CALIFORNIA PUBLIC UTILITIES COMMISSION

Public Staff Division
Water Operational Cost Branch

WATER UTILITY RATE DESIGN
AND ITS IMPACT ON RATE OF RETURN

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M E M O R A N D U M

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CHAPTER 1

INTRODCTION

1.1 On November 21,1984, the Commission issued OII 84-11-041 inviting comments on water rate design issues for the purpose of evaluating its current rate design policy. Accompanying the OII was a report on Water Rate Design Policy prepared by the Policy Division which:

(a) summarized the history of water rate design practice at the Commission;

(b) addressed the various rate design goals in a general sense,

(c) discused the relative merits of alternative rate design options; and

(d) advocated the adoption of a policy of moving towards a higher service charge and a single commodity charge.

1.2 Over the past several years, the water utilities have continued to express concern over the variability in their revenues and the alleged adverse impact that this has had on their operations, their return on rate base and their return on equity. Thus far, neither staff nor utilities have a measure of the severity of this problem and, as such, there is no policy on the acceptable limits of this variability.

1.3 Prior to Policy Division's report, the utilities were requested to provide information on (a) what rates would have been if lifeline had not been instituted, (b) the ratio of present service charge revenue to fixed costs, hereinafter referred to as the "Z-ratio", and (c) the rates that would result if the Z-ratio were increased to 0.65, as requested by the California Water Association.

1.4 The responses from the utilities did not address the issue of revenue/rate of return variability and implied that a Z-ratio of 0.65 would help them attain their objective of reducing variability to a comfortable level. The responses did not shed any light on the present level or proposed levels of expected variability and ignored the fact that factors influencing consumption, and therefore variability, vary from district to district and may also change over time. Furthermore, no acknowledgement was made that a lower degree of variability, as requested by the utilities, reduces the risk factor which in turn requires a lower return on equity. Their request for a lower degree of volatility therefore could possibly translate to an across-the-board request for a higher return on equity. The problem of trying to make noteworthy observations was further compounded by their lack of uniformity in classifying fixed costs and variable costs.

1.5 The object of this report is to illustrate a measure of variability and establish Public Staff Division's guidelines for future water rate design. It will also demonstrate the interaction of the critical parameters and will lay the foundation for the evolution of a more refined technique over future rate design.

CHAPTER 2

EXPECTED VARIABILITY IN RATE OF RETURN

2.1 Risk is defined as the possibility of loss or injury or, alternatively, as the degree or probability of such loss. One often hears of "downside risk" and "upside potential". The idea is straightforward: risk has to do with bad outcomes and potential has to do with good ones. A good measure of risk takes into account the probability of an outcome and its magnitude or, in simpler words, it is an estimate of the "extent" to which the actual outcome is "likely" to diverge from the expected value. This makes it necessary to identify and evaluate the major factors contributing to the variability in the outcome. Presently, the "gross revenues" outcome is of interest. Later in this analysis, the variability in this outcome is translated into variability in rate of return by simple algebraic operations.

2.2 The factors contributing to this variability in gross revenue, as shown in the equation below, are number-of-customers and consumption-per-customer. It will be observed that both these parameters are projections and therefore can deviate from the actuals that will occur in the test year.

Gross revenues = Service charge revenue + Commodity charge revenue = [(number-of-customers)(service charge rate)] + [(consumption-per-customer) (number-of-customers) (commodity charge rate)]

2.3 The deviation in number-of-customers is normally insignificant unless there is a large unexpected movement of population into or out of the service area. The deviation in consumption-per-customer is more critical as it is primarily a function of weather. This implies that consumption-per-customer is the major factor that contributes to the variability in gross revenue. Weather, in turn, is the major factor that contributes to the variability in consumption-per-customer. If a range of variability for consumption-per-customer is obtained, then establishing a range of expected variability in gross revenues would be a very simple task.

2.4 Some of the obvious factors that influence consumption-per-customer other than weather are price and living standards. The impact due to a change in price and a change in living standards is considered to be insignificant for varying reasons. Numerous studies in the past have concluded that the demand for water ranges from very mildly price-elastic to price-inelastic. This confirms the fact that water is not substitutable. Changes in living standards impact consumption over the long-term, such as, the use of dishwashers and installation of sprinkler systems. (The Commerce Department defines a product as a necessity when 25% of the households have it in place. Dishwashers are now classified as a necessity whereas sprinkler systems are not.) The use of dishwashers (or lack thereof) does not induce any noticeable variability in the consumption. Sprinkler systems, on the other hand, are expected to induce significant variability in consumption since their use is dictated by weather, which is known to be unpredictable, at best.

