A Study of the 2022 Lost and Unaccounted For Gas at Southern California Gas Company

Final Report Rev 2.0

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With Data Provided by Southern California Gas Company

Gas Engineering – Measurement Regulation & Control

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OVERVIEW:

Lost and Unaccounted-For gas is the difference between measured gas volumes entering and exiting the SoCalGas pipeline system, factoring in gas used for operations and several other adjustments. This report was prepared to characterize the origins and quantity of Lost and Unaccounted-For (LUAF) gas volumes and energy on the SoCalGas natural gas delivery system in 2022 attributable to meters and measurement processes. It constitutes an update to a study published by SoCalGas in 2006 entitled "Year 2006 Lost and Unaccounted-For Gas at Southern California Gas Company and San Diego Gas & Electric Company." The 2006 report was the basis for LUAF component volumes, energy contributions, and allocation to Core and Non-Core customer classes established between 2006-2021. A preliminary estimate of 2022 LUAF was prepared in early 2023 as part of SoCalGas' General Order and FERC Form No. 2 regulatory reporting using the 2006 assumptions and methodology. This study provides detail and updates to those estimates.

While the 2006 report chronicled LUAF from all sources for both SoCalGas and SDG&E, this 2022 update addresses only the SoCalGas LUAF contributions of measurement systems including physical gas meter accuracy and related processes and calculations. These contributions will collectively be referred to as "Measurement LUAF" in this report. It is specifically focused on the meters calculating the volumes used for customer bills, gas supply volumes, and injection and withdrawal of gas volumes from underground storage fields. Company fuel and other use is omitted from detailed analysis in this study. The contributions from accounting practices, pipeline system leakage, and theft are also excluded from analysis in this report. They are scheduled to be chronicled in companion documents to be completed in 2024.

This report, except for Table 1, is presented in base units of millions of standard cubic feet (MMCF), with notations on equivalent energy content in thousands of Decatherms (MDth), where appropriate. Dth is equivalent to MMBTU. Detailed tables for all equivalent MDth computations/values are presented in MDTH TABLES at the end of this report. These tables have the same relative numbering as the MMCF-based tables throughout this report, but with a postscript designation "MDth" for presenting findings in energy units. They are premised on a system average energy heating value of 1,031 BTU per standard cubic foot gas across all SoCalGas meters in 2022, as calculated from SoCalGas FERC Form No. 2 Filing (see Appendix Z.1). The (MDth) values are equal to the associated MMCF times a factor of 1.031.

Contributions to LUAF are reported as positive numbers in this report, while reductions to LUAF (gas gain) are expressed with negative signage. LUAF percentages in this document are calculated as a ratio of LUAF volumes relative to gas receipts into the gas pipeline system. In 2006 and 1991 LUAF percentages were calculated as a ratio of gas deliveries to customers and into storage. The absolute difference between these two methods is approximately 0.006% for 2022.

SUMMARY OF RESULTS:

Table 1 provides a high-level comparison of 2022 results to 1991 and 2006 under similar major "LUAF Sub-Component" aggregation as presented in those prior years studies. This Table is presented in units of thousands of cubic feet (MCF) for direct comparison with prior LUAF Study summary tables. The balance of this report is presented in millions of cubic feet (MMCF) and thousands of Decatherms (MDth). Figure 1 shows 2022 Measurement LUAF by Sub-Component contribution in pie chart form.

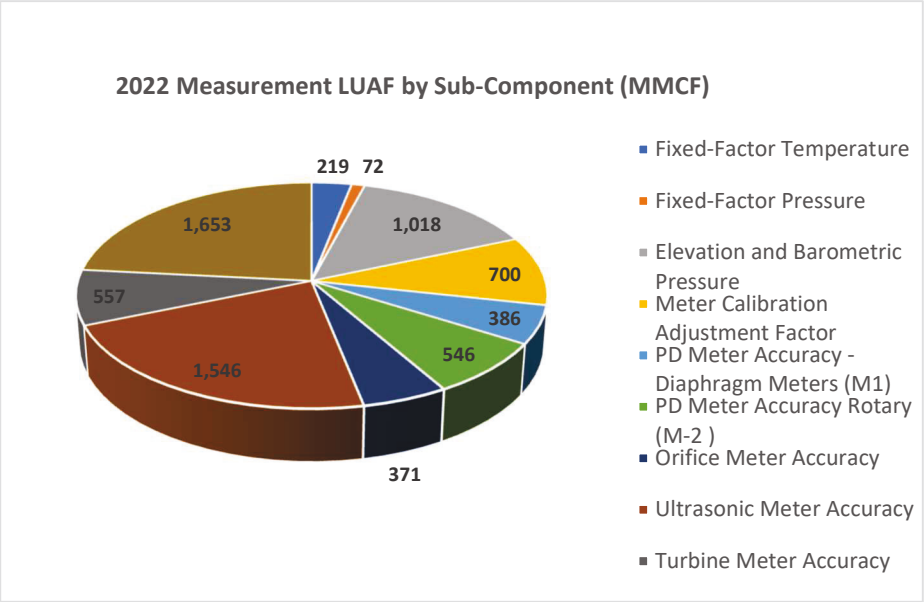
Table 1

Summary of 2022 LUAF Study with 1991 and 2006 LUAF Study Comparison (MCF)

