized standard industry practices such as the Tri Services Parametric Cost Model Standard .

estimates. The parametric technique is best used when the design basis has evolved little, but the overall parameters have been established.

There are several advantages to parametric cost estimating. Among them are:

- **Versatility**—If the data are available, parametric relationships can be derived at any level (system, subsystem component, etc.). As the design changes, CERs can be quickly modified and used to answer "what-if" questions about design alternatives.
- **Sensitivity**—Simply varying input parameters and recording the resulting changes in cost will produce a sensitivity analysis
- **Statistical output**—Parametric relationships derived through statistical analysis will generally have both objective measures of validity (statistical significance of each estimated coefficient and of the model as a whole) and a calculated standard error that can be used in risk analysis. This information can be used to provide a confidence level for the estimate based on the CERs predictive capability.

There are also disadvantages to parametric estimating techniques, including:

- **Database requirements**—The underlying data must be consistent and reliable. In addition, it may be time-consuming to normalize the data or to ensure that the data were normalized correctly. Without understanding how data were normalized, the estimator is accepting the database on faith, thereby increasing the estimate's risk.
- **Currency**—CERs must represent the "state-of-the-art;" that is, they must be periodically updated to capture the most current cost, technical, and programmatic data.
- **Relevancy**—Using data outside the CER range may cause errors because the CER loses its predictive capability for data outside the development range.
- **Complexity**—Complicated CERs (e.g., non-linear CERs) may be difficult for others to readily understand the relationship between cost and its independent variables.

5.2.2 End Products Unit Method

The End Products Unit Method is used when enough historical data are available from similar work based on the capacity of that work. The method does not take into account any economies of scale, or location or timing of the work.

Consider an example of estimating the construction cost of a parking lot. From a previous project the total cost was found to be $150,000 for 100 parking stalls, or $1,500/stall. For a new parking lot of 225 parking stalls, the estimated cost would be $1,500/parking stall x 225 parking stalls = $337,500.

5.2.3 Physical Dimension Method

The Physical Dimension Method is used when enough historical data is available from similar work based on the area or volume of that work. This method uses the physical dimension relationship of existing work data to that of the physical dimensions of similar new work. The method does not take into account any economies of scale, or location or timing of the work

To consider the example in section 5.3, the total cost of the previous project was $150,000 for a 3,000 square feet parking lot. The new parking lot is to be 7,000 square feet; therefore, ($150,000/3,000 square feet = $50/ square feet for the previous project so the estimated cost of the new project is $50/ square feet x 7,000 square feet = $350,000.

5.2.4 Capacity Factor Method

The Capacity Factor Method is used when enough historical data are available from similar work based on the capacity of that work. The method uses the capacity relationship of existing work data to that of the capacity of similar new work. It accounts for economies of scale, but not location or timing of the work.

For example, consider a known power plant that produces 250 MW(t)/hour and costs $150,000,000 to construct. A new plant will produce 300 MW(t)/hour. From historical data, 0.75 is the appropriate capacity factor.

Using the equation Cost (new) = Cost (known) (Capacity (new)/ Capacity (known)^{e}
Where: e = capacity factor derived from historical data
Cost (new) = $150,000,000 (300/250)$^{.75}$
Cost (new) = $172,000,000 (rounded)

5.2.5 Ratio or Factor Method

The Ratio or Factor Method is used when historical building and component data are available from similar work. Scaling relationships of existing component costs are used to predict the cost of similar new work. This method is also known as "equipment factor" estimating. The method does not account for any economies of scale, or location or timing of the work.

To illustrate, if a plant that cost $1,000,000 to construct has major equipment that costs $300,000, then a factor of 3.33 represents the plant cost to equipment cost "factor." If a proposed new plant will have $600,000 of major equipment, then the factor method would predict that the new plant is estimated to cost $600,000 x 3.33 = $2,000,000.

5.3 Other Estimating Methods

5.3.1 Level of Effort Method

A form of parametric estimating is based on level of effort (LOE). Historically, LOE is used to determine future repetitive costs based on past cost data, as in, "*we spent ~$10M on operations last year, so we need ~$10M next year.*" Often LOE estimates have few parameters or performance objectives from which to measure or estimate, but are carried for several time periods at a similar rate (e.g., the costs of operations, such as X number of operators for Y amount of time). LOE estimates are normally based on hours, full-time equivalents (FTEs), or "lot." Since they are perceived to have little objective basis, LOE estimates are often subject to scrutiny. The keys to LOE estimates are that they should generally be based on known scope (although quantities may be assumed) and have a basis, even if it is simply the opinion of an expert or a project team.

Variations on LOE techniques are numerous and should be considered carefully before deciding to employ a specific technique. For instance, using LOE for installing a piece of equipment may raise questions about why it does not include the circumstances surrounding the installation (contamination and security issues and related productivity adjustments). Also questionable in LOE estimates are indirect costs, overhead costs, profit/fee, and other assumptions.

5.3.2 Specific Analogy Method

Specific analogies use the known cost or schedule of an item as an estimate for a similar item in a new system. Adjustments are made to known costs to account for differences in relative complexities of performance, design, and operational characteristics.

A variation of this technique is the "review and update technique," where an estimate is constructed by examining previous estimates of the same or similar projects for logic, scope completion, assumptions, and other estimating techniques, and then updated to reflect any pertinent differences. The specific analogy technique is most appropriate in the early stages of a project; that is, for Class 5 and 3 cost estimates.

There are several advantages to using the analogy method, including:

- It can be used before detailed program requirements are known;
- If the analogy is strong, the estimate will be defensible;
- An analogy can be developed quickly and at minimal cost; and
- The tie to historical data is simple enough to be readily understood.

There are, however, also some disadvantages in using analogies, such as:

- An analogy relies on a single data point;
- It is often difficult to find the detailed cost, technical, and programmatic data required for analogies; and
- There is a tendency to be too subjective about the technical parameter adjustment factors.

The last disadvantage can be better explained through an example. If a cost estimator assumes that a new component will be 20 percent more complex, but cannot explain why, this adjustment factor is unacceptable. The complexity must be related to the system's parameters, such as the new system will have 20 percent more data processing capacity or will weigh 20 percent more. (GAO)

5.3.3 Expert Opinion Method

As stated in the GAO Cost Estimating and Assessment Guide, "expert opinion, also known as engineering judgment, is commonly applied to fill gaps in a relatively detailed WBS when one or more experts are the only qualified source of information, particularly in matters of specific scientific technology." Expert opinion is an estimating technique whereby specialists are consulted until a consensus can be established regarding the cost of a program, project, sub-project, task, or activity. The expert opinion technique is most appropriate in the early stages of a project, or for Class 5, 4, and 3, cost estimates. These cost estimates document a list of the experts consulted, their relevant experience, and the basis for their opinions.

A formalized procedure, the Oracle Method, has been used to forecast cost based on expert opinion. Six or more experts are given a specific, usually quantifiable, question. Each expert sees the estimates produced by the others and modifies his or her previous estimate until a consensus is reached. If after four rounds there is no consensus, the original question may be broken into smaller parts for further rounds of discussion or a moderator may attempt to produce a final estimate.

This technique may be used for either portions of or entire estimates and activities for which there is no other sound basis. A limitation arises when a cost estimator's or project manager's status as an expert is questioned.

The advantages of using an expert opinion are:

- It can be used in the case where there are no historical data available;
- The approach takes minimal time and is easy to implement once the experts are assembled;
- An expert may provide a different perspective or identify facets not previously considered leading to a better understanding of the program; and
- It can be useful as a cross-check for CERs that require data significantly beyond the data range.

The disadvantages associated with an expert opinion include:

- It should be used as a last resort due to its lack of objectivity;
- There is always a risk that one expert will try to dominate the discussion and sway the group toward his/her opinion; and
- This approach is not considered very accurate or valid as a primary estimating method.

The bottom line is that, because of its subjectivity and lack of supporting documentation, expert opinion should be used primarily for confirming that the estimate does not contain elementary mistakes or invalid assumptions.

5.3.4 Trend Analysis Method

Trend analysis method is an estimating technique for current, in-progress work, and is also used to explain quantitatively how a project is progressing. It is especially useful when large quantities of commodities are a significant part of a project, (e.g., mass excavations, mass concrete placement, structural steel fabrication/installation, etc.) A trend is established using an efficiency index derived by comparing originally planned costs (or schedules) against actual costs (or schedules) for work performed to date. For example, a project's actual costs to date, divided by the number of units produced provides a measure of current costs per unit. Variations in this measure from previous periodic trending information can be used to adjust the estimate for the remaining work, as well as to help project managers with decisions regarding resources (people, equipment, etc.) and make near term planning adjustments.

The trend analysis technique can be used at almost any stage of project development and can even be used to update cost estimates developed using other techniques. It should be remembered, however, that during a long project activity, productivity rates may vary, with less than optimal productivity occurring as project activity begins, improved productivity developing until an optimum sustained level can be achieved, and then less than optimal productivity encountered near the end of the project as problems are resolved and final activities are completed. Thus trend analysis estimates should consider the current stage and remaining stage of a project activity carefully before extrapolating current productivity or cost values.

5.3.5 Learning Curve Method

The learning curve is a way to understand the efficiency of producing or delivering large quantities. Studies have found that people engaged in repetitive tasks will improve their performance over time, i.e., for large quantities of time and units, labor costs will decrease, per unit.

The aircraft industry first recognized and named the learning curve and successfully used it in estimating. It can be used most effectively when new procedures are being fielded and where labor costs are a significant percentage of total unit cost. But it should always be understood that the learning curve applies only to direct labor input. Materials and overhead will not necessarily be affected by the learning curve. Figure 5-1 illustrates a hypothetical learning curve.

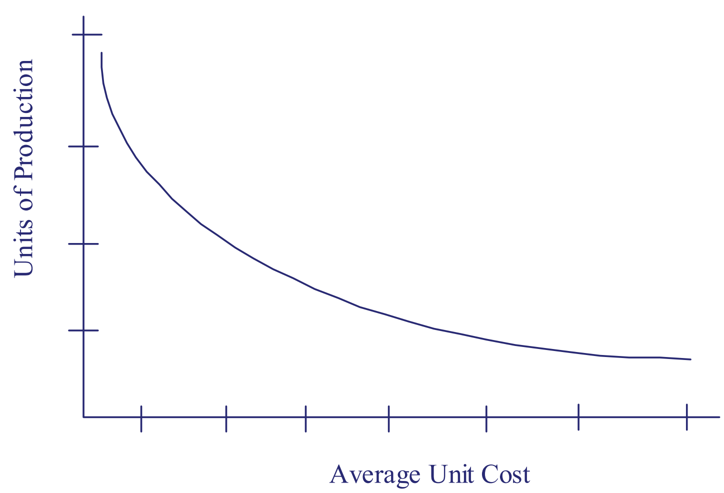

Figure 5-1. The Learning Curve Method

Typical learning curves start with high labor costs (hours) that decrease rapidly on early production units, and then flatten as production continues. This exponential relationship between labor productivity and cumulative production is expressed in terms of labor reduction resulting from production increases. For example, a 90-percent learning curve function requires only 90 percent of the labor hours per unit each time production doubles. When a total of 200 units are produced, labor costs for the second 100 units will be only nine tenths the costs of the first 100.

Increased productivity allows for lower labor costs later in a project, and should result in a lower overall project cost. Subsequent similar projects should have fewer labor hours for each unit of production also, which could result in both more contractor profit and lower government contract costs.

No standard reduction rate applies to all programs, and learning curve benefits will vary. When labor hour reductions of the first units are known, an accurate percentage reduction can be calculated and extended to subsequent units. If no data exists, it may be risky to assume that learning curve savings will be experienced.

The learning curve estimating technique can be considered for all traditional and nontraditional projects. The learning curve is most effective when applied to repetitive activities, and can also be used to update labor hours calculated in earlier estimates.

5.4 Methods of Estimating Other Life-Cycle Costs

Different methods may be used to estimate other project/program support costs, including design, engineering, inspections, ES&H, etc. Some common methods are counting drawings and specifications, FTE, and percentage.

5.4.1 Count Drawings and Specifications Method

The estimator calculates the number of drawings and specifications representing a specific project. The more complex a project is, the more drawings and specifications it will require meaning that associated design costs will be higher.

5.4.2 Full-Time Equivalent Method

The number of individuals anticipated to perform specific functions of a project forms the basis. The man-hour quantity is calculated and multiplied by the cost per labor hour and the duration of the project function to arrive at the cost.

5.4.3 Percentage Method

The estimator calculates a certain percentage of the direct costs and assigns this amount to the other project functions (such as design, project management, etc.). Some possible benchmarks for DOE projects include:

- Total design percentages are usually 15-25 percent of estimated construction costs for DOE projects. Non-traditional, first of a kind projects may be higher, while simple construction such as buildings will be lower than this range (on the order of 6 percent);

the more safety and regulatory intervention is involved, the higher the percentage.

- Project management costs range from 5 to 15 percent of the other estimated project costs for most DOE projects, depending on the nature of the project and the scope of what is covered under project management. The work scope associated with this range should be defined very specifically and clearly.

6.0 COST ESTIMATING DEVELOPMENT PROCESS

6.1 Overview of the Cost Estimating Process

The overall Cost Estimating Process Model followed here was described graphically by Figure 2.1 in Section 2.2. The cost estimating development process discussed in this section follow the 12 steps model recommended by GAO[11]and are part of the of the circle of iterative activities in Figure 2.1 for developing the cost estimate. Figure 6-1 depicts the 12 step GAO model. Table 6-1 further identifies the implementing tasks related to the GAO-12 step cost estimating development process. Systematically conducting these tasks enhances the reliability and validity of cost estimates. The process is iterative.

[11] **GAO-09-3SP**

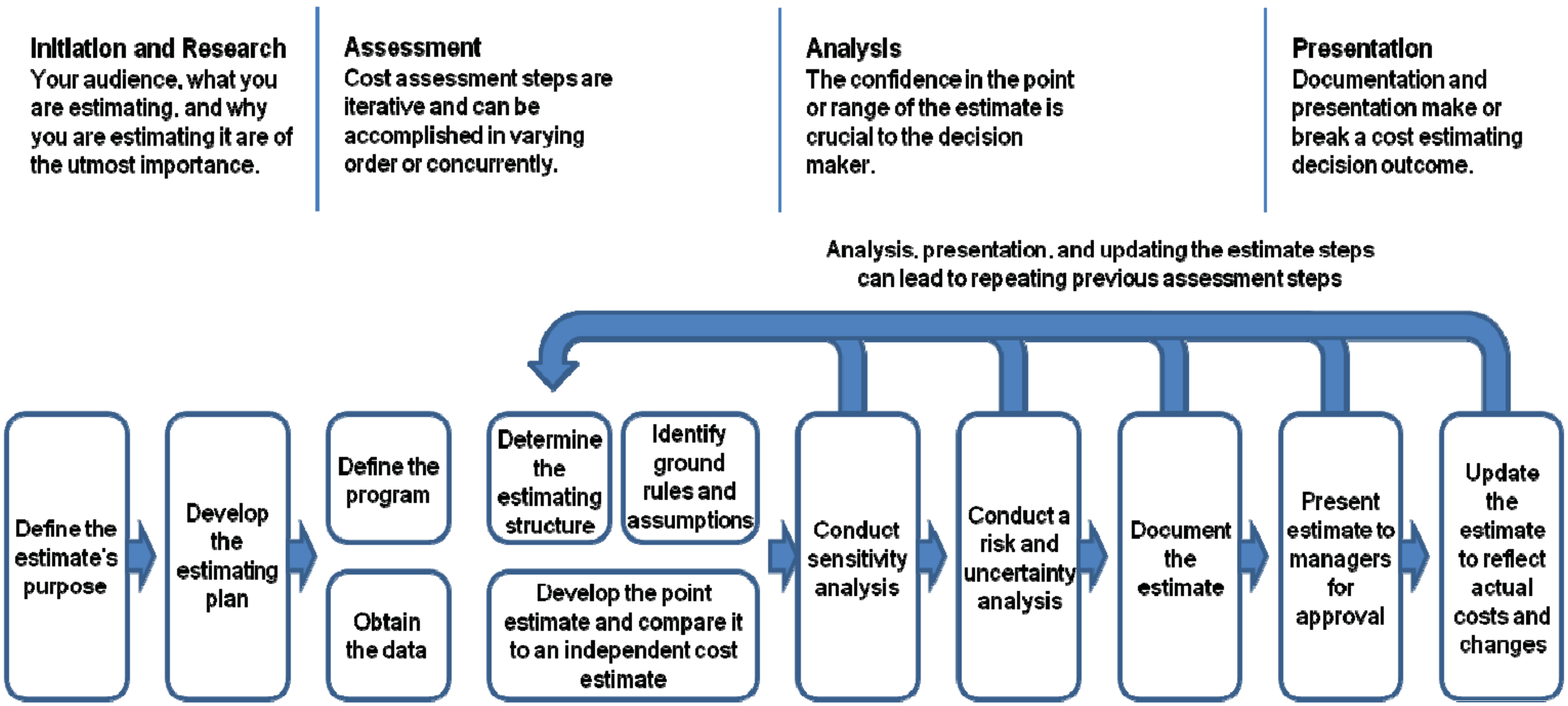

Figure 6.1. The GAO 12 Steps Cost Estimating Development Process Model

SOURCE: GAO-09-3SP

Note: A crosswalk between the GAO 12 Steps and the different sections in this Guide is shown in Appendix J.

Table 6-1. The GAO Cost Estimating Development Process

Step	Description	Associated Tasks
1	Define the Estimate's Purpose	- Determine the estimate's purpose. - The level of detail required. - Determine who will receive the estimate. - Identify the overall scope of the estimate.
2	Develop the Estimating Plan	- Determine the cost estimating team. - Outline the cost estimating approach. - Develop the estimate timeline. - Determine who will do the independent cost estimate. - Develop the team's master schedule.
3	Define the Program/Project Characteristics of the work	Identify the technical and program/project parameters that will bind the cost estimate based on the following information: - The purpose of the project. - Its system and performance characteristics. - Any technology implications. - All system configurations. - Project acquisition schedule. - Acquisition strategy. - Relationship to other existing systems. - Support (manpower, training, etc.) and security needs. - Identification of risk items. - System quantities for development, test and production. - Deployment and maintenance plans. - Predecessor or similar legacy systems.
4	Determine the Estimating Structure	- Define the work breakdown structure (WBS) and define each element in a WBS dictionary. - Choose estimating method best suited for each WBS element. - Identify potential cross-checks for likely cost and/or schedule drivers. - Develop a cost estimating checklist.
5	Identify Ground Rules and Assumptions	Clearly define what is included and excluded from the estimate. Identify global, program, and project specific assumptions such as: - The estimate's base year including its time-phasing and life cycle. - Project schedule information by phase. - Project acquisition strategy - Any schedule or budget constraints. - Inflation assumptions. - Travel costs. - Equipment to be furnished by the government. - Prime and major subcontractors involved. - Use of existing facilities or new modification / development. - Technology refresh cycles. - Technology assumptions and new technology to be developed. - Commonality with legacy systems and assumed heritage savings. - Effects of new ways of doing business.
6	Obtain the data	- Create a data collection plan with emphasis on collecting current and relevant technical, programmatic, project, and cost and risk data. - Investigate possible data sources. - Collect and normalize data for cost accounting, inflation, learning, location, quantity, and other adjustments. - Analyze the data to look for cost drivers, trends, and outliers. Compare

Step	Description	Associated Tasks
		results against rules of thumb and standard factors derived from historical data. - Interview data sources and document all pertinent information including an assessment of data reliability and accuracy. - Store the data for future estimates.
7	Develop the Point Estimate	- Develop the cost by estimating each WBS element using the best methodology from the data collected. - Include all estimating assumptions. - Express costs in constant year dollars. - Time-phase the results by spreading costs in the years they are expected to occur based on the project resources and schedule. - Sum each of the WBS elements to develop the overall point estimate - Validate the estimate by reviewing for errors such as double counting and omitting costs. - Compare estimate against the independent cost estimate and examine where and why there are differences. - Perform cross-checks on cost drivers to see if results are similar. - Update the estimate as more data becomes available or as changes occur. Compare results against previous estimates.
8	Conduct Sensitivity Analysis	- Test the sensitivity of cost elements to changes in estimating input values and key assumptions. - Identify the effects of changing the project schedule, funding profile, or quantities on the overall estimate. - Based on this analysis determine which assumptions are key cost drivers and which cost elements are the most impacted by changes.
9	Conduct a Risk and Uncertainty Analysis	- Determine the level of cost, schedule, and technical risk associated with each WBS element and discuss with technical experts. - Analyze each risk for its probability of occurrence and impact. - Develop minimum, most likely, and maximum ranges for each element of risk. - Use an acceptable statistical analysis methodology (e.g., Monte Carlo simulation) to develop a confidence interval around the point estimate. - Determine type of probability distributions and reason for their use. - Identify the confidence level of the point estimate based on risks that have already been mitigated. - Identify the amount of contingency funding and add this to the point estimate to determine the risk adjusted cost estimate. - This analysis should be performed by the IPT and reflect the latest approved project Risk Management Plan.
10	Document the Estimate	- Document all steps used to develop the estimate so that it can be recreated quickly by a cost analyst unfamiliar with the program and produce the same result. - Document the purpose of the estimate, the team that prepared it, and who approved the estimate and on what date. - Provide a description of the project including the schedule and technical baseline used to create the estimate. - Present the time-phased life cycle cost of the program. - Discuss all ground rules and assumptions. - Include auditable and traceable data sources for each cost element. - Document for all data sources how the data was normalized. - Describe in detail the estimating methodology and rationale used to derive each WBS element's cost (more detail preferred over too little). - Describe the results of the risk, uncertainty and sensitivity analysis and

Step	Description	Associated Tasks
		whether any contingency funds were identified. - Describe if the contingency and risk analysis was based on mitigated or unmitigated risks. - Document how the estimate compares to the funding profile. - Track how this estimate compares to previous estimates if applicable.
11	Present Estimate to Management for Approval	- Develop a briefing that presents the documented life cycle cost estimate for management approval including an explanation of the technical and programmatic baseline and any uncertainties. - Briefing should be detailed enough so the presenter can easily defend the estimate by showing how it is accurate, complete, and of high quality. - Focus should be on the largest cost elements and drivers of cost presented in a logical manner. - Content should be clear and complete making it easy for those unfamiliar with the cost estimate to comprehend the competence that underlies the estimate results. - Backup slides should be available to answer more probing questions. - Comparisons to an independent cost estimate should also be made and any differences explained. - Feedback from management should be acted upon and documented. - Cost estimating team should request acceptance of the estimate. - Include a comparison of the estimates (LCCE and/or ICE) to the budget.
12	Update the Estimate to Reflect Actual Costs and Changes	- Update estimate to reflect any changes in technical, programmatic, or project assumptions or as the project passes through new phases / milestones so that it is always current - Replace estimates with EVM EAC and Independent EAC from the integrated EVM system - Report progress on meeting cost and schedule estimates - Perform a post-mortem and document lessons learned for elements whose actual costs or schedules are different from the estimate - Document all changes to the program and each affects the cost estimate.

Source: DOD, DOE, NASA, Society of Cost Estimating and Analysis (SCEA), Industry, DHS

6.2 Estimate Planning

Estimate planning (Input in Figure 2.1, Process Model) should include:

- Establishing when the estimate is required
- Determining who will prepare the estimate
- Producing a plan/schedule for estimate completion
- Selecting and notifying individuals whose input is required
- Collecting scoping documents
- Selecting estimating technique
- Conducting an estimate kickoff meeting
- Visiting the work site

Develop Estimate Purpose Statement—The purpose of the estimate should be stated in precise, unambiguous terms. The purpose statement should indicate why the estimate is being prepared and how the estimate is to be used. This should include a description of any relevant regulatory or DOE drivers.

Prepare Technical Scope Summary—The technical scope summary should provide a detailed description of the work included in the estimate. Additionally, the technical scope should identify the activities included in the cost estimate as well as relevant activities excluded from the cost estimate and the rationale for their exclusion.

Determine Approaches to be used to develop the Estimate—Develop the estimate using techniques and methodologies such as the ones described in Section 5. For example, when developing a detailed estimate, the following approach could be followed (among others):

- **Activity-Based Estimates**—Section 5.1 describes detailed estimating methodologies used for preparing activity-based cost estimates. To be activity based, an estimate activity should have discrete quantifiable units of work associated with it. Examples of work items that are activity-based include:
  - Place 16 CY of concrete
  - Produce 12 monthly reports
  - Perform 100 surveillances
  - Prepare a lesson plan for a course in safe lifting

- **Level-of-Effort (LOE)**—Certain activities cannot be associated with quantifiable units of work. Instead, these activities should be expressed as a defined level of expenditure over time. Estimates that include LOE activities should be closely scrutinized, and the use of LOE estimates minimized. Examples of LOE activities include:
  - Secretarial support
  - Site safety program
  - Clerical support

6.3 Cost Estimate Inputs

6.3.1 Sources of Data Input

Since all cost estimating methods are data-driven, it is critical that the estimator know the best data sources (Input in Figure 2.1, Process Model). Whenever possible, estimators should use primary data sources. Primary data are obtained from the original source, are considered the best in quality, and are ultimately the most useful. They are usually traceable to an audited document. Secondary data are derived, rather than obtained directly from a primary data source. Since they were derived (and thus changed) from the original data, they may be of lower overall quality and usefulness. In many cases, data may have been "sanitized" for a variety of reasons that may further complicate its use as full details and explanations may not be available. Cost estimators must understand if and how data were changed before determining if they will be useful or how that data can be adjusted for use. Furthermore, it is always better to use actual costs, rather than estimates as data sources since actual costs represent the most accurate data available.

While secondary data are not the first choice, they may be all that are available. Therefore, the cost estimator must seek to understand how the data were normalized, what the data represent, how old the data are, and whether the data are incomplete. If these questions can be answered, the secondary data should be useful for estimating and would certainly be helpful for cross-checking the estimate for reasonableness.

Some specific sources of data are the following:

Estimating Manuals—The construction industry produces numerous costing manuals to assist in the pricing of work. RS Means and Richardson are two readily available manuals.

Data Bases—Commercial and in-house data bases provide the estimator with the ability to retrieve data to be used for estimating. Commercial data bases are readily available. In-house data bases more accurately reflect the parameters that influence local costs.

Vendor Quotes—Vendor quotes provide for a greater confidence of real time accuracy. Use caution when using vendor quotes. Often the vendors provide quotes with either incomplete or preliminary information. Other times only one vendor is polled, possibly skewing the information. In other situations, market conditions may drastically change from the time vendor quotes were obtained.

Level of Effort Data—As discussed in Section 5.3.1, LOE activities are of a general or supportive nature usually without a deliverable end product. Such activities do not readily lend themselves to measurement of discrete accomplishment. LOE is generally characterized by a uniform rate of activity over a specific period of time. Value is earned at the rate that the effort is being expended. LOE activities should be kept at a minimum for Class 1 and 2 estimates.

Expert Opinions (Subject Matter Experts)—As described in Section 5.3.3, expert opinions can provide valuable cost information in the early stages of a project, for Class 5, 4, and 3 cost estimates. The data base should include a list of the experts consulted, their relevant experience, and the basis for their opinions. If a formalized procedure was used, such as the Oracle Method, it should be properly documented.

Benchmarking—Benchmarking is a way to establish heuristics, or rules-of-thumb. Benchmarks may be useful when other means of establishing reasonable estimates are unavailable. An example of a benchmark is the statistic indicating that design should be 6 percent of construction cost for non-complex facilities. If construction costs can be calculated (even approximately) using a parametric technique, design should be approximately 6 percent. Typical benchmarks include such rules as:

- Large equipment installation costs should be X percent of the cost of the equipment
- Process piping costs should be Y percent of the process equipment costs
- DOE facility work should cost approximately Z percent of current, local, commercial work

Team/Individual Judgment Data—Team/Individual judgment data are used when the maturity of the scope has not been fully developed and/or the ability to compare the work to historical or published data is difficult. This involves the reliance of information on individuals or team members who have experience in the work that is to be estimated. This process may involve interviewing the person(s) and applying their judgment to assist in the development of the cost estimate. Because of its subjectivity and usually the lack of supporting documentation, team/individual judgment should be used sparingly.

Trend Analysis Data—As described in Section 5.3.4, trend analysis can provide data for comparing the original planned baseline costs (or schedules) and the per unit value against actual costs (or schedules) and the per unit value for work performed to date. Trend analysis data can be used at almost any stage of work and can even be used as a basis for cost estimates developed using other techniques.

The Learning Curve Data—As described in Section 5.3.5, learning curve data are useful for understanding the efficiency of producing or delivering large quantities. Numerous sources are available from trade associations and governmental organizations.

6.3.2 Considerations for Cost Estimate Development

When given the task of developing an estimate, an estimator must first gather general project information, including:

- project background,
- where the project stands in its life cycle,
- general description of the technical scope,
- pertinent contract or sub-contract information,
- estimate purpose, classification, how the estimate will be used, and techniques anticipated, and
- Approximate time frame for the work to be performed.

Some specific inputs to the cost estimating process include:

- Mission Need Statement
- Critical Decision approval documents
- Acquisition Strategy
- Project Execution Plan
- Work Breakdown Structure (WBS)
- Code of Accounts (COA; also known as account code)
- Key Milestone Activities and Proposed Dates
- Functional Design Criteria
- Functional Performance Requirements
- Conceptual Design Report
- Preliminary Design
- Definitive Design
- Risk Analysis and Register
- Historical Information and Other Sources of Information, including previous cost

estimates

- Results of Alternative and Requirements Analyses
- Applicable Resources and Labor Rates
- Applicable Indirect Rates
- Assumptions
  - Estimate ground rules and constraints; e.g., 4 day work-weeks**,** 10 days of weather shutdowns per year, site access limitations, acquisition strategies and associated contractor markups, and all other assumed conditions under which the estimator believes project work will be performed.
  - Assumptions made by the estimator to fill gaps and inconsistencies in the technical scope, sources of materials, etc.
- Estimate Allowances (see 6.4.2.3)
- Exclusions (a clearly stated list of excluded items such as furnishings, equipment, finishes, landscaping, etc.)
- Government supplied equipment
- Construction and Operations Input

From this information, whether provided by others or developed by the estimator as an assumption, appropriate estimating techniques may be determined.

6.4 Cost Estimate Production

The principle step in the estimating process is producing the cost estimate and its corresponding schedule and basis of estimate. It is important that scope development, documentation, and control be coordinated with the cost estimate production as key iterative processes. Cost estimate production includes several steps that should be based on requirements, purpose, use, classification, and technique, including:

- Identify the scope of work.
- Identify the project, subprojects, milestones, activities, and tasks.
- Document all bases of the estimate, assumptions, allowances, risks, etc. during the estimating process.
- Perform quantity takeoffs and field walk-downs.
- Develop the detail items or models that make up the activities.
- Assign measurable quantities to the detail items or models.
- Obtain budgetary or vendor information, conduct market research, or establish other pertinent sources of information.
- Establish productivity rates or perform task analyses.
- Calculate all applicable costs, including direct costs, indirect costs, contingency, and escalation (utilizing the schedule to calculate years for escalation).
- Produce all applicable detail and summary reports.
- Establish a funding profile utilizing the work breakdown structure and time phasing from the schedule.
- Determine what risks (and to what extent) should be mitigated with activities (or assumptions) in the cost estimate.

- Consider other inputs, including schedule information, risk management plan, and peer reviews, as appropriate.

6.4.1 Schedule Development

A project plan and schedule should be developed as a key basis for any cost estimate. By going through the process of schedule development, the activities needed to execute a project are clearly identified and appropriately sequenced. This then forms a basis for estimating the resources and costs needed to accomplish the project plan. That process in turn provides a basis for estimating activity durations used to construct the schedule. As this process indicates, the development of schedule and cost estimates is a highly iterative and inter-related process. However, it is difficult to generate a credible and realistic cost estimate without at least a basic understanding of the project plan and the activities that comprise the project schedule.

After both the schedule and cost estimates have been developed, the project schedule is also used to determine a cost estimate over time in order to calculate escalation, identify available resources, and establish budget requirements. This process can result in further iteration, both to refine the schedule (to accommodate resource and budget constraints) and to finalize the estimate (to adjust escalation allowances and other time-based costs, e.g., management staffing).

A project's schedule should not only reflect activities in a cost estimate, but it should also indicate project milestones, deliverables, and relationships between activities.

6.4.2 Direct Cost Development

Direct Costs include any costs that can be attributed solely to a particular project or activity, including labor, materials, subcontracts, equipment, salaries, and travel. Emphasis is placed on the term *activity*, which typically in standard practice equates to a lowest WBS element, account code, work package, or planning package.

Commonly recognized direct costs include:

- Common construction activities to include mobilization and de-mobilization, site work, concrete work, masonry work, etc.
- Operations labor, materials, equipment, subcontract costs, premium pay, and similar productivity adjustments, such as those for contamination or security restrictions.
- Maintenance labor, materials, equipment, subcontract costs, premium pay, and similar productivity adjustments, such as those for contamination or security restrictions.
- Common routine and preventive maintenance activities include minor facility repairs and/or upgrades, minor paving or landscaping, etc.
- Decontamination, decommissioning, dismantling, and demolition.
- Project management
- Construction management
- Design, development, and start-up
- Security escorts and restrictions
- Special (capital) and standard (capital or non-capital) equipment

- Freight, packaging, and transportation
- Health physics support, radiological controls support, protective clothing/PPE, and industrial safety/health
- Sales and use taxes

Some items that may be included within direct costs as a part of a loaded labor rate include:

- Holiday and vacation pay
- Payroll taxes and insurance
- Fringe benefits or labor burdens
- Contract fee/profit

6.4.2.1 Resources and Crews and Quantities

Cost estimators should be familiar with any site or project-specific labor agreements, and if applicable, reflect these labor agreements in the cost estimate.

Resources include the labor, material, equipment, services, and any other cost items required to perform a scope of work. One or more resource can be assigned to an activity. A list of the resources and their associated unit prices needs to be defined before applying resources to activities.

- Rates for labor should include wages, taxes, insurance, fringe benefits, overtime, and shift differential as applicable.

- Unit prices for material should include the material price, sales tax, and shipping costs as applicable.

- Equipment may be previously purchased by the Government; the hourly rate in these cases should only include operation and maintenance costs (not capital cost of ownership). The Site may have some pre-arranged pool and the equipment rate should correspond with current pool service rates.

Crews are groupings of the various labor classifications along with the tools and equipment (not installed equipment) required to accomplish activities. A production rate for each crew is identified. A crew used to place concrete slabs might include a foreman, laborers, cement finisher, concrete vibrators, forms, and air compressor. In addition, the crew's production rate should be established (e.g., 110 cubic yards per day).

- Estimators should examine the production rate for each crew and make adjustments for local conditions if necessary. Working with crews, rather than the individual cost elements, allows the estimator to estimate work activities more quickly.

Quantities are the units of measure and number of units associated with each activity. Each activity needs to have an identifiable unit of measure and a quantity associated with that activity (e.g., 200 tons, 75 linear feet, etc.) For LOE activities, the quantity may be "one" and the unit of measure "lot."

6.4.2.2 Assigning Resources to Activities

Detailed Work Scope. Once activities have been defined, units of measure identified, and quantities determined, resources are assigned to each activity. Unit rates are used to assign resources to estimate activities. The resources assigned should correspond with the resources that will be used to complete the work. Such distinctions are especially important when detailed schedules are required, but less important for Rough Order of Magnitude (ROM) or Conceptual Estimates. Unit rates can be expressed as dollars per unit, labor hours per unit, or a percentage of an associated cost.

Direct Labor. Unit rates expressed as labor hours per unit require that the type of labor (carpenter, engineer, secretary, etc.) be identified by associating a labor type or a crew with each unit rate. A crew is defined by the various labor types that make up the crew. Each labor type has a corresponding wage rate to allow calculation of cost in dollars. The wage rates for each labor type includes the base rate, taxes and insurance, fringe benefits, travel or subsistence, and adjustment for overtime, if required.

Percentages. Some activities may use percentages to assign resources. The appropriateness of using percentages for such items as project management and construction management will depend on the level of maturity in the work scope definition. Examples of cost items where percentages are often used include:

- Plan of the day (POD) meetings
- Small tools
- Consumable materials
- Labor insurance
- Project management
- Construction management

Regardless of the method used to assign resources to an activity, the following is true for each activity; all costs are identified, labor hours, when applicable, are identified, and labor type for all labor hours is identified.

Summary Work Scope. When details of the work scope are not known, the work scope may be estimated by using the analogy technique or the parametric technique. These techniques may use unit rates expressed as dollars per unit, labor hours per unit, or percentages.