2.5 Presently, projections for consumption-per-customer are obtained from an equation by regressing historical weather data with historical consumption-per-customer. Generally, the regression equation is obtained by using the last 5 to 10 years of data, since recent consumption behavior, as it varies with weather, is of most interest. This regression equation can be used to obtain a sample of 30 data points for consumption-per-customer by using the 30 years of historical weather data and test year as inputs. The essence, here, is to determine the consumption-per-customer that would result in the test year for the sample weather data. (It should be noted that several weather combinations of rainfall and temperature exist that would result in the same consumption-per-customer and that this variable could be assumed to be normally distributed.) The sample of consumption-per-customer thus obtained can be statistically analyzed to obtain what is known as the 99% confidence band for this sample. This implies that there is a 99% change (99% confidence) that the actual occurrence will fall within this range (band). The 99% confidence is the highest statistical assurance that is used when one deals with expectations. Beyond that, it is no longer considered an expectation. Rather, it is absolute, viz., 100% confidence. The use of the 99% confidence band ensures that the widest possible range of consumption-per-customer has been considered in the analysis and that the possibility of the actual consumption-per-customer lying outside this range is extremely remote (1% chance).

2.6 Gross revenues are derived from service charges, which are fixed, and commodity charges which are a function of consumption-per-customer. One can now obtain the 99% confidence band for gross revenue by use of the equation shown in paragraph 2.2. Net operating income is derived by subtracting the fixed costs and a proportionate share of variable costs from gross revenues. Rate of return is computed by dividing the net operating income by the rate base. A curve, hereinafter referred to as the Z-curve, can be plotted showing the variation in the rate of return with consumption-per-customer. A smaller variation in rate of return would result if a larger portion of gross revenues were obtained from service charge revenues. The ratio of service charge revenues to gross revenues can now be varied to generate a family of Z-curves. It could be inferred that any suitable service charge to gross revenue ratio may be authorized. This is true. But one cannot ignore another ratio which also has merit: The service charge-to-fixed, hereinafter referred to as the Z-ratio. Gross revenues (service charge revenue + commodity charge revenue) equal total costs (fixed + variable), inclusive of return. With fixed costs known, there would be a one-to-one relationship between the Z-ratio and the service charge revenue-to-gross revenue ratio.

Service charge revenues = (Z-ratio) x (Fixed costs)

2.7 In reviewing the utilities' responses to Policy Division's data request, the lack of uniformity in classifying fixed and variable costs presented a major problem as it was impossible to compare the results for any two utilities. At the same time, it is interesting to note that the precise designation of a cost as fixed ro variable is not crucial since it will be offset by a correspondingly different Z-ratio that would attain the same expected variability. This suggests that a uniform designation of what are fixed and variable costs are more important than a precise designation.

2.8 Fixed costs would be defined as those that do not vary with consumption in the short run; whereas, variable costs would be those that are dependent on consumption over the short run. Fixed costs would include payroll expenses, contracted maintenance, purchased services, general office expenses, depreciation, income taxes, payroll tax, ad valorem tax, investment tax credits and net operating income. Variable costs would include purchased water, purchased power, purchased chemicals, pump tax, uncollectibles and local franchise tax.

2.9 Although net operating income can vary in reality, it would be classified as a fixed cost since (a) the adopted rate base and the authorized rate of return are fixed in a rate case decision - the product, i.e., net operating income, must therefore be fixed, and (b) the net operating income comprises of debt expense and return on equity. Debt expense is a fixed obligation and return on equity is determined by equilibrium in the financial markets. Income taxes are levied on net operating income and, consequently, would also be classified as fixed.

2.10 It should also be noted that (a) the family of Z-curves will vary from district to district and from rate case to rate case, and (b) a district with "flat rates" is a special case with a Z-ratio greater the 1.0 i.e., fixed and variable charges are recovered from the flat charge with the commodity charge non-existent.

2.11 Given the uniqueness of the Z-curves for each district and the changing economic environment, rate case testimony would now include staff and utility views of expected variability in rate of return and the rate case decision-making process would now include the authorization of a regression equation and the concomitant Z-ratio that will limit the expected variability in rate of return.

2.12 With the fixed costs and Z-ratio known, the revenue to be derived from service charges and commodity charges now can be computed.