SoCalGas Measurement LUAF - Contributions by Study Year (MCF)

	LUAF REPORTING YEAR	1991	2006	2022	Mcf Diff	% Diff	2022 PROCESS NOTES
LINE ITEM	LUAF MEASUREMENT SUB-COMPONENT	(MCF)	(MCF)	(MCF)	2006-2022	2006-2022	
I	Fixed-Factor Temperature	(1,331,123)	(1,539,192)	218,926	1,758,118	-114.2%	Employed 1991 Method: Apply 2022 volumes and temperature data. Year 2022 was a colder when gas was flowing than 1991 and 2006. Less Net LUAF gain in 2022 than 1991 and 2006.
J	Fixed-Factor Pressure	271,007	312,599	72,141	(240,458)	-76.9%	2022 pressure data from 3,114 field tests. Improved field process for calibrations have reduced pressure by 0.1" on average for standard svcs small meters.
K	Elevation and Barometric Pressure	1,603,207	1,205,718	1,017,996	(187,722)	-15.6%	Year 1994 method and elevation was applied to 2022 customers by elevation zone. Volume shift to pressure corrected meters.
L	Super Compressibility	(425,932)	(44,947)	-	44,947	-100.0%	Not studied in 2022. Contribution negligible in 2006.
X	Meter Calibration Adjustment Factor	-		700,019	700,019	0.0%	New process began in 2021. Reduce recorded meter volumes for 1.1 million small meters by 2% for final billing. Average accuracy of meters in program 1.17% fast. Ensuing over crediting.
M-DIA	PD Meter Accuracy - Diaphragm Meters (M1)	3,445,678	2,395,416	386,353	(2,009,063)	-83.9%	Results from 60,000+ as found in-test in 2022. Review 1100 of as-found Aux factors in Electronic Correctors. Meters tested faster in 2022 than prior LUAF Study years. Reduced population of slow running meters at
M-ROT	PD Meter Accuracy Rotary (M-2)	(488,379)	(150,937)	546,448	697,385	-462.0%	Rotary meters tested ~0.3% slow on in-test and Aux Factor also slowed meter down.
N	Orifice Meter Accuracy	5,849,534	4,137,346	370,539	(3,766,807)	-91.0%	Updated estimates with 2022 flow data. Significant customer, storage and supplier volumes shifted to Ultrasonic metering. Supplier meters main LUAF contributor.
O	Ultrasonic Meter Accuracy	-	(205,780)	1,545,960	1,751,740	-851.3%	Year 2022 larger customer use, replacing orifice meters, More LUAF from gas suppliers due to fouling - multiple supplier rebillings. Under registration of storage field injection volumes at low flow. Interstate supplies shift to US meters 2018-2022 trends with increased LUAF. SDGE US meter running slower than 2020. (Trend with LUAF)
P	Turbine Meter Accuracy	(912,157)	(797,839)	557,282	1,355,121	-169.8%	2022 Turbine meter in-test slower than 2006. Deviation from as-found Aux factor. Also Bias between mfg meter test curve meter factor and Pico Intest standard prover results.
Q	Instrument Calibration	(28,031)	(261,961)	1,652,850	1,914,811	-731.0%	1,643 MMcf in 2022 attributable to interstate suppliers. SoCalGas meters average bias very low based on as found tests.
R	Ambient Temperature on Instrument Accuracy	116,012	-	-	-	0.0%	Negligible in both 2006 and 2022 due to instrument accuracy improvements
S	Chart Integration Bias	(50,999)	-	-	-	0.0%	No Charts in system in 2022
	TOTAL Measurement LUAF (MCF) - Study Assigned	**8,048,817**	**5,050,423**	**7,068,514**	**2,018,091**	**39.96%**	
	GO112 Reported Measurement LUAF (MCF)			**7,118,000**			
	Difference reported GO112 vs 2022 Measurement Study Results			(49,486)			Assigned to Non-Study Components
	TOTAL Reported System LUAF - Measurement, Accounting, Leakage, Theft, Other	10,489,800	7,049,738	9,478,460	2,428,722		
	Total Receipts into Pipeline System (MCF)			952,242,858			
	TOTAL Volumes Delivered for Year	1,052,063,306	963,340,871	942,789,142	(20,551,729)		Adjusted for off-system use and fuel set asides
	Total LUAF as % of Total Deliveries	0.997%	0.732%	1.005%	0.274%		
	Total LUAF as % of Total Receipts			0.995%			
	Total LUAF Allocation to Core Customers (%)	N/A	71.1%	58.4%			Includes Measurement, Theft, Accounting and Leakage Components.
	Total LUAF Allocation to Non-Core Customers (%)	N/A	28.9%	41.6%			Includes Measurement, Theft, Accounting and Leakage Components.
	Total Allocation to Core Customers (MCF)	N/A	5,012,364	5,535,525			Includes Measurement, Theft, Accounting and Leakage Components.
	Allocation to Non-Core Customers (MCF)	N/A	2,037,374.28	3,943,935			Includes Measurement, Theft, Accounting and Leakage Components.
	2022 Measurement LUAF to Core (%)	N/A	N/A	53.7%	N/A		
	2022 Measurement LUAF to Non-Core (%)	N/A	N/A	46.3%	N/A		
	2022 Measurement LUAF to Core (MCF)	N/A	N/A	3,822,475	N/A		
	2022 Measurement LUAF to Non-Core (MCF)	N/A	N/A	3,296,285	N/A		