Costs Included in Unit Rate. All costs should be "fully burdened." A description of what is included in the burdened rate should be included because the definition of "fully burdened" frequently varies.

Unit Rate Adjustments. The development and/or use of estimating factors to adjust unit rates require the skills of an experienced cost estimator. Such adjustments allow use of a database with known productivity or costs, which are then adjusted to reflect the project specific activities and the conditions under which the work is to be performed. Situations that might affect productivity include type of work, weather conditions, level of confinement, security posture, etc.

Examples of estimating factors (or unit rate adjustments):

- Add 25 percent to labor for work in radiation zones.
- Reduce labor for shop work by 20 percent.
- Add 20 percent to labor for work requiring use of a respirator.

Estimating factors are available from published sources or estimators can develop them. For example, the U. S. Army Corps of Engineers, "Productivity Study for Hazardous, Toxic and Radioactive Waste (HTRW) Remedial Action Projects," dated October 1994, provides suggested labor productivity adjustment factors considering levels of worker protection and temperature.

6.4.2.3 Allowances

In planning projects, it is normal to include allowances for activities for which there is little or no design basis, especially in the earliest stages. These are *not* considered contingency costs. Allowances should be included at the discretion of the Federal Project Director, project manager, and IPT to cover anticipated costs associated with a known technical requirement or activity. Any allowances included in cost estimates should include a basis for these costs within the supporting Basis of Estimate (BOE) document.

For instance, in a Class 5 cost estimate (order of magnitude), it would be appropriate to see a line item (cost account or activity) such as "utility relocation, 1 lot, $1M material and $1M labor," indicating that some utilities needed to be relocated as part of this project. Documentation supporting these costs should include approximate quantities, basis for those quantities, and source of the projected costs (e.g., consensus of the project team) proportional to the significance of the activity. Allowances also may be included in a project to cover costs associated with productivity adjustments, anticipated subcontract changes, anticipated design changes, and similar elements of known scope and costs.

6.4.2.3.1 Allowances for Special Conditions

Consideration must be given to all factors that affect a project or program. Some of these factors are:

- Availability of skilled and experienced manpower and its productivity
- The need for overtime work
- The anticipated weather conditions during the period of performance
- Work in congested areas
- Working under the authorization basis
- Work in radiation areas
- Security requirements imposed on the work area
- Use of respirators and special clothing

- Training
- Site access

Special conditions may be estimated by applying a factor. For example, 10 percent applied to labor hours for loss of productivity due to work in a congested area. Other items may be calculated by performing a detailed takeoff. An example would be an activity that could only be performed over a 2-days period. Overtime would be required to complete the activity and the number of hours and rates could be calculated.

An estimator should be vigilant that there is no duplication of costs—for example, if the control account manager who provided the cost data to the estimator already included unit rate adjustments such as productivity factors, additional allowances for productivity should not be included or the cost estimate may be inflated. All allowances applied or used to develop the cost estimate should be documented in the Basis of Estimate (BOE).

6.4.2.4 Design Costs

To estimate design costs, the estimator should understand what activities are included. Table 6-2 lists typical design-related activities.

Design-Related Activities		
Preliminary and final design calculations and analyses	Surveys (surveying), topographic services, core borings, soil analyses, etc., to support design	Design studies required to support safety analysis if not included in the Conceptual Design Report
Preparation of as-built drawings	Travel to support design	Acceptance procedures
Outline specifications	Reproduction during design	Design Reviews (not third party)
Construction cost estimates	Design kickoff meeting	Certified engineering reports
Computer-Aided Drafting and computer services	Constructability reviews	Bid package preparation
A/E internal design coordination	Safety reviews by A/E	Bid evaluation/opening/ award
Design cost and schedule analyses and control	Value engineering	Inspection planning
Design progress reporting	Identification of long lead procurements	Inspection services
Regulatory/code overview by A/E	Design change control	Review shop drawings
Procurement and construction specifications	Modification of existing safety analysis report	Preliminary and final plans and drawings

Table 6-2 Typical Design-Related Activities

Design costs are normally directly related to the magnitude and complexity of a project. Table 6-3 lists factors that should be considered when assessing design costs for the design-related activities due to the magnitude and complexity of a particular project.

Factors Impacting Design Costs	
Comprehensive functional requirements	Off-site architecture/engineering
Quality level	Overtime
Design planning	Adequacy of plans and specifications
Design layout	Off-site fabrications
Drafting and CADD methodologies	Travel and per diem
Project reviews	Guidelines
Design reviews	Performance specification
Safety analysis requirements	Cost estimating Activities
Reporting requirements	Inspection Requirements
Government furnished equipment	Schedule Analysis
Complexity	Labor density

Table 6-3 Factors Impacting Design Costs

All factors in Table 6-3 bear upon the cost ***of*** a ***project*** design phase.

For EM projects, the regulatory process requires rigorous examination of design alternatives before the start of cleanup design, especially for remedial investigation/feasibility studies under CERCLA to support a record of decision (ROD) or for corrective measure studies under RCRA to support issuance of a permit. Cleanup design executes a design based on the method identified in the ROD or permit, which often narrows the scope of preliminary design and reduces the cost and schedule requirements.

On EM projects, the estimator should assess the extent to which design development is required or allowed in cleanup design. In some cases, the ROD or permit will be specific, such as for a disposal facility where all features such as liner systems and configuration, are fixed. When treatment options such as incineration are recommended, considerable design effort may be required.

Requirements for construction engineering, including observation, design of temporary facilities, quality control, testing, and documentation, will often be higher than for conventional construction because of requirements to comply with rigid regulations governing health and safety, quality assurance and other project requirements.

6.4.2.5 Construction Management Costs

A construction management (CM) firm, whether in the form or a subcontractor or as a function of an M&O contractor, is responsible for construction activities, including coordination between prime contractors and subcontractors. This responsibility includes subcontracting, purchasing, scheduling, and often a limited amount of actual construction. The cost estimate for this function must include all CM costs for site management and force account labor wages, payroll taxes, overheads, and procurements for which the CM is responsible.

6.4.2.6 Project Management Costs

The estimates for project and program management must consider project duration from start of preliminary design through completion of the construction for the project. Other factors to consider are the complexity of the project, the specific design group, the organization for which the project is to be performed, and the extent of procured items. The encompassed functions include:

- management and integration
- program/project management
- administrative services
- peer review
- records management
- training
- information resources management
- project controls
- quality assurance
- licensing
- communications
- travel by management staff

Management functions associated with environmental restoration projects parallel construction project management.

6.4.2.7 Construction Coordination Costs

Construction coordination comprises field engineering services, sometimes called "Title III Engineering" services or "Engineering Support during Construction". Field engineers should be involved in the review of the design documents, as well as in the coordination of field construction and resolution of design conflicts encountered during the construction phase. Other responsibilities may include furnishing and maintaining governing lines and benchmarks to provide horizontal and vertical controls to which construction may be referred; checking and approving or requiring revision to all vendor shop drawings to assure conformity with the approved design, working drawings and specifications; inspecting the execution of construction to assure conformance with approved drawings and specifications, and with established requirements for workmanship, materials and equipment; and providing field or laboratory tests of construction workmanship, materials and equipment as may be required.

6.4.2.8 Research and Development (R&D) Costs

Traditionally, cost estimating involves the use of historical cost data to correlate and validate existing estimating methodologies. Historical cost data lend some accuracy and credibility to a cost estimate. When a cost estimate is required for new, innovative, state-of-the-art, first-, or one-of-a-kind projects, historical data are not always available.

For these projects, knowledge of the processes involved should help the cost estimator to prepare an accurate and credible cost estimate. In the absence of accurate cost information, process knowledge can focus the estimator toward parts of the project that are significant contributors to overall project cost.

Personnel Costs—Personnel costs are usually the largest R&D expense. R&D personnel are often well-educated and may have a correspondingly higher pay scale than personnel for conventional projects. Personnel resources include those needed to construct R&D facilities; purchase supplies, materials, and equipment; operate equipment, prototypes, pilot plants or laboratories; develop software; information technology operations; and other labor functions needed to complete R&D efforts.

Equipment Costs—Equipment costs for R&D projects can be divided into hardware (for prototypes and pilot plants as well as other activities) and software costs (including computer models discussed below). Hardware includes machinery, computers, and other technical equipment. Equipment costs increase with increasing project complexity and a lengthy testing and verification phase may be required. Vendor quotes can sometimes be obtained to support early-stage cost estimates, but expert opinion is often the only recourse to obtain Class 5 cost estimates for equipment with no precedent.

Prototypes and Pilot Plants—In some instances, it will be cost effective to develop a prototype or a pilot plant for an R&D project. A cost estimate for a prototype or a pilot plant will have to account for the following major items:

- Procurement and/or construction of the equipment or plant
- Operation of the equipment, including necessary utilities
- Development of test criteria for plant studies
- Analysis of test results
- Computer simulation of plant processes
- Supplies and materials used for testing

The cost estimate may also need to include costs for project management and other personnel during the pilot plant study or prototype testing.

Scaled and Computer Models—Scaled or computer-generated 3D models may need to be created for some projects. For example, if the project goal is to construct a new incinerator for mixed waste, site-specific air-dispersion modeling may be required to demonstrate that emissions from the incinerator will not have an adverse impact on public health or the environment.

Groundwater modeling may be required for some remediation sites (e.g., groundwater contamination has been found at a site, and several technologies are being proposed). Modeling can be used to select the best technology or determine the optimum locations for equipment. Some models can be quite complex and require specialized technical expertise.

R&D Disposition – Finally, it is important to consider the cost of disposing of all equipment, chemicals, products, materials, facilities, etc., used during the R&D phase. The assumption that another project will pay for the "cleanup" of an experiment, bench-scale demonstration or even a pilot scale facility has often resulted in low initial government life-cycle estimates. The initial government life-cycle estimate should consider the R&D disposition estimate attributable to the project or share of the R&D disposition estimate when attributable to multiple projects.

6.4.2.9 Regulatory Costs

Environmental, safety and health (ES&H) regulatory compliance is required for all projects thus, an estimate should contain sufficient provisions for ES&H compliance costs. Regulatory costs should include the cost of coordination and negotiation with regulators, documentation costs, site characterization analysis, stakeholder meetings and other related activities.

For Government projects, the facility must satisfy all Federal, state, and local requirements (i.e., building permits, energy conservation and the Leadership in Energy and Environmental Design (LEED) requirements, waste disposal, wastewater effluent disposal, and air emission limitations) imposed by the other agencies. Regulations are even more stringent for facilities that process or store radioactive materials. Construction sites must follow Occupational Safety and Health Administration (OSHA) rules.

Familiarity with applicable regulations is required so that a plan may be developed for the project to comply with those regulations.

Environmental Compliance Costs

The number and requirements of environmental regulations have increased dramatically in the past 30 years. When preparing cost estimates for environmental compliance activities, the following should be considered.

- type of project
- project location
- waste generation
- effluent characteristics
- air emissions
- noise requirements
- project start-up or completion date

Location is significant to project cost when a wetlands area will be disturbed, or the project is located in an area with extensive environmental regulations (e.g., California). Increased environmental compliance costs should be factored into projects in such locations.

Knowledgeable design staff and personnel familiar with environmental regulations that will affect the project should be consulted when composing an estimate. Knowledge of wastes or air emissions generated during the project will facilitate the identification of environmental compliance design requirements and subsequent costs. For example, wastewater treatment may be required prior to effluent discharge into a stream or publicly owned treatment works. Air pollution control devices may be required for process equipment. Permitting costs could include

- labor for data gathering
- equipment for testing
- analytical tests
- data analysis and writing or completing documents
- time for interface with project personnel and outside consultants
- time for interaction and negotiation with regulator and stakeholders
- application and/or permit fees
- annual permitting costs
- upgrades to existing equipment
- new pollution control equipment

Once a plan for regulatory compliance has been established, the regulatory costs can be estimated. This will establish a baseline for the regulatory costs such that changes that affect the baseline can be tracked and estimated throughout the project's life.

For some projects, a permit is required before work can commence. For example, construction projects that will disturb more than 5 acres are required to obtain a storm water permit before commencing construction. Project scheduling can be affected if operating permits are not received in a timely manner. Facilities may be shut down for violations of operating permits or failure to comply with existing regulations. The time required for regulatory review of the permit application also must be factored into the cost estimate.

Health and Safety Compliance Costs

Employee health and safety regulations have also increased. As allowable limits for worker exposure decrease, design cost estimates must account for specific engineering controls to minimize employee exposures to toxic or hazardous substances in the workplace, especially for facilities with radioactive materials. Planning for environmental controls is essential because retrofit costs can exceed original installment costs. State-of-the-art, high-technology facilities may require initial employee exposure monitoring if unknown factors are encountered. Protective equipment must also be supplied and maintained for the employee.

Past experience with increased regulatory rigor within DOE has shown that the costs associated with employee workspace controls, including industrial hygiene monitoring, is the most significant cost factor in a rigorous health and safety program. The trend will probably continue. Health and safety compliance issues may involve strict health and safety requirements, including routine medical surveillance, preparation of health and safety plans, and employee training. Employees may not be able to work 8 hours per day if daily personnel and equipment decontamination is mandatory.

Other Regulatory Costs

In addition to the costs described above, there are QA, security, and other ES&H requirements that the project must consider.

6.4.3 Indirect Costs

Indirect costs are incurred by an organization for common or joint objectives that cannot be specifically identified with a particular activity or project. Indirect costs are those resources that need to be expended to support the activity or asset but that are also associated with other activities and assets. In other words, indirect costs are "Any costs not directly identified with a single final cost objective but identified with two or final cost objectives." Consequently, allocate indirect costs to an activity or asset based upon some direct cost element, such as labor hours, material cost or both (see Section 6.4.3.1)

Some typical indirect costs are:

- facilities, operating equipment, small tools, and general maintenance;
- temporary facilities (e.g., water, compressed air, and power);
- motor pool, camp, and aircraft operations;
- warehousing, transfer, and relocation;
- safety, medical, fire protection, and first aid;
- security;
- administration, accounting, procurement, and legal;
- personnel expenses, office supplies, and time reporting
- site-wide permits and licenses;
- contributions to welfare plans and signup/termination pay; and
- contract fee/profit, bond costs (performance and material payment).

> **NOTE:** Do not double count costs. For example, if acquisitions personnel are costed with the pilot plant activity ensure that this person is not also included as part of Indirect Costs.

6.4.3.1 Indirect Rates

The development of indirect rates is usually the responsibility of both the financial accounting organization and the cost estimator. Indirect rates should be developed in accordance with Cost Accounting Standards. The financial accounting organization determines rates for organizational overheads and general and administrative (G&A) cost, while the cost estimator usually estimates rates for project management, construction management, and subcontract costs. The estimator, however, should clearly understand how to allocate all indirect rates in the estimate to avoid duplication or omission, as well as document what is included in the indirect rates.

Indirect rates for work to be performed by contractors should be developed by the contractor for review and approval by DOE. Backup information that clearly describes how the indirect rates were developed should be provided to DOE and maintained by the contractor. Indirect rates should be evaluated and revised on a periodic basis as necessary.

Indirect rates estimated for subcontract work such as Architect/Engineer services, construction, and remedial actions should be estimated and documented at a level of detail appropriate to the type of cost estimate being prepared. There is no uniform standard for establishing indirect rates; a typical method for applying indirect rates calculates indirect costs as a percentage of a category of work. For example, quality control inspection could be estimated as 6 per cent of direct craft labor, consumable materials at 6 per cent of direct craft labor, and administrative support for engineering at 38 per cent of direct engineering, etc.

The basis for applying individual indirect rates will vary greatly depending on the specific costs included in the rate. Allowances for small tools or consumable materials would typically use the direct labor cost of the appropriate construction craft, operations or maintenance activities as its base. General and administrative cost is usually estimated using the sum of all direct and indirect costs for the specific items of work as its base. Indirect rates should be documented in detail so that what is included (and excluded) in each rate is clear. A separate line item in the estimate should exist for each rate used.

6.4.4 Escalation

Escalation costs change continuously following changes in: such as technology, availability of resources, and value of money (e.g., inflation).

Historical cost indices and forecast escalation indices have been developed to document and forecast changing costs. The use of an established escalation index is required to consistently forecast future project costs. To ensure proper use of an index, estimators must understand its bases and method of development.

Escalation is the provision in a cost estimate for increases in the cost of equipment, material, labor affected by continuing price changes over time. Escalation may be: forecasted, to estimate the future cost of a project based on current year costs; or historical, to convert a known historical cost to the present.

Although the forecasted and historical escalation rates may be used in succession, most cost estimating is done in current dollars and then escalated to the time when the project will be executed. This section discusses the use and calculation of escalation and historical cost indices. An example of the calculation and use of escalation can be found in Appendix F.

6.4.4.1 Forecasted Escalation Rates

Forecasted escalation rate*s* may be obtained from commercial forecasting services, such as Global Insight, which supplies its most current predictions using an econometric model of the United States economy. The forecast escalation index is the ratio of the future value to the current value expressed as a decimal.

Forecasted escalation rates are simply the percentage change from one year to the next, typically prepared for various groups, utilizing different sources of data. Because larger projects extend over several years, it is necessary to have a method for predicting budgets that must be made available in the future. This is where forecasted escalation rates are used. The current year cost estimate is divided into components and then multiplied by the appropriate escalation rate to produce an estimate of the future cost of the component. The future costs of these components are then summed to give the total cost of the project.

To properly apply escalation, the following data are required:

- reference date the estimate was prepared and base date of costs:
- escalation index, or cumulative rates, to be used (including issue date and index); and
- schedule, with start and completion dates of scheduled activities

Escalation could be applied for the period from the date the estimate was prepared to the midpoint of the performance schedule or the activity being escalated. There are many other more detailed methods of calculating escalation, but care should be taken not to make this calculation too complex. Remember, someone external to the project may need to review this calculation. Regardless of the method used, the process should be well-documented.

"Which comes first, contingency or escalation?" If a project includes a contingency that is based on risks, and those risks have associated costs, this may imply use of the same base-year dollars. And generally, performance periods can be associated with those risks within components, so, escalation may be applied to contingency. However, if contingency is not easily discernable by WBS element (or cost elements) or cannot be associated with a time period, it may not be appropriate to escalate contingency. Also, the accuracy of an escalation forecast can also be considered a risk, with appropriate cost impacts that are then included in contingency allowances. *The cost estimate should ultimately represent total escalated costs, or "then-year dollars."*

6.4.4.2 Historical Escalation

Generally, historical escalation is generally easily evaluated. For example, the cost of concrete increased between 1981 and 2002. The ratio of the two costs expressed as a percentage is the historical escalation rate, or expressed as a decimal number is the historical cost index. Several commercial historical cost indices are available.

To properly apply a historical cost index to make price more current, the following data are required

- The prior cost or price, with a reference date, such as an actual price for a known project or a component. This cost or price may include direct material and/or labor cost, and it should be known to what extent indirect costs (sales taxes, freight, labor burden, etc.), overheads, and profit were included.
- An applicable historical cost index.

6.4.4.3 Escalation Calculations

Most costs are estimated in "current dollars" and then escalated to the time when the work is expected to be performed. The escalation rates are used for developing project performance baselines. Rates should be evaluated for global, regional, and local conditions; should have a maximum period of 1 year; and should be clearly documented including the basis.

The following are some suggested sources of major indices and escalation (recognized by industry best practices).

- U.S. Department of Labor, Bureau of Labor Statistics, Inflation & Prices, http://www.bls.gov/bls/inflation.htm
- U.S. Department of Labor, Bureau of Labor Statistics, Contract Escalation, http://www.bls.gov/bls/escalation.htm
- Engineering News Record, Economics, http://enr.construction.com/economics/
- RSMeans, Cost Books, http://rsmeans.reedconstructiondata.com/CostBooks.aspx
- RSMeans, Market Analytics, http://rsmeans.reedconstructiondata.com/MarketAnalytics.aspx
- The Richardson Construction Estimating Standards, http://www.costdataonline.com/
- IHS Global Insight, http://www.ihsglobalinsight.com

6.4.5 Contingency

This section is compatible with the guidance provided in DOE G 413.3-7A, *Risk Management Guide*, dated January 2011, for the consistent use and development of Contingency and Management Reserve (MR) in capital asset projects cost estimates. Contingency and MR are project cost elements directly related to project risks and are an integral part of project cost estimates. For further detailed guidance and examples of calculations refer to DOE G 413.3-7A.

The specific confidence level (CL) used to develop a project performance baseline estimate is determined by the project's FPD/IPT and approved by the Acquisition Executive. The project confidence level should be based on but not limited to the project risk assumptions, project complexity, project size, and project criticality. At a minimum, it is recommended that project performance baselines should be estimated, budgeted, and funded to provide a CL range of 70 - 90 percent for DOE capital asset projects. FPDs should confirm with their program sponsor whether additional guidance is to be provided. The CL for Major Items of Equipment may be significantly different from the construction of conventional facilities that will house the equipment. If a project has an approved performance baseline change, the FPD should consider reanalyzing the risks at a higher CL for budgetary requests and funding profiles to ensure project completion.

The DOE G 413.3-7A defines four categories of contingency, each of which is briefly described below:

- DOE contingency budget is identified as funded contingency for use by the FPD. Contingency is the risk based, quantitatively derived portion of the project budget that is available for managing risks within the DOE performance baseline. At a minimum, it is recommended that DOE capital asset project costs should be estimated to provide a CL range of 70 - 90 percent.

- DOE schedule contingency is the risk-based, quantitatively derived portion of the overall project schedule duration that is estimated to allow for the time-related risk impacts and other time-related project uncertainties. It is recommended that project schedule contingency should be estimated to provide a CL range of 70 - 90 percent.
- Contractor MR budget is the risk-based quantitatively derived portion of the contract budget base (CBB) that is set aside for management purposes to handle risks that are within the contractor's contractual obligations. Once the CBB has been established, it is allocated to MR and the Performance Measurement Baseline (PMB). The MR is not intended to justify a post contract increase to the CBB. MR is maintained separately from the PMB and is utilized through the contractor's change control process. MR is not used to resolve past variances (positive or negative) resulting from poor contractor performance or to address issues that are beyond the scope of the contract requirements. Use of MR should follow EVMS rules as per ANSI/EIA-748A.
- Contractor schedule reserve is the risk-based quantitatively derived portion of the overall contract schedule duration estimated to allow the contractor time to manage the time-related impacts of contractor execution risks and other contractor duration uncertainties within the contract period. Contractor schedule reserve does not add time or schedule duration to the contracted end date.

The quantitative method used to analyze project contingency and MR should consist of objective analysis of cost and schedule estimate uncertainties and discrete project risks. The analysis should aggregate the probability and consequences of individual risks, and cost and schedule uncertainties to provide an estimate of the potential project costs.

The quantitative risk analysis determines a risk-based project budget and completion date using statistical modeling techniques such as Monte Carlo, Quasi-Monte Carlo, sensitivity simulations, and other stochastic methodologies depending upon the project data.

While the Monte Carlo simulation is one standard used by DOE, alternate forms of quantitative analysis may be used. Other recognized forms of quantitative analysis include: decision trees, influence diagrams, system dynamics models, and neural networks. Figures 6-4 and 6-5 show the typical components of the DOE project performance baseline.

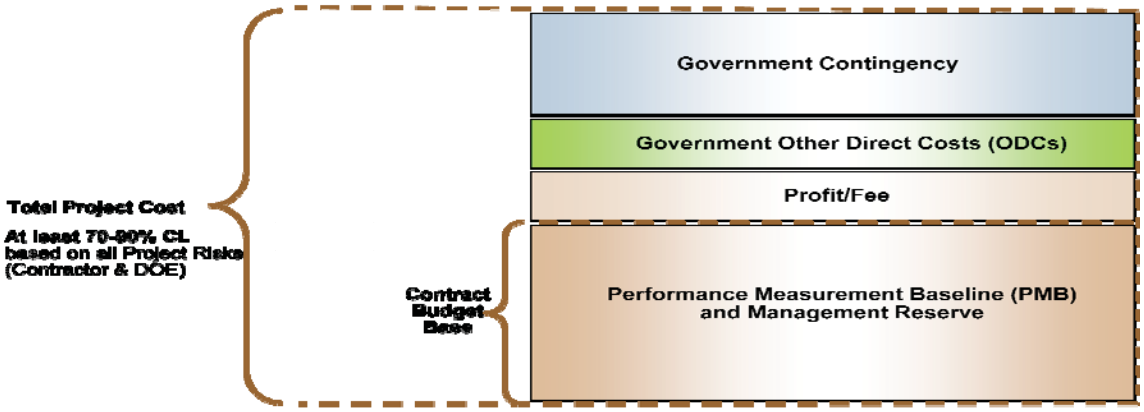

Figure 6-4. Total Project Cost Composition. ***Note: CL = Recommended Confidence Level***

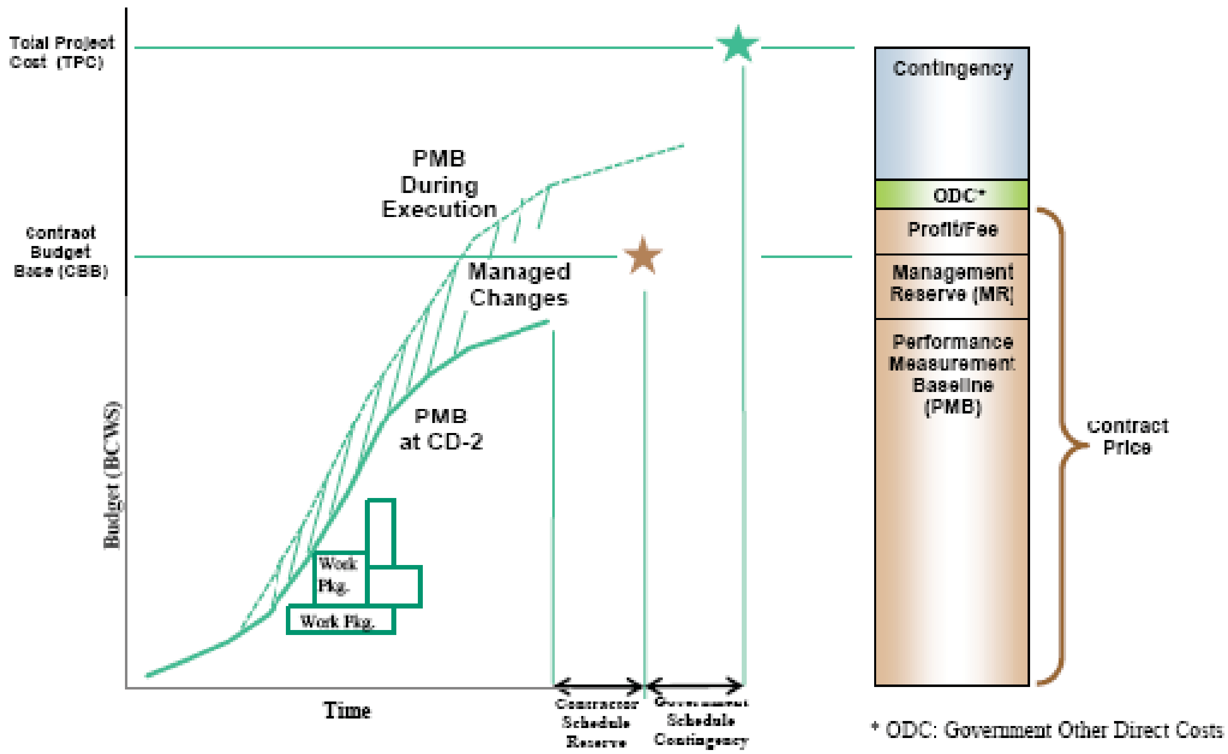

Figure 6-5. DOE and Contractor Budget Baseline

6.4.5.1 Quantitative Contingency Analysis

DOE O 413.3B requires that DOE project estimates be developed based on qualitative and quantitative analysis of project risks and other uncertainties. The DOE qualitative and quantitative analysis process begins in the project's planning stage with the identification of project risks during the initial project planning phase prior to the first CD point (approval of mission need). After CD-0, project development and planning documentation are prepared that includes the initial Risk Management Plan (RMP). During this phase of the project, development of the project risk register is initiated with the identification of potential project risks and enabling assumptions.

At CD-1, the baseline scope is refined enough to develop a preliminary baseline cost range and schedule. The RMP continues to evolve as the project scope is refined, new risks are added to the risk register and existing risks are re-examined and the project knowledge base increases. In preparation for the CD-2, the performance baseline estimate is refined to include costs to be incurred in executing the risk handling strategies. The baseline estimate is also evaluated, and adequate contingency allowance incorporated, to determine the project budget needed to provide an appropriate CL so that the project execution will be successful as defined in DOE O 413.3B.

This document assumes Monte Carlo methodologies will be used to develop the cost and schedule baselines. The diverse and unique nature of DOE projects characterized by an assortment of distinct technologies, physical locations, project duration, and project size has a significant impact on the risk profile that makes it impossible to establish a prescriptive procedure or single quantitative risk model for determining a project's contingency needs. Consequently, only a basic framework is used to outline considerations essential in the development of DOE contingencies.

6.4.5.2 Cost and Schedule Risk Models

Contingency risk models are used to evaluate the probability and effects of risk impacts, and estimate uncertainties on project cost and schedule performance baselines. The results of the risk analysis are used to establish the cost and schedule contingency needed to provide a suitable confidence level for DOE project success. The analyses may use one or more risk models to evaluate the cost impacts and the associated schedule impacts.

For each risk, a percent or percentage distribution is assigned to the probability (the likelihood of the risk occurring), a dollar value or dollar value distribution is assigned to the cost impact, and a schedule duration impact or schedule duration distribution is assigned to the affected activity in the schedule.

In general the concept is implemented as:

$$EV = \sum P_{Ri} \text{ x } CI_{Ri} \text{ (or } SI_{Ri}\text{)}$$

Where: EV = Expected Value of cost impact (or duration impact) of all risks
P_{Ri} = Probability distribution function of a risk occurring
CI_{Ri} = Cost Impact distribution function of a risk occurrence
SIRi = Schedule Impact distribution function of a risk occurrence.

[**Note**: $\sum$ is not the summation of individual expected values for each risk, but represents a stochastic process (e.g., Monte Carlo simulation) using the collective probabilities and cost/schedule impacts for all identified risk events.]

Figure 6-6 is a sample from a DOE construction project risk register showing the residual risk data elements used for modeling the probability of occurrence (probability percentage) and the triangular distribution representing a three-point estimate of the anticipated range of cost and schedule impacts (the assumption in this example is of a triangular distribution of cost and schedule impacts; other distributions can be used, such as step, rectangular, etc.).

Risk #	Owner	Risk Description	Residual Risk									
			Likelihood	Consequence	Risk Score/Rank	Probability (%)	Cost Impacts ($)			Schedule Impacts (Days)		
							Best Case	Most Likely	Worst Case	Best Case	Most Likely	Worst Case
T47	Federal	Nonperformance of contract to provide shielded overpack containers leads to project delays and cost.	Unlikely	Significant	Moderate	40	850,000	3,000,000	6,000,000	0	0	0
T52	Federal	Overnight organizations interpret requirements different than implementation, leading to cost and schedule impacts.	Likely	Significant	Moderate	60	--	3,000,000	6,000,000	0	30	90
T12	Contractor	Failure of crane results in delayed removal of canisters, impacting schedule.	Unlikely	Marginal	Low	40	100,000	200,000	1,400,000	1	2	14
T61	Contractor	Calibration services are unavilable causing shut down of operations.	Very Unlikely	Marginal	Low	10	100,000	410,000	715,000	1	4	7
T266	Contractor	Hot cell cannot be designed to meet active ventilation strategy increasing design and construction costs.	Very Unlikely	Critical	Moderate	10	3,200,000	7,000,000	20,000,000	30	60	150

Figure 6.6. Sample Risk Register

The results of Monte Carlo analyses are generally summarized by a probability distribution function (PDF) and a cumulative distribution function (CDF), as shown in Figure 6-7. The PDF represents the distribution of the analytical model outcomes. As an example, the Monte Carlo analysis may be designed to estimate the cost or duration of a project. The PDF represents the number of times a certain cost or duration is achieved. The CDF is a statistical function based on the accumulation of the probabilistic likelihoods of the analytical analysis. In the case of the DOE risk analysis, it represents the likelihood that at a given probability the project cost or duration will be at or below a given value. As an example, the x-axis might represent the range of potential project cost values evaluated by the Monte Carlo simulation, and the y-axis represents the project's probability of success.

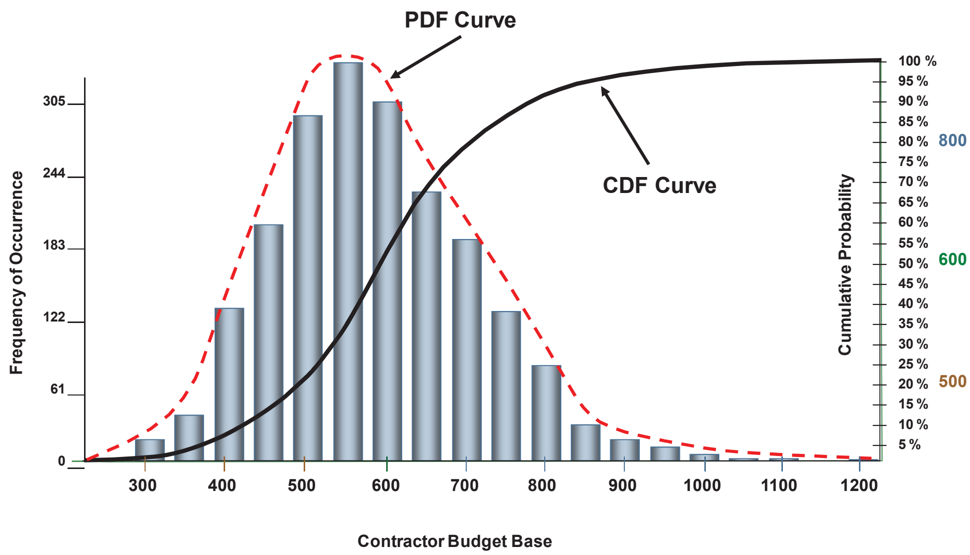

Figure 6-7. Sample PDF and CDF Curves

An advantage of an integrated cost and schedule risk model is the ability to capture schedule-related costs impacts, such as LOE support activities that increase project costs as schedule-related risk impacts delay or extend work efforts. Ideally, the integrated risk model is based on a life-cycle resource-loaded critical path schedule to which cost and schedule risks and cost and schedule uncertainties are applied. Integrated risk models increase the flexibility of the risk analysis and reduce the amount of manual coordination needed to model cost and schedule risk impacts.

Project risks and the associated cost and schedule impacts are the primary inputs to the risk model and are maintained within the project's risk register. Figure 6-8 depicts a conceptual risk model showing typical inputs and outputs.

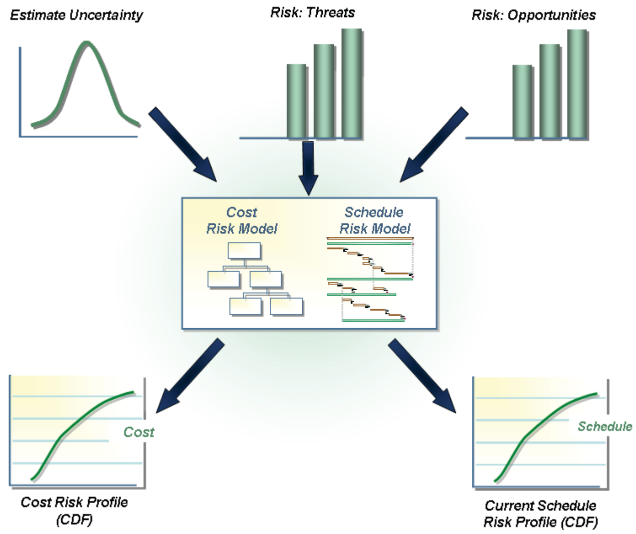

Figure 6-8. Conceptual Risk Analysis Process

An important consideration when identifying project risks is the careful analysis of the assumptions upon which the cost estimate and schedule are predicated. Each assumption made by the estimator, scheduler, or the project team should be analyzed by the IPT to determine if there is a risk (threat or opportunity) that the assumption may not be valid or representative of the actual conditions realized during project execution. In such cases, the probability of alternative situations should be assessed and the impacts of those situations occurring should be quantified and analyzed. These impacts can be an important element in both the cost and schedule risk models and the determination of cost and schedule contingency allowances appropriate for the project.