Service charge revenue = (Z-ratio) x (Fixed costs)

Commodity charge revenue =

Authorized gross revenue - Service charge revenue

CHAPTER 3

SERVICE CHARGE RATE RATIOS & COMMODITY CHARGE RATE RATIOS

3.1 Having thus obtained the revenues to be derived from service charges and commodity charges, the next step is to spread this desired revenue over all the meter sizes and commodity blocks.

3.2 The authorized service charge revenue can be spread over the various meter sizes in one of several ways. The service charge rate spread as called out in the "Guide to the Preparation of Rate Schedules for Water Utilities - 1967" seeks to spread the service charge on a cost-of-plant basis and was the result of a California Water Service (CWS) study conducted at that time. The costs of each meter size were based on the sum of the costs for (i) a meter, (ii) a meter box, (iii) 60 feet of branch pipe, and (iv) 30 feet of distribution main. The pre-lifeline rate spread which varied from district to district and from rate case to rate case was based on historical rates or the method of cost allocation as described in Standard Practice U-20. The present "Lifeline service charge rate spread" used the pre-lifeline rate spread as a base and seeks to hold the rates for the 5/8" residential meter artificially low thereby shifting the burden to the larger meter sizes. A recent cost-of-plant based analysis conducted by CWS revealed that the cost ratios varied from 1:10.2 to 1:41.6 depending on how the costs for the distribution main were allocated. The old CWS cost ratios of 1:20.8 are very close to the mid-range of the recent CWS study and would serve as a guideline for Public Staff Division. This may appear to be arbitrary -

but the costs to conduct a special study and monitor the validity of the ratios over time for each district will undoubtedly outweigh any accuracy that may be gained.

3.3 The authorized commodity charge revenue is presently spread over 3 commodity blocks in several districts. Generally, the first commodity block is "0 - 3 CCF", the second block is "greater than 300 CCF". As a guideline, Public Staff Division will reduce the 3 commodity blocks to 2 by consolidating the first two blocks into one insofar as it is feasible. This will not significantly impact on total monthly bills as there will be limits on their percentage increase. Public Staff will limit the percentage increase in total monthly bills to 1.5 times the percentage revenue increase for the district. Furthermore, no total bill will experience a decrease in any one rate case if any other total bill in that district experiences an increase.

3.4 One obvious impact of shifting to a higher service charge and lower commodity charge is that the (theoretical) incentive to conserve water will decrease since a larger component of the customer's bill will be fixed by the service charge. In reality, the impact could be, at most, negligible for many areas, since there are serious doubts that the existing conservation policy has been effective over the long-term. Perhaps, this is true since water is a non-substitutable commodity.

CHAPTER 4

CONCLUSION AND RECOMMENDATIONS

4.1 With the authorized regression equation and varying Z-ratios, the family of Z-curves, the "measure of variability" in rate of return, can be computed and plotted. This would enable the Commission to authorize a Z-ratio that will limit the expected variability to within certain limits.

4.2 With the gradual shift from present Lifeline service charge rates to cost-based ratios, a switch from 3 commodity blocks to 2 commodity blocks to the extent that its impact is insignificant, and an authorized Z-ratio, the compounded impact on customers can be calculated. The overall impact on low-usage customers will be greater than that on high-usage customers. Public Staff will recommend that the changes are phased-in in such a way that customers in any meter class will neither have their total monthly bill increased by more than 1.5 times the system increase nor have their total monthly bill decrease in any one rate case if any other total bill in that district experience an increase.

4.3 Appendix A illustrates the analysis of California Water Service Company's Westlake District and demonstrates the impact of implementing Public Staff Division guidelines.

APPENDIX A

SAMPLE DISTRICT ANALYSIS

The object of this analysis is (a) to develop a rate spread using Public Staff Division guidelines, and (b) to compare the impact of the actual Decision with the impact that would result by adopting the proposed guidelines.

As an example, Public Staff has analyzed the Westlake District of California Water Service. The analysis has been confined to the commercial segment as it is the major component of the district's business. Total revenues (in thousands of dollars) at pre-decision rates were $2,463.2 and the authorized total revenues, as per Decision 85-03-054, were $2,852.4 resulting in a system revenue increase of 15.8%. This limits the increase in any customers monthly bill to 1.5 times 15.8%, which amounts to 23.7%. The authorized commercial revenues were $2,442.0. First, it is necessary to determine the authorized-commercial-revenue to authorized-total-revenue ratio for the district, which is 0.856. Next, segregate the authorized expenses as fixed or variable and compute the commercial components of these costs and the rate base, as shown in Table A, by using the 0.856 factor as a proxy for this apportionment. The Z-ratio, as incidentally authorized, was 0.409. For this Z-ratio, the authorized service charge revenues were $441.3 and the authorized commodity charge revenues were $2,000.7 totaling to $2,442.0. The pre-decision and post-decision service charge and commodity charge rates and revenues are shown in columns 3 through 6 on Table B. Column 4 in Tables C-1 through C-3 shows the percentage increase in total bills, as was authorized. It can be observed that the bulk of low-usage customers will experience a total bill increase (11.7% for the 3 CCF, 3/4" meter) which is less than the authorized system increase of 15.8%, thereby confirming our present adherence to the Lifeline policy.