Figure 1



The changes between the LUAF results for the different study years, noted briefly under Table 1 "Process Notes," are discussed in detail under the Chapter entitled "LUAF COMPARISONS AND TRENDS - LUAF Attribution and Changes from Prior Study Years".

Table 2 provides LUAF results in greater detail and provides a clearer picture of the contribution of each meter type to LUAF as Functional Groupings when all biases associated with meter types are included. In this tabular data, Sub–Component LUAF values including Fixed-Factor Pressure, Fixed-Factor Temperature, Elevation/Barometric Pressure and Meter Calibration Adjustment Factor LUAF and Electronic Instrument/Transmitter results are imbedded in four Meter Types as they impact to manifest LUAF (Positive Displacement, Orifice, Ultrasonic and Turbine meters) categorized in this Table. See discussion on LUAF-Total versus LUAF-ACC below (page 10). The LUAF data for meter types are further distributed into one of five Functional Groupings (Core Sales, Non-Core sales, Interstate Supplier Deliveries, California Production and Underground Storage.) Based on these Functional Groupings, meters are provided a specific code shown in the Table under "Functional Group and Meter Type." These groupings and definitions are discussed further in conjunction with data tables 2-M, 2-N, 2-O, and 2-P.

Key Measurement 2022 LUAF Metrics from Table 2 and Appendix Table 2-MDth are summarized below:

- A total of 952,243 MMCF of gas entered the SoCalGas pipeline system (as receipts) in 2022 from Interstate Suppliers, California Producers and Storage Withdrawal. Expressed in energy equivalent units, receipts totaled 981,777 MDth.

- Gas deliveries to customers and storage injection totaled 942,789 MMCF (972,030 MDth) in 2022. This represents a reduction of over 110,000 MMCF from 1991 and 20,000 MMCF from 2006 deliveries.

- There was a total of 9,478 MMCF LUAF (9,772 MDth) reported from all sources on the SoCalGas system in 2022, with 7,118 MMCF (7,339 MDth) attributable to Measurement. Of this total, 7,068 MMCF (7,288 MDth) is attributed to measurement systems and processes specifically-identified in this 2022 LUAF Study, while 50 MMCF (52 MDth) was characterized as unassigned to any specific measurement process.

- Measurement LUAF represented 0.742% of all system receipts in 2022. Measurement LUAF as a percentage of system deliveries was 0.749%. Measurement LUAF as a percentage of all 1,847,025 MMCF metering volumes considered for LUAF computation - deliveries plus receipts - was 0.38%. Note that deliveries include gas to customers and to storage injection. Receipts includes gas from storage withdrawal, Interstate Pipelines Companies and California Gas Producers.

- Year 2022 Measurement LUAF allocation to customer designations are: 3,822 MMCF (3,941 MDth) to Core Customers and 3,296 MMCF (3,399 MDth) to Non-Core customers, primarily based on meter volumes and purpose. This represents a 53.7%/46.3% split between core and non-core customers, respectively. When all 2022 LUAF is considered, including Accounting, Leakage and Theft LUAF sub-components, the LUAF allocations are 58.4% assigned to Core Customers and 41.6% assigned to Non-Core Customers.

- There are significant changes in LUAF totals, Sub-Component volumes, and attribution to customer class from 2006 to 2022. Measurement-related LUAF was 5,051 MMCF in 2006 and escalated to 7,118 MMCF (7,739 MDth) in 2022. The largest contributors to the 2022 Measurement LUAF escalation of 2,067 MMCF from 2006 levels were 1) lower average ambient temperatures in 2022 – adding 1,758 MMCF, 2) introduction of a Meter Calibration Adjustment Factor Policy - adding 700 MMCF and 3) small biases in large metering used by interstate gas suppliers-adding 2,890 MMCF. LUAF increases in the above areas were partially off-set by registration speed-up in diaphragm meters, due to aging and new meter replacements, decreasing LUAF by 2,010 MMCF from the Positive Displacement Meter (Rotary and Diaphragm Meters) LUAF contributions in 2006. The differences between year 2022, 2006 and 1991 LUAF are discussed in greater detail under “LUAF Comparisons and Trends - LUAF Attribution Changes from Prior Study Years.”