For example, if the estimate is based upon an assumption of full and open competition for the construction contract, with a suitably large number of bidders, and with incentive clauses built into the contract for schedule completion, it is likely that there will be fairly low contractor markups included in that estimate for the contractor's overhead and profit adders. If the actual bidding documents then require a small business award, and even include a liquidated damages clause for missing schedule milestones (rather than incentives), the actual contractor markups will most likely be significantly higher than had been estimated. In such a case, the baseline will not be adequate unless appropriate cost and schedule contingency allowances had been included because the threat of this alternative approach had been identified and modeled.

It should also be noted that Monte Carlo simulations are based on estimates of probability of occurrence and estimated impacts when risk events do occur. As such, the quality of the output is dependent on the quality and accuracy of these inputs. Inaccurate estimates of either probability or impact will lead to erroneous project probability outputs and misstatement of needed contingency allowances and/or CL.

Another issue that can lead to poor Monte Carlo analysis results is a failure to identify significant project risks. Only if all significant risks are identified and properly evaluated can the Monte Carlo model be expected to provide realistic forecasts of project outcomes and the contingency allowances needed to achieve the desired CL.

6.4.5.3 Cost Risk Model

DOE capital asset projects should be estimated to provide a CL which is adequate to support project success and reflects evaluation of all project risks, with reasonable estimates of cost and schedule impacts. Risk models should include all risks (DOE, contractor and subcontractor assumed risks). The risk cost model should provide an estimate of the performance baseline with a CL range of 70 - 90 percent for success (recommended), which includes the contractor's CBB, profit/fee, and government contingency and other direct costs. The contractor MR is determined by the contractor and represents the amount of the CBB that will be used for project management purposes for accomplishing the work scope within the contractor's PMB.

When developing risk models, care should be exercised to assure the risk models are developed using appropriate performance baseline information and project risk assumptions.

The recommended cost risk model should:

- Include all risks, especially significant risks;
- Use reasonable estimates of cost impacts;
- Include estimate uncertainties (cost and schedule) that are within the project baseline;
- Contain enough detail to allow identification of risk owners;
- Contain enough detail to allow project risks to be associated with the WBS they affect;
- Include a provision for uncertainty ranges in cost escalation rates for the project;
- Allow correlated risks that affect multiple cost elements, e.g., escalation rates, to be modeled at a high level to preserve the dependent relationship among correlated risks;
- Include sufficient information to estimate costs associated with uncertainties in task durations consistent with the schedule risk model;
- Allow for inclusion of threats and opportunities; and
- Allow risk impacts to be placed in the appropriate fiscal year to support the identification of annual contingency budgeting and reporting requirements.

6.4.5.4 Schedule Risk Model

Schedule risk models should be based on the project performance baseline schedule. If practical, the schedule risk model should be developed to include the schedule impacts of all risks that impact the project, as well as any schedule duration uncertainties.

The recommended schedule risk model should:

- Include all significant risks;
- Use reasonable estimates of schedule impacts;
- Contain enough detail to allow identification of risk owners;
- Contain enough detail to distinguish among schedule activities that have different degrees of schedule uncertainty and should include estimate uncertainties;
- Contain enough detail to allow specific risk events to be associated with the schedule activity that they affect;
- Estimate the schedule impact on LOE activities so cost increases associated with

schedule slippages can be calculated and incorporated into the contingency estimates; and

- Allow for alterations in activity duration that result from implementation of risk handling strategies or opportunities.

6.4.5.5 Estimate Uncertainty

Estimate uncertainty is part of the risk analysis process for the development of contingency estimates as was illustrated in Figure 6-8. Estimate uncertainties are fundamental contributors to cost growth and are expected to decrease over time as the project definition improves and the project matures. Estimate uncertainty is a function of, but not limited to, the quality of the project scope definition, the current project life-cycle status, and the degree to which the project team uses new or unique technologies. Estimate uncertainties occur throughout the DOE baseline. One approach to account for estimate uncertainty is to use uncertainty ranges established by the professional societies such as the Association for the Advancement of Cost Engineering International (AACEI), Table 6-2, or other estimating guidance. Estimate uncertainty contributes to both cost and schedule contingency. Table 6-2 could be used for both cost and schedule estimate uncertainty and should be done separately for evaluating quantitative impacts on project contingency.

Class of Cost Estimate	Estimate Uncertainty (Low Range)	Estimate Uncertainty (High Range)
Class 5 – Concept Screening	-20% to -50%	+30% to +100%
Class 4 – Study or Feasibility	-15% to -30%	+20% to +50%
Class 3 – Budget Authorization	-10% to -20%	+10% to +30%
Class 2 – Control or Bid	-5% to -15%	+5% to +20%
Class 1 – Check Estimate	-3% to -10%	+3% to +15%

Table 6-2. Estimate Uncertainty Range as a Function of Estimate Class

6.4.5.6 Determining Cost Contingency Amounts

A common method to evaluate risk model results is the use of CDF curves, also referred to as S-curves. For a cost risk model, the S-curve represents the probability of completing the project at or below a given project cost baseline. In this example the x-axis represents the range of potential project cost values estimated by the Monte Carlo simulation and the y-axis represents the probability of project success. Figure 6-9 illustrates two S-curves for a hypothetical project. The S-curve on the left is based on the CBB and the S-curve on the right is for the DOE capital asset project performance baseline and includes both the contractor and DOE risks.

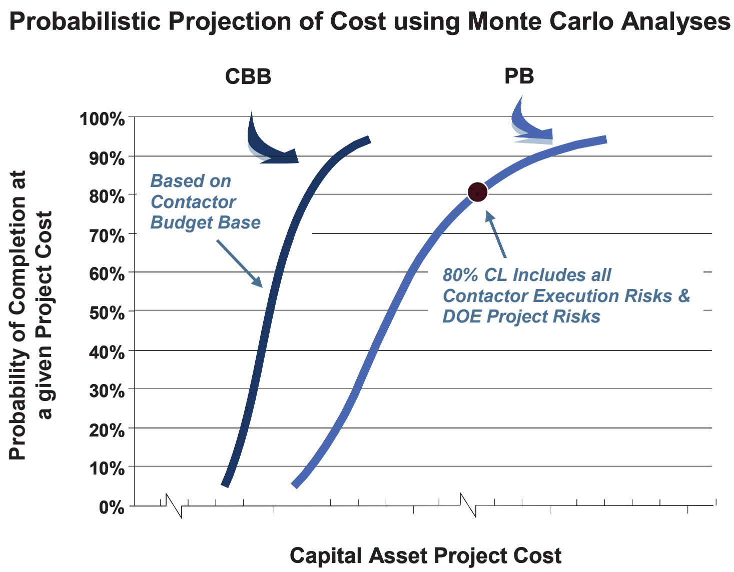

Figure 6-9. S-Curves of Contractor CBB and DOE Performance Baseline

6.4.5.7 Determining Schedule Contingency

The DOE schedule contingency is based on the same risks used in the development of the DOE cost contingency. The DOE schedule contingency requirements should be analyzed using a resource-loaded and logically tied schedule, so that impacts to overall schedule duration along the critical path can be fully assessed. As risks and uncertainties are realized, the critical path for the project may possibly change; the model needs to accommodate such situations.

Schedule activities that are affected by an identified risk or duration uncertainty are modeled in the schedule risk analysis with an appropriate probability distribution. The calculation of schedule contingency is an iterative process requiring an initial analysis of the schedule to determine the base schedule contingency values followed by a revision of the schedule to adjust work scope to meet the existing selected key milestones and deliverable dates.

DOE schedule contingency needs to be added to the overall critical path of the project. This can be completed by applying the DOE schedule contingency incrementally before key milestones or in total before the project completion date. In this way, forecasted completion dates (individual milestones and/or overall project) can be established based on a probabilistic determination of the expected completion date should project risks be realized. This differs from contractor schedule reserve, which cannot add time or schedule duration to the contracted end date.

6.4.5.8 Risk Model Outputs

To support the required budgeting, management, and reporting requirements of the project, the contingency analysis should provide the following:

- The contingency analysis models should be able to produce a PDF and a CDF for the project.
- The contingency analysis models should be able to produce a PDF and a CDF for each

selected milestone.

- The models should be capable of performing a sensitivity analysis for project cost and schedule elements. Risk analysis sensitivity results are typically presented as tornado diagrams that provide an analytical and visual representation of risk event impacts.
- Ideally, the model should place resulting contingencies in a time frame to allow for fiscal year budgeting of DOE contingency. Figure 6-10 illustrates how contingency budget projections can be depicted.

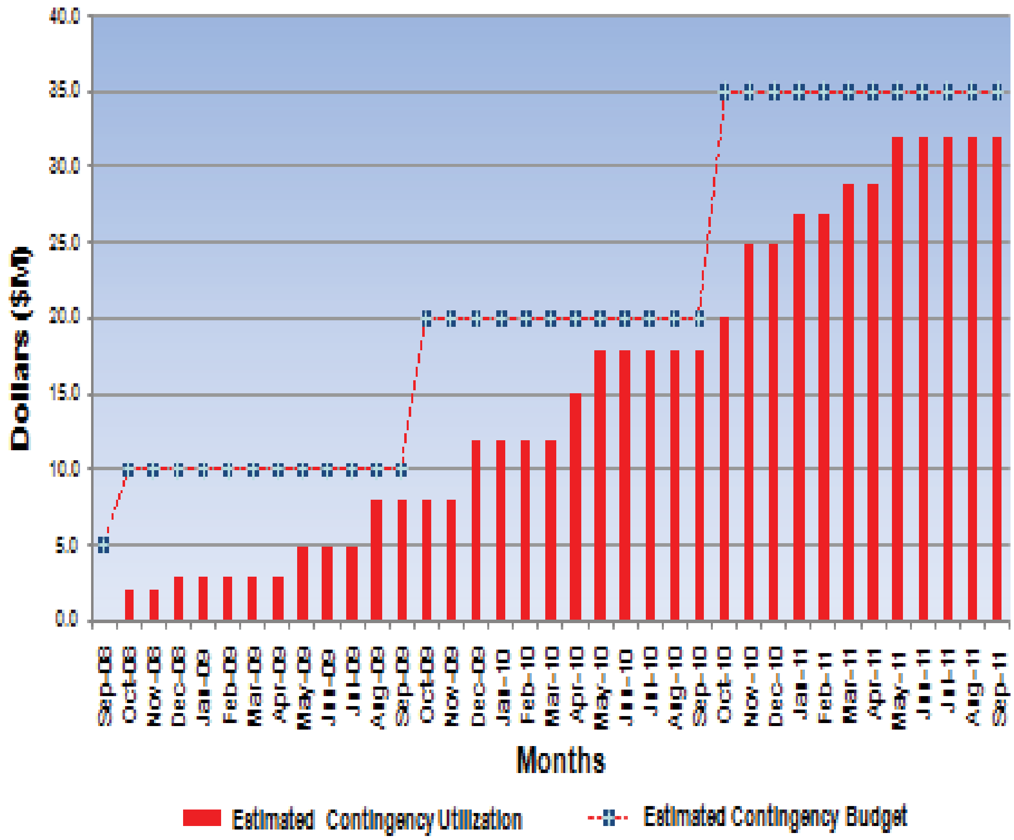

Figure 6-10. Contingency Budget Projection

6.4.5.9 Unknown-Unknowns

Because there may not be viable means to quantify certain "unknown-unknowns", IPTs may not be expected to set aside contingency for them. Unknown-unknowns could be major schedule changes or unknown design factors, unanticipated regulatory standards or changes, additions to project scope definition (changes outside a project's intended scope), *force majeure* situations, or program budget reductions. These may be considered *programmatic risks*, which could be applicable to all projects within a respective specific Program.

However, there should be clear communication between the project team and their sponsoring Program to communicate and agree to the bounding assumptions for the project. Furthermore, Programs are advised to include appropriate allowances for programmatic contingencies (for risks and events that occur outside project space but that may in fact impact on project execution) in their overall portfolio budgets.

6.4.5.10 Contingency Adequacy Evaluation

Numerous tools exist to analyze the adequacy of the contingency valuation that has resulted from the qualitative and/or quantitative analysis of the risks. Various costs estimating guidance documents have been compiled by industry and are available in texts and journals (e.g., AACEI), and are updated on a regular basis. These references provide percent ranges of the base that a contingency should represent in order to be considered adequate. Further, the contingency value should be commensurate with the maturity and type of the project, project size, and risks, including technical and technology uncertainties. It should be cautioned that the recommended contingency levels in these documents do not provide a basis for the recommended confidence levels (70 – 90 percent) in this Guide for the derivation of contingency and management reserve by quantitative risk analysis.

If a quantitative risk analysis will not be conducted, estimates for cost and schedule contingency should be provided. As a general rule, the IPT should use various inputs to determine those values. Those inputs may be, but should not be limited to:

- Historical records (considering actual costs and time impacts for certain events)
- Subject matter experts
- Employing Delphi techniques.
- Interviewing staff, crafts, retirees, and others familiar with similar work activities at the site or similar sites.
- Technical records such as safety analysis documents including the risk and opportunity assessment, quality assessments, and environmental assessments.

As the information is gathered and finalized, the data should be analyzed for bias and perception errors. While the data will not be systematically used for a quantitative analysis, it should still be analyzed and perceptions scrutinized.

6.5 Cost Estimate Review

Cost estimates should be reviewed for quality and reasonableness before release. Reviews can be either objective, subjective, or a combination of both. As a minimum, *all* estimates should address the review criteria listed in Appendix E.

DOE cost estimates, and the Basis of Estimate (BOE) that supports them should include an assessment of cost realism and reasonableness. In an effort to test the reasonableness and realism of a cost baseline, there needs to be an assessment of the overall cost baseline from the perspective of the primary cost elements that comprise the baseline. Such an assessment evaluates the relative percentages of the total proposed cost baseline and the underlying BOE for each of the significant cost elements. Additionally, primary cost drivers within the estimate consistent with a product oriented WBS, should be identified and compared to established benchmarks for similar items or activities.

Such efforts will facilitate independent reviews of cost estimate reasonableness by competent qualified personnel who have not been involved in preparing the estimate. This review should provide an unbiased check of the assumptions, productivity factors, and cost data used to develop the estimate. An independent cost review is a vital step in providing consistent, professionally prepared cost estimates (Step 7, GAO 12 Key Steps Development Process, GAO-09-SP). The review should be documented to indicate:

- The name of the reviewer(s) – Office/Agency/Contractor it belongs
- The date of the review
- Review comments and comment disposition

6.6 Estimate Reconciliation

Reconciliation may be necessary to account for changes made between CDs or other life-cycle project milestones. Reconciliations should be organized by WBS and cover all aspects of project documentation (cost estimate, basis of estimate, schedule, and risks). In general, reconciliation should recognize or focus on specific changes in scope, basis of estimate, schedule, and risks. There should be an understanding that, as time progresses, more and better information is expected to be available and used as project or cost estimate documentation. Reconciliations are necessary to mitigate budget shortfalls and may be used to correct deficiencies identified during internal or external reviews.

6.7 Cost Estimate Documentation

Well-documented cost estimates are considered a best practice for high-quality cost estimates for several reasons.[12]

- First, complete and detailed documentation is essential for validating and defending a cost estimate.
- Second, documenting the estimate in detail, step by step, provides enough documentation so that someone unfamiliar with the program/project could easily recreate or update it.

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[12] GAO-09-3SP

- Third, good documentation helps with analyzing changes in program costs and contributes to the collection of cost and technical data that can be used to support future cost estimates.
- Finally, a well-documented cost estimate is essential if an effective independent review is to ensure that it is valid and credible. It also supports reconciling differences with an independent cost estimate, improving understanding of the cost elements and their differences so that decision makers can be better informed.
- Whenever possible, documentation should be organized into an indexed repository, either physical or digital, with a document control plan and, preferably, a documentation engineer/administrator. To the extent practical, the documentation index should be consistent with the WBS for the project for ease of reference.

6.7.1 Cost Estimate Package

A cost estimate package or report should be prepared for all cost estimates. Each estimate package should contain the same categories of information and the same types of documentation; only the level of detail in the estimate package varies. The contractor in coordination with the IPT determines the format used to present this information. A cost estimate package or report supporting baselines, management decisions, and budgetary documents should include the following information. A graded approach to cost estimate packaging and reporting should be used when documenting cost estimates for other purposes.

- **Estimate Purpose Statement**—the reason the estimate was prepared including
  - Determine the estimate's purpose
  - The level of detail required
  - Determine who will receive the estimate
  - Identify the overall scope of the estimate

- **Technical Scope Summary**—summary of the technical scope of the project including what is included in the project as well as what is not included.

- **Qualifications and Assumptions**—the key project qualifications and cost assumptions that provide a "bounding" of the estimate and scope. Specifically, the assumed condition under which the estimator believes the project work scope will be performed should be defined. The qualifications and assumptions may describe the types of work expected, the amount of work expected, the source of various materials, conditions in which the work is to be performed (winter, contaminated building, etc.), and any other information that significantly influences the estimate but is not clearly identified in the technical scope description. Major assumptions and exclusions that affect the project or the accuracy of the estimate are also described.

  In completing this activity, the estimator should identify areas where work scope descriptions have deficiencies, or where key information is missing and has to be assumed. Vital information concerning the project is also identified for those reviewing or using the estimate.

Qualifications and assumptions should be described and documented at the most detailed level practical, and they should be clearly described so an individual not intimately involved with the project can understand the estimate's basis.

- **Overall Basis of Estimate (BOE)**— The dollar amount indicated in a cost estimate is meaningless without understanding the quality of information that led to developing the estimate. With all estimates, the basis is communicated at a higher level in a summary document and at a more specific level within the estimate.

  Include in the estimate package a high level summary explaining the genesis for the source information for the estimated resources and a breakdown of cost estimate basis. For example, 30% is vendor quote, 20% engineering judgment, 30% historical data, and 20% cost database/cost books.

  The basis should also describe the design basis, the planning basis (significant features and components, proposed methods of accomplishment, and proposed project schedule), the risk basis, supporting research and development requirements (important when new technologies are contemplated for certain components, equipment or processes), special construction or operating procedures, site conditions, the cost basis, and any other pertinent factors or assumptions that may affect costs.

  If the estimate is prepared in support of another formal document that addresses these issues (i.e., a Conceptual Design Report or definitive design document), separate documentation is not required. If the estimate is a standalone document, or deviates substantially from a previous estimate scope, the above issues should be addressed and included in the estimate basis.

- Estimate Summary and Detail Reports—a presentation of the estimate details in a variety of ways (e.g., sorted by labor type, by WBS etc.)

- Technical Scope Detail—a statement of the details of the technical scope necessary for a thorough understanding of the work. This ma**y be by reference to s**pecific technical documents.

- **Estimate Specific WBS and WBS Dictionary**—a decomposition of the organization and related cost estimates.

  The initial basis for any cost estimate should be documented at the time the estimate is prepared. The basis should describe or reference the purpose of the project element, the design basis, the planning basis (significant features and components, proposed methods of accomplishment, and proposed project schedule), the risk basis, supporting research and development requirements (important when new technologies are contemplated for certain components, equipment or processes), special construction or operating procedures, site conditions, the cost basis, and any other pertinent factors or assumptions that may affect costs.

If the estimate is prepared in support of another formal document that addresses these issues (i.e., a Conceptual Design Report or definitive design document), separate documentation is not required. If the estimate is a standalone document, or deviates substantially from a previous estimate scope, the above issues should be addressed and included in the estimate basis.

At the WBS level, include quantities, applicable rates and costs. Also, include sources of information, such as historical costs, industry standards, published price lists; cost databases, informal budgetary information, cost estimating relationships, etc. for the WBS.

At the WBS level, include the resource and Crew Listing—a listing of the type of resources used in the estimate.

- **Method and Justification for Use of Indirect Rates**—an explanation of how indirect rates were selected and applied.

- **Method and Justification for use of Allowances**—an explanation of how allowances were determined and applied.

- **Method and Justification for use of Escalation**—an explanation of the escalation rates used, how they were obtained, why they were selected and how they were applied.

- **Schedule**—a time-frame for the work to assist in understanding how escalation was applied. The schedule should reflect the same technical scope and cost as the estimate.

- **Risks**—discuss sources of risk and uncertainty, including critical assumptions, associated with the estimate. Identify major risks within the scope of work and how those risks are mitigated. The basis for contingency reserves and how they were calculated is fully documented.

- **Sensitivity Analysis**—describes the effect of changing key cost drivers and assumptions independently. Identifies the major cost drivers that should be closely monitored.

- **List of Participants**—a list of contacts for questions about the estimate. Estimate preparers and reviewers should be identified in the cost estimate documentation.

- **Documentation of Review and Approval**—evidence that the estimate was reviewed and approved.

- **Location of Estimate Files and Reference Information**—a location to obtain copies of the estimate, review the original, and review information that was not included in the estimate package. The cost estimate package should include documentation providing the location of the estimate, historical data, technical scope, worksheets and any other pertinent information used to prepare the estimate.

- **Documentation of Changes to the Estimate**—clarification of how and where the estimate was changed, eliminating the need to review the entire estimate. Cost estimates should be updated or modified as necessary. Updates should be promptly documented when significant changes occur.

6.7.2 Cost Classification

A specific definition of items to be included as direct costs and indirect costs should be included at the discretion of the DOE program offices and field offices and/or determined by their contractor's financial system. This would also apply to activities under either Other Project Costs (OPC) or Total Estimated Cost (TEC) (refer to DOE O 413.3B for definitions and requirements for these terms as they apply to projects).

It is important to assure that there is no double counting of costs estimated as direct, indirect, or overhead. Generally, all cost estimates include

- direct costs,
- indirect costs,
- contingency, and
- escalation.

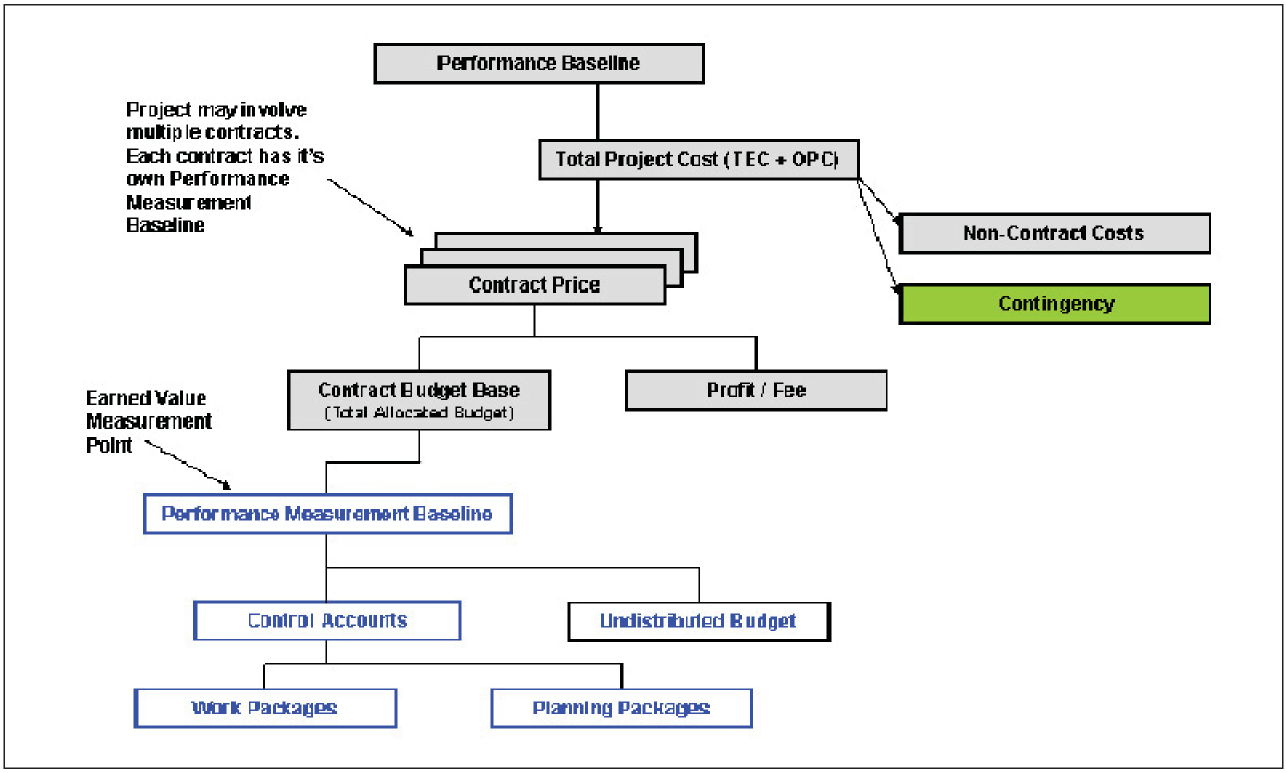


Figure 6–11. Contents of a Project Performance Baseline (Project Budget Allocations)

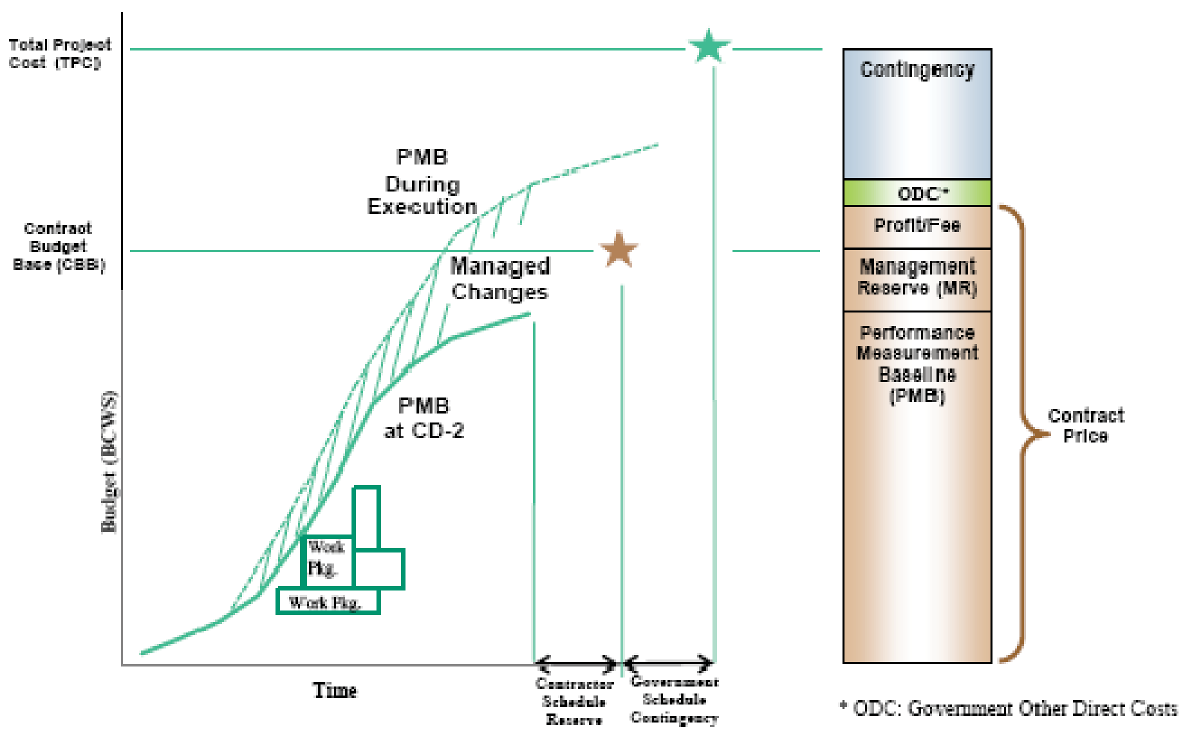


Figure 6-12. Typical Project Performance Baseline Including Cost and Schedule

6.8 Estimate Maintenance

It is important to maintain estimates over the life cycle of the project or program. For projects, the cost estimate is a key element in establishing the Performance Baseline, as depicted in Figures 6-11 and 6-12. The project cost performance baseline consists of a project's TPC, which includes various contract prices, non-contract costs, profit/fee, and contingency.

Project baselines in turn are key elements of overall program planning and budgeting, including portfolio management. As projects are identified and defined, and the cost estimates and baselines evolve, they become key inputs into the management of the program's life cycle. This may involve multiple projects and/or operational activities (e.g., construction of facilities to treat waste, decommissioning of treatment facilities, waste management, surveillance and maintenance). As such, active maintenance of all estimates is essential – they need to reflect the latest and most realistic projections of cost and resource requirements to facilitate effective program planning.

The need to make changes to a cost estimate generally results from determining that the estimate no longer accurately portrays the expected cost for the work. The means to formally control changes to a cost estimate are dependent on the purpose of the estimate. Estimates supporting project baselines must be changed and approved through a formal baseline change process (refer to DOE O 41.3.3B, Appendix A, Section 6, Baseline Management).

Changes require documentation, and as each estimate is updated, modified, or revised, an audit trail must be maintained to show the relationship between the new estimate and the previous estimate. The reason(s) for each change should be identified and may include such things as modification of scope, unexpected increases in labor rates, schedule extensions, variance in escalation rates, project reprioritization, etc. All such changes should be identified in a manner that will permit verification of the specific quantitative change(s) in the cost estimate. Changes may be documented by the use of addenda, officially approved change request documents, or by completion of a new estimate. The method used depends upon the magnitude of the estimated change and the underlying causes. All estimate changes should include the appropriate level of indirect costs, escalation, and allowances, as dictated by the phase of the project when the change was identified.

The process of officially revising and updating cost estimates supporting project baselines frequently involves the use of change requests. Change requests are the official means by which all changes to the cost baseline should be documented. Change requests are prepared using standard contractor procedures and forms, which describe proposed changes to approved technical, cost and/or schedule baselines.

As work is authorized to proceed, cost estimates become budgets. There is a distinction between budget allocations and cost estimates. The budget forms the basis for work execution.

7.0 COST ESTIMATING OUTPUTS

This Guide defines traditional output coming out of the Cost Estimating Process as shown in Figure 7.1. Outputs include, the traditional change control process, economic and cost-benefit analysis, value engineering, earned-value, and final project cost reports.

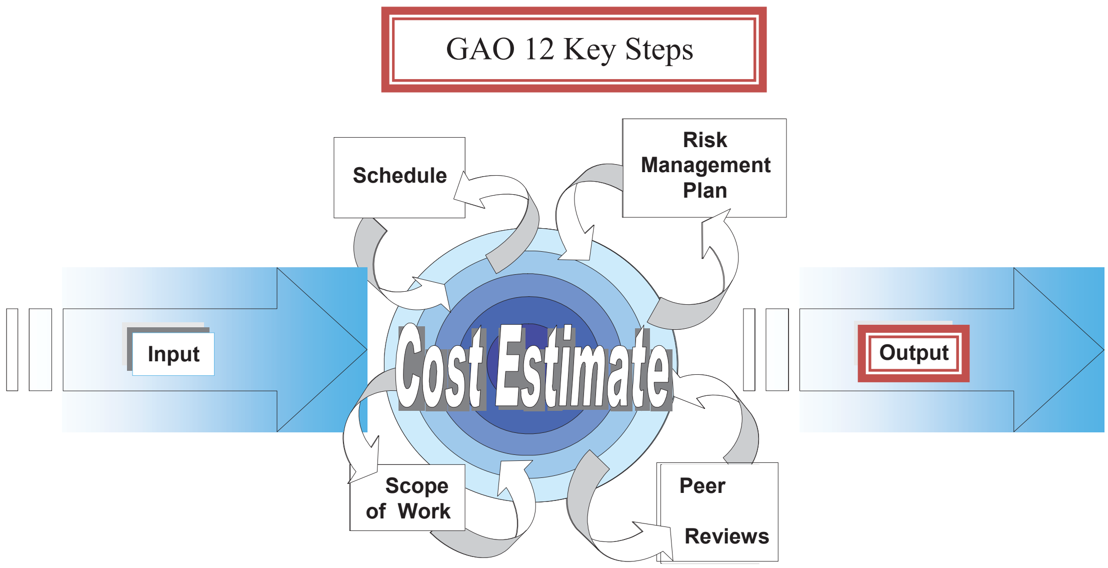


Figure 7-1. Cost Estimating Process Model

7.1 Cost Estimate Interfaces

Cost estimate development is initiated into a process through one-time or iterative inputs. Potential one-time inputs may include (but are not limited to) the project charter, project execution plan, acquisition strategy, and acquisition plan. All of these are inputs to the cost estimating process.

Other inputs may evolve through the cost estimating process and use the outputs from the cost estimating process, such as the risk assessment (primarily risk identification and impact assessment), schedule, and scope development. Input from cost estimating peers may improve the quality of a cost estimate, and peer reviews should be required before external reviews are conducted.

The cost estimate output provides a key interface to other project processes, including the planning/scheduling, project control, risk management, and project approval processes.

7.2 Estimate Presentations to Management

As discussed in Section 3, cost estimates are a primary input into the DOE decision-making and project approval CD process. As a result, a cost estimate is documented and presented to management with an understanding that the quality of the cost estimate adheres to such decisions and approvals. A graded approach to cost estimate packaging and reporting should be used when documenting cost estimates for other purposes. The following is recommended to be included in most presentations of cost estimates to management, whenever such presentations are necessary and warranted:

- Develop a briefing that presents the documented life-cycle cost (LCC) estimate;
- Include an explanation of the technical and programmatic baseline and any uncertainties;
- Compare the estimate to an independent cost estimate (ICE) and explain any differences;
- Compare the estimate LCC estimate or ICE to the budget with enough detail to easily defend it by showing how it is accurate, complete, and high quality;
- Focus in a logical manner on the largest cost elements and cost drivers;
- Make the content clear and complete so that those who are unfamiliar with it can easily appreciate the competence that underlies the estimate results;
- Make backup slides available for more probing questions;
- Act on and document feedback from management; and
- Request acceptance of the estimate.

In many instances, the results of sensitivity analyses should be presented to further management understanding of the reliability and accuracy of the presented cost estimate. Such analyses should focus on key cost drivers and critical assumptions and inform management of the resulting estimate result if those drivers or assumptions were changed. Usually ranges that can bracket potential estimate results are a useful management presentation approach; however, such bracketing must be clearly explained and the potential risks and uncertainties associated fully described for management's understanding.

7.3 Baselines and Change Control

Cost estimates are normally organized by a WBS, account code, and/or some other standardized definition. Standard definitions of direct and indirect costs provide consistency in estimating costs and project reporting. This also benefits program/project management, independent estimates (Government estimates), reviews, and contract/project validations and cost/price analysis. The cost portion of the performance baseline consists of a project's TPC, including various contract prices, non-contract costs, and contingency.

As projects evolve, baselines are established and changes are managed against those baselines. Cost estimates supporting proposed or directed changes should contain the same level of quality as the primary baseline cost estimate.

Baselines are expected to remain intact throughout the project execution from approval at CD-2 to completion at CD-4. Changes are expected to remain within the performance baseline as per the definition of a successful project at CD-4 in DOE O 413.3B. Cost estimates for the baseline project are modified (updated) when changes are approved.

7.4 Analysis

Analysis includes decomposition and examination. In many cases, analysis will provide insight to a decision maker. Such is the case of cost benefit analysis. Cost-benefit analysis is a required element in capital planning within the Federal government. In the contracting community, cost analysis or price analysis is a comparison of either costs or price, respectively (e.g., comparing a proposal to a government estimate). If a contract is competitively bid, cost analysis (which is more detailed and complex than price analysis) may not be required.

Analysis could be performed in the life of a project, including cost benefit analysis, cost-effective analysis, economic analysis, LCC analysis, sensitivity analysis and uncertainty analysis. Analyses supporting CDs should be structured and formal; i.e., well documented. Other analyses may be loosely structured and informal.

Normally, analyses require using similar cost estimate structures (i.e., separate cost estimates for each alternative considered); having all costs for all alternatives depicted; and comparing alternatives using net present value or annuities. Normally a written summary of the findings is also prepared to explain the analysis.

More information on parametric cost estimates, including the Parametric Estimating Initiative (PEI) Parametric Estimating Handbook, can be found through the International Society of Parametric Analysts (ISPA), at http://www.ispa-cost.org/

More information on cost estimating and analysis can be found through the Society for Cost Estimating and Analysis (SCEA), at http://www.sceaonline.net/

More information on cost engineering can be found through the Association for the Advancement of Cost Engineering International (AACEI), at http://www.aacei.org/

8.0 COST ESTIMATING EXPECTATIONS

This Section summarizes what could be expected from the use of DOE cost estimates for capital asset projects.