Table D-1 shows the variability in revenues, net operating income and rate of return that can be expected in this district in test year 1985. The decision authorized the consumption-per-customer to be 450 CCF/year without providing a regression equation to back it up. Therefore, a proxy for this was selected to demonstrate the variability aspects. Given the sample weather data and the regression equation, the consumption-per-customer sample can be generated as shown in column 5. Standard statistical tests on this sample will generate the confidence bands as shown at the bottom of the page. It can be seen that there is a 99% chance that the actual consumption-per-customer in test year 1985 will lie between 444.89 CCF/year and 455.12 CCF/year and that 450.0 CCF/year, as authorized, is indeed the average of these limits and that the odds of attaining this precise average are virtually nil. With the service charge fixed at the authorized rates and the number of customers constant, the resulting service charge revenue of $441.3 will be constant. The variability in total revenue, as shown in column 6, therefore is a result of the variability in consumption-per-customer. Variable costs, as identified in Table A, are a function of consumption. As consumption-per-customer decreases, these variable costs will decrease proportionately. Net operating income, as shown in column 8, is derived by subtracting the fixed costs (as shown on Table D-1 with the exclusion of $237.9) and a proportionate amount of variable costs from total revenue. The rate of return for the commercial segment, column 9, is computed by dividing the net operating income by the rate base of $2,233.8 (from Table A) for the commercial segment. Assuming no variability in the rate of return from other business segments, the weighted average rate of return for the district can be computed. It can be seen that the district's expected variability in rate of return is -0.324% to +0.325% from the authorized 12.44%, i.e., there is a 99% chance that the district's rate of return will lie between 12.116% and 12.765%. Is this level of variability acceptable?

Assuming that this variability is considered to be high, a higher Z-ratio could be selected. The new revenues to be derived from the service charge and commodity charge are as shown in Tables A & B. With the commodity charge revenues known and the weighted average of pre-decision commodity rates for the first and second block computed to be 0.8705, the pre-decision commodity rates of 0.8705 and 0.792 are proportionately increased to yield commodity rates of 1.006 and 0.915 for the 2 commodity blocks. The next step is to determine the service charge rates for the various meter sizes. The rate for the 5/8" meter is increased to a level such that the total bill increase for the 3 CCF consumer is 23.7% over the monthly bill at pre-decision rates. Next, go to the 1" meter and repeat the process down the line until the desired total service charge revenue is obtained. If the desired total service charge revenue is higher than that obtained, it would imply that the selection of the Z-ratio was higher than that which can be accommodated and vise-versa. The analysis shows that the highest Z-ratio that could be accommodated in this rate case to be 0.430 and that with this Z-ratio there is a 99% chance that the expected variability in the district's rate of return will lie between 12.128% and 12.753%. Observe that a higher Z-ratio corresponds to a smaller range of expected variability.

Graph I, page T15, depicts the variability in the district's rate of return with varying consumption-per-customer for Z-ratios of 0.409 and 0.430.

Assuming that the expected variability with the Z-ratio of 0.409 is considered high and that with a Z-ratio of 0.430 is considered low. This would suggest that a Z-ratio in between 0.409 and 0.430 is desirable. Assume that the targeted range for expected variability is 12.125% to 12.756%. This translates to a Z-ratio of 0.425 which is analyzed on Tables E through H-2. The Z-ratio of 0.430 was the highest ratio that could be accommodated since the low-usage customers in each meter class observed a 23.7% increase (the maximum) in their monthly bill. A Z-ratio of 0.425 therefore would result in the low-usage customers in the small meter classes experiencing the maximum increase of 23.7% and the low-usage customers in the larger meter classes experiencing an increase in the range of 15.8% to 22.2% (lesser than the maximum) thereby bringing the meter rate ratios closer to the cost-based ratios. Observe that all of Public Staff Division's guidelines, as outlined in Chapter 4 have been met.