Table 2

Summary of 2022 Measurement LUAF by Functional Group and Meter Type (MMCF)

SUMMARY OF 2022 MEASUREMENT LUAF - INCLUDES ALL LUAF SUB-COMPONENTS IN THE METER TYPE (LUAF-Total)								LUAF ALLOCATION TO CUSTOMER CLASS			
Functional Group and Meter Type Codes	Active Meter Counts	Meter Volumes (MMCF)	Measurement LUAF-Total 2022 (MMCF)	LUAF % of Meter Code(s) Type	LUAF as % of Receipts	LUAF as % of Deliveries	% of Total Measurement LUAF	Core LUAF Allocation (%)	Non-Core Allocation (%)	Core LUAF (MMCF)	Non-Core LUAF (MMCF)
Diaphragm Sales Meters Core: M1-1, M1-2	5,843,284	202,251	2,892	1.430%	0.3037%	0.3067%	40.6266%	100.0%	0%	2,891.71	-
Rotary Sales Meters Core: M1-3, M1-4, M1-5	89,996	94,906	(169)	-0.178%	-0.0177%	-0.0179%	-2.3725%	100.0%	0%	(168.87)	-
Turbine Sales Meters Core: P1	18	1,136	0.3	0.030%	0.0000%	0.0000%	0.0049%	100.0%	0%	0.35	0.0000%
Sub-Total: Core Sales	***5,933,298***	***298,293***	***2,723***		**0.2860%**	**0.2888%**	**38.2590%**			***2,723***	-
Diaphragm Sales Meters Non-Core: M2-7	*10*	*2*	*(0.002)*	-0.074%	0.0000%	0.0000%	0.0000%	0.0%	***100%***	0.0000%	0.0000%
Rotary Sales Meters Non-Core: M2-6	915	55,309	132	0.239%	0.0139%	0.0140%	1.8557%	0.0%	100.0%	-	132
Turbine Meters Sales Non-Core: P2	196	130,993	436	0.333%	0.0458%	0.0463%	6.1269%	0.0%	100.0%	-	436
Orifice Meter Sales: N2	19	22,305	91	0.406%	0.0095%	0.0096%	1.2725%	0.0%	100.0%	-	91
Ultrasonic Sales Meters Non-Core: 02	40	352,729	591	0.167%	0.0620%	0.0626%	8.2979%	0.0%	100.0%	-	591
Sub-Total: Non-Core Sales	***1,170***	***561,339***	***1,249***		***0.1312%***	**0.1325%**	**17.5530%**			-	***1,249***
SALES TOTAL(Core plus Non-Core) Meter Data	**5,934,468**	**859,632**	**3,973**		***0.4172%***	**0.4214%**	**55.8120%**			**2,723**	**1,249**
Storage Injection Meters (US and orifice net inj including bi-directional): N5-1, O5-1	10	43,234	384	0.888%	0.0403%	0.0407%	5.3912%	34.7%	65.3%	133.16	251
Storage Withdrawal meters: N5-2, O5-2, P5	22	62,813	(109)	-0.174%	-0.0115%	-0.0116%	-1.5320%	34.7%	65.3%	(37.84)	(71)
Interstate Supply Pipelines (US and Orifice): N3, O3	40	848,865	2,890	0.340%	0.3035%	0.3065%	40.6025%	34.7%	65.3%	1,002.83	1,887
California Producers Meters: N4	33	32,481	(68)	-0.209%	-0.0071%	-0.0072%	-0.9538%	34.7%	65.3%	(23.56)	(44)
Metered TOTALS	**5,934,573**	**1,847,025**	**7,068**		**0.7424%**	**0.7498%**	**99.3059%**			**3,798**	**3,272**
Other/Non-Study Measurement			**49**		0.005%	0.0052%	0.6941%	50.0%	50.0%	25	25
TOTAL 2022 Measurement (Inc Non-Study)	**5,934,573**		**7,118**		**0.748%**	**0.755%**	100.0000%	**53.7%**	**46.3%**	**3,822**	**3,296**
Sales Total plus Injection		902,866									
Other Deliveries Adjustment		39,923									
Total System Deliveries		**942,789**									
Receipts Total (IS/WD/P-MD)		944,159									
Other Receipts Adjustment FERC		8,084									
TOTAL RECEIPTS (Metered plus other FERC adjusted)		**952,243**									
CALCULATED LUAF ALL SOURCES (MMCF)		**9,454**									
Net Storage Injection		(19,579)									

	Mcf	% of total LUAF
2022 MEASUREMENT LUAF (STUDY) w/o Unassigned	7,068	74.6%
2022 GO112 REPORT TOTAL LUAF (ACCT, MEAS, LEAK, THEFT)	9,478	100.0%
2022 GO112 REPORT TOTAL NON-MEASUREMENT LUAF	2,361	24.9%
2022 GO112 REPORT MEASUREMENT LUAF	7,118	75.1%
2022 MEASUREMENT NON-STUDY COMPONENT	49	0.5%

SOCALGAS 2022 LUAF GROUPED BY METER TYPE AND FUNCTIONAL GROUP:

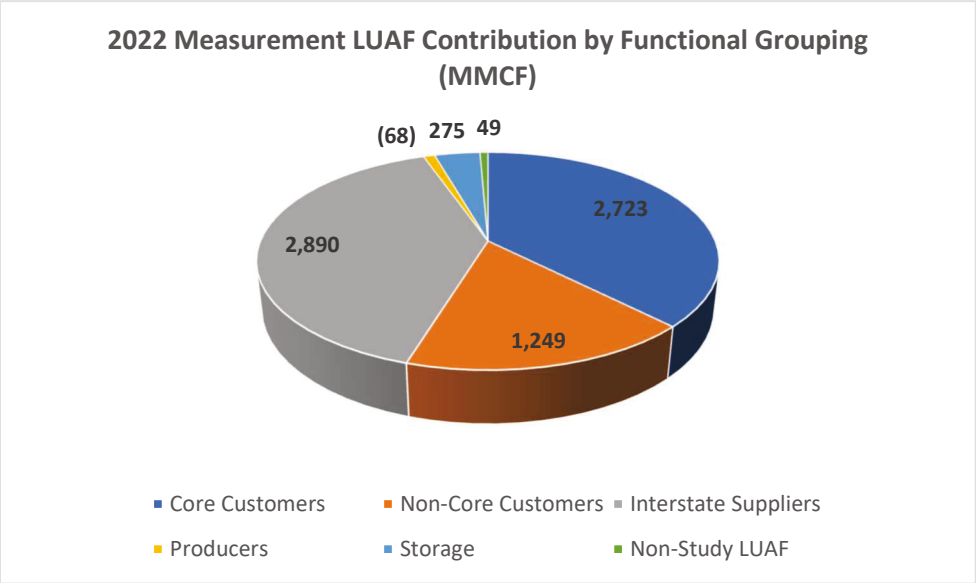
Tables 2-M, 2-N, 2-O, and 2-P provide LUAF areas in greater resolution grouped by Meter Type, and Functional Group. An Explanation on Meter Types, Functional Group and Meter Code Designations relative to those Tables and Table 2 follows.

Measurement LUAF origin can be analyzed and sorted multiple ways: by the Operating Functional Group served, by the type of meters contributing, and/or how meters are fitted with special equipment and/or treated in policy and applicable financial considerations. In this study, the most direct manner by which to establish the Core and Non-Core split accurately was to designate five (5) Functional Groupings as follows: 1-Core Customer Sales, 2-Non-Core Customer Transportation, 3- Interstate Pipeline suppliers, 4-California Production and 5-Gas Storage Operations (injection and withdrawal). Measurement LUAF summarized by the 5 Functional Groups is shown in Table2, Table 2-A and Figure 2 below.

Table 2-A
2022 Measurement LUAF Allocated to Functional Groups (MMCF)

Functional Group (FG Table Summation)	LUAF (MMcf)	Percent of Measurement LUAF
Core Customers	2,723	38%
Non-Core Customers	1,249	18%
Interstate Suppliers	2,890	41%
Producers	(68)	-1%
Storage	275	4%
Non-Study LUAF	49	1%
Total	7,118	100%

Figure 2



Tables FG1 through FG5 - discussed later- provide details on how these LUAF groupings were compiled.

Similarly, different meter types contribute to LUAF based on design, operating impacts and how meter measurement registration inaccuracies are derived. Because of these differences, proper assignment of LUAF contributions have been developed for 4 Meter Types within each of the 5 Functional Groups and then further sub divided with Meter Codes for LUAF calculation purposes.

Four (4) meter types were selected to be consistent with prior LUAF studies. They are M-Positive Displacement Meters -Diaphragm/Rotary, N-Orifice Meters, O-Ultrasonic meters and P-Turbine meters.

Tables 2, 2-M, 2-N, 2-O and 2-P show the variants of Meter Type, Functional Group and Meter Sub-Type used throughout this document and their process contributions to LUAF in 2022. See column entitled "Meter (Code), Type and Functional Group." In this column, Meter Code letter pre-fixes (M, N, O and P) correspond to the Meter Types noted above while the first number represents one of the 5 Functional Groupings noted. The dash and trailing number represent further meter sub-type. For example, M1-1 represents positive displacement meters (Meter Type M) in Functional Group 1 (Core Sales) and the Sub-Type 1 within that functional group as shown. In this case the trailing "1" represents Core diaphragm meters not under the MCAF program, as noted.

Measurement LUAF is shown two different ways in Table 2-B and Tables 2-M, 2-N, 2-O and 2-P

Within each of the Tables, there are two main LUAF calculation totals for each meter groupings:

1) <u>The totals based only on the mechanical accuracy contributions of the meters:</u> this includes field testing results, field conditions, calibration factors and other direct registration impacts. These results are shown in the Column with the heading "<u>LUAF-ACC"</u> (ACC designating meter registration accuracy) The data in these columns is the equivalent tabulation to both the 1991 and 2006 studies for each of the meter types (M, N, O and P). These results are mapped to Table

1. As shown in Summary Table 2, the addition of the LUAF contribution for the LUAF-ACC column (LUAF Sub-Components M, N, O and P) is only 3,407 MMCF, less than half of the Measurement LUAF total of 7,118 MMCF in 2022. See Figure 3-A for graphical representation.