8.1 Summary of Expectations

A DOE cost estimate, regardless of purpose, classification, or technique employed, should demonstrate sufficient quality to infer that it is appropriate for its intended use, is complete, and has been subjected to *internal* checks and reviews. It should also be clear, concise, reliable, fair, reasonable, and accurate, within some probability or confidence levels. **In addition, it is expected to have followed accepted standards such as the GAO 12 steps of a high quality cost estimating process (GAO-09-3SP)**. There could be more expectations, depending on the program, project, contract type, specific budget requirements, or other situations.

Common elements of good cost estimates are expected to be constant. Suggested review criteria are summarized in Appendix E. DOE expectations for quality cost estimates are summarized in Appendix L.

Other expectations are associated with organization of the estimate. Types of cost elements included; resources, material, other direct costs, and sub-contract costs, structure the type of work embodied in the cost estimate. These coded costs facilitate development of management information and earned value assessments, and can provide extremely useful information as projects are completed. Industry standard codes are exemplified by the Construction Specifications Institute's Uniformat II and Masterformat, for construction projects. The environmental cost element structure (ECES), an ASTM standard for environmental projects, is another common coding structure. Some of these industry standard codes are listed in the appendices.

Other formats, such as project data sheets (PDSs) for budget formulation, should be produced, as necessary.

More information on the Uniformat II can be found at http://www.uniformat.com/index.html

More information on the Masterformat can be found at http://www.masterformat.com/

More information on the ECES can be found at http://www.emcbc.doe.gov/dept/ce&a/aceteam_eces.php

More information on DOE Budget Guidance with PDS sample and template, can be found at http://www.cfo.doe.gov/crorg/cf30.htm

More information on OMB's Exhibit 300 forms can be found in OMB A-11, Part 7 at http://www.whitehouse.gov/omb/circulars_all_current_year_all_toc

8.2 Lessons Learned

Lessons learned from experience are essential to structuring increasingly more accurate cost estimates. A reasonable expectation of a cost estimating process is that it systematically collects historical project information in real time, rather than being done at the last minute or by trying to recollect long after the fact.

Historical cost information can be collected as lump sum (representing some specific scope of work), unit cost, or productivity (hours per unit, or units per hour) information. Historical costs should be collected for analysis, normalization, and use in future project cost estimates. Lessons learned that can help cost estimators with future cost estimates may be generic in nature or specific to a site, location, contract type, etc. They may apply to a particular scope of work or a cost estimating technique. There are many ways to communicate lessons learned. The point is to document what has been learned from the experience and share it with others, as appropriate (DOE G 413.3-11, *Project Management Lessons Learned*, dated 8-5-08).

8.3 Independent Cost Estimates and Cost Reviews

The following requirements are described in DOE O 413.3B:

Prior to CD-0, for Major System Projects, or for projects as designated by the SAE, OECM will conduct an Independent Cost Review (ICR).

Prior to CD-1, for projects with a TPC ≥ $100M, OECM will develop an Independent Cost Estimate (ICE) and/or conduct an ICR, as they deem appropriate.

Prior to CD-2, for projects with a TPC ≥ $100M, OECM will develop an ICE. The ICE will support validation of the Performance Baseline (PB).

Prior to CD-3, for projects with a TPC ≥ $100M, OECM will develop an ICE, if warranted by risk and performance indicators or as designated by the SAE.

The definitions of ICR and ICE, as provided in DOE O 413.3B, are as follows:

Independent Cost Review. An independent evaluation of a project's cost estimate that examines its quality and accuracy, with emphasis on specific cost and technical risks. It involves the analysis of the existing estimate's approach and assumptions.

Independent Cost Estimate. A cost estimate, prepared by an organization independent of the project sponsor, using the same detailed technical and procurement information to make the project estimate. It is used to validate the project estimate to determine whether it is accurate and reasonable.

In addition to the specific requirements placed on OECM in DOE O 413.3B, a project may be well-served by having its own ICR or ICE completed at various points in the development and execution of the project, no matter the size of the project (for projects less than $100M). Comparison to an ICE is a key element in Step 7 of the GAO Best Practices.

Appendix K provides some specific guidance relative to ICRs and ICEs. All ICRs and ICEs should be developed by individuals or organizations that are truly independent of the project. This may be accomplished by issuance of contracts or task orders by OECM, through another DOE direct contract vehicle, or directly by other DOE organizations. However, it may not be generally appropriate for the project proponents (i.e., a DOE site office, a DOE program office, or a DOE contractor) to conduct, or to contract for, and direct an ICE or ICR development.

In general, the types of reviews that DOE normally recognizes (the types of reviews may be modified/combined by the size, technology and complexity of the project) are the following:

Documentation Review (Type I)—this type of review is not normally accomplished as an ICR/ICE, nor does it fulfill the requirements as specified in DOE O 413.3B, since it only consists of an assessment of the documentation available to support the estimate. It is merely an inventory of existing documents to determine that the required support documentation exists and to identify any missing data. This type of review can be beneficial for a project team facing an upcoming EIR or ICE, to ensure readiness to proceed with those activities.

Reasonableness Review (Type II)—this equates to the DOE O 413.3B ICR
For this review the ICR team reviews all available project documentation, receives briefings from the project team, holds discussions with the project team, completes sufficient analysis to assess the reasonableness of the project assumptions supporting the cost and schedule estimates, ascertains the validity of those assumptions, assesses the rationale for the methodology used, and checks the completeness of the estimate, including appropriate allowances for risks and uncertainties. The result is a report that details the findings and recommendations.

Parametric Estimating Approach (Type III)—this approach, in addition to incorporating all of the activities needed for a Reasonableness Review, uses parametric techniques, factors, etc., to analyze project costs and schedules, and is usually accomplished at a summary WBS level. The parametric techniques (including CERs and factors) should be based on accepted historical cost/schedule analyses. At a minimum, these tools should be based on historic estimates from which models have been derived, and, where possible, from actual completed projects. An estimate with a minimum of 75 percent of the TPC based on parametric techniques is classified as a parametric estimate.

Sampling Approach (Type IV)—this review also begins with the activities needed for a Reasonableness Review, but it also requires the ICE team to identify the key cost drivers. A "cost driver" is a major estimate element whose sensitivity significantly impacts TPC. Detailed, independent estimates should be developed for these cost drivers. Such estimates should include vendor quotes for major equipment, and detailed estimates of other materials, labor, and subcontracts. For the balance of the project costs, the project team's estimate may be used (if deemed reasonable), or, if appropriate, parametric techniques may be used for certain portions of the project costs. An estimate which provides a detailed cost for all cost drivers is classified as a Sampling Estimate.

Bottom-up Estimating Approach (Type V)—this is the most detailed and extensive ICE effort. It begins with the activities needed for a Reasonableness Review. In addition, this approach requires a detailed bottom-up independent estimate for both cost and schedule. This will require quantity take-offs/development, vendor quotations, productivity analysis, use of historical information, and any other means available to do a thorough and complete estimate of at least 75 percent of the project's cost. It may not be possible to do a completely independent estimate on some portions of the project estimate, and for those portions – which should not exceed 25 percent of the total estimate – the project estimate may be used if it has passed the test of reasonableness. In all cases, the total cost (TEC and TPC) should be developed.

ICEs will often involve a combination of the approaches and techniques described above, due to the varying levels and quality of information available. The accuracy of the ICE will be subjectively determined based on the weighted evaluation of the information available.

A key element of any ICE is a comprehensive reconciliation between the ICE and the project team estimate. Such reconciliation identifies areas of significant difference between the estimates and attempts to explain those differences. This information provides a useful basis for subsequent estimate (cost range or baseline) approval or identification of necessary estimate revision and refinement.

8.4 Independent Government Cost Estimates

As described in DOE O 413.3B, an Independent Government Cost Estimate (IGCE) is the government's estimate of the resources and projected costs that a contractor will incur in the performance of a contract. These costs include direct costs such as labor, supplies, equipment, or transportation and indirect costs such as labor overhead, material overhead, as well as general and administrative expenses, profit or fee. (Refer to FAR 36.203 and FAR 15.406-1)
An IGCE should be based on the exact same bidding documents (describing scope, terms and conditions, contract clauses, etc.) as will be used by the contractor. Not only do IGCEs play an important role in the contractor bid evaluation and selection/award processes, but the actual IGCE development can also be a great value in making the actual bid documents and contract language more effective by clearing up ambiguous elements and identifying more cost/schedule efficient contract approaches.

The IGCE can play a vital role in helping identify what is "reasonable" because the IGCE is the Government's best independent estimation of the potential cost of a contract. A detailed and well-documented IGCE is a valuable tool for supporting cost or cost realism analysis. The IGCE also supports a Price Analysis, which is an estimate of the "should pay" price that the Government should reasonably expect to pay based on current competitive market conditions. Additionally, the IGCE is an aid in deciding whether to go ahead with the acquisition as well as provide supportive documentation for the Purchase Request.

It should also be understood that IGCEs, by themselves, do not fulfill the requirements for an ICR or ICE. That is because the scope of the estimate needs to be restricted to the contract scope and conditions. As such, an IGCE does not usually represent the full project scope nor does it appropriately incorporate government furnished items or reflect DOE risks and uncertainties.

9.0 APPENDICES

The objective of this Guide is to provide uniform guidance and best practices for developing high quality cost estimates for capital assets projects while meeting the requirements of DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets*. The project cost estimate is an essential element of a credible project baseline. This Guide provides cost estimating and processes that meet Federal and DOE requirements and are consistent with industry standards and practices, and facilitate local requirements. The Appendices that follow supplement the material presented in the core sections of this Guide.

Appendices A and B – Provide the list of the most common acronyms used in this document plus the definition of common terms used with cost estimating.

Appendices C and D – Provide a summary of the most important Federal and DOE requirements for cost estimating.

Appendix E – Provide a suggested criteria for reviewing a cost estimate for quality and credibility.

Appendix F – Provides a generic example for the calculation and use of economic escalation for a project.

Appendix G – Provides a generic simple example for a life-cycle cost analysis for two alternatives in a project.

Appendix H – Provides as a reference the AACEI Cost Estimate Classification.

Appendix I – Provides a bibliography of references in cost estimating.

Appendix J – Provides a crosswalk of the 12 key GAO estimating steps to sections of this Guide wherein each step is described in detail.

Appendix K – Provides additional ICE and ICR guidance regarding the timeframe for completion, as well as documentation needs.

Appendix L – Provides DOE expectations for checking the quality of cost estimates to meet the four characteristics of quality estimates and the reasonableness of the cost estimating techniques employed.

Appendix A: Acronyms

AE	Acquisition Executive
A/E	architect/engineer
AACEI	Association for the Advancement of Cost Engineering, International
ABC	activity-based costing
ANSI	American National Standards Institute
AS	acquisition strategy
ASTM	American Society for Testing Materials
BOE	basis of estimate
CD	critical decision
CDR	conceptual design report
CER	cost estimating relationship
CFO	Chief Financial Officer
CFR	Code of Federal Regulations
CM	construction management
CO	contracting officer
COA	code of accounts
CPM	Contractor Project Manager, otherwise Critical Path Method
CSI	Construction Specifications Institute
DoD	Department of Defense
DOE	Department of Energy
EIR	external independent review
ESAAB	Energy System Acquisition Advisory Board
ES&H	Office of Environment, Safety, and Health
EVMS	Earned Value Management System
FPD	Federal Project Director
FTE	full-time equivalents
GFE	Government-Furnished Equipment
ICE	independent cost estimate
ICR	independent cost review
IGCE	independent government cost estimate
IPT	integrated project team
IT	information technology
LEED	Leadership in Energy and Environmental Design
LCC	life-cycle cost
LOE	level of effort
NPV	net present value
NNSA	National Nuclear Security Administration
OMB	Office of Management and Budget
OPC	other project costs
PARS	Project Assessment and Reporting System
PBC	performance based contracts
PDS	project data sheet
PED	project engineering design
PHA	preliminary hazard analysis

PM	project management or contractor project manager
PMB	performance measurement baseline
PPBES	Planning, Programming, Budgeting and Execution System
QA	quality assurance
QC	quality control
R&D	research and development
SME	subject matter expert
TEC	total estimated cost
TPC	total project cost
VE	value engineering
WBS	work breakdown structure

Appendix B: Definitions

These definitions of terms are derived within the context of how terms are used in this Guide.

Acquisition plan (AP) – is the document that facilitates attainment of the acquisition objectives. The plan must identify: those milestones of which decisions should be made; all the technical, business, management; and other significant considerations that will control the acquisition including, but not limited to, market research, competition, contract type, source selection procedures and socio-economic considerations.

Acquisition strategy (AS) - a business and technical management approach designed to achieve acquisition objectives within the resource constraints; the framework for planning, directing, contracting, and managing a system, program, or project; a master schedule for research, development, test, production, construction, modification, postproduction management, and other activities essential for success; the basis for formulating functional plans and strategies (e.g., acquisition strategy, competition, systems engineering). Once approved, the AS should reflect the approving authority's decisions on all major aspects of the contemplated acquisition.

Activity-based costing (ABC) -

- Costing using a method to ensure that the budgeted amounts in an account truly represent all the resources consumed by the activity or item represented in the account.
- Cost estimating in which the project is divided into activities and an estimate is prepared for each activity. Also used with detailed, unit cost, or activity-based cost estimating.

Actual Cost - the costs actually incurred and recorded in accomplishing work performed.

Allowance - an amount included in a base cost estimate to cover known but undefined requirements for a control account, work package, or planning package.

Analysis - the separation of a whole (project) into parts; examination of a complex entity, its elements, and their relationships; a statement of such analysis.

Assumptions - factors used for planning purposes that are considered true, real or certain. Assumptions affect all aspects of the planning process and of the progression of the project activities. (Generally, the assumptions will contain an element of risk.)

Baseline - a quantitative definition of cost, schedule, and technical performance that serves as a standard for measurement and control during the performance of an activity; the established plan against which the status of resources and the effort of the overall program, field programs, projects, tasks, or subtasks are measured, assessed, and controlled. Once established, baselines are subject to change control discipline.

Basis (basis of estimate, or BOE) - documentation that describes how an estimate, schedule, or other plan component was developed, and defines the information used in support of development. A basis document commonly includes a description of the scope, methodologies, references and defining deliverables, assumptions and exclusions, clarifications, adjustments, and level of uncertainty.

Benchmark - a standard by which performance may be measured.

Bias - a repeated or systematic distortion of a statistic or value, imbalanced about its mean.

Bounding assumption - identified risks that are totally outside the control of the project team and therefore cannot be managed (i.e., transferred, avoided, mitigated, or accepted). Bounding assumptions are also referred to as "enabling assumptions".

Brainstorming - interactive technique designed for developing new ideas with a group of people.

Budgeting - a process for allocating estimated of resource costs into accounts (i.e., the cost budget) against which cost performance will be measured and assessed. Budgeting often considers time-phasing in relation to a schedule or time-based financial requirements and constraints.

Buried contingency - costs that may have been hidden in the details of an estimate to protect a project from the removal of explicit contingency and to ensure that the final project does not go over budget. To reviewers, buried contingency often implies inappropriately inflated quantities, lowered productivity, or other means to increase project costs. Buried contingency should not be used.

Capital assets -

- Land, structures, equipment, systems, and information technology (e.g., hardware, software, and applications) used by the Federal government and having an estimated useful life of 2 years or more. Capital assets include environmental restoration (decontamination and decommissioning) of land to make useful leasehold improvements and land rights, and assets whose ownership is shared by the Federal government with other entities (does not apply to capital assets acquired by state and local governments or other entities through DOE grants).
- Strategic assets; unique physical or intellectual property that is of long-term or ongoing value to an enterprise; in total cost management, a strategic asset may also include fixed or intangible assets; assets created by the investment of resources through projects (excludes cash and financial assets).

Change control - a process that ensures changes to the approved baseline are properly identified, reviewed, approved, implemented and tested, and documented.

Change order - a unilateral requirement signed by the Government contracting officer directing the contractor to make a change that the *changes clause* authorizes without the contractor's consent.

Code of accounts (COA) - a systematic coding structure for organizing and managing asset, cost, resource, and schedule information; an index to facilitate finding, sorting, compiling, summarizing, and otherwise managing information to which the code is tied. A complete COA includes definitions of the content of each account.

Conceptual design - the concept that meets a mission need; requires a mission need as an input. Concepts for meeting a mission need are explored and alternatives considered before arriving at the set of alternatives that are technically viable, affordable, and sustainable.

Conceptual design report (CDR) - documentation of conceptual design phase outcome; forms the basis for a preliminary baseline.

Co-dependent risk - co-dependent project risks are generated when intermediate deliverables or outcomes (two or more projects or sub-projects at the same site) interlock in such a way that if both projects are not successfully completed, neither can be successfully completed.

Confidence (confidence level) - the probability that a cost estimate or schedule can be achieved or bettered. This is typically determined from a cumulative probability profile (see Cumulative Distribution Function") that is the output from a Monte Carlo simulation.

Construction - a combination of engineering, procurement, erection, installation, assembly, demolition, or fabrication to create a new facility or to alter, add to, rehabilitate, dismantle or remove an existing facility; includes alteration and repair (dredging, excavating, and painting) of buildings, structures, or other real property and construction, demolition, and excavation conducted as part of environmental restoration or remediation. Construction normally occurs between Critical Decisions 3 and 4 (does not involve the manufacture, production, finishing, construction, alteration, repair, processing, or assembling of items categorized as personal property).

Consequence – is the outcome of an event. (Normally includes scope, schedule, and cost.)

Construction management - a wide range of professional services relating to the management of a project during the pre-design, design, and construction phases; includes development of project strategy, design review of cost and time consequences, value management, budgeting, cost estimating, scheduling, monitoring of cost and schedule trends, procurement, observation to ensure that workmanship and materials comply with plans and specifications, contract administration, labor relations, construction methodology and coordination, and other management of construction acquisition.

Contingency -

- The portion of a project budget that is available for uncertainty *within the project scope* but outside the scope of the contract. That is, contingency is budget that is not placed on contract.
- An amount derived from a structured evaluation of identified risks, to cover a likely future event or condition, arising from presently known or unknown causes, within a defined project scope. Contingency is controlled by the government.

Contract - a mutually binding agreement that obligates the seller to provide a specified product and obligates the buyer to pay for it.

Contract fee - fee earned by the contractor based on dollar value or another unit of measure, such as man hours; an indirect cost.

Contractor - a person, organization, department, division, or company having a contract, agreement, or memorandum of understanding with DOE or another Federal agency.

Control account (or cost account) - the point at which budgets (resource plans) and actual costs are accumulated and compared to earned value for management control purposes; a natural management point for planning and control that represents work assigned to one responsible organizational on one work breakdown structure element.

Correlation - relationship between variables such that changes in one (or more) variable(s) is generally associated with changes in another. Correlation is caused by one or more dependency relationships. Measure of a statistical or dependence relationship existing between two items estimated for accurate quantitative risk analysis.

Cost accounting - historical reporting of actual and/or committed disbursements (costs and expenditures) on a project. Costs are denoted and segregated within cost codes that are defined in a chart of accounts. In project control practice, cost accounting provides measure of cost commitment and expenditure that can be compared to the measure of physical completion (earned value) of an account.

Cost budgeting – is allocating the estimated costs to project components.

Cost control - controlling changes to a project budget and forecast to completion.

Cost-Benefit Analysis - is the systematic, quantitative method of assessing the desirability of government projects or policies when it is important to take a long view of future effects and a broad view of possible side-effects.

Cost-effective analysis - appropriate when it is unnecessary or impractical to consider the dollar value of the benefits provided by the alternatives under consideration when

- each alternative has the same annual benefits expressed in monetary terms or
- each alternative has the same annual effects, but dollar values cannot be assigned to their benefits.
  Analysis of alternative defense systems often falls into this category. Cost-effective analysis can also be used to compare projects with identical costs but differing benefits. In this case, the decision criterion is the discounted present value of benefits. The alternative program with the largest benefits would normally be favored.

Cost estimate -
- A documented statement of costs to be incurred to complete a project or a defined portion of a project.
- Input to budget, contract, or project management planning for baselines and changes against which performance may be measured.

Cost estimating - a process used to quantify, cost, and price the resources required by the scope of an asset investment option, activity, or project. As a predictive process, estimating must address risks and uncertainties. The output of estimating is used primarily as input for budgeting, cost or value analysis, decision making in business, asset and project planning, or project cost and schedule control.

Critical decision (CD) - a formal determination made by an acquisition executive or designated official at a specific point in a project life cycle that allows the project to proceed. Critical decisions occur at any point in the course of a project (before commencement of conceptual design, at commencement of execution, and at turnover).

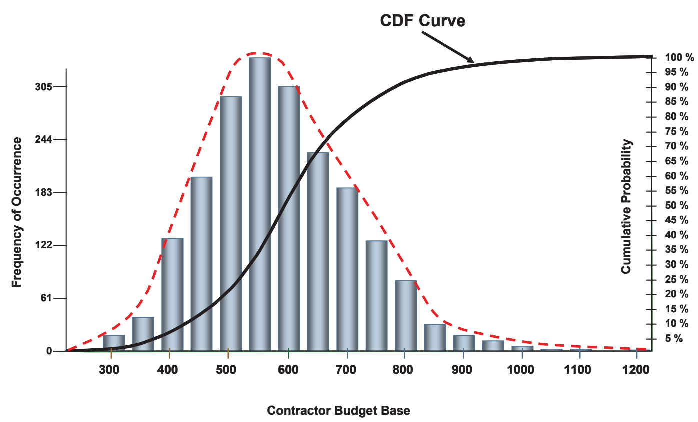
Critical decisions (CDs) -

CD-0, Approve Mission Need
CD-1, Approve Alternative Selection and Cost Range

CD-2, Approve Performance Baseline
CD-3, Approve Construction Start
CD-4, Approve Start of Operations or Project Closeout

Critical path – is a logically related sequence of activities in a critical path schedule having the longest duration. The total float is zero. A delay in any activity will have a corresponding impact on the completion date of the project.

Cumulative Distribution Function (CDF) - a statistical function based on the accumulation of the probabilistic likelihood of occurrences. In the case of the DOE risk analysis, it represents the likelihood that at a given percentage the project cost or duration will be at or below a given value. As an example, the x-axis might represent the range of potential project cost values evaluated by the Monte Carlo simulation and the y-axis represents the project's probability of completion. (See the figure below.)



Decision analysis – is the process for assisting decision makers in capturing judgments about risks as probability distributions, having single value measure, and putting these together with expected value calculations.

Delphi technique - technique used to gather information used to reach consensus within a group of subject matter experts on a particular item. Generally a questionnaire is used on an agreed set of items regarding the matter to be decided. Responses are summarized, further comments elicited. The process is often repeated several times. Technique is used to reduce bias in the data and to reduce the bias of one person, one voice.

Decision trees: A diagram that shows key interactions among decisions and associated chain events as they are understood by the decision maker. Branches of the tree represent either decisions or change events. The diagram provides for the consideration of the probability of each outcome.

Deviation - when the current estimate of a performance, technical, scope, schedule, or cost parameter is not within the threshold value of the performance baseline for that parameter; handled as a deviation, not as part of the normal change control system.

Direct cost - costs identified with a particular project or activity; includes salaries, travel, equipment, and supplies directly benefiting the project or activity.

Discount rate - the interest rate used in calculating the present value of expected yearly benefits and costs (see definitions for *nominal interest rate* and *real interest rate*).

DOE acquisition management system - a systematic method to acquire and deliver a product or capability in response to a program mission or business need; includes facility construction, infrastructure repairs or modifications, systems, production capability, remediate land, closed site, disposal effort, software development, information technology, a space system, research capability, and other assets.

DOE contingency - cost contingency for risks that are within the project's baseline but outside the contractor's management control. DOE contingency is held by DOE.

DOE schedule contingency - duration allowance used to adjust schedule for realized risks that are within the project baseline, and outside the contractor's control.

Enabling assumption- identified risks that are totally outside the control of the project team and therefore cannot be managed (i.e., transferred, avoided, mitigated, or accepted).

Earned Value Management System (EVMS) - is the integrated set of processes used to implement the standard and its criteria. In its simplest form, EVMS can be implemented without any software. Software simply enhances productivity, allows the implementation of EVMS more economically and facilitates managing complex projects. EVMS is not software.

Economic analysis - considers all costs and benefits (expenses and revenues) of a project, considering various economic assumptions made, such as inflation and discount rates.

Escalation – the provision in actual or estimated costs for an increase in the cost of equipment, material, labor, etc, due to continuing price level changes over time. Inflation may be a component of escalation, but non-monetary policy influences, such as supply-and-demand, are often components.

Estimate – is the assessment of the most likely quantitative result. (Generally, it is applied to costs and durations with a confidence percentage indication of likelihood of its accuracy.)

Estimate-at-completion - the current estimated total cost for project authorized work. EAC equals the actual cost to a point in time plus the estimated costs to completion.

Estimate to complete (ETC) - the current estimated cost for remaining authorized work to complete the project.

Estimate uncertainty - the inherent accuracy of a cost or schedule estimate. Represents a function of the level of project definition that is available, the resources used (skill set and knowledge) and time spent to develop the cost estimate and schedule, and the data (e.g., vendor quotes, catalogue pricing, historical databases, etc.) and methodologies used to develop the cost estimate and schedule.

External independent review (EIR) - an assessment mandated by Congress for projects of significant size and complexity; may warrant management attention.

Expert interviews - process of seeking opinions or assistance on the project from subject matter experts (SMEs).

External risks - risks outside the project control or global risks inherent in any project such as global economic downturns, trade difficulties affecting deliverables such as construction materials or political actions that are beyond the direct control of the project.

Facilities - buildings and other structures; their functional systems and equipment; site development features such as landscaping, roads, walks, and parking areas; outside lighting and communications systems; central utility plants; utility supply and distribution systems; and other physical plant features.

Feedback - system concept where a portion of the output is fed back to the input.

Fishbone diagram - technique often referred to as cause and effect diagramming. Technique often used during brainstorming and other similar sessions to help identify root causes of an issue or risk. Structure used to diagram resembles that of a fish bone.

Government other direct costs - Government costs that are needed for the project such as government furnished services, items and equipment, government supplied utilities (if directly metered), and applicable waste disposal fees.

Historical cost information - a database of information from completed projects normalized to some standard (geographical, national average, etc.) and time-based (e.g., brought to current year data) using historical cost indices.

Holding Time – Time that an item is not operational so that it may be serviced.

Hotel loads - a term used to identify the cost associated with level of effort activities and fixed costs that will be incurred until a given piece of work is complete. These costs can include the costs for project management and administration and other direct costs associated with generic facilities, rentals, money or opportunity lost from the facility not being complete, and other indirect costs that are not part of the direct production activities.

Impact scores - convergence of the probability and consequence scores.

Improvements to land - site clearing, grading, drainage, and facilities common to a project as a whole (such as roads, walks, paved areas, fences, guard towers, railroads, port facilities, etc.) but excluding buildings, structures, utilities, special equipment/process systems, and demolition, tunneling, and drilling that are a significant intermediate or end products of the project.

Independent cost estimate (ICE) – a cost estimate, prepared by an organization independent of the project proponent, using the same detailed technical and procurement information to make the project estimate. It can be used to validate the project estimate to determine whether it is accurate and reasonable.

Independent cost review – an independent evaluation of a project’s cost estimate that examines its quality and accuracy, with emphasis on specific cost and technical risks. It involves the analysis of the existing estimate’s approach and assumptions.

Independent government cost estimate – the government's estimate of the resources and their projected costs that a contractor would incur in the performance of a contract. These costs include direct costs such as labor, supplies, equipment, or transportation and indirect costs such as labor overhead, material overhead, as well as general and administrative expenses, profit or fee. (Refer to FAR 36.203 and FAR 15.406-1)

Indirect cost - costs incurred for common or joint objectives which cannot be identified with a particular activity or project.

Inflation - the proportionate rate of change in general price, as opposed to the proportionate increase in a specific price.

Influence diagram - a graphical aid to decision making under uncertainty, it depicts what is known or unknown at the time of making a choice, and the degree of dependence or independence (influence) of each variable on other variables and choices.

Information technology (IT) project – is one that establishes a system (hardware and/or software) capability to manage information.

Initiation - authorization of the project or phase of the project.

Integrated project team (IPT) - a cross-functional group organized to deliver a project to a customer (external or internal).

Integrated safety management system (ISMS) - a management system designed to ensure that environmental protection and worker and public safety are appropriately addressed in the planning, design, and performance of any task.

Internal risks - risks that the project has direct control over, such as organizational behavior and dynamics, organizational structure, resources, performance, financing, and management support.

Key risk - key risks are a set of risks considered to be of particular interest to the project team. These key risks are those estimated to have the most impact on cost and schedule and could include project, technical, internal, external, and other sub-categories of risk. For example on a nuclear design project, the risks identified using the "Risk and Opportunity Assessment" process may be considered a set of key risks on the project. Key risks should be interpreted to have the same meaning as "Critical Risks" as referred in DOE O 413.3B.

Lessons learned - formal or informal set of "learning" collected from project or program experience that can be applied to future projects or programs after a risk evaluation. They can be gathered at any point during the life of the project or program.

Level-of-effort – is baseline scope of a general or supportive nature for which performance cannot be measured or is impracticable to measure using activity-based methods. Resource requirements are represented by a time-phased budget scheduled in accordance with the time the support will likely be needed. The value is earned by the passage of time and is equal to the budget scheduled in each time period.

Life cycle – are the stages of an object's or endeavor's life. A life cycle presumes a series of beginnings and endings, with each end implying a new beginning. In life-cycle cost or investment analyses, the life cycle is the length of time over which an investment is analyzed.

Life-cycle cost -

- The overall estimated cost for a particular program alternative over the time period corresponding to the life of the program, including direct and indirect initial costs plus any periodic or continuing cost of operation and maintenance. (OMB)
- The sum total of the direct, indirect, recurring, nonrecurring, and other costs incurred or estimated to be incurred in the design, development, production, operation, maintenance, support, and final disposition of a major system over its anticipated useful life span. Where system or project planning anticipates the use of existing sites or facilities, restoration, and refurbishment, costs should be included.

Life-cycle cost analysis (LCCA) - assessment of the direct, indirect, recurring, nonrecurring, and other related costs incurred or estimated to be incurred in the design, development, production, operation, maintenance, support, and final disposition of a major system over its anticipated useful life span. LCCA considers all costs (capital, operating, and decommissioning expenses for the duration of a project) for various alternative approaches, including inflation and discount rates.

Line-item project – are the ones that are specifically reviewed and approved by Congress; a project with total cost greater than $10 million.

Major system (MS) – is a project or system of projects having a total project cost of $750 million or greater or designated by the Deputy Secretary as a major system.

Management reserve (MR) - determined by the contractor and represents the amount of the contractor budget that will be used for cost contingency arising from estimate uncertainties and realized risk events that are within the contractor's contractual obligations. Developed by the contractor after contract award, MR is maintained separately from the performance measurement baseline and is utilized by means of the contractor's change control process.

Milestone - a schedule event marking the due date for accomplishment of a specified effort (baseline activity) or objective. A milestone may mark the start, an interim step, or the completion of one or more activities.

Mitigate - to eliminate or lessen the likelihood and/or consequence of a risk.

Mitigation strategy - the risk handling strategy used to eliminate or lessen the likelihood and/or consequence of a risk.

Mission need - a required capability within DOE's overall purpose, scope, cost, and schedule considerations. Mission analysis or studies directed by an executive or legislative authority that identifies a deficiency or an opportunity will be set forth as justification for system acquisition approvals, planning, programming, and budget formulation.

Monte Carlo Analysis - a method of calculation that approximates solutions to a variety of mathematical problems by performing statistical sampling experiments on a computer; applies to problems with no probabilistic content as well as to those with inherent probabilistic structure.

Net present value (NPV) – is the difference between the discounted present values of benefits and costs.

Network logic – is the collection of activity dependencies that makes up a project network diagram.

Nominal interest rate - a rate that is not adjusted to remove the effects of actual or expected inflation. Market interest rates are generally nominal interest rates.

Objective reviews - a very structured approach using checklists and grading systems, which address consistency of projects estimated or procedures followed. Objective reviews may also indicate a minimum acceptable level of quality.

Operation - an ongoing endeavor or activity that uses strategic assets for a defined function or purpose.

Opportunity – is a risk with positive benefits.

Optimization - a technique that analyzes a system to find the best possible result. Finding an optimum result usually requires evaluating design elements, execution strategies and methods, and other system inputs for effect on cost, schedule, safety, or some other set of outcomes or objectives; employs computer simulation and mathematical modeling.

Other project costs - all other costs related to projects that are not included in the TEC. OPCs will include, but are not limited to: research and development; pre-authorization costs prior to start of conceptual design; plant support costs during construction; activation and startup; NEPA documentation; PDS; CDR; surveying for siting; and evaluation of RCRA/EPA/State permit requirements.

Performance-based management, contracting, and budgeting - cost and performance tied to quantities, establishing a baseline, and regularly reported to assess performance.

Performance baseline -

- A quantitative expression reflecting the total scope of a project with integrated technical, schedule, and cost elements; the established risk-adjusted, time-phased plan against which the status of resources and the progress of a projects are measured, assessed, and controlled; a Federal commitment to OMB and Congress. Once established, performance baselines are subject to change control.
- The cost portion of a performance baseline represents a project's total project cost after CD 2.

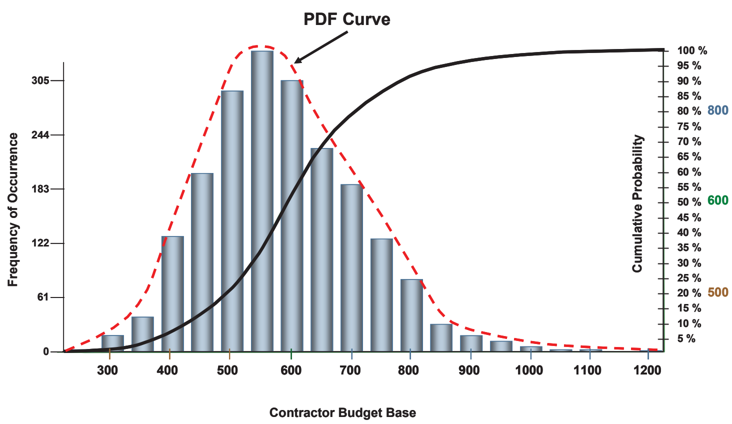
Preliminary design - continues the design effort using conceptual and project design criteria as bases for project development; develops topographical and subsurface data and determines the requirements and criteria that will govern the definitive design; includes preparation of preliminary planning and engineering studies, preliminary drawings and outline specifications, life-cycle cost analyses, preliminary cost estimates, and scheduling for project completion. Preliminary design provides identification of long-lead procurement items and analysis of risks associated with continued project development and occurs between CD-1 and CD-2.

Primary risk - initial risk entry in the risk register. A residual or secondary risk can become a primary risk if in the case of a residual risk the primary risk is closed and the Federal Project

Director and/or Contractor Project Manager determines the residual risk should be made the primary risk or the risk entry in the risk register. The secondary risk can become the primary risk in the risk register if the Federal Project Director and/or Contractor Project Manager determine that it should become the risk entry based upon the realization of the trigger metric or other determining factor.

Probability - likelihood of an event occurring, expressed as a qualitative and/or quantitative metric.

Probability Distribution Function (PDF) - a probability distribution, also described as a probability density function, represents the distribution of the probability of an outcome. As an example, the Monte Carlo analysis may be designed to estimate the cost or duration of a project. The PDF represents the number of times a certain cost or duration is achieved. (See the figure below.)



Productivity - consideration for factors that affect the efficiency of construction labor (e.g., location, weather, work space, coordination, schedule); a direct cost.

Program - an organized set of activities directed toward a common purpose or goal undertaken or proposed in support of an assigned mission area and characterized by a strategy for accomplishing a definite objectives, which identifies the means of accomplishment, particularly in quantitative terms, with respect to manpower, materials, and facilities requirements. Programs usually include an element of ongoing activity and are typically made up of technology, projects, and supporting operations.

Program risks - events identified as potential threats or opportunities that are within the program baseline cost or schedule.

Project - a unique effort that supports a program mission, having defined start and end points, undertaken to create a product, facility, or system, and containing interdependent activities planned to meet a common objective or mission. A project is a basic building block in relation to a program that is individually planned, approved, and managed. A project is not constrained to any specific element of the budget structure (e.g., operating expense or plant and capital equipment). Construction, if required, is part of the total project. Authorized, and at least partially appropriated, projects will be divided into two categories: major system projects and other projects. Projects include planning and execution of construction, renovation, modification, environmental restoration, decontamination and decommissioning efforts, and large capital equipment or technology development activities. Tasks that do not include the above elements, such as basic research, grants, ordinary repairs, maintenance of facilities, and operations are not considered projects.