2) The total contribution to LUAF for each of the four (4) meter types, rolling all contributing factors: including the effects of base mechanical accuracy, instrument calibration, elevation/pressure, and temperature. Sub-Components I, J, K, Q and X ultimately are responsible for LUAF on specific meters. The column designated with the heading "LUAF-Total" in Tables 2-M, 2-N, 2-O, and 2-P conveys the LUAF totals consolidated in this manner. This is summary method used for LUAF attribution to each Meter Type/ Code shown in Table 2. See Figure 3-B for graphical representation.

Table 2-B
MEASUREMENT LUAF-TOTAL and LUAF-METER ACCURACY COMPARISON (MMCF)

Measurement LUAF using Prior Year Study Groupings (measurement LUAF – ACC) and by consolidating all sub-components into the 4 Meter Types (Measurement LUAF-TOTAL)

Meter Type	LUAF-TOTAL GROUPING (MMcf)	LUAF-ACC GROUPING (MMcf)
(M) Positive Displacement Meters	2,855	933
(N) Orifice Meters	1,593	371
(O) Ultrasonic Meters	2,186	1,546
(P) Turbine Meters	436	558
Sub-Components I,J,K,L,Q, X	0	3,662
Non-Study	49	49
TOTALS	7,118	7,118

Figure 3-A
2022 LUAF Displayed with Four (4) Meter Type Base Accuracies Separate from Other Sub-Components

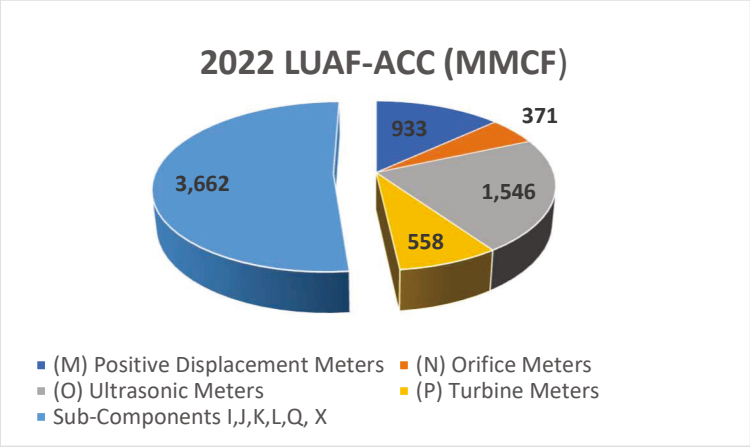
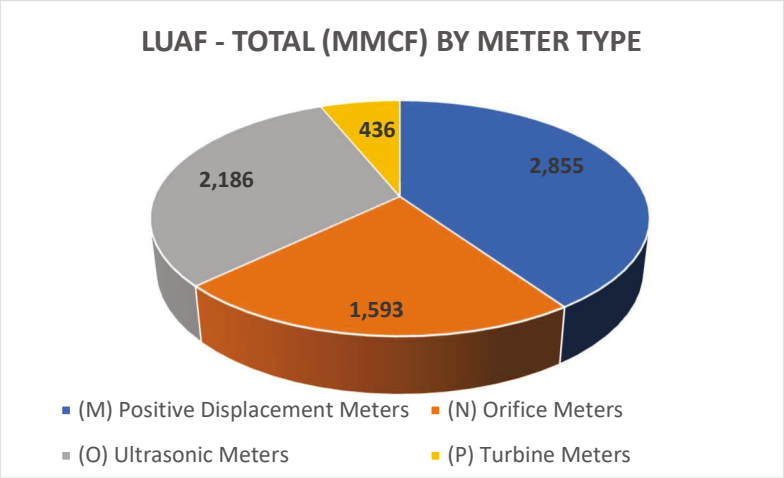


Figure 3-B
2022 LUAF-TOTAL Displayed WITH Other Sub-Components Consolidated into 4 Meter Types



A discussion of Tables 2-M, 2-N, 2-O, and 2-P data/results follows.

Table 2-M: Positive Displacement Meters

Refer to Table 2-M. This Table shows there were 5,934,205 positive displacement (PD) meters in service in 2022, with associated deliveries to customers registering 352,469 MMCF. Meters included in this category include diaphragm and rotary meters serving Core and Non-Core customers. The Column designated "LUAF-ACC" shows a composite LUAF contribution of 933 MMCF attributed to only the mechanical accuracy of these meters - using the 1991 and 2006 Studies' calculation method for all Positive Displacement Meters. The Column entitled "LUAF-TOTAL" shows the LUAF taking into account all bias factors impacting rotary and diaphragm meter system accuracy. The LUAF-Total contribution was 2,855 MMCF (2,956 MDth). Details on the derivation of the LUAF bias factor associated with each LUAF Sub-component category are provided under the Chapter Entitled "LUAF DETAILED SUB-COMPONENT ANALYSIS," Sub-Component M.

As shown in Column "X" The Meter Calibration Adjustment Factor program (MCAF) contributes 700 MMCF to this total while Elevation/Barometric Pressure (K) and Meter Low Fow accuracy (ACC-4) contribute 1,036 MMCF and 1,028 MMCF to LUAF, respectively. Electronic Corrector LUAF contribution is an 87 MMCF LUAF reduction (gas gain) for PD meters in 2022.

Allocation to Customer Class for Positive Displacement (PD) meters is based on the sales volumes registered by each customer classification within these meter categories. For Core customers' meters this adds to 2,723 MMCF. The total is 132 MMCF for Non-Core Customers.

Overall, PD meters and related processes contributed 30.1% of all system LUAF and 40.4% of all Measurement LUAF in 2022.

Table 2-N: Orifice Meter LUAF:

There were 81 system orifice meters, including those meters owned and operated by SoCalGas and Interstate Suppliers in 2022, with total Meter Volumes registered at 503,235 MMCF.

Table 2-N under the Column headed “LUAF-ACC” shows a composite LUAF of 371 MMCF due to mechanical (in)accuracy using the 1991 and 2006 Study calculation method for Orifice Meters. This total excludes transmitter accuracy contribution for orifice meters. Transmitter calibration bias added an additional 1,222 MMCF of LUAF. Overall, the “LUAF-Total” is 1,593 MMCF for registered orifice meter volumes of 503,255 MMCF in 2022. More than 70% of this 1,593 MMCF LUAF-Total is attributable to orifice meters operated by the Interstate Suppliers exhibiting a combination of transmitter accuracy and pulsation induced error bias. Details are provided under the Chapter entitled “LUAF DETAILED SUB-COMPONENT ANALYSIS”, Sub-Component N.

Orifice meter LUAF-TOTAL allocation to Customer Class is 521 MMCF to Core and 1,072 MMCF to Non-Core Customers. See “LUAF Allocation” columns. Non-Core Customer meters are 100% allocated to Non-Core, while all other supplier and Operations’ meters allocations are based on the ratio of Customer Class use as a fraction of total deliveries to customers. This allocation is 34.7% - to Core Customers and 65.3% to Non-Core Customers.

Overall, orifice meters and related processes contributed 16.8% of all system LUAF and 22.5% of all Measurement LUAF in 2022.

Table 2-O: Ultrasonic Meter LUAF:

Table 2-O shows the LUAF-ACC contribution of 1,546 MMCF for all 61 system ultrasonic meters, including those meters owned and operated by SoCalGas and Interstate Suppliers. Ultrasonic meters registered 734,162 MMCF in 2022. Ultrasonic meter transmitter (P/T) calibration bias contributed an additional 640 MMCF of LUAF, bringing the “LUAF-Total” attributable to ultrasonic metering systems to 2,186 MMCF. It is estimated that over 60% of ultrasonic metering LUAF-Total is s attributable to ultrasonic meters operated by the Interstate Suppliers, due to a combination of transmitter accuracy and minor meter fouling induced error bias.

Details are provided under the Chapter entitled “LUAF DETAILED SUB-COMPONENT ANALYSIS,” Sub-Component O.

Allocations (for regulatory assignment) to Customer Class are 553 MMCF to Core and 1,632 MMCF to Non-Core Customers. See Allocation columns. Non-Core Customer meter LUAF is 100% allocated to Non-Core, while all other Supplier and operational meter allocations are based on the 34.7%-Core, 65.3% Non-Core ratio derived from deliveries to each Customer Class in 2022.

Overall, ultrasonic meters and related processes contributed 23.1% of all System LUAF and 30.1% of all Measurement LUAF-TOTAL in 2022.

Table 2-P: Turbine Meter LUAF:

Table 2-P shows the "LUAF-ACC" contribution of all 215 system turbine meters is 558 MMCF, with associated meter volumes registered at 131,534 MMCF. More than 60% of this total is attributable to turbine meters exhibiting under-registration at low flow conditions. Details are provided under the Chapter entitled "LUAF DETAILED SUB-COMPONENT ANALYSIS," Sub-Component P.

Instrument Calibration Biases contributed a net LUAF gain of 122 MMCF due to a slight collective over-registration.

Combining the mechanical registration (LUAF-ACC) and Instrumentation Calibration bias results in a LUAF-TOTAL of 436 MMCF LUAF contribution from all turbine meter systems in 2022.

Allocation to Customer Class is a LUAF-TOTAL of 0 MMCF to Core and 436 MMCF positive LUAF contribution to Non-Core Customers. Non-Core Customer meters are 100% allocated to Non-Core, while all other Supplier and Operational meters allocations are 34.7%-Core/65.3%-Non-Core, based on sales volumes delivered the respective customer classes.

Overall, turbine meters and related processes contributed 4.6% of all system LUAF and 6.1% of all Measurement LUAF-TOTAL in 2022. The development of the accuracy bias factors and associated LUAF volumes used to derive the values in Table 2-P are discussed under the Chapter entitled "LUAF DETAILED SUB-COMPONENT ANALYSIS, Sub-Component P."