Project data sheet (PDS) - a document that summarizes project data and justifies a project as a part of the Departmental budget. PDSs are submitted to request project engineering design and construction funds. Specific instructions on the format and content of PDSs are contained in the annual budget call [DOE O 130.1, *Budget Formulation,* dated 9-29-95].

Project engineering and design (PED) funds - design funds established for use on preliminary design, which are operating expense funds.

Project execution plan (PEP) - the plan which establishes roles and responsibilities and defines how a project will be executed.

Project life cycle -

- A collection of generally sequential project phases with names and numbers determined by the control needs of the organization or organizations involved in the project.
- The stages or phases of project progress during the life of a project. Project life-cycle stages typically include ideation, planning, execution, and closure.

Project management - a structure in which authority and responsibility for executing a project are vested in a single individual to provide focus on the planning, organizing, directing, controlling, and closing of all activities within a project.

Project risk - risks that are captured within the scope, cost, or schedule of the project.

Project support - activities performed by the operating contractor for internal management and technical support of the project manager.

Qualitative risk analysis - involves assessing the probability and impact of project risks using a variety of subjective and judgmental techniques to rank or prioritize the risks.

Quantitative risk analysis - involves assessing the probability and impact of project risks and using more numerically based techniques, such as simulation and decision tree analysis for determining risk implications.

Range (cost estimate range) – is an expected range of costs for a project or its components. Ranges may be established based on a range of alternatives, confidence levels, or expected accuracy, and are dependent on a project's stage of development, size, complexity, and other factors.

Real property – is land and/or improvements or interests in them except for land in the public domain.

Reconciliation - comparison of a current estimate to a previous estimate to ensure that differences between them is appropriate and reasonably expected. A formal reconciliation may include an account of those differences.

Residual Risk – risk that remains after risk strategies have been implemented.

Resource - a consumable (other than time) required to accomplish an activity; include real or potential investment in strategic assets including time, money, human, and physical resources. A resource becomes a cost when it is invested or consumed in an activity or project.

Review - determination of project or system acquisition conditions based evaluation of project scope, cost, schedule, technical status, and performance in relation to program objectives, approved requirements, and baseline project plans. Reviews provide critical insight into the plans, design, cost, schedule, organization, and other aspects of a project (see definitions for *objective review* and *subject review*).

Objective review - one based on set criteria; a checklist approach to reviewing.

Review criteria - components of a review used to reflect the general nature of project (or project element) content.

Risk - factor, element, constraint, or course of action that introduces an uncertainty of outcome, either positively or negatively that could impact project objectives. This definition for risk is strictly limited for risk as it pertains to project management applications in the development of the overall risk management plan and its related documentation and reports.

Risk acceptance - an informed and deliberate decision to accept consequences and the likelihood of a particular risk.

Risk analysis - process by which risks are examined in further detail to determine the extent of the risks, how they relate to each other, and which ones are the highest risks.

Risk analysis method - the technique used to analyze the risks associated with a project. Specific categories of risk analysis methods are:

1. Qualitative - based on project characteristics and historical data (check lists, scenarios, etc.)

2. Risk models - combination of risks assigned to parts of the estimate or project to define the risk of the total project.

3. Probabilistic models - combining risks from various sources and events (e.g., Monte Carlo, Latin hypercube, decision tree, influence diagrams, etc.)

Risk assessment - identification and analysis of project and program risks ensuring an understanding of each risk in terms of probability and consequences.

Risk assumption – is any assumptions pertaining to the risk itself.

Risk category - a method of categorizing the various risks on the project to allow grouping for various analysis techniques such as Risk Breakdown Structure or Network Diagram.

Risk documentation – includes the recording, maintaining and reporting assessments, handling analysis and plans, and monitoring results.

Risk Event – is a potential (identified or unidentified) condition (threat or opportunity) that may or may not occur during the execution of a project.

Risk handling - strategies developed with the purpose of eliminating, or at least reducing, the higher risk levels identified during the risk analysis. The strategies may include risk reduction or mitigation, risk transfer/share, risk avoidance, and risk acceptance.

Risk handling strategy - process that identifies, evaluates, selects, and implements options in order to set risk at acceptable levels given project constraints and objectives. Includes specific actions, when they should be accomplished, who is the owner, and what is the cost and schedule.

Risk identification - process to find, list and characterize elements of risk.

Risk management - the handling of risks through specific methods and techniques.

Risk Management Plan - Documents how the risk processes will be carried out during the project.

Risk mitigation - process to reduce the consequence and/or probability of a risk.

Risk modeling - creation of a physical representation or mathematical description of an object, system or problem that reflects the functions or characteristics of the item involved. Model building may be viewed as both a science and an art. Cost estimate and critical path schedule development should be considered modeling practices and not exact representations of future costs, progress and outcomes.

Risk monitoring and tracking - process of systematically watching over time the evolution of the project risks and evaluating the effectiveness of risk strategies against established metrics.

Risk owner - the individual responsible for managing a specified risk and ensuring effective treatment plans are developed and implemented.

Risk planning - process of developing and documenting an organized, comprehensive, and interactive strategy and methods for identifying and tracking risk, performing continuous risk assessments to determine how risks have changed, developing risk handling plans, monitoring the performance of risk handling actions, and assigning adequate resources.

Risk register - database for risks associated with the project. (Also known as risk database or risk log.)

Risk transfer – is the movement of the risk ownership to another organizational element. (However, to be successfully and fully transferred, the risk should be accepted by the organization to which the risk is being transferred.)

S-curve (spending curve; funding profile) -

- Graphic display of cumulative costs, labor hours, or other quantities plotted against time. The name is derived from the S-shaped curve (flatter at the beginning and end, steeper in the middle) produced on a project that starts slowly, accelerates, and then slows again.

- A representation of costs over the life of a project.

Schedule baseline - time phased project activity durations and milestone commitment dates by which projects are accomplished. The approved project schedule is a component of the overall project plan. The schedule baseline provides the basis for measuring and reporting schedule performance.

Schedule contingency - time allowance used to adjust schedule for realized DOE risks; based on the schedule risk analysis.

Schedule reserve - time allowance used to adjust schedule for realized risks within the contractor's baseline.

Secondary risk - risk arising as a direct result of implementing a risk handling strategy.

Scope - the sum of all that is to be or has been invested in and delivered by an activity or project. In project planning, the scope is usually documented (i.e., the scope document), but it may be verbally or otherwise communicated and relied upon. Generally limited to that which is agreed to by the stakeholders in an activity or project (i.e., if not agreed to, it is out of scope.). In contracting and procurement, scope includes all that an enterprise is contractually committed to perform or deliver.

Sensitivity analysis - considers all activities associated with one cost estimate. If a cost estimate can be sorted by total activity cost, unit cost, or quantity, sensitivity analyses can determine which activities are "cost drivers" to answer the question: "If something varies, what most affects the total cost of the project?"

Simulation, (Monte Carlo) - process for modeling the behavior of a stochastic (probabilistic) system. A sampling technique is used to obtain trial values for key uncertain model input variables. By repeating the process for many trials, a frequency distribution is built up, which approximates the true probability distribution for the system's output. This random sampling process, averaged over many trials, is effectively the same as integrating what is usually a very difficult or impossible equation.

Special equipment - large items of special equipment and process systems, such as vessels, (e.g., towers, reactors, storage tanks), heat transfer systems (e.g., heat exchangers, stacks, cooling towers, de-super-heaters), package units (e.g., waste treatment packages, clarifier packages, demineralization), and process piping systems.

Standard equipment - items which require only a minimum of design; off-the-shelf items (office furniture, laboratory equipment, heavy mobile equipment, and spare parts that are made part of the capital cost); a direct cost.

Start-up - one-time costs incurred during the transition from construction completion to facility operation.

Statement of work (SOW) – is a narrative description of contracted products or services.

String diagram - technique used to analyze the physical or proximity connections within a process. Technique is often used to find latent risks.

Subjective reviews - are less structured and may address areas differently, depending on various levels of emphasis. Internal reviews may combine objective and subjective criteria but should be performed consistently between projects within a program to the most practical extent.

Successful project - one that is completed or expected to be completed within the technical and schedule estimates of the performance baseline. Cost not to exceed by more than 10% of the original cost baseline approved at CD-2.

Technical risk - risks that include disciplines such as mechanical, electrical, chemical engineering, safety, safeguards and security, chemistry, biology, etc.

Threat - risk with negative consequences.

Total cost management - effective application of professional and technical expertise to plan and control resources, costs, profitability, and risks; a systematic approach to managing cost throughout the life cycle of any enterprise, program, facility, project, product, or service through the application of cost engineering and cost management principles, proven methodologies, and the latest technology in support of the management process. It can also be considered the sum of the practices and processes that an enterprise uses to manage the total life-cycle cost investment in its portfolio of strategic assets.

Total estimated cost (TEC) - all engineering design costs (after conceptual design), facility construction costs and other costs specifically related to those construction efforts. These are typically capitalized. TEC will include, but is not limited to: project, design and construction management during conceptual, preliminary and final design; contract modifications (to include equitable adjustments) resulting in changes to these costs; design and construction management reporting; contingency and economic escalation for TEC-applied elements; contractor support directly related to design and construction; and equipment rental and refurbishment.

Total project cost (TPC) - all costs between CD-0 and CD-4 specific to a project incurred through startup of a facility, but prior to the operation of the facility. Thus, TPC includes TEC and OPC.

Trending analysis - systematic tracking of performance against established or planned objectives.

Triangle distribution - subjective distribution of a population for which there is limited sample data. It is based on knowledge of the minimum and maximum and an inspired guess as to what the modal value might be. It is also used as an alternative to the Beta distribution in PERT, CPM, and similar forms of project management tools.

Uncertainty analysis - considers all activities associated with one cost estimate and their associated risks. An uncertainty analysis may also be considered part of a risk analysis or risk assessment.

Undistributed budget (UB) - funding associated with specific work scope or contract changes that have not been assigned to a control account or summary level planning package.

Unidentified Risks - risks that were not anticipated or foreseen by the IPT or by DOE-HQ staff members. Unidentified risks might originally be unanticipated because the probability of the event is so small that its occurrence is virtually unimaginable. Alternatively, an unidentified risk might be one that falls into an unanticipated or uncontrolled risk event category. (These risks are also categorized as "unknown-unknown" risks)

Validation - the process of evaluating project planning, development, baselines, and proposed funding before including a new project or system acquisition in the DOE program budget.

Value management - an organized effort to analyze the functions of systems, equipment, facilities, services, and supplies for the purpose of achieving essential functions at the lowest life-cycle cost that is consistent with required performance, quality, reliability, and safety.

Work breakdown structure (WBS) - product-oriented grouping of project elements that organizes and defines the total scope of the project; a multi-level framework that organizes and graphically displays elements representing work to be accomplished in logical relationships. Each descending level represents an increasingly detailed definition of a project component. Components may be products or services. The structure and code that integrate and relate all project work (technical, schedule, and cost) and are used throughout the life cycle of a project to identify and track specific work scope. Note: WBS should not be developed or organized along financial or organizational lines. It should be broken into organized blocks of work scope, and scope related activities. Financial and/or organizational identification needs should be attached as separate codes that relate to the WBS element.

Work package - a task or set of tasks performed within a control account.

Appendix C: Summary of Federal Requirements

Summary of Requirements

Generally, Federal requirements are promulgated by:

- Office of Management and Budget (OMB), which provides specifics for budgeting, discount rates, and management of projects (acquisitions) in their circulars.
- The Federal Acquisition Regulation (FAR), which provides Federal contract requirements for government estimates, cost and price analyses, and contract changes.
- The Code of Federal Regulations (CFR), which provides requirements for alternative considerations and life-cycle cost analyses.
- Various other Federal laws, such as the Government Performance and Results Act (GPRA), the Government Management Reform Act, the Federal Acquisition Reform Act, the Federal Acquisition Streamlining Act, the Information Technology Management Reform Act, the Chief Financial Officers Act (CFO Act), and others.

These Federal laws and policies drive the way DOE conducts business. DOE's Directives Management System is the means by which departmental policies, requirements, and responsibilities are developed and communicated. Directives are used to inform, direct, and Guide employees in the performance of their jobs and enable employees to work effectively within the Department and with Agencies, contractors, and the public.

The most significant, relevant DOE Orders include:

- DOE O 130.1, Budget Formulation, dated 9-29-95.
- DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets*, dated 11-29-10.
- DOE O 430.1B Chg 1, *Real Property Asset Management,* dated 9-24-03.
- DOE O 520.1A Chg 1, *Chief Financial Officer Responsibilities*, dated 11-21-06.
- DOE O 534.1B, *Accounting*, dated 1-6-03.

This section includes a summary of Federal requirements stemming from Office of Management and Budget (OMB), the Code of Federal Regulations (CFR), Federal Acquisition Regulation (FAR), and Public Laws (P.L.) that drive DOE requirements for cost estimating relative to capital asset acquisitions and real property.

OMB Circular No. A-11, *Preparation, Submission, and Execution of the Budget* (7-21-10), Part 7, Planning, Budgeting, Acquisition, and Management of Capital Assets, provides the framework to guide Federal agencies through the process of formulating a cost-benefit analysis and ultimately the budget submission for Federal agency projects and programs. Major capital investments proposed for funding must:

- support Agency missions;
- support work redesign to cut costs and improve efficiency and use of off-the-shelf technology;
- be supported by a cost-benefit analysis based on both qualitative and quantitative measures;
- integrate work processes and information flows with technology to achieve the strategic

goals;
- incorporate clear measures to determine not only a project's success, but also its compliance with a security plan;
- be acquired through a strategy that allocates the risk between the Government and the contractor and provides for the effective use of contracting; and
- ensure that the capital plan is operational and supports the Information resource management (IRM) strategic plan.

OMB Circular No. A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs* (October 29, 1992), provides an analytical framework for capital planning and investment control for information technology investments. The circular provides the information necessary to complete a thorough review of an IT investment's financial performance. Requirements include:

- evidence of a projected return on investment in the form of reduced cost; increased quality, speed, or flexibility; and improved customer and employee satisfaction; and
- a cost-benefit analysis for each information system throughout the life cycle that describes
  - level of investment,
  - performance measures , and
  - consistent methodology with regard to discount rates for cost benefit analyses of Federal programs.

10 CFR 436, Subpart A, *Methodology and Procedures for Life-Cycle Cost Analyses,* establishes methodology and procedures for estimating and comparing the life-cycle costs of Federal buildings, determining the life-cycle cost effectiveness of energy and water conservation measures, and rank-ordering life-cycle cost effectiveness measures in order to design a new Federal building or to retrofit an existing Federal building. It also establishes the method by which efficiency shall be considered when entering into or renewing leases of Federal building space.

In accordance with GAO-09-3SP, Chapter 5, *"A life-cycle cost estimate is a best practice because it provides an exhaustive and structured accounting of all resources and associated cost elements required to develop, produce, deploy, and sustain a program. As such, a life-cycle cost estimate should encompass all past (or sunk), present, and future costs for every aspect of the program, regardless of funding source. Life-cycle costing enhances decision making, especially in early planning and concept formulation of acquisition. Design trade-off studies conducted during this period can be evaluated on a total cost basis, as well as on a performance and technical basis. A life-cycle cost estimate can support budgetary decision, key decision points, milestone reviews, and investment decisions. Because they encompass all possible costs, life-cycle cost estimates provide a wealth of information about how much programs are expected to cost over time."*

Chief Financial Officers (CFO) Act of 1990 (P.L. 101-576)

Section 902(a) lists the CFO's regular duties. Among other things, these include:

- Develop and maintain an integrated Agency-accounting and financial management system, including financial reporting and internal controls, which:
  - Complies with applicable accounting principles, standards, and requirements and

internal control standards.
  - Complies with such policies and requirements as may be prescribed by the Director of OMB.
  - Complies with any other requirements applicable to such systems.

  Provides for:
  - Complete, reliable, consistent, and timely information, which is prepared on a uniform basis and which is responsive to the financial information needs of Agency management.
  - The development and reporting of cost information.
  - The integration of accounting and budgeting information.
  - The systematic measurement of performance.

- Direct, manage, and provide policy guidance and oversight of Agency financial management personnel, activities, and operations, including:
  - The preparation and annual revision of an Agency plan to (i) implement the 5-year financial management plan prepared by the Director of OMB under section 3512(a)(3) of this title and (ii) comply with the requirements established under sections 3515 and subsections (e) and (f) of section 3521 of this title.
  - The development of Agency financial management budgets.
  - The recruitment, selection, and training of personnel to carry out Agency financial management functions.
  - The approval and management of Agency financial management systems design or enhancement projects.
  - The implementation of Agency asset management systems, including systems for cash management, credit management, debt collection, and property and inventory management and control.

The CFO Act also set requirements for submission of annual financial statements and annual external audits.

Government Performance and Results Act (GPRA) of 1993, P.L. 103-62, establishes the foundation for budget decision making to achieve strategic goals in order to meet Agency mission objectives. GPRA provides for the establishment of strategic planning and performance measurement in the Federal government.

GPRA changes the way the Federal government does business, changes the accountability of Federal managers, shifts organizational focus to service quality and customer satisfaction, and improves how information is made available to the public. GPRA states that an organization's mission should drive its activities. Furthermore, GPRA states that the final measure of Federal program effectiveness and efficiency is results, and it requires organizations to measure their results through stated goals. It requires the development of annual performance plans and Agency strategic plans. It requires a return on investment that equals or exceeds those of alternatives.

Federal Managers Financial Integrity Act (FMFIA) of 1982 (P.L. 97-255), as codified in 31 U.S.C. 3512, requires accountability of financial and program managers for financial results of actions taken, control over the Federal government's financial resources, and protection of

Federal assets.

Paperwork Reduction Act of 1995 (P.L. 104-13) requires that Agencies perform their information resource management activities in an efficient, effective, and economical manner.

Federal Acquisition Streamlining Act of 1994 (P.L. 103-355) requires Agencies to establish cost, schedule, and measurable performance goals for all major acquisition programs and achieve, on average, 90% of those goals. OMB policy for performance-based management is also provided in this section.

Clinger-Cohen Act of 1996 (P.L. 104-106) requires Agencies to use a disciplined capital planning and investment control process to acquire, use, maintain, and dispose of IT. P.L. 104-208 directs the OMB to establish clear and concise direction regarding investments in major information systems and to enforce that direction through the budget process. The spirit and intent of ITMRA directs Agencies to ensure that IT investments are improving mission performance by:

- establishing goals to improve the efficiency and effectiveness of Agency operations and, as appropriate, the delivery of services to the public through the effective use of information technology;

- ensuring that performance measurements assess how effectively the information technology supports programs of the executive agency;

- quantitatively benchmarking processes in terms of cost, speed, productivity, and quality of outputs and outcomes where comparable processes and organizations in the public or private sectors exist;

- analyzing the missions of each executive agency and, based on the analysis, revising the executive agency's processes as appropriate before making significant investments in information technology; and

- ensuring that the information security policies, procedures, and practices of the executive agency are adequate.

Table C-1: Relevant Cost Estimating and EVM Legislation and Regulation

Applicable Agency	Name of Legislation or Regulation
All federal agencies	Government Performance and Results Act (GPRA) of 1993 (Among other things, GPRA requires agencies to prepare multiyear strategic plans that describe mission goals and methods for reaching them. The act also requires agencies to prepare annual program performance reports to review progress toward annual performance goals.)
All federal agencies	Clinger-Cohen Act of 1996 (Among other provisions, this law requires agencies to base decisions about Information Technology (IT) investments on quantitative and qualitative factors associated with the costs, benefits, and risks of those investments and to use performance data to demonstrate how well the IT expenditures support improvements to agency programs.)
All federal agencies	Federal Acquisition Regulation (FAR) Case 2004–019, Earned Value Management System (EVMS) Applicable Changes to Section 7.105 and Subpart 34.2

Source: GAO and DOD

Table C-2. Relevant Cost Estimating and EVM Policy

Applicable Agency	Name of Policy
All federal agencies	Office of Management and Budget (OMB) Circular No. A-11, *Preparation, Submission, and Execution of the Budget,* Part 7, 07-21-10
All federal agencies	Office of Management and Budget (OMB) Circular No. A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*, 10-29-92
All federal agencies	Office of Management and Budget (OMB) Circular No. A-109, *Major Systems Acquisitions*, April 5, 1976
All federal agencies	Office of Management and Budget (OMB) Memorandum for Chief Information Officers, No. M-05-23, *Improving Information Technology (IT) Project Planning and Execution*, August 4, 2005

Source: GAO, OMB, and DOD

Table C-3: Relevant Cost Estimating and EVM Guidance

Applicable Agency	Name of Guidance
All federal agencies	NDIA, PMSC,[13] *ANSI/EIA-748-A Standard for Earned Value Management System (EVMS) Intent Guide*, January 2006
All federal agencies	NDIA, PMSC, *Surveillance Guide*, October 2004
All federal agencies	NDIA, PMSC, *Integrating Risk Management with Earned Value Management*
All federal agencies	NDIA, PMSC, *Earned Value Management System Acceptance Guide*, November 2006

Source: DOD

[13] National Defense Industrial Association (NDIA), Program Management Systems Committee (PMSC).

Federal Acquisition Regulation (FAR)

The FAR has many references to cost estimates and cost estimating. Some topics covered by the FAR that should be considered, especially in relation to the procurement or acquisition process, include:

- Acquisition
- Acquisition planning
- Alternate
- Architect-engineering services
- Best value
- Bundling
- Change order
- Claim
- Commercial item
- Component
- Computer software
- Construction
- Contract
- Cost or pricing data
- General and administrative (G&A) expense
- Indirect cost
- Indirect cost rate
- Information technology
- Inherently Government function
- Inspection
- Insurance
- Major system
- Make-or-buy program
- Market research
- Option
- Overtime
- Overtime premium
- Performance-based contracting
- Pricing
- Forward-pricing rate agreement
- Freight
- Warranty
- Waste reduction
- FOB-origin
- Value engineering
- FOB-destination
- Final indirect cost rate
- Task order
- Design-to-cost
- Residual value
- Cost sharing
- Cost realism
- Value engineering change proposal

Cost estimating and related topics can be found in the following sections of the FAR:

- Part 7, Acquisition Planning
- Part 10, Market Research
- Part 14, Sealed Bidding
- Part 15, Contracting by Negotiations
    - 15.4, Contract Pricing - Contains information on proposal analysis, cost and price analysis, technical analysis, and cost realism
    - 15.402, Pricing policy - Says “Contracting officers must (a) purchase supplies and services from responsible sources at fair and reasonable prices.”
    - 15.407-5, Estimating systems
- Part 16 - Contract Types
    - 16.4 - Incentive Contracts - Discusses establishing reasonable and attainable

  - targets that are clearly communicated to the contractor and including appropriate incentive arrangements in contracts
  - 16.402-2(f) - Says "Because performance incentives present complex problems in contract administration, the contracting officer should negotiate them in full coordination with Government engineering and pricing specialists"
- Part 34 - Major System Acquisitions
- Part 35 - Research and Development Contracting
- Part 36 - Construction and Architect-Engineering Contracts
- Part 37 - Service Contracting
- Part 42 - Contract Administration and Audit Services
- Part 43 - Contract Modifications
- Part 48 - Value Engineering

Appendix D: Summary of DOE Requirements

There are several DOE Orders that reference *cost estimating.* Among them, the primary DOE Orders are:

- DOE O 130.1, *Budget Formulation,* dated 9-29-95, establishes the processes for developing, reviewing, and exchanging budget data. DOE O 130.1 requires that budget formulation be performance based, supportive of the DOE strategic plans, measurable, verifiable, and based on cost estimates deemed reasonable by the program and field offices.
- DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets,* dated 11-29-10, promotes the systematic acquisition of projects and emphasizes the necessity for managing successful projects. *DOE O 413.3B* defines particulars of the Critical Decision process: establishing protocol, authorities, and consistency between the DOE programs.
- DOE O 430.1B Chg 1, *Real Property Asset Management (RPAM),* dated 9-24-03, establishes a corporate, holistic, and performance-based approach to real property life-cycle asset management that links real property asset planning, programming, budgeting, and evaluation to program mission projections and performance outcomes. The implementation of RPAM maintains requirements for cost estimates and Life Cycle Cost Analysis (LCCA). RPAM also includes DOE's requirements of the Facilities Information Management System (FIMS) and the Condition Assessment and Information System (CAIS). These systems require cost estimate information concerning replacement plant values (RPVs) and facility maintenance costs.
- DOE O 520.1A, *Chief Financial Officer Responsibilities,* dated 11-21-06, promotes the achievement of the objectives of the *CFO Act (*sound financial management policies and practices, effective internal controls, accurate and timely financial information, and well-qualified financial managers) by setting forth the functions, organizational roles, and specific financial management responsibilities of the CFO, the field CFOs, and other appropriate DOE officials.
- DOE O 534.1B, *Accounting,* dated 1-6-03, designates the requirements and responsibilities for the accounting and financial management of the DOE. Requirements include, but are not limited to establishing a single, integrated financial management system that serves program management, budgetary, and accounting needs so that DOE and integrated contract records contain sufficient details in accounting for all DOE funds, assets, liabilities, and costs.

Appendix E: Generic Review Criteria

When reviewing DOE cost estimates, this generic criterion is suggested as a minimum. All criteria should be addressed to be complete, and if all criteria are reasonably addressed, then the estimates represented may be considered of quality, reasonable and as accurate as possible. **The estimates should also have been prepared by following the GAO 12 steps for a High Quality Estimating Process (GAO-09-3SP) as recommended in this Guid**e.[14]

Work Breakdown Structure (WBS) - A WBS should be consistent between the technical definition, cost estimate, and schedule. The use of a common WBS should be considered for consistency between projects within a program WBS. Use of a standardized code of accounts is also recommended.

Scope of Work - A scope of work should be commensurate with the planning phase size and complexity of the project and should be activity based to the most practical extent.

Direct and Indirect Costs - All direct costs should be included appropriately, *and* rates applied as percentages—including contract indirect and overhead rates or site indirect rates—should be documented and referenced in the basis of estimate. Indirect rates should be defined for consistent application and appropriate for a given project.

Escalation - Escalation should be included appropriately. The rates applied should be based upon those provided by DOE, or they should have some other documented basis. Escalation is the provision in a cost estimate for increases in the cost of equipment, material, labor, etc., due to continuing price changes over time. Escalation is used to estimate the future cost of a project or to bring historical costs to the present.

Contingency - Contingency should be included appropriately, based on apparent project risks or project risk analysis to the most possible extent. In any event, contingency should have a documented basis. Contingency may be calculated using a deterministic or probabilistic approach, but the method employed should be appropriate and documented.

Contingency is an amount included in an estimate to cover costs that may result from incomplete design, unforeseen and unpredictable conditions, or uncertainties. Contingency should also be commensurate with risk—a factor, element, constraint, or course of action in a project that introduces the uncertainty of outcomes and the possibilities of technical deficiencies, inadequate performances, schedule delays, or cost overruns that could impact a Departmental mission. In the evaluation of project risk, the potential impact and the probability of occurrence should be considered.

Contingency is most significant and appropriate for long-term projects and most order of magnitude and preliminary estimate classes with significant size and complexity. Contingency may be less significant for nearer term projects with less significant size and complexity.

[14] GAO-09-3SP, Chapter 15, Validating the Estimate

Techniques - Cost estimating techniques employed should be appropriately based on estimate class and purpose, available technical information, time constraints, and compliance with planning and project size and complexity. The chosen techniques should facilitate systematic cost estimate duplication or verification.

Basis of Estimate Documentation - Documentation that should describe how an estimate, schedule, or other plan component was developed, and defines the information used in support of development. It should explain the origins and logic of all WBS elements. A basis document should commonly include a description of the scope, methodologies, references and defining deliverables, assumptions and exclusions, clarifications, adjustments, and level of uncertainty.

Cost Estimate Documentation - Cost estimate documentation should be easily discernable, traceable, and consistent. As a matter of great relative importance, cost estimate documentation should be very thorough (provided to the most possible extent). In most cases, documentation should be specific for a given project (or sub-project) and should be centrally maintained to assure technical/cost/schedule consistency, management focus, and ease of reference.

Cost Estimate Updates - Cost estimate updates should be considered and included, as appropriate, to reflect new information, given a project planning phase and/or execution. Previous versions of cost estimates should be appropriately considered, whether considering information contained in a previous estimate supporting a critical decision, a potential change to a project/contract/budget, or a value engineering study.

Life-Cycle Costs - Life-cycle costs should be appropriately included in estimates. Life-cycle cost estimates are most pertinent during the decision-making phases of a project's life, or when LCC analyses (comparison of life-cycle cost estimates or VE Studies) are performed, but should also be considered throughout a project's life.

Life-cycle costs should include: start-up costs, operating costs, manufacturing costs, machining costs, research and development costs, engineering costs, design costs, equipment costs, construction costs, inspection costs, and decommissioning costs, as well as direct costs, indirect costs, overhead costs, fees, contingency, and escalation costs.

Qualified Cost and Schedule Estimators - Normally, cost and schedule estimators/cost engineers and risk managers are an important part of an integrated project team. Cost estimates should be performed and documented by those qualified to do so. Professional cost and schedule estimators, and cost engineers are trained in the use of cost estimating tools, techniques, and all aspects of estimating, project control, and project management.

Appendix F: Example of the Calculation and Use of Economic Escalation

Economic cost escalation should be included in all estimates where TPC may be affected by inflation or increases in unit costs. Following are the steps in calculating escalation amounts.

Step 1 – Finalize the estimate cost in "current dollars" and develop a corresponding schedule estimate. Ensure that the cost and schedule estimates are organized by a common WBS.

Step 2 - Determine the midpoint of primary scheduled activity groups (e.g., design, construction, construction management, start-up, etc.)

Step 3 - Select appropriate escalation rates by using the estimate preparation date ("today") as the index date for determining the rates. The rates are ideally based on documented information for the worksite location, but alternative rates provided by DOE/HQ may be used in the absence of appropriate local information.

Step 4 – Calculate the estimate of escalation for each scheduled activity grouping by applying the rates selected in Step 3 to the midpoint dates determined in Step 2. A straight-line spending curve application may be assumed, although other spending curves may be used, as appropriate.

To illustrate the application of escalation calculations, following is an example of a five-year project. The Tables F-1 through F-4 presents the stages necessary for calculating cost escalation. Note that major activity groupings defined as "scheduled activity."

Table F-1. Escalation Example - Step 1, Sample Project Cost Estimate Summary Represents the Estimate Summary Prior to Adding Cost Escalation

WBS	Scheduled Activity	Total Base Cost (000$)	Start	Duration (Months)	Complete	Midpoint
A1A	Preliminary Design (Title I Design)	100	10/1/02	6	3/30/03	1/1/03
A1B	Definitive Design (Title II Design)	200	4/1/03	6	9/30/03	7/1/03
A1C	Design During Construction (Title III Design)	100	10/1/03	36	9/30/06	7/1/05
B2A	Equipment Procurement (General Services)	200	10/1/04	24	9/30/06	10/1/05
B2B	Equipment Procurement (Long-Lead, GFE)	2,500	3/30/03	18	9/30/04	1/1/04
B2C	Facility Construction	6,000	10/1/04	37	9/30/06	10/1/05
C1A	Project Management	500	10/1/02	48	9/30/06	10/1/04
C1B	Construction Management	250	10/1/02	48	9/30/06	10/1/04

WBS	Scheduled Activity	Total Base Cost (000$)	Start	Duration (Months)	Complete	Midpoint
C1C	Project Support	250	10/1/02	48	9/30/06	10/1/04
	Totals	**10,100**				

Table F-2 provides illustrative DOE escalation rates taken from the DOE Budget Formulation Handbook. Site specific rates based on documented information for the worksite location are best, but alternative rates provided by DOE/HQ (when available) are used in the absence of appropriate local information. Regardless of the source, the rates used, and the reason for using them should be clearly explained in the cost estimate documentation. In the table, "index" represents the compounded escalation rate as a factor for multiplying costs in a given year. The "%" term is the expected percentage of cost increase in each stated year, Thus, the 1.076 construction index in 2005 is determined from the 2003, 2004 and 2005 escalation percentages as follows: 1.021 (2003 percentage)x 1.025 (2004 percentage)x 1.029 (2005 percentage)= 1.076. Thus, 1.076 would be the factor to multiply costs estimated in 2002 and expected to occur in 2005.

Table F-2. DOE Escalation Rates (as of January 2002)

	Project Categories *									
FY	Construction		EM		IT		O&M		R&D	
2002	Index	%	Index	%	Index	%	Index	%	Index	%
2003	1.021	2.1	1.02	2	1.008	0.8	1.018	1.8	1.023	2.3
2004	1.046	2.5	1.047	2.7	1.017	0.9	1.045	2.6	1.051	2.8
2005	1.076	2.9	1.075	2.7	1.022	0.5	1.073	2.7	1.08	2.7
2006	1.106	2.8	1.103	2.6	1.032	1	1.101	2.6	1.108	2.6
2007	1.135	2.6	1.13	2.4	1.041	0.8	1.127	2.4	1.136	2.5

Table F-3 provides a table of monthly escalation rates through the corresponding fiscal years. This example assumes a straight-line escalation for each FY, although other applications may be appropriate (e.g., weighted at the beginning or end of a FY). Use of the escalation "curve" (i.e., straight-line or other) and the reason it was selected should be well-documented. From the table, the escalation rate to apply to costs estimated "today" and expected to occur in July 2005 would be 9.17%.

Table F-3. Illustrative Monthly Escalation Rates

Months of Escalation		0	1	2	3	4	5	6	7	8	9	10	11	12
Month of the Year (Mid-Point)		10	11	12	1	2	3	4	5	6	7	8	9	10
FY	Rate													
2002	2.10%	0.00%	0.17%	0.35%	0.52%	0.70%	0.87%	1.05%	1.22%	1.40%	1.57%	1.75%	1.92%	2.10%
2003	2.10%	2.10%	2.28%	2.46%	2.64%	2.81%	2.99%	3.17%	3.35%	3.53%	3.71%	3.89%	4.07%	4.24%
2004	2.50%	4.24%	4.46%	4.68%	4.90%	5.11%	5.33%	5.55%	5.76%	5.98%	6.20%	6.42%	6.63%	6.85%
2005	2.90%	6.85%	7.11%	7.37%	7.62%	7.88%	8.14%	8.40%	8.66%	8.92%	9.17%	9.43%	9.69%	9.95%
2006	2.80%	9.95%	10.21%	10.46%	10.72%	10.98%	11.23%	11.49%	11.74%	12.00%	12.26%	12.51%	12.77%	13.03%
2007	2.60%	13.03%	13.27%	13.52%	13.76%	14.01%	14.25%	14.50%	14.74%	14.99%	15.23%	15.48%	15.72%	15.97%
2008	2.60%	15.97%	16.22%	16.47%	16.72%	16.97%	17.22%	17.47%	17.72%	17.98%	18.23%	18.48%	18.73%	18.98%

Table F-4 provides an example of the project cost estimate summary with columns added to illustrate compound escalation rates and escalation amounts by summary WBS element.

In calculating applicable escalation percentages, repetitive calculations are normal, so use of a computerized escalation forecast algorithm is recommended. The specific conditions that prevail must also be taken into account. For example, a construction subcontract awarded to span multiple fiscal years at a firm fixed-price would not need to have escalation applied to the cost of that contract.

Table F-4. Sample Project Cost Estimate Summary (Including Escalation)

WBS	Scheduled Activity	Total Base Cost (000$)	Start	Duration (Months)	Complete	Midpoint	Compounded Escalation Rate	Total Escalation Cost (000$)
A1A	Preliminary Design (Title I Design)	100	10/1/02	6	3/30/03	1/1/03	2.64%	103
A1B	Definitive Design (Title II Design)	200	4/1/03	6	9/30/03	7/1/03	3.71%	207

WBS	Scheduled Activity	Total Base Cost (000$)	Start	Duration (Months)	Complete	Midpoint	Compounded Escalation Rate	Total Escalation Cost (000$)
A1C	Design during Construction (Title III Design)	100	10/1/03	36	9/30/06	7/1/05	9.17%	109
B2A	Equipment Procurement (General Services)	200	10/1/04	24	9/30/06	10/1/05	9.95%	220
B2B	Equipment Procurement (Long-Lead, GFE)	2,500	3/30/03	18	9/30/04	1/1/04	4.90%	2,623
B2C	Facility Construction	6,000	10/1/04	37	9/30/06	10/1/05	9.95%	6,597
C1A	Project Management	500	10/1/02	48	9/30/06	10/1/04	6.85%	534
C1B	Construction Management	250	10/1/02	48	9/30/06	10/1/04	6.85%	267
C1C	Project Support	250	10/1/02	48	9/30/06	10/1/04	6.85%	267
	Totals	**10,100**						**10,927**

NOTE

Cost vs. Obligations - Funding Profile

A funding profile is a normal part of budget submissions. There is a difference between the timing of project costs and obligations and funding requirements. As a project evolves, it should be very clear that funds are required prior to spending them. This lead time should be carefully evaluated and established by the project team. Care should be taken to establish the most appropriate funding profile to provide for efficient use of funds and to minimize carry-over (where funds are not obligated within the FY for which they are authorized).

Appendix G: Example of Life-Cycle Cost Analysis

OMB A-94 - Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs provides guidance in performing cost-benefit analyses, or life-cycle cost analyses (LCCA). Per OMB, LCCAs should always consider all pertinent costs and benefits. Due to the nature of projects considered in fulfilling missions of the DOE, LCCAs may include a component of benefits which may be depicted as costs to be avoided or saved as a result of a particular alternative. DOE has very few income or revenue streams. However, as a part of life-cycle analyses, all benefits and costs should be recognized, including those that are difficult to quantify (such as benefits to the public or the general economy).

Generally, the steps in performing LCCA are as follows:

Step 1 – Determine cost estimate summary funding profile for base case and for each alternative case, including all costs and benefits.

Step 2 - Determine appropriate discount rates to be used. Note discussion on real and nominal discount rates. If escalation is included in the cost estimate summary, use nominal discount rates established by OMB.

Step 3 - Calculate appropriate discount factors, using the rates determined in Step 2.

Step 4 - Calculate present-worth (PW) of base case and each alternative case.

Step 5 - Compare all alternatives and determine the most cost-effective alternative. The lowest PW is the preferred alternative from an economic perspective.

Following is an example that generally shows the steps to be used in performing LCCA.

Step 1 - Determine the cost estimate summary funding profile for the base case and each alternative case being considered, including all costs and benefits. It is important to ensure that similar functions and activities are considered together (e.g., consistent use of a work breakdown structure or account code) to make the scenario as comparable as possible. Table G-2 and Table G-3 are examples of these summary tables.

Step 2 - Determine appropriate discount rates to be used. If escalation is included in the cost estimate summary, as in this example, use nominal discount rates established by OMB. The following information may also be found in OMB A-94. It is updated biannually.

Nominal Discount Rates - A forecast of nominal or market interest rates for 2003 based on the economic assumptions from the 2004 Budget are presented below. These nominal rates are to be used for discounting nominal flows, which are often encountered in lease-purchase analysis.

Table G-1. Nominal Interest Rates on Treasury Notes and Bonds of Specified Maturities (in Percent)

3-Year	5-Year	7-Year	10-Year	30-Year
3.1	3.6	3.9	4.2	5.1

Real Discount Rates - A forecast of real interest rates from which the inflation premium has been removed and based on the economic assumptions from the 2004 Budget are presented below in Table G-4. These real rates are to be used for discounting real (constant-dollar) flows, as is often required in cost-effective analysis.

Table G-2. Example LCCA – Step 1
Life-Cycle Cost Estimate Summary, Base Case

WBS	Activity	TPC	03	04	05	06	07	08	09	10	11	12	13	14	15
A1A	Preliminary Design	103	103												
A1B	Definitive Design	207	207												
A1C	Design During Construction	109		37	37	36									
B2A	Equipment Procurement (General Services)	220			110	110									
B2B	Equipment Procurement (Long-Lead, GFE)	2,623	2000	623											
B2C	Facility Construction	6,597		1500	3597	1500									
C1A	Project Management	534	75	175	175	109									
C1B	Construction Management	267	25	100	100	42									
C1C	Project Support	267	25	100	100	42									
E	Contingency (DOE-Held)	86	10	25	25	26									
	Total Project Costs (Escalated)	**11,193**	**2,445**	**2,560**	**4,144**	**1,866**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
		Annual													
F	Operations (LOE)	250			269	277	284	291	299	307	315	323	331	340	349
G	Security (LOE)	100		105	108	111	114	117	120	123	126	129	132	136	139
H	Infrastructure (LOE)	50		52	54	55	57	58	60	61	63				
I	Maintenance (LOE)	100		105	108	111	114	117	120	123	126	129	132	136	139
J	Transition (LOE)	50										65	66	68	70
K	Decontamination (LOE)	50									63	65	66	68	70

WBS	Activity	TPC	03	04	05	06	07	08	09	10	11	12	13	14	15
L	Decommissioning (LOE)	50									63	65	66	68	70
M	Demolition (LOE)	500										646	662	680	697
	Total Operations (Escalated)	**21,392**	**2,445**	**2,822**	**4,682**	**2,419**	**568**	**583**	**598**	**613**	**755**	**1,420**	**1,457**	**1,495**	**1,534**
	Total Life-Cycle Costs (Escalated)	**32,585**	**4,890**	**5,382**	**8,826**	**4,285**	**568**	**583**	**598**	**613**	**755**	**1,420**	**1,457**	**1,495**	**1,534**

Table G-3. Example LCCA – Step 1
Life-Cycle Cost Estimate Summary, Alternative Case

	Activity	TPC	03	04	05	06	07	08	09	10	11	12	13	14	15
A	Design During Construction/Renovation	50	50												
B2A	Procurement/Lease Facility	1,560	102	105	108	111	114	117	120	123	126	129	132	136	139
B2C	Facility Construction/Renovation	6,597		1500	3597	1500									
C1A	Project Management	150	25	50	50	25									
C1B	Construction Management	100	25	50	25										
C1C	Project Support	60	10	40	10										
E	Contingency (DOE-Held)	78	5	5	5	6	6	6	6	6	6	6	7	7	7
	Total Project Costs (Escalated)	**11,193**	**217**	**1,750**	**3,795**	**1,641**	**119**	**122**	**126**	**129**	**132**	**136**	**139**	**143**	**146**
		Annual													
F	Operations (LOE)	250			269	277	284	291	299	307	315	323	331	340	349
G	Security (LOE)	100		105	108	111	114	117	120	123	126	129	132	136	139
H	Infrastructure (LOE)	50		52	54	55	57	58	60	61	63				
I	Maintenance (LOE)	100		105	108	111	114	117	120	123	126	129	132	136	139
J	Transition (LOE)	50										65	66	68	70
K	Decontamination (LOE)	50									63	65	66	68	70
L	Decommissioning (LOE)	50									63	65	66	68	70
M	Demolition (LOE)	500													

	Activity	TPC	03	04	05	06	07	08	09	10	11	12	13	14	15
	Total Operations (Escalated)	**7,693**	**-**	**262**	**538**	**554**	**568**	**583**	**598**	**613**	**755**	**775**	**795**	**816**	**837**
	Total Life-Cycle Costs (Escalated)	**18,886**	**217**	**2,012**	**4,334**	**2,195**	**687**	**705**	**723**	**742**	**887**	**910**	**934**	**958**	**983**

Table G-4. Real Interest Rates on Treasury Notes and Bonds of Specified Maturities (in Percent)

3-Year	5-Year	7-Year	10-Year	30-Year
1.6	1.9	2.2	2.5	3.2

Analyses of programs with terms different from those presented above may use a linear interpolation. For example, a four-year project can be evaluated with a rate equal to the average of the three-year and five-year rates. Programs with durations longer than 30 years may use the 30-year interest rate.

Step 3 - Calculate appropriate discount factors, using the appropriate discount rates. The discount factor is calculated as:

$$\mathbf{1/(1 + i)^{t}}$$

where **i** is the discount rate and **t** is the year. For this example, a nominal discount rate is calculated for a ~15-year project, to be ~4.4%. Discount factors are calculated in Table G-5.

Step 4 - Calculate PW of base case and each alternative case using the discount factors calculated in Step 3. Table G-6 and G-7 show the results of this calculation.

Table G-5. Example LCCA – Step 3, Discount Rate Application, Discount Factor Calculation

FY	Consecutive Year	Discount Rate	Discount Factor
2003	1	0.044	0.9579
2004	2	0.044	0.9175
2005	3	0.044	0.8788
2006	4	0.044	0.8418
2007	5	0.044	0.8063
2008	6	0.044	0.7723
2009	7	0.044	0.7398
2010	8	0.044	0.7086
2011	9	0.044	0.6787
2012	10	0.044	0.6501
2013	11	0.044	0.6227
2014	12	0.044	0.5965
2015	13	0.044	0.5713
2016	14	0.044	0.5473
2017	15	0.044	0.5242

Table G-6. Example LCCA – Step 4
Cost Estimate Summary, Including Present Worth, Base Case

	Activity	TPC	03	04	05	06	07	08	09	10	11	12	13	14	15
A1A	Preliminary Design	103	103												
A1B	Definitive Design	207	207												
A1C	Design During Construction	109		37	37	36									
B2A	Equipment Procurement (General Services)	220			110	110									
B2B	Equipment Procurement (Long-Lead, GFE)	2,623	2000	623											
B2C	Facility Construction	6,597		1500	3597	1500									
C1A	Project Management	534	75	175	175	109									
C1B	Construction Management	267	25	100	100	42									
C1C	Project Support	267	25	100	100	42									
E	Contingency (DOE-Held)	86	10	25	25	26									
	Total Project Costs (Escalated)	**11,193**	**2,445**	**2,560**	**4,144**	**1,866**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
		Annual													
F	Operations (LOE)	250			269	277	284	291	299	307	315	323	331	340	349
G	Security (LOE)	100		105	108	111	114	117	120	123	126	129	132	136	139
H	Infrastructure (LOE)	50		52	54	55	57	58	60	61	63				
I	Maintenance (LOE)	100		105	108	111	114	117	120	123	126	129	132	136	139
J	Transition (LOE)	50										65	66	68	70
K	Decontamination (LOE)	50									63	65	66	68	70

	Activity	TPC	03	04	05	06	07	08	09	10	11	12	13	14	15
L	Decommissioning (LOE)	50									63	65	66	68	70
M	Demolition (LOE)	500										646	662	680	697
	Total Operations (Escalated)	10,378	-	262	538	554	568	583	598	613	755	1,420	1,457	1,495	1,534
	Total Life-Cycle Costs (Escalated)	21,571	2,445	2,822	4,682	2,419	568	583	598	613	755	1,420	1,457	1,495	1,534
			0.9579	0.9175	0.8788	0.8418	0.8063	0.7723	0.7398	0.7086	0.6787	0.6501	0.6227	0.5965	0.5713
	Discounted Costs (PW)	16,979	2,342	2,589	4,115	2,036	458	450	442	435	513	923	908	892	877

Table G-7. Example LCCA – Step 4
Cost Estimate Summary, Including Present Worth, Alternative Case

	Activity	TPC	03	04	05	06	07	08	09	10	11	12	13	14	15
A	Design During Construction/Renovation	50	50												
B2A	Procurement/Lease Facility	1,560	102	105	108	111	114	117	120	123	126	129	132	136	139
B2C	Facility Construction/Renovation	6,597		1500	3597	1500									
C1A	Project Management	150	25	50	50	25									
C1B	Construction Management	100	25	50	25										
C1C	Project Support	60	10	40	10										
E	Contingency (DOE-Held)	78	5	5	5	6	6	6	6	6	6	6	7	7	7
	Total Project Costs (Escalated)	**11,193**	**217**	**1,750**	**3,795**	**1,641**	**119**	**122**	**126**	**129**	**132**	**136**	**139**	**143**	**146**
		Annual													
F	Operations (LOE)	250			269	277	284	291	299	307	315	323	331	340	349
G	Security (LOE)	100		105	108	111	114	117	120	123	126	129	132	136	139
H	Infrastructure (LOE)	50		52	54	55	57	58	60	61	63				
I	Maintenance (LOE)	100		105	108	111	114	117	120	123	126	129	132	136	139
J	Transition (LOE)	50										65	66	68	70
K	Decontamination (LOE)	50									63	65	66	68	70
L	Decommissioning (LOE)	50									63	65	66	68	70

	Activity	TPC	03	04	05	06	07	08	09	10	11	12	13	14	15
M	Demolition (LOE)	500													
	Total Operations (Escalated)	**7,693**	**-**	**262**	**538**	**554**	**568**	**583**	**598**	**613**	**755**	**775**	**795**	**816**	**837**
	Total Life-Cycle Costs (Escalated)	**18,886**	**217**	**2,012**	**4,334**	**2,195**	**687**	**705**	**723**	**742**	**887**	**910**	**934**	**958**	**983**
			0.9579	0.9175	0.8788	0.8418	0.8063	0.7723	0.7398	0.7086	0.6787	0.6501	0.6227	0.5965	0.5713
	Discounted Costs (PW)	**12,778**	**208**	**1,846**	**3,808**	**1,847**	**554**	**545**	**535**	**526**	**602**	**592**	**582**	**572**	**562**

Step 5 - Compare all alternatives and determine the most cost-effective one. The lowest PW is the preferred alternative, from an economic perspective. Table G-8 shows an example summary of this PW comparison and clearly shows the most cost-effective alternative.

Table G-8. Example LCCA – Step 5, Summary of Base Case and Alternative Discounted Costs, or PW

Activity FY	Base Case	Alt Case
03	2,342	208
04	2,589	1,846
05	4,115	3,808
06	2,036	1,847
07	458	554
08	450	545
09	442	535
10	435	526
11	513	602
12	923	592
13	908	582
14	892	572
15	877	562
PW	**16,979**	**12,778**

A standard for life-cycle cost analysis (LCCA) is currently being established by the National Institute for Science and Technology (NIST).

Appendix H: Cost Estimate Classifications (AACEI)

The following Association for the Advancement of Cost Engineering International (AACEI) Recommended Practices, No. 17R-97, *Cost Estimate Classification System*, and No. 18R-97, *Cost Estimate Classification System – As Applied in Engineering*, *Procurement and Construction for the Process Industries*, dated January 15, 2011; provide guidance for classifying project cost estimates.

January 15, 2011

PURPOSE

As a recommended practice of AACE International, the Cost Estimate Classification System provides guidelines for applying the general principles of estimate classification to asset project cost estimates. Asset project cost estimates typically involve estimates for capital investment, and exclude operating and life-cycle evaluations. The Cost Estimate Classification System maps the phases and stages of asset cost estimating together with a generic maturity and quality matrix that can be applied across a wide variety of industries.

This guideline and its addenda have been developed in a way that:

- provides common understanding of the concepts involved with classifying project cost estimates, regardless of the type of enterprise or industry the estimates relate to;
- fully defines and correlates the major characteristics used in classifying cost estimates so that enterprises may unambiguously determine how their practices compare to the guidelines;
- uses degree of project definition as the primary characteristic to categorize estimate classes; and
- Reflects generally-accepted practices in the cost engineering profession.

An intent of the guidelines is to improve communication among all of the stakeholders involved with preparing, evaluating, and using project cost estimates. The various parties that use project cost estimates often misinterpret the quality and value of the information available to prepare cost estimates, the various methods employed during the estimating process, the accuracy level expected from estimates, and the level of risk associated with estimates.

This classification guideline is intended to help those involved with project estimates to avoid misinterpretation of the various classes of cost estimates and to avoid their misapplication and misrepresentation. Improving communications about estimate classifications reduces business costs and project cycle times by avoiding inappropriate business and financial decisions, actions, delays, or disputes caused by misunderstandings of cost estimates and what they are expected to represent.

This document is intended to provide a guideline, not a standard. It is understood that each enterprise may have its own project and estimating processes and terminology, and may classify estimates in particular ways. This guideline provides a generic and generally-acceptable classification system that can be used as a basis to compare against. If an enterprise or organization has not yet formally documented its own estimate classification scheme, then this guideline may provide an acceptable starting point.

INTRODUCTION

An AACE International guideline for cost estimate classification for the process industries was developed in the late 1960s or early 1970s, and a simplified version was adopted as an ANSI Standard Z94.0 in 1972. Those guidelines and standards enjoy reasonably broad acceptance within the engineering and construction communities and within the process industries. This recommended practice guide and its addenda improves upon these standards by:

1. providing a classification method applicable across all industries; and
2. unambiguously identifying, cross-referencing, benchmarking, and empirically evaluating the multiple characteristics related to the class of cost estimate.

This guideline is intended to provide a generic methodology for the classification of project cost estimates in any industry, and will be supplemented with addenda that will provide extensions and additional detail for specific industries.

CLASSIFICATION METHODOLOGY

There are numerous characteristics that can be used to categorize cost estimate types. The most significant of these are degree of project definition, end usage of the estimate, estimating methodology, and the effort and time needed to prepare the estimate. The "primary" characteristic used in this guideline to define the classification category is the degree of project definition. The other characteristics are "secondary."

Categorizing cost estimates by degree of project definition is in keeping with the AACE International philosophy of Total Cost Management, which is a quality-driven process applied during the entire project life cycle. The discrete levels of project definition used for classifying estimates correspond to the typical phases and gates of evaluation, authorization, and execution often used by project stakeholders during a project life cycle.

Five cost estimate classes have been established. While the level of project definition is a continuous spectrum, it was determined from benchmarking industry practices that three to five discrete categories are commonly used. Five categories are established in this guideline as it is easier to simplify by combining categories than it is to arbitrarily split a standard.

The estimate class designations are labeled Class 1, 2, 3, 4, and 5. A Class 5 estimate is based upon the lowest level of project definition, and a Class 1 estimate is closest to full project definition and maturity. This arbitrary "countdown" approach considers that estimating is a process whereby successive estimates are prepared until a final estimate closes the process.

	Primary Characteristic	*Secondary Characteristic*			
ESTIMATE CLASS	**LEVEL OF PROJECT DEFINITION** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical +/- range relative to best index of 1 [a]	**PREPARATION EFFORT** Typical degree of effort relative to least cost index of 1 [b]
Class 5	0% to 2%	Screening or Feasibility	Stochastic or Judgment	4 to 20	1
Class 4	1% to 15%	Concept Study or Feasibility	Primarily Stochastic	3 to 12	2 to 4
Class 3	10% to 40%	Budget, Authorization, or Control	Mixed, but Primarily Stochastic	2 to 6	3 to 10
Class 2	30% to 70%	Control or Bid/ Tender	Primarily Deterministic	1 to 3	5 to 20
Class 1	50% to 100%	Check Estimate or Bid/Tender	Deterministic	1	10 to 100

Notes: *[a] If the range index value of "1" represents +10/-5%, then an index value of 10 represents +100/-50%.*

[b] If the cost index value of "1" represents 0.005% of project costs, then an index value of 100 represents 0.5%.

Figure 1 – Generic Cost Estimate Classification Matrix

DEFINITIONS OF COST ESTIMATE CHARACTERISTICS

The following are brief discussions of the various estimate characteristics used in the estimate classification matrix. For the secondary characteristics, the overall trend of how each characteristic varies with the degree of project definition (the primary characteristic) is provided.

Level of Project Definition (Primary Characteristic)

This characteristic is based upon percent complete of project definition (roughly corresponding to percent complete of engineering). The level of project definition defines maturity or the extent and types of input information available to the estimating process. Such inputs include project scope definition, requirements documents, specifications, project plans, drawings, calculations, learning from past projects, reconnaissance data, and other information that must be developed to define the project. Each industry will have a typical set of deliverables that are used to support the class of estimates used in that industry. The set of deliverables becomes more definitive and complete as the level of project definition (e.g., project engineering) progresses.

End Usage (Secondary Characteristic)

The various classes (or phases) of cost estimates prepared for a project typically have different end uses or purposes. As the level of project definition increases, the end usage of an estimate

typically progresses from strategic evaluation and feasibility studies to funding authorization and budgets to project control purposes.

Estimating Methodology (Secondary Characteristic)

Estimating methodologies fall into two broad categories: stochastic and deterministic. In stochastic methods, the independent variable(s) used in the cost estimating algorithms are generally something other than a direct measure of the units of the item being estimated. The cost estimating relationships used in stochastic methods often are somewhat subject to conjecture. With deterministic methods, the independent variable(s) are more or less a definitive measure of the item being estimated. A deterministic methodology is not subject to significant conjecture. As the level of project definition increases, the estimating methodology tends to progress from stochastic to deterministic methods.

Expected Accuracy Range (Secondary Characteristic)

Estimate accuracy range is in indication of the degree to which the final cost outcome for a given project will vary from the estimated cost. Accuracy is traditionally expressed as a +/- percentage range around the point estimate after application of contingency, with a stated level of confidence that the actual cost outcome would fall within this range (+/- measures are a useful simplification, given that actual cost outcomes have different frequency distributions for different types of projects). As the level of project definition increases, the expected accuracy of the estimate tends to improve, as indicated by a tighter +/- range.

Note that in figure 1, the values in the accuracy range column do not represent + or - percentages, but instead represent an index value relative to a best range index value of 1. If, for a particular industry, a Class 1 estimate has an accuracy range of +10/-5 percent, then a Class 5 estimate in that same industry may have an accuracy range of +100/-50 percent.

Effort to Prepare Estimate (Secondary Characteristic)

The level of effort needed to prepare a given estimate is an indication of the cost, time, and resources required. The cost measure of that effort is typically expressed as a percentage of the total project costs for a given project size. As the level of project definition increases, the amount of effort to prepare an estimate increases, as does its cost relative to the total project cost. The effort to develop the project deliverables is not included in the effort metrics; they only cover the cost to prepare the cost estimate itself.

RELATIONSHIPS AND VARIATIONS OF CHARACTERISTICS

There are a myriad of complex relationships that may be exhibited among the estimate characteristics within the estimate classifications. The overall trend of how the secondary characteristics vary with the level of project definition was provided above. This section explores those trends in more detail. Typically, there are commonalties in the secondary characteristics between one estimate and the next, but in any given situation there may be wide variations in usage, methodology, accuracy, and effort.

The level of project definition is the "driver" of the other characteristics. Typically, all of the secondary characteristics have the level of project definition as a primary determinant. While the other characteristics are important to categorization, they lack complete consensus. For example, one estimator's "bid" might be another's "budget." Characteristics such as "accuracy" and "methodology" can vary markedly from one industry to another, and even from estimator to estimator within a given industry.

Level of Project Definition

Each project (or industry grouping) will have a typical set of deliverables that are used to support a given class of estimate. The availability of these deliverables is directly related to the level of project definition achieved. The variations in the deliverables required for an estimate are too broad to cover in detail here; however, it is important to understand what drives the variations. Each industry group tends to focus on a defining project element that "drives" the estimate maturity level. For instance, chemical industry projects are "process-equipment centric" (i.e., the level of project definition and subsequent estimate maturity level is significantly determined by how well the equipment is defined). Architectural projects tend to be "structure-centric," software projects tend to be "function-centric," and so on. Understanding these drivers puts the differences that may appear in the more detailed industry addenda into perspective.

End Usage

While there are common end usages of an estimate among different stakeholders, usage is often relative to the stakeholders' identity. For instance, an owner company may use a given of estimate to support project funding, while a contractor may use the same class of estimate to support a contract bid or tender. It is not at all uncommon to find stakeholders categorizing their estimates by usage-related headings such as "budget," "study," or "bid." Depending on the stakeholders' perspective and needs, it is important to understand that these may actually be all the same class of estimate (based on the primary characteristic of level of project definition achieved).

Estimating Methodology

As stated previously, estimating methodologies fall into two broad categories: stochastic and deterministic. These broad categories encompass scores of individual methodologies. Stochastic

methods often involve simple or complex modeling based on inferred or statistical relationships between costs and programmatic and/or technical parameters. Deterministic methods tend to be straightforward counts or measures of units of items multiplied by known unit costs or factors. It is important to realize that any combination of methods may be found in any given class of estimate. For example, if a stochastic method is known to be suitably accurate, it may be used in place of a deterministic method even when there is sufficient input information based on the level of project definition to support a deterministic method. This may be due to the lower level of effort required to prepare an estimate using stochastic methods.

Expected Accuracy Range

The accuracy range of an estimate is dependent upon a number of characteristics of the estimate input information and the estimating process. The extent and the maturity of the input information as measured by percentage completion (and related to level of project definition) is a highly-important determinant of accuracy. However, there are factors besides the available input information that also greatly affect estimate accuracy measures. Primary among these are the state of technology in the project and the quality of reference cost estimating data.

State of technology - technology varies considerably between industries, and thus affects estimate accuracy. The state of technology used here refers primarily to the programmatic or technical uniqueness and complexity of the project. Procedurally, having “full extent and maturity” in the estimate basis deliverables is deceptive if the deliverables are based upon assumptions regarding uncertain technology. For a “first-of-a-kind” project there is a lower level of confidence that the execution of the project will be successful (all else being equal). There is generally a higher confidence for projects that repeat past practices. Projects for which research and development are still under way at the time that the estimate is prepared are particularly subject to low accuracy expectations. The state of technology may have an order of magnitude (10 to 1) effect on the accuracy range.

Quality of reference cost estimating data - accuracy is also dependent on the quality of reference cost data and history. It is possible to have a project with “common practice” in technology, but with little cost history available concerning projects using that technology. In addition, the estimating process typically employs a number of factors to adjust for market conditions, project location, environmental considerations, and other estimate-specific conditions that are often uncertain and difficult to assess. The accuracy of the estimate will be better when verified empirical data and statistics are employed as a basis for the estimating process, rather than assumptions.

In summary, estimate accuracy will generally be correlated with estimate classification (and therefore the level of project definition), all else being equal. However, specific accuracy ranges will typically vary by industry. Also, the accuracy of any given estimate is not fixed or determined by its classification category. Significant variations in accuracy from estimate to estimate are possible if any of the determinants of accuracy, such as technology, quality of reference cost data, quality of the estimating process, and skill and knowledge of the estimator vary. Accuracy is also not necessarily determined by the methodology used or the effort expended. Estimate accuracy must be evaluated on an estimate-by-estimate basis, usually in conjunction with some form of risk analysis process.

Effort to Prepare Estimate

The effort to prepare an estimate is usually determined by the extent of the input information available. The effort will normally increase as the number and complexity of the project definition deliverables that are produced and assessed increase. However, with an efficient estimating methodology on repetitive projects, this relationship may be less defined. For instance, there are combination design/estimating tools in the process industries that can often automate much of the design and estimating process. These tools can often generate Class 3 deliverables and estimates from the most basic input parameters for repetitive-type projects. There may be similar tools in other industry groupings.

It also should be noted that the estimate preparation costs as a percentage of total project costs will vary inversely with project size in a nonlinear fashion. For a given class of estimate, the preparation cost percentage will decrease as the total project costs increase. Also, at each class of estimate, the preparation costs in different industries will vary markedly. Metrics of estimate preparation costs normally exclude the effort to prepare the defining project deliverables.

ESTIMATE CLASSIFICATION MATRIX

The five estimate classes are presented in figure 1 in relationship to the identified characteristics. Only the level of project definition determines the estimate class. The other four characteristics are secondary characteristics that are generally correlated with the level of project definition, as discussed above.

This generic matrix and guideline provide a high-level estimate classification system that is non industry specific. Refer to subsequent addenda for further guidelines that will provide more detailed information for application in specific industries. These will provide additional information, such as input deliverable checklists, to allow meaningful categorization in that industry.

REFERENCES

ANSI Standard Z94.2-1989. **Industrial Engineering Terminology: Cost Engineering.**

ADDENDUM, RP No. 18-R-97 dated January 15, 2011

PURPOSE

As a recommended practice of AACE International, the Cost Estimate Classification System provides guidelines for applying the general principles of estimate classification to project cost estimates (i.e., cost estimates that are used to evaluate, approve, and/or fund projects). The Cost Estimate Classification System maps the phases and stages of project cost estimating together with a generic maturity and quality matrix, which can be applied across a wide variety of industries.

This addendum to the generic recommended practice provides guidelines for applying the principles of estimate classification specifically to project estimates for engineering, procurement, and construction (EPC) work for the process industries. This addendum supplements the generic recommended practice (17R-97) by providing:

- a section that further defines classification concepts as they apply to the process industries;
- a chart that maps the extent and maturity of estimate input information (project definition deliverables) against the class of estimate.

As with the generic standard, an intent of this addendum is to improve communications among all of the stakeholders involved with preparing, evaluating, and using project cost estimates specifically for the process industries.

The overall purpose of this recommended practice is to outline relationship of specific design input data and design deliverables, to the estimate accuracy and methodology used to produce the cost estimate. An implied confidence level can be inferred by the completeness of project data and design deliverables, coupled with the quality of the information shown. The estimate confidence level or estimate accuracy range is limited by the reliability of the scope information available at the time of the estimate, in addition to other variables.

It is understood that each enterprise may have its own project and estimating processes and terminology, and may classify estimates in particular ways. This guideline provides a generic and generally acceptable classification system for process industries that can be used as a basis to compare against. This addendum should allow each user to better assess, define, and communicate their own processes and standards in the light of generally-accepted cost engineering practice.

INTRODUCTION

For the purposes of this addendum, the term process industries is assumed to include firms involved with the manufacturing and production of chemicals, petrochemicals, and hydrocarbon processing. The common thread among these industries (for the purpose of estimate classification) is their reliance on process flow diagrams (PFDs) and piping and instrument diagrams (P&IDs) as primary scope defining documents. These documents are key deliverables in determining the degree of project definition, and thus the extent and maturity of estimate input information.

Estimates for process facilities center on mechanical and chemical process equipment, and they have significant amounts of piping, instrumentation, and process controls involved. As such, this addendum may apply to portions of other industries, such as pharmaceutical, utility, metallurgical, converting, and similar industries. Specific addendums addressing these industries may be developed over time.

This addendum specifically does not address cost estimate classification in non-process industries such as commercial building construction, environmental remediation, transportation infrastructure, “dry” processes such as assembly and manufacturing, “soft asset” production such as software development, and similar industries. It also does not specifically address estimates for the exploration, production, or transportation of mining or hydrocarbon materials, although it may apply to some of the intermediate processing steps in these systems.

The cost estimates covered by this addendum are for engineering, procurement, and construction (EPC) work only. It does not cover estimates for the products manufactured by the process facilities, or for research and development work in support of the process industries. This guideline does not cover the significant building construction that may be a part of process plants. Building construction will be covered in a separate addendum.

This guideline reflects generally-accepted cost engineering practices. This addendum was based upon the practices of a wide range of companies in the process industries from around the world, as well as published references and standards. Company and public standards were solicited and reviewed, and the practices were found to have significant commonalities.

COST ESTIMATE CLASSIFICATION MATRIX FOR THE PROCESS INDUSTRIES

The five estimate classes are presented in table 1 in relationship to the identified characteristics. Only the degree of project definition determines the estimate class. The other characteristics are secondary and are generally correlated with the degree of project definition, as discussed in the generic RP No. 17R-97. The characteristics are typical for the process industries but may vary from application to application.

Cost Estimate Classification System – As Applied in Engineering Procurement, and Construction for the Process Industries

January 15, 2011

	Primary Characteristic	Secondary Characteristic		
ESTIMATE CLASS	**DEGREE OF PROJECT DEFINITION** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low and high ranges [a]
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 70%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	70% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Notes: [a] The state of process technology and availability of applicable reference cost data affect the range markedly. The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for given scope.

Table 1 – Cost Estimate Classification Matrix for Process Industries

This matrix and guideline provide an estimate classification system that is specific to the process industries. Refer to the generic estimate classification RP No. 17-97 for a general matrix that is non-industry specific, or to other addendums for guidelines that will provide more detailed information for application in other specific industries. These will typically provide additional information, such as input deliverable checklists to allow meaningful categorization in those particular industries.

Table 1 illustrates typical accuracy ranges that are associated with the process industries. Depending on the technical and project deliverables (and other variables) associated with each estimate, the accuracy range for any particular estimate is expected to fall into the ranges identified.

In addition to the degree of project definition, estimate accuracy is also subject to:

- Level of non-familiar technology in the project.
- Complexity of the project.
- Quality of reference cost estimating data.
- Quality of assumptions used in preparing the estimate.
- Experience and skill level of the estimator.
- Estimating techniques employed.
- Time and level of effort budgeted to prepare the estimate.

Another way to look at the variability associated with estimate accuracy ranges is shown in Figure 1. Depending upon the technical complexity of the project, the availability of appropriate cost reference information, the degree of project definition, and the inclusion of appropriate contingency determination, a typical Class 5 estimate for a process industry project may have an accuracy range as broad as -50% to +100%, or as narrow as -20% to +30%.

Figure 1 also illustrates that the estimating accuracy ranges overlap the estimate classes. There are cases where a Class 5 estimate for a particular project may be as accurate as a Class 3 estimate for a different project. For example, this may occur if the Class 5 estimate is based on a repeat project with good cost history and data, whereas the Class 3 estimate is for a project involving new technology. There are also cases where a Class 3 estimate has no better accuracy than a Class 5 estimate. It is for this reason that Table 1 provides a range in accuracy values. This allows application of the specific circumstances inherent in a project, and an industry sector, to the indication of realistic estimate class accuracy range percentages.

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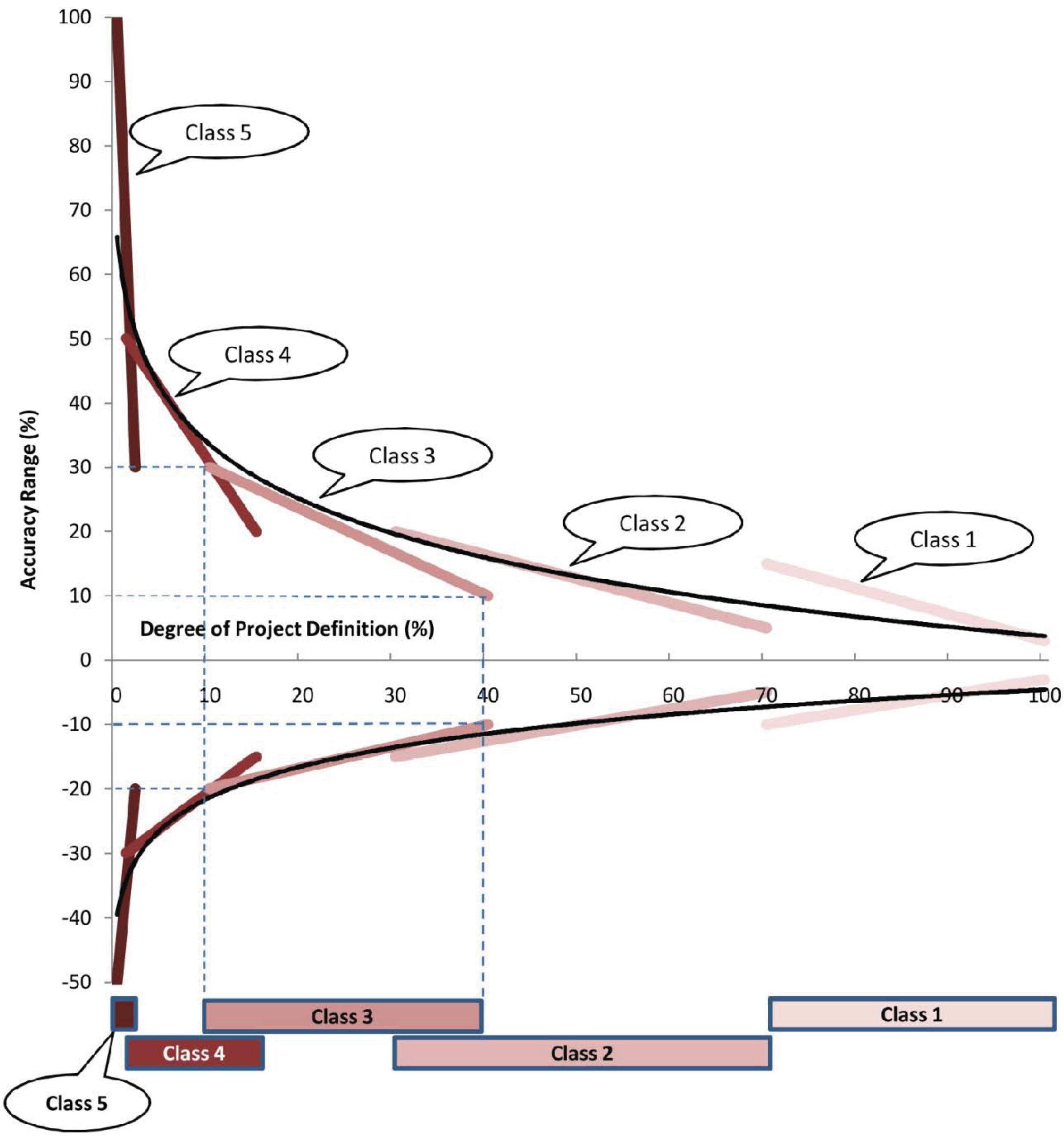

Figure 1 – Example of the Variability in Uncertainty Ranges for a Process Industry Estimate

DETERMINATION OF THE COST ESTIMATE CLASS

The cost estimator makes the determination of the estimate class based upon the degree of project definition (design % complete). While the determination of the estimate class is somewhat subjective, the design input data, completeness and quality of the design deliverables serve to make the determination more objective.

CHARACTERISTICS OF THE ESTIMATE CLASSES

The following tables (2a through 2e) provide detailed descriptions of the five estimate classifications as applied in the process industries. They are presented in the order of least-defined estimates to the most-defined estimates. These descriptions include brief discussions of each of the estimate characteristics that define an estimate class.

For each table, the following information is provided:

- **Description:** a short description of the class of estimate, including a brief listing of the expected estimate inputs based on the degree of project definition.
- **Degree of Project Definition Required:** expressed as a percent of full definition of project and technical deliverables. For the process industries, this correlates with the percent of engineering and design complete.
- **End Usage:** a short discussion of the possible end usage of this class of estimate.
- **Estimating Methods Used:** a listing of the possible estimating methods that may be employed to develop an estimate of this class.
- **Expected Accuracy Range:** typical variation in low and high ranges after the application of contingency (determined at a 50% level of confidence). Typically, this provides a 90% confidence level that the actual cost will fall within the bounds of the low and high ranges. The estimate confidence level and accuracy range is limited by the reliability of the scope information available at the time of the estimate in addition to the other variables identified above. Note: the cost estimate represents a point estimate based upon a prescriptive design, which may or may not change throughout the life cycle of the design phase. The expected accuracy range is influenced by the complexity and uncertainties of the project.
- **Alternate Estimate Names, Terms, Expressions, Synonyms:** this section provides other commonly used names that an estimate of this class might be known by. These alternate names are not endorsed by this Recommended Practice. The user is cautioned that an alternative name may not always be correlated with the class of estimate as identified in Tables 2a-2e.

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CLASS 5 ESTIMATE	
Description: Class 5 estimates are generally prepared based on very limited information, and subsequently have wide accuracy ranges. As such, some companies and organizations have elected to determine that due to the inherent inaccuracies, such estimates cannot be classified in a conventional and systemic manner. Class 5 estimates, due to the requirements of end use, may be prepared within a very limited amount of time and with little effort expended—sometimes requiring less than an hour to prepare. Often, little more than proposed plant type, location, and capacity are known at the time of estimate preparation. **Degree of Project Definition Required:** 0% to 2% of full project definition. **End Usage:** Class 5 estimates are prepared for any number of strategic business planning purposes, such as but not limited to market studies, assessment of initial viability, evaluation of alternate schemes, project screening, project location studies, evaluation of resource needs and budgeting, long-range capital planning, etc.	**Estimating Methods Used:** Class 5 estimates generally use stochastic estimating methods such as cost/capacity curves and factors, scale of operations factors, Lang factors, Hand factors, Chilton factors, Peters-Timmerhaus factors, Guthrie factors, and other parametric and modeling techniques. **Expected Accuracy Range:** Typical accuracy ranges for Class 5 estimates are -20% to -50% on the low side, and +30% to +100% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. **Alternate Estimate Names, Terms, Expressions, Synonyms:** Ratio, ballpark, blue sky, seat-of-pants, ROM, idea study, prospect estimate, concession license estimate, guesstimate, rule-of-thumb.

Table 2a – Class 5 Estimate

CLASS 4 ESTIMATE	
Description: Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Typically, engineering is from 1% to 15% complete, and would comprise at a minimum the following: plant capacity, block schematics, indicated layout, process flow diagrams (PFDs) for main process systems, and preliminary engineered process and utility equipment lists. **Degree of Project Definition Required:** 1% to 15% of full project definition. **End Usage:** Class 4 estimates are prepared for a number of purposes, such as but not limited to, detailed strategic planning, business development, project screening at more developed stages, alternative scheme analysis, confirmation of economic and/or technical feasibility, and preliminary budget approval or approval to proceed to next stage.	**Estimating Methods Used:** Class 4 estimates generally use stochastic estimating methods such as equipment factors, Lang factors, Hand factors, Chilton factors, Peters-Timmerhaus factors, Guthrie factors, the Miller method, gross unit costs/ratios, and other parametric and modeling techniques. **Expected Accuracy Range:** Typical accuracy ranges for Class 4 estimates are -15% to -30% on the low side, and +20% to +50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. **Alternate Estimate Names, Terms, Expressions, Synonyms:** Screening, top-down, feasibility, authorization, factored, pre-design, pre-study.

Table 2b – Class 4 Estimate

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CLASS 3 ESTIMATE	
Description: Class 3 estimates are generally prepared to form the basis for budget authorization, appropriation, and/or funding. As such, they typically form the initial control estimate against which all actual costs and resources will be monitored. Typically, engineering is from 10% to 40% complete, and would comprise at a minimum the following: process flow diagrams, utility flow diagrams, preliminary piping and instrument diagrams, plot plan, developed layout drawings, and essentially complete engineered process and utility equipment lists. **Degree of Project Definition Required:** 10% to 40% of full project definition. **End Usage:** Class 3 estimates are typically prepared to support full project funding requests, and become the first of the project phase control estimates against which all actual costs and resources will be monitored for variations to the budget. They are used as the project budget until replaced by more detailed estimates. In many owner organizations, a Class 3 estimate is often the last estimate required and could very well form the only basis for cost/schedule control.	**Estimating Methods Used:** Class 3 estimates generally involve more deterministic estimating methods than stochastic methods. They usually involve a high degree of unit cost line items, although these may be at an assembly level of detail rather than individual components. Factoring and other stochastic methods may be used to estimate less-significant areas of the project. **Expected Accuracy Range:** Typical accuracy ranges for Class 3 estimates are -10% to -20% on the low side, and +10% to +30% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. **Alternate Estimate Names, Terms, Expressions, Synonyms:** Budget, scope, sanction, semi-detailed, authorization, preliminary control, concept study, development, basic engineering phase estimate, target estimate.

Table 2c – Class 3 Estimate

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CLASS 2 ESTIMATE	
Description: Class 2 estimates are generally prepared to form a detailed contractor control baseline (and update the owner control baseline) against which all project work is monitored in terms of cost and progress control. For contractors, this class of estimate is often used as the bid estimate to establish contract value. Typically, engineering is from 30% to 70% complete, and would comprise at a minimum the following: process flow diagrams, utility flow diagrams, piping and instrument diagrams, heat and material balances, final plot plan, final layout drawings, complete engineered process and utility equipment lists, single line diagrams for electrical, electrical equipment and motor schedules, vendor quotations, detailed project execution plans, resourcing and work force plans, etc. **Degree of Project Definition Required:** 30% to 70% of full project definition. **End Usage:** Class 2 estimates are typically prepared as the detailed contractor control baseline (and update the owner control baseline) against which all actual costs and resources will now be monitored for variations to the budget, and form a part of the change management program.	**Estimating Methods Used:** Class 2 estimates generally involve a high degree of deterministic estimating methods. Class 2 estimates are prepared in great detail, and often involve tens of thousands of unit cost line items. For those areas of the project still undefined, an assumed level of detail takeoff (forced detail) may be developed to use as line items in the estimate instead of relying on factoring methods. **Expected Accuracy Range:** Typical accuracy ranges for Class 2 estimates are -5% to -15% on the low side, and +5% to +20% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. **Alternate Estimate Names, Terms, Expressions, Synonyms:** Detailed control, forced detail, execution phase, master control, engineering, bid, tender, change order estimate.

Table 2d – Class 2 Estimate

CLASS 1 ESTIMATE	
Description: Class 1 estimates are generally prepared for discrete parts or sections of the total project rather than generating this level of detail for the entire project. The parts of the project estimated at this level of detail will typically be used by subcontractors for bids, or by owners for check estimates. The updated estimate is often referred to as the current control estimate and becomes the new baseline for cost/schedule control of the project. Class 1 estimates may be prepared for parts of the project to comprise a fair price estimate or bid check estimate to compare against a contractor's bid estimate, or to evaluate/dispute claims. Typically, engineering is from 70% to 100% complete, and would comprise virtually all engineering and design documentation of the project, and complete project execution and commissioning plans. **Degree of Project Definition Required:** 70% to 100% of full project definition. **End Usage:** Generally, owners and EPC contractors use Class 1 estimates to support their change management process. They may be used to evaluate bid checking, to support vendor/contractor negotiations, or for claim evaluations and dispute resolution. Construction contractors may prepare Class 1 estimates to support their bidding and to act as their final control baseline against which all actual costs and resources will now be monitored for variations to their bid. During construction, Class 1 estimates may be prepared to support change management.	**Estimating Methods Used:** Class 1 estimates generally involve the highest degree of deterministic estimating methods, and require a great amount of effort. Class 1 estimates are prepared in great detail, and thus are usually performed on only the most important or critical areas of the project. All items in the estimate are usually unit cost line items based on actual design quantities. **Expected Accuracy Range:** Typical accuracy ranges for Class 1 estimates are -3% to -10% on the low side, and +3% to +15% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. **Alternate Estimate Names, Terms, Expressions, Synonyms:** Full detail, release, fall-out, tender, firm price, bottoms-up, final, detailed control, forced detail, execution phase, master control, fair price, definitive, change order estimate.

Table 2e – Class 1 Estimate

ESTIMATE INPUT CHECKLIST AND MATURITY MATRIX

Table 3 maps the extent and maturity of estimate input information (deliverables) against the five estimate classification levels. This is a checklist of basic deliverables found in common practice in the process industries. The maturity level is an approximation of the degree of completion of the deliverable. The degree of completion is indicated by the following letters.

- None (blank): development of the deliverable has not begun.
- Started (S): work on the deliverable has begun. Development is typically limited to sketches, rough outlines, or similar levels of early completion.
- Preliminary (P): work on the deliverable is advanced. Interim, cross-functional reviews have usually been conducted. Development may be near completion except for final reviews and approvals.
- Complete (C): the deliverable has been reviewed and approved as appropriate.

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	ESTIMATE CLASSIFICATION				
	CLASS 5	CLASS 4	CLASS 3	CLASS 2	CLASS 1
DEGREE OF PROJECT DEFINITION	**0% to 2%**	**1% to 15%**	**10% to 40%**	**30% to 70%**	**70% to 100%**
General Project Data:					
Project Scope Description	General	Preliminary	Defined	Defined	Defined
Plant Production/Facility Capacity	Assumed	Preliminary	Defined	Defined	Defined
Plant Location	General	Approximate	Specific	Specific	Specific
Soils & Hydrology	None	Preliminary	Defined	Defined	Defined
Integrated Project Plan	None	Preliminary	Defined	Defined	Defined
Project Master Schedule	None	Preliminary	Defined	Defined	Defined
Escalation Strategy	None	Preliminary	Defined	Defined	Defined
Work Breakdown Structure	None	Preliminary	Defined	Defined	Defined
Project Code of Accounts	None	Preliminary	Defined	Defined	Defined
Contracting Strategy	Assumed	Assumed	Preliminary	Defined	Defined
Engineering Deliverables:					
Block Flow Diagrams	S/P	P/C	C	C	C
Plot Plans		S/P	C	C	C
Process Flow Diagrams (PFDs)		P	C	C	C
Utility Flow Diagrams (UFDs)		S/P	C	C	C
Piping & Instrument Diagrams (P&IDs)		S/P	C	C	C

January 15, 2011

	ESTIMATE CLASSIFICATION				
	CLASS 5	CLASS 4	CLASS 3	CLASS 2	CLASS 1
DEGREE OF PROJECT DEFINITION	**0% to 2%**	**1% to 15%**	**10% to 40%**	**30% to 70%**	**70% to 100%**
Heat & Material Balances		S/P	C	C	C
Process Equipment List		S/P	C	C	C
Utility Equipment List		S/P	C	C	C
Electrical One-Line Drawings		S/P	C	C	C
Specifications & Datasheets		S	P/C	C	C
General Equipment Arrangement Drawings		S	C	C	C
Spare Parts Listings			P	P	C
Mechanical Discipline Drawings			S/P		
Electrical Discipline Drawings			S/P	P/C	C
Instrumentation/Control System Discipline Drawings			S/P	P/C	C
Civil/Structural/Site Discipline Drawings			S/P	P/C	C

Table 3 – Estimate Input Checklist and Maturity Matrix

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Appendix J: Crosswalk to GAO-09-3SP

GAO Project Phase	GAO Best Practice	GAO Associated Tasks	Where Conformance to GAO Practice is Demonstrated in DOE G 413.3-21
INITIATION AND RESEARCH—Your audience, what you are estimating, and why you are estimating it are of the utmost importance.	***Step 1: Define the Estimate's Purpose***	Determine estimate's purpose, required level of detail, and overall scope.	Guidance related to the purpose of the estimate can be found in Sections 2.1, 3.2.1, and 6.7.1..
		Determine who will receive the estimate.	
	Step 2: Develop an Estimating Plan	Determine the cost estimating team and develop its master schedule.	Guidance related to planning the estimate development can be found in Section 4.1, Table 4-1,and Section 6.2.
		Determine who will do the independent cost estimate	
		Outline the cost estimating approach	
		Develop the estimating timeline.	
ASSESSMENT—Cost assessment steps are iterative and can be accomplished in varying order or concurrently.	***Step 3: Define the Program Characteristics***	In a technical baseline description document, identify the program's purpose and its system and performance characteristics and all system configurations.	Guidance related to DOE Program characteristics and requirements for cost estimates are discussed in Section 3 and also in Section 6.3.2.
		Describe technology implications.	
		Describe acquisition schedule and strategy.	
		Describe relationship to other existing systems, including predecessor or similar legacy systems.	
		Define support (manpower, training, etc.) and security needs and risk items.	
		Develop system quantities for development, test, and production.	
		Develop system quantities for development, test, and production.	
		Define deployment and maintenance plans.	
	Step 4: Determine the Estimating Structure	Define a work breakdown structure (WBS) and describe each element in a WBS dictionary (a major automated information system may have only a cost element structure).	Guidance relative to estimate structure is found in Table 4-1, and discussed extensively in Section 5
		Choose the best estimating method for each WBS element.	
		Identify potential cross-checks for likely cost and schedule drivers.	
		Develop a cost estimating checklist.	
	Step 5: Identify Ground Rules and Assumptions	Clearly define what the estimate includes and excludes.	The concepts related to ground rules and

GAO Project Phase	GAO Best Practice	GAO Associated Tasks	Where Conformance to GAO Practice is Demonstrated in DOE G 413.3-21
		Identify global and program-specific assumptions, such as the estimate's base year, including time-phasing and life cycle.	assumptions are discussed in Table 4-1, and again in Section 6, with specific guidance in Section 6.7.1.
		The estimate's base year, including time-phasing and life cycle.	
		Identify program schedule information by phase and program acquisition strategy.	
		Identify any schedule or budget constraints, inflation assumptions, and travel costs.	
		Specify equipment the government is to furnish as well as the use of existing facilities or new modification or development.	
		Identify prime contractor and major subcontractors.	
		Determine technology refresh cycles, technology assumptions, and new technology to be developed.	
		Define commonality with legacy systems and assumed heritage savings.	
		Describe effects of new ways of doing business.	
	Step 6: Obtain Data	Create a data collection plan with emphasis on collecting current and relevant technical, programmatic, cost, and risk data.	Estimate data sources and associated guidance can be found in Section 2.2, Section 3,and is the focus of Section 6.3
		Investigate possible data sources.	
		Collect data and normalize them for cost accounting, inflation, learning and quantity adjustments.	
		Analyze the data for cost drivers, trends, and outliers and compare results against rules of thumb and standard factors derived from historical data.	
		Interview data sources and document all pertinent information, including an assessment of data reliability and accuracy.	
		Store data for future estimates	
	Step 7: Develop a Point Estimate and Compare it to an Independent Cost Estimate	Develop the cost model, estimating each WBS element, using the best methodology from the data collected, and including all estimating assumptions.	The techniques available for estimate development are described in Section 5 and the estimate development process itself is discussed extensively in Section 6.4.
		Express costs in constant year dollars.	

GAO Project Phase	GAO Best Practice	GAO Associated Tasks	Where Conformance to GAO Practice is Demonstrated in DOE G 413.3-21
		Time-phase the results by spreading costs in the years they are expected to occur, based on the program schedule.	Other tasks identified here are discussed in Sections 6.5 and 6.6. Independent Cost Estimates are discussed in Section 8.3 with guidance provided in Appendix K.
		Sum the WBS elements to develop the overall point estimate.	
		Validate the estimate by looking for errors like double counting and omitted costs.	
		Compare estimate against the independent cost estimate and examine where and why there are differences.	
		Perform cross-checks on cost drivers to see if results are similar.	
		Update the model as more data become available or as changes occur and compare results against previous estimates.	
ANALYSIS—The confidence in the point or range of the estimate is crucial to the decision maker.	***Step 8: Conduct Sensitivity Analysis***	Test the sensitivity of cost elements to changes in estimating input values and key assumptions.	The concept of Sensitivity Analysis is discussed in Section 6.4.5 as a subset of contingency analysis. However the requirements for such analyses can also be found throughout the Guidance document, specifically, Section 6.1, Table 6-1 and Section 6.7.1.
		Identify effects on the overall estimate of changing the program schedule or quantities.	
		Determine which assumptions are key cost drivers and which cost elements are affected most by changes.	
	Step 9: Conduct Risk and Uncertainty Analysis	Determine and discuss with technical experts the level of cost, schedule, and technical risk associated with each WBS element.	A full explanation of DOE's guidance relative to risk and uncertainty analysis and contingency allowances can be found in Section 6.4.5 and more in-depth treatment can be found in DOE G 413.3-7A, Risk Management Guide.
		Analyze each risk for its severity and probability.	
		Develop minimum, most likely, and maximum ranges for each risk element.	
		Determine type of risk distributions and reason for their use.	
		Ensure that risks are correlated.	
		Use an acceptable statistical analysis method (e.g., Monte Carlo simulation) to develop a confidence interval around the point estimate.	
		Identify the confidence level of the point estimate.	

GAO Project Phase	GAO Best Practice	GAO Associated Tasks	Where Conformance to GAO Practice is Demonstrated in DOE G 413.3-21
		Identify the amount of contingency funding and add this to the point estimate to determine the risk-adjusted cost estimate.	
		Recommend that the project or program office develop a risk management plan to track and mitigate risks.	
	Step 10: Document the Estimate	Document all steps used to develop the estimate so that a cost analyst unfamiliar with the program can recreate it quickly and produce the same result.	Estimate documentation is discussed in Section 3.2, and extensively in Section 6.7.
		Document the purpose of the estimate, the team that prepared it, and who approved the estimate and on what date.	
		Describe the program, its schedule, and the technical baseline used to create the estimate.	
		Present the program's time-phased life-cycle cost.	
		Discuss all ground rules and assumptions.	
		Include auditable and traceable data sources for each cost element and document for all data sources how the data were normalized.	
		Describe in detail the estimating methodology and rationale used to derive each WBS element's cost (prefer more detail over less).	
		Describe the results of the risk, uncertainty, and sensitivity analyses and whether any contingency funds were identified.	
		Document how the estimate compares to the funding profile.	
		Track how this estimate compares to any previous estimates.	

GAO Project Phase	GAO Best Practice	GAO Associated Tasks	Where Conformance to GAO Practice is Demonstrated in DOE G 413.3-21
PRESENTATION—Documentation and presentation make or break a cost estimating decision outcome.	***Step 11: Present Estimate to Management for Approval***	Develop a briefing that presents the documented life-cycle cost estimate.	Guidance related to the presentation of estimate results can be found in Table 3-1, Section 3.2.4, Section 6.7.1, and specifically in Section 7.2.
		Include an explanation of the technical and programmatic baseline and any uncertainties.	
		Compare the estimate to an independent cost estimate (ICE) and explain any differences.	
		Compare the estimate (life-cycle cost estimate (LCCE)) or independent cost estimate to the budget with enough detail to easily defend it by showing how it is accurate, complete, and high in quality.	
		Focus in a logical manner on the largest cost elements and cost drivers.	
		Make the content clear and complete so that those who are unfamiliar with it can easily comprehend the competence that underlies the estimate results.	
		Make backup slides available for more probing questions.	
		Act on and document feedback from management.	
		Request acceptance of the estimate.	
	Step 12: Update the Estimate to Reflect Actual Costs and Changes	Update the estimate to reflect changes in technical or program assumptions or keep it current as the program passes through new phases or milestones.	Estimate maintenance is discussed in Sections 6.8 and 7.3, and more extensively in DOE O 413.3B (requirements) and other associated guidance documents.
		Replace estimates with EVM EAC and Independent estimate at completion (EAC) from the integrated EVM system.	
		Report progress on meeting cost and schedule estimates.	
		Perform a post mortem and document lessons learned for elements whose actual costs or schedules differ from the estimate.	
		Document all changes to the program and how they affect the cost estimate.	

Appendix K: ICR and ICE Guidance

General ICR/ICE Guidance

- In most cases it is best to allow the ICE team to have access to the project estimate. In this way, the approaches used to develop the ICE can be tailored to fit the available data and subsequent reconciliation between the estimates is facilitated if the ICE is structured in the same manner as the project estimate.
- ICR/ICE teams need to be comprised of individuals with appropriate industry and DOE experience and credentials. Ideally, teams will include individuals with appropriate industry certifications (PE, CCE, PMP, etc.) and subject matter experts knowledgeable in the areas addressed by the project (in particular any unique technical areas or project execution strategies).
- It is important to establish a charter that clearly defines the boundaries of ICR and ICE teams. For example, it should be clearly understood that the purpose of an ICR or ICE is to establish an independent cost for a project based on the same execution strategy, conditions, technical scope and schedule as used by the project team. It is not appropriate for an ICR or ICE team to question mission need, develop alternative execution strategies, etc. and then generate an estimate based on these “new” strategies, scope or alternatives. The ICR or ICE team may propose or recommend alternatives based on observation and expert opinion; however attempting to use those alternatives to compare to project estimates is generally inappropriate.

ICR/ICE Schedule (suggested and varies by project size and complexity)

Activity	**Typical Duration (weeks)**
Establish ICR/ICE requirements and approved budget	1 - 2
Develop task order and complete negotiations with ICE contractor	2-4
Hold kick-off meeting and initial site briefings	1-2
Development of ICR/ICE and draft report	2-10 (varies with project and ICE Type)
Reconciliation between ICE and project estimate	1-2
Complete and issue final report	1-4
Overall Duration	8-24 weeks

Typical Information Requirements for ICR/ICE

The following lists some typical data needs to support ICRs and ICEs. These needs should be addressed in light of the stage of project development (CD-0, CD-1, CD-2, etc.) and the nature of the project (environmental remediation, standard construction, new technology, etc.)

1. Project Status/Management/Technical Briefings should include, but not be limited to:
    a. Project history and overview
    b. Technical baseline
    c. Current project status
    d. Major issues and problems
    e. Project organization
    f. Acquisition Strategy
    g. Project Execution Plan
    h. Work Breakdown Structure (WBS)
    i. Risk Management Plan and Risk Analysis
2. Project Schedule should include, but not be limited to:
    a. NEPA activities
    b. Milestones (including Critical Decisions)
    c. Critical Path
    d. Major contracts
    e. Procurement Plan
3. Design and Estimate Documentation/Back-up should include, but not be limited to:
    a. Project information such as
        i. Facilities descriptions
        ii. Plot plans and layout drawings
        iii. P&IDs, Process Diagrams
        iv. Electrical One-Line drawings
        v. System Descriptions
    b. Design basis documentation
    c. Cost estimate summary
    d. Cost estimate details
    e. Cost estimate backup data, such as
        i. Vendor quotes
        ii. Labor rates
        iii. Productivity factors
        iv. Contracting basis/assumptions
        v. Overhead/markup assumptions and calculations
        vi. Engineering/CM/PM staffing plans and manpower estimates
4. Cost Briefing (analysis of the results of the estimate) should include, but not be limited to:
    a. Current estimate
    b. Estimate basis (all major components)
    c. Contingency analysis (and supporting risk and uncertainty analysis)
    d. Escalation
    e. Cash flow
    f. Funding plan

g. TEC and OPC buildup and classification
h. Major assumptions
i. Value engineering results
j. Project staffing plan and resource availability/leveling analysis

Reconciliation of ICR/ICE and Project Estimate

- A draft of the DOE ICE report is generated which represents the consensus of both the DOE lead (e.g., OECM) and the ICE contractor, and includes the ICE contractor's report as backup.
- The DOE ICE report includes the team leader's programmatic observations and comments.
- The draft DOE ICE report is transmitted to the project office for review and comments.
- The ICE team leader will review the comments with the support contractor to determine whether the major differences between the project estimate and the ICE can be resolved via a teleconference or if a face-to-face meeting is required for reconciliation.
- Reconciliations
    - Concentrate on major cost differences or items of special interest.
    - Reconciliation does not necessarily mean consensus.
    - An attempt should be made to keep reconciliations non-adversarial.
    - If data is presented at the reconciliation that proves the ICE is in error, the ICE should be changed. The project team should adhere to this rule as well.
- A final draft ICE report will be developed to reflect any changes resulting from the reconciliation meeting.

ICE Report Contents

- Executive Summary
- Background (including project cost/baseline history)
- Project Status
- Technical Baseline Description
- Information available to the ICE team
- Cost estimate methodology (s) used
- Comparison of Project Estimate and the ICE by WBS
- Variance Analysis
- Contingency Analysis
- Schedule Analysis/Variance
- Funding Profile Analysis/Variance

- Conclusions
- Recommendations

Appendix L: DOE Expectations for Quality Cost Estimates

It is important that cost estimators and the program office validate that all cost elements are credible and can be justified by acceptable estimating methods, adequate data, and detailed documentation. This crucial step ensures that a high-quality cost estimate is developed, presented, and defended to management. This process verifies that the cost estimate adequately reflects the program baseline and provides a reasonable estimate of how much it will cost to accomplish all tasks. It also confirms that the program cost estimate is traceable and accurate and reflects realistic assumptions.

Verifying the quality of the point estimate is considered a best practice. One reason for this is that independent cost estimators typically rely on historical data and therefore tend to estimate more realistic program schedules and costs for state-of-the-art technologies. Moreover, independent cost estimators are less likely to automatically accept unproven assumptions associated with anticipated savings. That is, they bring more objectivity to their analyses, resulting in estimates that are less optimistic and higher in cost. An independent view provides a reality check of the point estimate and helps reduce the odds that management will invest in an unrealistic program that is bound to fail.

<u>Cost Estimating Best Practices</u>

There are four characteristics of a high-quality, reliable cost estimate. It is well-documented, comprehensive, accurate, and credible.

An estimate must be thoroughly documented, including source data and significance, clearly detailed calculations and results, and explanations of why particular methods and references were chosen. Data must be traced to their source documents.

An estimate must have enough detail to ensure that cost elements are neither omitted nor double counted. All cost-influencing ground rules and assumptions are detailed in the estimate's documentation.

An estimate must be unbiased, not overly conservative or overly optimistic, and is based on an assessment of most likely costs. Few, if any, mathematical mistakes are present; those that are minor.

Any limitations of the analysis because of uncertainty or bias surrounding data or assumptions are discussed. Major assumptions are varied, and other outcomes are recomputed to determine how sensitive they are to changes in the assumptions. Risk and uncertainty analysis is performed to determine the level of risk associated with the estimate. The estimate's results are crosschecked, and an independent cost estimate (ICE) conducted by a group outside the acquiring organization is developed to determine whether other estimating methods produce similar results.

Table L-1 shows how the 12 steps of a high-quality cost estimating process can be mapped to these four characteristics of a high-quality, reliable cost estimate.

Table L-1: The Twelve Steps of High-Quality Cost Estimating (GAO) Mapped to the Characteristics of a High-Quality Cost Estimate

Cost estimate characteristic:	Cost estimating step:
Well documented. The estimate is thoroughly documented, including source data and significance, clearly detailed calculations and results, and explanations for choosing a particular method or reference: • Data are traced back to the source documentation; • Includes a technical baseline description; • Documents all steps in developing the estimate so that a cost analyst unfamiliar with the program can recreate it quickly with the same result; • Documents all data sources for how the data were normalized; • Describes in detail the estimating methodology and rationale used to derive each WBS element's cost.	1. Define the estimate's purpose; 3. Define the program; 5. Identify ground rules and assumptions; 6. Obtain the data; 10. Document the estimate; 11. Present the estimate to management.
Comprehensive. The estimate's level of detail ensures that cost elements are neither omitted nor double counted: • Details all cost-influencing ground rules and assumptions; • Defines the WBS and describes each element in a WBS dictionary; • A major automated information system program may have only a cost element structure.	2. Develop the estimating plan; 4. Determine the estimating approach.
Accurate. The estimate is unbiased, not overly conservative or overly optimistic, and based on an assessment of most likely costs: • It has few, if any, mathematical mistakes; its mistakes are minor; • It has been validated for errors like double counting and omitted costs; • Cost drivers have been cross-checked to see if results are similar; • It is timely; • It is updated to reflect changes in technical or program assumptions and new phases or milestones; • Estimates are replaced with EVM EAC and the independent EAC from the integrated EVM system.	7. Develop the point estimate and compare it to an independent cost estimate; 12. Update the estimate to reflect actual costs and changes.

<table>
<tr><th>Cost estimate characteristic:</th><th>Cost estimating step:</th></tr>
<tr><td>Credible. Discusses any limitations of the analysis from uncertainty or biases surrounding data or assumptions:

• Major assumptions are realistic, varied and other outcomes recomputed to determine their sensitivity to changes in assumptions;
• Risk and uncertainty analysis is performed to determine the level of risk associated with the estimate;
• An independent cost estimate is developed to determine if other estimating methods produce similar results</td><td>7. Develop the point estimate and compare it to an independent cost estimate;

8. Conduct sensitivity analysis;

9. Conduct risk and uncertainty analysis.</td></tr>
</table>

Validating Cost Estimates

Too often program assumptions are optimistic and thus cost estimates are unrealistic and as a result, cost more than originally estimated. One way to avoid this predicament is to ensure that program and project cost estimates are both internally and externally validated—that is, that they are comprehensive, well documented, accurate, and credible. This increases the confidence that an estimate is reasonable and as accurate as possible.

The following steps should be taken to validate a program or project cost estimate:

1. Determine That the Estimate Is Well Documented:

   Cost estimates are considered valid if they are well documented to the point at which they can be easily repeated or updated and can be traced to original sources through auditing. Rigorous documentation also increases an estimate's credibility and helps support an organization's decision making. The documentation should explicitly identify the primary methods, calculations, results, rationales or assumptions, and sources of the data used to generate each cost element.

   Cost estimate documentation should be detailed enough to provide an accurate assessment of the cost estimate's quality. For example, it should identify the data sources, justify all assumptions, and describe each estimating method (including any cost estimating relationships) for every WBS cost element. Further, schedule milestones and deliverables should be traceable and consistent with the cost estimate documentation. Finally, estimating methods used to develop each WBS cost element should be thoroughly documented so that their derivation can be traced to all sources, allowing for the estimate to be easily replicated and updated.

2. Determine That the Estimate Is Comprehensive:

   Cost Estimators or Analysts should make sure that the cost estimate is complete and accounts for all costs that are likely to occur. They should confirm its completeness, its consistency, and the realism of its information to ensure that all pertinent costs are included. Comprehensive cost estimates completely define the program, reflect the current schedule, and are technically reasonable. In addition, cost estimates should be structured in sufficient detail to ensure that cost elements are neither omitted nor double-counted. For example, if it is assumed that software will be reused, the estimate should account for all associated costs, such as interface design, modification, integration, testing, and documentation.

   To determine whether an estimate is comprehensive, an objective review must be performed to certify that the estimate's criteria and requirements have been met. This step also infuses quality assurance practices into the cost estimate. In this effort, the reviewer checks that the estimate captures the complete technical scope of the work to be performed, using a logical WBS that accounts for all performance criteria and requirements. In addition, the reviewer must determine that all assumptions and exclusions the estimate is based on are clearly identified, explained, and reasonable.

3. Determine That the Estimate Is Accurate:

   Estimates are accurate when they are not overly conservative or too optimistic, based on an assessment of most likely costs, adjusted properly for inflation, and contain few, if any, minor mistakes. In addition, when schedules or other assumptions change, cost estimates should be revised to reflect their current status.

   Validating that a cost estimate is accurate requires thoroughly understanding and investigating how the cost estimate was constructed. For example, all WBS cost estimate elements should be checked to verify that calculations are accurate and account for all costs, including indirect costs. Moreover, proper escalation factors should be used to inflate costs so that they are expressed consistently and accurately. Finally, rechecking spreadsheet formulas and data input is imperative to validate cost model accuracy.

   Besides these basic checks for accuracy, the estimating technique used for each cost element should be reviewed, to make sure it is appropriate for the degree of design or requirements definition that is complete.

   Depending on the analytical method chosen, several questions should be answered to ensure cost estimate accuracy. Table L-2 outlines typical questions that should be answered to assess accuracy associated with various estimating techniques.

Table L-2: Questions for Checking the Accuracy of Cost Estimating Techniques

Technique:	Question:
Analogy;	• What heritage programs and scaling factors were used to create the analogy? • Are the analogous data from reliable sources? • Did technical experts validate the scaling factor? • Can any unusual requirements invalidate the analogy? • Are the parameters used to develop an analogous factor similar to the program being estimated? • How were adjustments made to account for differences between existing and new systems? Were they logical, credible, and acceptable?
Data collection;	• How old are the data? Are they still relevant to the new program? • Is there enough knowledge about the data source to determine if it can be used to estimate accurate costs for the new program? • Has a data scatter plot been developed to determine whether any outliers, relationships, and trends exist? • Were descriptive statistics generated to describe the data, including the historical average, mean, standard deviation, and coefficient of variation? • If data outliers were removed, did the data fall outside three standard deviations? • Were comparisons made to historical data to show they were an anomaly? • Were the data properly normalized so that comparisons and projections are valid? • Were the cost data adjusted for inflation so that they could be described in like terms?
Engineering build-up;	• Was each WBS cost element defined in enough detail to use this method correctly? • Are data adequate to accurately estimate the cost of each WBS element? • Did experienced experts help determine a reasonable cost estimate? • Was the estimate based on specific quantities that would be ordered at one time, allowing for quantity discounts? • Did the estimate account for contractor material handling overhead? • Is there a definitive understanding of each WBS cost element's composition? • Were labor rates based on auditable sources? Did they include all applicable overhead, general and administrative costs, and fees? Were they consistent with industry standards? • Is a detailed and accurate materials and parts list available?

Technique:	Question:
Expert opinion	• Do quantitative historical data back up the expert opinion? • How did the estimate account for the possibility that bias influenced the results?
Extrapolate from actuals (averages, learning curves, estimates at completion)	• Were cost reports used for extrapolation validated as accurate? • Was the cost element at least 25% complete before using its data as an extrapolation? • Were functional experts consulted to validate the reported percentage as complete? • Were contractors interviewed to ensure the cost data's validity? • Were recurring and nonrecurring costs separated to avoid double counting? • How were first unit costs of the learning curve determined? What historical data were used to determine the learning curve slope? • Were recurring and nonrecurring costs separated when the learning curve was developed? • How were partial units treated in the learning curve equation? • Were production rate effects considered? How were production break effects determined?
Parametric;	• Was a valid statistical relationship, or CER, between historical costs and program, physical, and performance characteristics established? • How logical is the relationship between key cost drivers and cost? • Was the CER used to develop the estimate validated and accepted? • How old are the data in the CER database? Are they still relevant for the program being estimated? • Do the independent variables for the program fall within the CER data range? • What is the level of variation in the CER? How well does the CER explain the variation (R2) and how much of the variation does the model not explain? • Do any outliers affect the overall fit? • How significant is the relationship between cost and its independent variables? • How well does the CER predict costs?
Software estimating;	• Was the software estimate broken into unique categories: new development, reuse, commercial off-the-shelf, modified code, glue code, integration? • What input parameters—programmer skills, applications experience, development language, environment, process—were used for commercial software cost models, and how were they justified? • How was the software effort sized? Was the sizing method reasonable?

Technique:	Question:
	• How were productivity factors determined? • How was labor hours converted to cost? How many productive hours were assumed in each day? • How were savings from auto-generated code and commercial off-the-shelf software estimated? Are the savings reasonable? • What were the assumptions behind the amount of code reuse? Were they supported? • How were the integration between the software, commercial software, system, and hardware estimated, and what historical data supported the results? • Were software license costs based on actual or historical data? • Were software maintenance costs adequately identified and reasonable?

Validating Parametric Cost Estimates and Cost Models

Cost Estimating Relationships (CERs) and cost models also need to be validated to demonstrate that they can predict costs within an acceptable range of accuracy. To do this, data from historical programs similar to the new program should be collected to determine whether the CER selected is a reliable predictor of costs. In this review, technical parameters for the historical programs should be examined to determine whether they are similar to the program being estimated. For the CER to be accurate, the new and historical programs should have similar functions, objectives, and program factors, like acquisition strategy, or results could be misleading. Equally important, CERs should be developed with established and enforced policies and procedures that require staff to have proper experience and training to ensure the model's continued integrity.

Before a parametric model is used to develop an estimate, the model should be calibrated and validated to ensure that it is based on current, accurate, and complete data and is therefore a good predictor of cost. Like a CER, a parametric model is validated by determining that its users have enough experience and training and that formal estimating system policies and procedures have been established. The procedures focus on the model's background and history, identifying key cost drivers and recommending steps for calibrating and developing the estimate. To stay current, parametric models should be continually updated and calibrated.

Validation with calibration gives confidence that the model is a reliable estimating technique. To evaluate a model's ability to predict costs, a variety of assessment tests can be performed. One is to compare calibrated values with independent data that were not included in the model's calibration. Comparing the model's results to the independent test data's "known value" provides a useful benchmark for how accurately the model can predict costs. An alternative is to use the model to prepare an estimate and then compare its result with an independent estimate cost or check estimate based on another estimating technique.

4. Determine That the Estimate Is Credible:

   Credible cost estimates clearly identify limitations because of uncertainty or bias surrounding the data or assumptions. Major assumptions should be varied and other outcomes recomputed to determine how sensitive outcomes are to changes in the assumptions. In addition, a risk and uncertainty analysis should be performed to determine the level of risk (cost estimate uncertainty) associated with the estimate. Finally, the results of the estimate should be cross-checked and an ICE performed to determine whether alternative estimate views produce similar results.

   To determine an estimate's credibility, key cost elements should be tested for sensitivity, and other cost estimating techniques should be used to cross-check the reasonableness of Ground Rules & Assumptions (GR&As). It is also important to determine how sensitive the final results are to changes in key assumptions and parameters. A sensitivity analysis identifies key elements that drive cost and permits what-if analysis, often used to develop cost ranges and risk reserves. This enables management to know the potential for cost growth and the reasons behind it.

   Along with a sensitivity analysis, a risk and uncertainty analysis adds to the credibility of the cost estimate, because it identifies the level of confidence associated with achieving the cost estimate. Risk and uncertainty analysis produces more realistic results, because it assesses the variability in the cost estimate from such effects as schedules slipping, missions changing, and proposed solutions not meeting users' needs. An uncertainty analysis gives decision maker's perspective on the potential variability of the estimate should facts, circumstances, and assumptions change. By examining the effects of varying the estimate's elements, a degree of uncertainty about the estimate can be expressed with a range of potential costs that is qualified by a factor of confidence.

   Another way to reinforce the credibility of the cost estimate is to see whether applying a different method produces similar results. In addition, industry rules of thumb can constitute a sanity check. The main purpose of cross-checking is to determine whether alternative methods produce similar results. If so, then confidence in the estimate increases, leading to greater credibility. If not, then the cost estimator should examine and explain the reason for the difference and determine whether it is acceptable.

   An Independent Cost Estimate (ICE) is considered one of the best and most reliable validation methods. ICEs are typically performed by organizations higher in the decision-making process than the office performing the baseline estimate. They provide an independent view of expected program costs that tests the program office's estimate for reasonableness. Therefore, ICEs can provide decision makers with additional insight into a program's potential costs—in part, because they frequently use different methods and are less burdened with organizational bias. Moreover, ICEs tend to incorporate adequate risk and, therefore, tend to be more conservative by forecasting higher costs than the program office.

The ICE is usually developed from the same technical baseline description the program office used so that the estimates are comparable. An ICE's major benefit is that it provides an objective and unbiased assessment of whether the program estimate can be achieved, reducing the risk that the program will proceed underfunded. It also can be used as a benchmark to assess the reasonableness of a contractor's proposed costs, improving management's ability to make sound investment decisions, and accurately assess the contractor's performance.

In most cases, the ICE team does not have insight into daily program events, so it is usually forced to estimate at a higher level or use analogous estimating techniques. It is, in fact, expected that the ICE team will use different estimating techniques and, where possible, data sources from those used to develop the baseline estimate. It is important for the ICE team and the program's cost estimate team to reconcile the two estimates.

Two issues with ICEs are the degree of independence and the depth of the analysis. Degree of independence depends on how far removed the estimator is from the program office. The greater the independence, the more detached and disinterested the cost estimator is in the program's success. The basic test for independence, therefore, is whether the cost estimator can be influenced by the program office.

Thus, independence is determined by the position of the cost estimator in relation to the program office and whether there is a common superior between the two. For example, if an independent cost estimator is hired by the program office, the estimator may be susceptible to success-oriented bias. When this happens, the ICE can end up too optimistic.

History has shown a clear pattern of higher cost estimates the further away from the program office that the ICE is created. This is because the ICE team is more objective and less prone to accept optimistic assumptions. To be of value, however, an ICE must not only be performed by entities far removed from the acquiring program office but must also be accepted by management as a valuable risk reduction resource that can be used to minimize unrealistic expectations. The second issue with an ICE is the depth of the review.

Table L-3 lists eight types of independent cost estimate reviews and describes what they entail.

Table L-3: Eight Types of Independent Cost Estimate Reviews:

Review:	Description:
Document review;	It is an inventory of existing documentation to determine whether information is missing and an assessment of the available documentation to support the estimate.

Review:	Description:
Independent cost assessment;	An outside evaluation of a program's cost estimate that examines its quality and accuracy, with emphasis on specific cost and technical risks, it involves the same procedures as those of the program estimate but using different methods and techniques.
Independent cost estimate Description:	Conducted by an organization outside the acquisition chain, using the same detailed technical information as the program estimate, it is a comparison with the program estimate to determine whether it is accurate and realistic.
Independent government cost estimate;	Analyzing contractors' prices or cost proposals, it estimates the cost of activities outlined in the statement of work; does not include all costs associated with a program and can only reflect costs from a contractor's viewpoint. Assumes that all technical challenges can be met as outlined in the proposal, meaning that it cannot account for potential risks associated with design problems.
Non-advocate review Description:	Performed by experienced but independent internal non-advocate staff, it ascertains the adequacy and accuracy of a program's estimated budget; assesses the validity of program scope, requirements, capabilities, acquisition strategy, and estimated life-cycle costs.
Parametric estimating technique;	Usually performed at the summary WBS level, it includes all activities associated with a reasonableness review and incorporates cross-checks using parametric techniques and factors based on historical data to analyze the estimate's validity.
Reasonableness, or sufficiency, review;	It is a review of all documentation by an independent cost team, meeting with staff responsible for developing the program estimate, to analyze whether the estimate is sufficient with regard to the validity of cost and schedule assumptions and cost estimate methodology rationale and whether it is complete.

Sampling technique;	It is an independent estimate of key cost drivers of major WBS elements whose sensitivity affects the overall estimate; detailed independent government cost estimates developed for these key drivers include vendor quotes and material, labor, and subcontractor costs. Other program costs are estimated using the program estimate, as long as a reasonableness review has been conducted to ensure their validity.

As the table shows, the most rigorous independent review is an ICE. Other independent cost reviews address only a program's high-value, high-risk, and high-interest elements and simply pass through program estimate values for the other costs. While they are useful to management, not all provide the objectivity necessary to ensure that the estimate going forward for a decision is valid.

After an ICE or independent review is completed, it should be reconciled to the project or baseline estimate to ensure that both estimates are based on the same GR&As. A synopsis or reconciliation of the cost estimates and their differences is then presented to management. Using this information, decision makers use the ICE or independent cost estimate review to validate whether the program estimate is reasonable.

ATTACHMENT 10

CALIFORNIA DEPARTMENT OF TRANSPORTATION

Preparation Guidelines for Project Development Cost Estimates

Cost Estimating Guidelines

Last Update: 10/10/2014

Abstract

This Document replaces Appendix AA of Project Development Procedure Manual (PDPM). PDPM Chapter 20 – Project Development Cost Estimates includes the policy and procedures required for developing project cost estimates. This document provides minimum guidance necessary to develop reasonably accurate cost estimates but doesn't take place of experience and prudent engineering judgment. This guidance included discussion of many different factors that affect project cost estimates. Estimator should consider all of these factors as necessary in developing a project cost estimate.

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Preparation Guidelines for Project Development Cost Estimates

SECTION 1 General Guidelines

Overview

Importance of Quality Cost Estimates

The reliability of project cost estimates at every stage in the project development process is necessary for responsible fiscal management. (See Chapter 20 for procedural information.) Unreliable cost estimates result in severe problems in Caltrans' programming and budgeting, in local and regional planning, and it results in staffing and budgeting decisions which could impair effective use of resources. This, in turn, affects Caltrans' relations with the California Transportation Commission (CTC), the Legislature, local and regional agencies, and the public, and results in loss of credibility.

Goal and Objective

Caltrans' goal is to avoid project cost overruns and also avoid excessive cost underruns. Cost overrun leads to shortage of funding to deliver the project, while cost underruns leaves unused funds that could have been used to deliver other important projects. The objective is to produce reliable construction estimates throughout project planning, development, and delivery process. It is important to identify costly unforeseen items of work before the project has been programmed to avoid delays and/or cancelation. Estimators should try to minimize the differences between project's planning estimates and final design estimate, as well as the difference between the Engineer's Estimate and the Low Bid.

Consistent and Comprehensive Methodology

Estimating cost is not an exact science. However, Caltrans must strive for reliable project cost estimates so that projects can be delivered within budget. To this end, Caltrans requires that project cost estimates be prepared using a consistent and comprehensive methodology. Even with a consistent and comprehensive methodology, careful attention is needed to ensure a quality cost estimate. The cost estimator needs to research, compare and, above all, use professional judgment to prepare a quality cost estimate. Consideration of project scope, schedule, and level of design details is required to develop accurate cost estimates. Cost estimates, in a sense, are never completed. They are not static, but have to be reviewed continually to keep them current.

Consult Others

Other functional units (Structures, Right of Way, Traffic Operations, Materials, Maintenance, Construction, Environmental, Landscape Architecture, etc.) and local entities should be involved as appropriate in the preparation of both project planning cost estimates and project design cost estimates. Project cost estimates should be developed through consultation with the project development team.

Identifying Items of Work and Estimating Quantities - Project Planning Phase

Systematic Field Reviews

In order to use project estimate with confidence it is essential that project alternatives be adequately scoped. This is best accomplished by visiting the project site and performing a systematic field review. Systematic field reviews are an essential part of the project development process. They provide an important perspective that supplements the mapping, photos, survey data and other sources of information about the project that are used in the office. Going to the proposed project site and seeing it first-hand minimizes the possibility of overlooking significant design features.

While in the field, project personnel should be on the lookout for high cost items such as utility relocation, noise barriers, retaining walls, major storm drains, hazardous waste mitigation, and other environmental impacts. Consult with the local construction and traffic leads to determine the need for a transportation management plan or a traffic handling plan. Local maintenance lead could point out if there are any drainage or accidents issues. If high cost items are present or need to be designed into the project alternatives, they must be quantified. The “worst probable case” scenario should always be assumed, particularly on reconstruction projects. Existing facilities thought to be adequate may have become inadequate because of changes to standards, new data, further deterioration prior to construction, or other factors. Design feature decisions, project constructability, construction staging, etc should be evaluated in the field. The estimator should take notes to document decisions and to identify limits, boundaries, etc. A strip map and proposed typical sections are very useful in the field to document proposed project features. Consultation with the Survey Unit and a review of the *Drafting and Plans Manual* are advisable.

Additional Information

Additional types of information that must be obtained to prepare a Project Planning Cost Estimate include but are not limited to: existing and forecasted traffic; geotechnical design information (particularly where foundation and slope stability problems can be anticipated); materials and pavement structural section design information; advance planning cost estimates for new structures and modifying existing structures; hazardous waste assessment; potential environmental issues and mitigation; right-of-way and utilities data sheets; utilization of existing resources (recycling). Research the information already available early in the project development process and utilize it. If this information is not available, request it from the appropriate source unit.

Use Groupings from Standard Cost Estimate Format

Individual contract items are difficult to identify at the early project development stages, but it is possible to group basic work functions together to form a systematic approach to project cost estimating. Most projects have grading, pavement structural section materials, drainage, and structures that are relatively easy to recognize and quantify. The standard cost estimating format provides for this approach by using such groupings. Coordination between the planning cost estimate and the Standard Specifications is also essential, since they will be used to construct the project.

Contingencies Versus Confidence Factor

Contingency factors for project planning cost estimates vary depending on the cost estimate type. Contingencies are intended to compensate for the use of limited information. The percentage decreases as the project becomes more defined and there are fewer unknowns. Contingencies are not intended to take the place of incomplete design work. Project alternatives and their associated cost estimates must be thoroughly compiled by diligently using all of the available data, modifying that data with good judgment, and using past cost estimating experience so that the cost estimates can be used with confidence.

Documentation

Typically, the project development process for a project occurs over a period of years, during which many decisions and agreements are made. All too frequently during this time, project personnel changes occur, which can affect the continuity of earlier project decisions. To avoid this situation, all project decisions and agreements that are made throughout the project development process should be thoroughly documented and retained in the project files. This philosophy also applies to notes, decisions, photos, and mapping used during field reviews of the project site. All the assumptions used to develop cost estimate should be documented along with different versions of cost estimates as they are updated over time.

Identifying Contract Items and Estimating Quantities - Project Design Phase

Items Entered Into the Basic Engineering Estimating System

The items of work identified and estimated during the Project Planning phase should now be better defined as work performed by the project design staff and the other functional units is completed. As additional information and design details become available, improvements that were previously estimated can be quantified as contract items of work, increasing the reliability of the cost estimate greatly. .Timely entry in of these quantities in the Basic Engineering Estimating System (BEES) facilitates estimate updates and eases the preparation of the Engineer's Cost Estimate.

District Cost Estimate

The Engineer's Cost Estimate consists of two components: 1) the district cost estimate, and 2) the Structures cost estimate. When these two components are combined, they equal the total construction cost for the project. The district cost estimate is comprised of the following:

- Contract Items – These are the contract bid items of work used in the Engineer's Cost Estimate in the Proposal as well as the other Contract documents.
- Supplemental Work – Supplemental work is work of an uncertain nature or amount; therefore, it is not done on a contract item basis. Work that is known but cannot be predetermined and provided for under contract items of work should be included as supplemental work. Supplemental work is not intended to take the place of incomplete design work, nor is it to be used for contingencies. Do not add supplemental work items for possible additional work for any major area of work (for example, drainage or traffic items). Additional funds for

undeterminable changes, such as increased asphalt content or price fluctuations for paving asphalt, should be included as supplemental work. Extra work identified in the contract special provisions must be itemized as supplemental work.

- State Furnished Materials and Expenses – Items listed under this component consist of work done by State forces or others, concurrently with contract construction operations, or materials to be purchased and charged against the project, but which will be paid for directly by the State, not the contractor. Typical items of State expense are payment to a utility company to provide electrical service, transportation management plan work, or work to be done by a railroad or other agency under a service contract. Certain materials are preapproved by the Federal Highway Administration (FHWA), as being in the public interest, for Caltrans to furnish to the contractor on federal-aid projects (for example, sign panels, marker panels, monument disks, traffic controllers, or recycled/salvaged materials in stock). State furnished materials and expenses are a part of the total construction costs of the project and are subtotaled and included in the district cost estimate.
- Contingencies – Contingencies are a percentage of the subtotal of the cost of contract items, supplemental work, and State-furnished materials and expenses, and are included in the grand total of the district cost estimate to allow for unforeseen increases.

Basing Estimates on Standard Specifications, Contract Plans and Special Provisions

All district cost estimates are to be based on the *Standard Specifications*, Contract Plans, and Special Provisions. These documents form the basis for determining contract items. The *Standard Specifications*, along with the Contract Plans and Special Provisions for a specific project, prescribe the details for construction and completion of the work which the Contractor undertakes to perform in accordance with the terms of the contract. Coordination between the district cost estimate, the *Standard Specifications*, Contract Plans, and Special Provisions is required.

Identifying Contract Items of Work

The other functional units (Division of Structures, Traffic Operations, Materials, Maintenance, Construction, Environmental, Landscape Architecture, etc.) and local entities involved in the preparation of the project design should also be involved in identifying the contract items of work. If the Office of Structure Design is designing structural features for the project, be careful to avoid either duplicating or overlooking quantities in the cost estimate. Common Office of Structure Design and district items (for example, temporary railing) can be easily duplicated and may also have pricing conflicts.

Specific contract items should be identified using the BEES coded item list. A copy of the BEES coded item list may be requested through the district BEES coordinator. Coded contract items list is also available on Division of Engineering Services - Office Engineer (DES-OE) intranet website: http://oe.dot.ca.gov/occs.html#bid

Cost Estimate Pricing Methods

Two Common Methods

There are two methods commonly used for estimating prices. One method is to use previous bid prices as a basis for establishing prices on the proposed project. The other method is to make a complete analysis of production rates, labor costs, and material costs. These methods may be used individually or together.

Previous Bid Prices Method

The use of previous bid prices as a basis for cost estimating is probably the most frequently used method and, in most cases, the most practical method. When using this method, it is important to consider the following factors:

- Similarly-sized projects should be used, and quantities for individual items should be similar.
- Consider using the average of the top three low bidders or average of all bidders after removing the outliers.
- Historic bid prices should be adjusted to the current cost based on the change in the California Historical Highway Construction Price Index (DES-OE) between the date of the old bid and the date of the current estimate. (Escalated price column in Caltrans Contract Cost Database on District 8 website reflects this adjustment). Also current estimate should be escalated forward to the date of anticipated mid-point of construction using available forecasted indices for construction cost escalation and/or inflation. A table of Construction Cost Indices and Forecast is available at the Headquarters Division of Design (HQ DOD) Cost Estimating website.
- The reference bid price should be adjusted to reflect different conditions between the reference project and the project for which the cost estimate is being prepared. This would include considerations of differences in type of terrain, geographical location, soil, traffic, and specifications.

- Historic lump sum bid prices or unit prices for items of work (for example, culverts, trench excavation, clearing and grubbing) that include varying amounts of other related project specific work should not be used.

In arriving at an estimated price for the individual contract items of work, cost estimators should make full use of recent bid prices from similar projects that had competitive bidding. Sources of historic bid prices and other information are:

- Caltrans Contract Cost Database (District 8 Website)
- Bid Summaries (DES-OE Website)
- (not recommended) (not recommended) (not recommended)Historical Highway Construction Price Index Reports (DES-OE Website)
- Construction Cost Indices and Forecast (HQ-DOD Cost Estimating)

For further information on cost estimating activities, roles and responsibilities refer to the *Ready to List Guide*. For help with BEES_contact the district BEES Coordinator. Questions on current cost estimating methods and practice should be directed to the Headquarters Division of Design, Office of Special Projects, Cost Estimating. Visit our websites on:

Intranet: http://onramp.dot.ca.gov/hq/design/specproj/costestimate.php

Internet: http://www.dot.ca.gov/hq/oppd/costest/costest.htm

Complete Analysis Method

This method is usually not practical for use on each and every item of work included in a project. It may occasionally be necessary to use this method for earthwork items where rock or unusual material hauling is required, or for lump sum items such as signals and lighting. Under this method, the operation is analyzed, production rates are assumed, and material lists are determined. The cost of materials is determined using available price lists. Labor and equipment hours are determined based upon production rates multiplied by the respective labor rates and equipment rental rates to determine the costs. Overhead costs and profit are then added to obtain the final estimate of cost. It is especially important to consider possible premium pay for overtime on night work and subsistence. On larger projects with lengthy time limits, it will be necessary to determine whether the majority of a work item will be accomplished early or late in the project. To provide for work that cannot be accomplished early in the project, it may be necessary to project wage scales, rental rates, and other such values to take into account inflation in order to accurately estimate the costs.

Factors that Affect Unit Prices

Prepare Reasonable Cost Estimates

Project cost estimating is not an exact science; however, estimators are expected to prepare reasonable project cost estimates that represent the cost to complete the project. These costs include those required not only for the contractor to construct the project but also include the costs for the purchase of right-of-way, mitigation of environmental issues, and any other costs that will be incurred to complete the project.

Almost all project cost overruns are due to conditions that exist at the time that the cost estimate was initially made. There is no single answer to good price estimating for contract items, Rather it is a matter of diligently using all of the available data, modifying that data with good judgment, and a measure of experience. Experience has shown that project cost estimators should consider the following factors which can affect bid prices on construction projects.

Fluctuation of Costs

Project cost estimates should be reviewed and updated periodically. This practice should continue as close as possible to the project "Listing" for advertisement. Material shortages may develop at unexpected intervals, which can result in an increase in material prices. Wages continually increase, although usually at a somewhat predictable rate. The time of the year that the project is advertised or constructed often affects prices and, if this has changed for the project, the unit prices for the contract items may need revision. Project cost estimates must be current at the time of preparation of the final contract documents. The BEES Item Price and Quantity Reports contain dates when item prices and quantities were last updated. Estimate review and updates, are especially necessary when the construction market is volatile. Construction cost indices and forecasts are good indicators of construction market volatility and fluctuations

Traffic Conditions

Traffic conditions significantly affect prices. Prices should be adjusted to reflect difficulties, dangers, and expenses caused by traffic conditions. Contractors are inclined to raise their prices on projects to be constructed with work sites exposed to considerable traffic.

Restrictive Work Hours or Method of Work

Restrictions on contractors' working hours and the method of work on a project may significantly affect prices. The prices for work that is limited to short shifts, required to be completed in long shifts, or limited to nighttime operations should be increased to reflect the cost of premium wages required for such work and for the general inefficiencies and decreased productivity that may result. Night work for plant operations (for example, asphalt concrete production) can especially be expensive when small quantities are involved. Plants usually do not operate at night and may require special production runs at much higher than normal operating costs.

Quantities of Work

Small quantities of work usually always have higher unit cost than identical work in larger quantities. This is because move-in, overhead, and other such costs must be distributed over a smaller base. Production rates are also less efficient and are usually slower for small quantities, which also tend to increase unit prices.

Separate Operations

Separate operations will usually increase item costs, especially if the order of work or the work unit is to be constructed in scattered locations throughout the project (each requiring move-in and move-out costs). If this is the case, unit prices should be based on the smaller unit sizes and should not be based upon the entire quantity for the total project.

Handwork and Inefficient Operations

Handwork and small or inefficient operations (even though equipment may be used) will have higher unit costs than work that is able to be mass produced or constructed by using techniques that result in higher production rates.

Accessibility

Work requiring long out of direction movements by construction personnel and equipment can be especially expensive. Material hauling that must be accomplished by entering and exiting only on interchange ramps, material hauling uphill rather than downhill, and work on the top of slopes or retaining walls are always more expensive to construct than work that is easy to accomplish on level or gentle slopes. The ease of accessibility to the work will affect the cost to do the work.

Geographic Location

Geographically remote locations usually result in higher bid prices. If subsistence payment will be required for the workers, it will affect the bid prices. It is also important to take into account where the sources of supply are and the distance to the project from which materials must be delivered.

Construction Season

The time of the year that the project is advertised and constructed affects the unit cost for items of work. Contractors are usually more readily available for work early in the spring and will therefore bid conservatively at that time. Later in the spring and during the summer, many contractors have ongoing projects that keep them busy; therefore, they tend to bid higher or not at all. Consideration should also be given when a project is to be awarded near the end of summer or the end of the construction season. It is important to know whether the work can be accomplished before winter weather causes the project to be shut down. If the job cannot be finished before the end of the construction season and the project needs to be suspended, contractors will increase their bid prices to cover their overhead during the winter and repair any damage that may occur. Even if contractors reasonably expect to finish before the winter, they may protect themselves to allow for an early winter. This can especially be true if construction involves work on items that may be affected by winter weather (for example, drainage channels or earthwork).

Material Shortages

Material shortages will have a major effect on prices since prices are directly affected by supply and demand. In a location where a shortage of an item is known to be especially acute, a change in design should be considered if appropriate rather than increased bid prices.

SECTION 2 Project Planning Cost Estimates

General

Estimate Each Alternative

The project development process includes engineering and environmental studies to determine alternatives to ensure that all social, economic and environmental issues have been considered. In doing so, when a range of alternatives have been developed costs for each viable alternative should be determined. The highest realistic cost alternative should be used for programming the project.

Exception Approval Required

Project Planning Cost Estimates should be prepared based on designing to all applicable standards. (See PDPM Chapter 20 – Project Development Cost Estimates for procedural information.) Cost estimates for alternatives, that do not meet mandatory or advisory design standards, are only legitimate when there is an approved fact sheet. Proposed exceptions to mandatory and advisory design standards must be approved following the procedures in Chapter 21 – Exceptions to Design Standards.

Format

All project planning cost estimates, except those specialized formats developed for certain project types (see Article 3 in this section), are to be prepared and submitted using the standard format included at the end of this appendix.

Keep the Cost Estimate Current

As studies progress in the Project Planning phase, more information such as final contour mapping, materials and drainage information, and structure studies becomes available. Each piece of new information will increase the accuracy of the cost estimate and provides the opportunity to update the project cost. Project cost estimates should be reviewed periodically and updated as appropriate. (See policy for updating cost estimates in PDPM Chapter 20)

Preparing the Standard Format for Project Planning Cost Estimates

General

A new standard cost estimate template is available in Excel spreadsheets format on Headquarters Division of Design Cost Estimating website under "Templates" tab. It is intended to be used as a standard format for all project planning cost estimates and replaces the former six-page cost estimate format. For many projects, the template can be used as is by completing the project information on the cover sheet and filling in the unit costs and quantities for items or subtotals for the subsections in rest of the sheets. If needed, lines can be deleted, replaced or added for items not listed. Additional lines for subsections or subtotals may be added as necessary. It is estimator's responsibility to make sure that the Excel formulas works properly and the math adds up for the completed spreadsheets.

The standard format is broken into four main components Roadway, Structures, Right-of-Way, and Support Costs. They are organized over 11 spreadsheets in an Excel file as follows:

- Cover Sheet - sheet 1 of 11
- Roadway Items Summary - sheet 2 of 11
- Roadway Item Sections - sheets 3 through 8 of 11
- Structure Items - sheet 9 of 11
- Right-of-Way Datasheet - sheet 10 of 11
- Support Cost Summary, and Escalated Cost - sheet 11 of 11

Note: When attaching the cost estimate to a Project Initiation Document (PID) only first 10 sheets should be printed. The support costs on sheet 11 are attached separately under Support Cost Tables in PID.

The concept behind the standard format requires that the cost estimator determine quantities and costs for groups of related work. Identification of contract items is not necessary but would be beneficial to obtain a realistic cost estimate for each viable project alternative. Calculation sheets, maps, and sketches used to determine costs and quantities for the cost estimate should be retained in the project files until the project has been completed and finalized. The following is a discussion on the components of the standard format:

Cover Sheet

All project planning cost estimates should have a standard cover sheet to provide project description information, a summary of the project (or alternate) cost estimate, and approval signatures. Totals from the other sheets automatically transfer to this main summary sheet in the Excel template but estimator should verify them.

I. Roadway Items Summary

All of the roadway items subsections are summarized here. Subtotals from roadway subsections automatically transfer to this sheet but estimator should verify them.

Section 1: Earthwork

Roadway excavation and the possible need for imported borrow is ideally estimated by developing typical cross sections, profiles, contour maps, and then using electronic calculations. Without this luxury, it is necessary to walk the project with a map and a typical cross section and profile (for a new facility). Quantities can be calculated using slope distance, amount of widening, and length. With careful judgment used in averaging the various end areas, a realistic cost estimate can be obtained. For projects with a new profile, it is possible to calculate earthwork by plotting the profile and existing ground line and then plotting a few critical cross sections. Additional cross sections may need to be plotted at interchanges.

Clearing and grubbing is an important factor in all cost estimates, but particularly in forested areas. Calculations by the hectare are desirable but payment is usually made by lump sum.

Develop water supply can be included in other items of work, but it is prudent to include a lump sum amount where availability of water is in doubt (for example, in desert areas). A good method would be to use a realistic percentage figure based on the quantity of roadway excavation (5 to 10 percent, for example). Special studies on the availability of water and the economics of supplying water may be required. If water is not supplied, compaction methods may need to be altered and thus reflected in the estimate.

Section 2: Pavement Structural Section

Preliminary materials information is necessary to adequately estimate pavement structural section items. If not available, the pavement structural section of a similar adjacent project could be used. Most of these items are calculated by determining width, depth, and length. Items with side slope material such as aggregate base should be calculated using average widths and depths times length for the portions outside the hinge point.

Typical cross sections need to be developed at the very earliest stage to facilitate cost estimating, and a sketch should be provided with the cost estimate to indicate the basis for the calculations. The Traffic Index (T.I.) and "R" Values used should be shown on the referenced typical cross section sketch. These values should be obtained as early as possible. (They can be assumed from adjacent projects or with consultation with the District Materials Unit.) If ordering "R" Value tests, ensure that an adequate number of tests are performed. The estimate should be updated as appropriate if this information changes.

Section 3: Drainage

Large drainage facilities (for example, reinforced concrete boxes or animal crossings) should be estimated separately and the *Standard Plans* should be consulted for quantities. Drainage items for widening and rehabilitation projects can be estimated by determining extensions to existing culverts and the number of other features, such as inlets, and overside drains, that will be affected. Be aware of any additional right-of-way that may be needed for drainage easements. Bid sheets from adjacent or similar type projects can be evaluated for use for unit costs. Cost estimates for drainage on new alignment projects can be quantified by comparisons with similar types of projects.

Section 4: Specialty Items

Features such as retaining walls and noise barriers can usually be identified during field reviews. Locations can be shown on the field map and reasonable calculations can be made using *Standard Plans*. Some specialty items such as retaining walls and sound walls require consultation with other functional units in the District, Division of Engineering Services, and Headquarters.

Section 5: Environmental Items

District Environmental functional unit should be consulted to develop reasonable cost estimate for environmental items such as hazardous wastes and environmental mitigation It is important to deal with hazardous waste and environmental issues immediately and avoid them if possible, since they often cause large cost increases that impact project cost estimates. Landscape, irrigation and NPDES (National Pollutant Discharge Elimination

System) items should be included in the estimate as necessary after consultation with respective functional units. Make sure to use latest specifications for these items.

Reconstruction of irrigation facilities (for example, pumps, sumps, and return lines) that are to be handled as a part of the construction contract can also be identified from the field review. Locations should be shown on the field map, and reasonable calculations can be made using Standard Plans.

Items such as erosion control or slope protection (both during construction and permanent) can be estimated by using slope information obtained from the field review.

Section 6: Traffic Items

The district Traffic Unit can provide realistic cost estimates for signing, stripping, and traffic electrical items when they are given project specific data. Traffic handling is almost always a major consideration for cost estimates, especially for staged construction. A Transportation Management Plan must be developed, as appropriate, early in the process with consultation from other functional units within the District (for example, Traffic, Construction, Maintenance, and Surveys).

Section 7: Detours

Section 8: Minor Items

Minor items (for example, fencing, curbs, sidewalks, and access ramps) can be estimated by using a percentage (5% to 10% depending on level of design) of total cost of the “main” construction items (Sections 1-5). Ideally, these items should be identified in the field and placed on the strip map to be calculated and totaled in the office later. Remember to consider work on local streets, such as work that may eventually be shown on a freeway agreement, and other requirements for the project, such as access features needed to comply with the Americans with Disabilities Act (ADA), and bike path requirements.

Section 9: Mobilization

Depending on the project need Mobilization is allowed to be anywhere from 0 to10 percent of the sum of all contract item costs, including the mobilization item. Mobilization percentage should be determined using recent contract item cost data for similar projects with mobilization and by taking into consideration project conditions such as project size, duration, location and other conditions that could influence mobilization. Mobilization for structures should not be included in this total as it is part of the cost estimates provided by the Division of Structures. On occasion it may be justified to increase the mobilization percentage above 10 percent for a project due to stage construction with multiple move-ins and -outs, or if the project is in a remote location. If this is the case, discuss it with the Headquarters Office of Office Engineer before making the increase in mobilization percentage.

Section 10: Supplemental Work

Supplemental Work (SW) provides funds for construction work that cannot be predicted or calculated beforehand because of an uncertain nature or amount; therefore, it is not done on a contract item basis. Typical examples are removal of slide material, removal of unsuitable material, or increases in the asphalt content. Supplemental work does not take the place of incomplete design work, nor is it used for contingencies. Smaller projects could require 10 percent of the total of the main construction items plus minor items while large projects could require only 2 to 3 percent.

Section 11: State Furnished Material and Expenses

State Furnished Materials and Expenses (SFME) include items that are paid for by state or other agency. These items are not part of the contract items but must include in the project estimate. It includes items such as COZEEP, RE Office, Public Information, etc.

Section 12: Time-Related Overhead

For projects over $5 million Time-Related Overhead (TRO) is an item. TRO is calculated based on percentage of contract items only, excluding mobilization, SW, SFME and contingency. TRO percentage is allowed to be anywhere from 0 to 10 percent. Select the TRO depending on project specific circumstances. Consider TRO on bid history of recent similar type of projects near the project location.

Section 13: Contingency

Contingency factors for the cost estimate vary from 50 percent to 10 percent depending on the project cost estimate type. Contingencies are calculated as percentages of the total main construction items plus minor items, SW, SFME, and TRO. They are used for unforeseen items of work that crop up as studies progress. The percentage goes down as the project becomes more defined and thus fewer unknowns.

II. Structures Items

Estimates of structure costs should be obtained from the Division of Engineering Services (DES), Office of Structures Estimating They should be contacted to discuss the cost estimate requirements for each project with structures items. Besides the bridge work other structure work may be required on a project. For example, non-standard noise barriers and non-standard retaining walls will require special designs and therefore need cost estimates prepared by the Structures Estimating unit. (See the *Standard Plans* for details.) When cost estimates are requested, provide sufficient information in the request to adequately define the proposed structure or structure modifications required. Advanced Planning Structure cost estimates and other appropriate back-up calculations provided by the Structures Estimating unit should be referred to in the project cost estimate.

In the cost estimate template the structure sheet (sheet 9 of 11) contains spacing for six bridges (or other structures). If more than six spaces are required, insert additional spaces or sheets (e.g. sheets 9A, 9B …) as appropriate.

Any railroad related work that is required for such items as shooflys or track reallocations is to be shown on the form. This work may be identified through the right-of-way process, but it should be shown in the cost estimate at this location.

The cost estimates for structure items usually include separate contingencies and mobilization. Check for duplication on these items when compiling the project cost estimate.

III. Right-of-Way Items

The right-of-way portion of the cost estimate should be obtained from the District Right of Way Branch. The Right of Way Branch prepares its cost estimate based on current procedures and guidelines contained in the *Right of Way Manual*. Costs for the listed right-of-way items are to be obtained from the Right of Way Data Sheet (see Appendix JJ – Resolutions of Necessity). The Right of Way Data Sheet should be referenced in the project cost estimate as backup information.

"Construction Contract Work," contractual obligations made by the Right of Way Branch with the property owner, such as the costs to relocate fencing, reconstruct gates, reconstruction road approaches, should be described briefly and the estimated cost to perform this work given. The estimated cost should only be shown in this portion of the project planning cost estimate, not included. Construction contractual obligations are to be included in the project cost estimate as construction items of work.

Specialized Project Planning and Other Cost Estimates

Specialized Project Types

Some units at Caltrans have developed specialized project development reports to aid the project approval process for certain specialized project types. Many of these specialized project development reports also include their own specialized cost estimate formats. In most cases, these specialized formats were created from the standard format but have been simplified to focus on the typical items of work associated with these specialized project types.

Some of the specialized formats have a “fill in the blanks” structure and include preparation guidelines to facilitate completion of the cost estimate formats. The standard format templates can be modified to serve the same purpose.

The concepts presented in this guidance relating to field reviews, identifying items of work, determining prices, and other factors still apply to the specialized forms and should be followed while completing them.

Other Cost Estimates

Various programs (Transportation System Management, Facilities, etc.) and processes during project development (for example, fact sheets for mandatory and advisory design exceptions and determination of cooperative features) require cost estimating. For guidance on preparing these specialized cost estimates, see the appropriate appendices in PDPM manual or instructions in other manuals or documents, as appropriate