TABLE 2-M: POSITIVE DISPLACEMENT METERS

				SUB-COMPONENT LUAF CONTRIBUTION (MMCF) See Associated Lettered Appendicies for details									LUAF-ACC Allocation to Core and Non-Core			
			LUAF -TOTAL	ACC-1	ACC-2	Q.1	J	I	K	X	ACC-4	LUAF-ACC				
Meter (Code), Type and Functional Group	# Meters in Category (Active in billing system)	Meter Volumes (MMCF)	Total LUAF Bias Component Sum (MMCF)	As-Found Meter Calib LUAF Component	Aux Factor LUAF Component	Electronic Corrector LUAF Component	Fixed-factor Pressure LUAF Component	Fixed-Factor Temperature LUAF Component	Elevation and Barometric Pressure LUAF Component	Meter Calibration Adjustment Factor LUAF Component	Meter Low Flow Accuracy LUAF Component	LUAF due to mechanical registration factors only. (1991, 2006 method)	Core Allocation (%)	Non-Core Allocation (%)	Core Allocation (MMCF)	Non-Core Allocation (MMCF)
(M1-1) Core Diaphragm Meters not in Meter Calibration Adjustment Protocol Size 1-3	4,738,957	167,937	2,113	(240)	-	-	47	566	886	-	853	613	100.0%	0.0%	613	-
(M1-2) Core Diaphragm Meters in Meter Calibration Adjustment Factor Protocol Size 1-3	1,104,328	34,315	779	(401)	-	-	10	116	181	700	174	(227)	100.0%	0.0%	(227)	-
(M1-3) Core Rotary meters - Size 4+ without electronic pressure or temperature correction.	24,391	3,625	25	12	1	-	1	12	(1)	-	-	13	100.0%	0.0%	13	-
(M1-4) Core Rotary meters Size 5+ w/o Temperature correction (includes 3,111 electronic Pressure Correctors)	63,651	52,191	(287)	169	21	-	15	(475)	(17)	-	-	190	100.0%	0.0%	190	-
(M1-5) Core Rotary meters - with Temperature Correction or Temperature and Pressure Correction	1,954	39,090	93	127	15	(36)	-	-	(13)	-	-	142	100.0%	0.0%	142	-
(M2-6) Rotary Meter Non-Core (presssure and temperature corrected)	915	55,309	132	179	22	(51)	(18)	-	-	-	-	201	0.0%	100.0%	-	201
(M2-7) Diaphragm Non-Core	10	2	(0)	(0)	-	-	(0)	-	-	-	-	(0)	0.0%	100.0%	-	(0)
TOTALS - Active Core Meters	**5,934,205**	**352,469**	**2,855**	(154)	59	(87)	54	219	1,036	700	1,028	**933**			**732**	**201**
% of 2022 System LUAF			30.120%	-1.625%	0.624%	-0.921%	0.572%	2.310%	10.933%	7.385%	10.843%	9.841%			7.719%	2.123%
% of 2022 Measurement LUAF			40.390%	-2.179%	0.837%	-1.236%	0.767%	3.097%	14.661%	9.904%	14.540%	13.197%			10.350%	2.846%

TABLE 2-N: ORIFICE METER SUMMARY

				SUB-COMPONENT LUAF CONTRIBUTION (MMCF) See Associated Lettered Appendicies for details									LUAF-ACC Allocation to Core and Non-Core			
			LUAF -TOTAL	ACC-1	ACC-2	Q.1	K	Q.2	ACC-6	ACC-7	NOTE	LUAF-ACC				
Meter (Code), Type and Functional Group	# Meters in Category	Meter Volumes (MMCF)	Total LUAF Component (MMCF)	As-Found Meter Calib LUAF Component	Aux Factor LUAF Component	Electronic Corrector LUAF Component	Elevation/Altitude Zone LUAF Component	Transmitter Accuracy LUAF Component	Field Effects LUAF Component	Other LUAF Component	Other LUAF Component Note	LUAF Excluding Transmitter, Elec Corrector, Elevation (2006 method)	Core Allocation (%)	Non-Core Allocation (%)	Core Allocation (MMCF)	Non-Core Allocation (MMCF)
(N2) Orifice Meter Non-Core	19	22,305	91	-	-	-	-	13	56	22		78	0.0%	100.0%	-	78
(N3) Orifice Meter - Interstate Supplier	23	478,706	1,331	-	-	-	-	1,171	(239)	399		160	34.7%	65.3%	55	104
(N4) Orifice Meter - California Producer	33	32,481	(68)	-	-	-	-	-	(32)	(35)		(68)	34.7%	65.3%	(24)	(44)
(N5-1) Orifice Meter Storage Injection	6	29,013	349	-	-	-	-	30	160	160		319	34.7%	65.3%	111	208
(N5-2) Orifice Meter Storage Withdrawal	20	(59,269)	(110)	-	-	-	-	9	(59)	(59)	-	(119)	34.7%	65.3%	(41)	(77)
Total	**81**	**503,235**	**1,593**	-	-	-	-	**1,222**	**(116)**	**486**		**370.5**			**101.5**	**269.1**
															-	-
% of 2022 System LUAF			16.807%	0.000%	0.000%	0.000%	0.000%	12.897%	-1.221%	5.131%	0.000%	3.909%			1.071%	2.839%
% of 2022 Measurement LUAF			22.537%	0.000%	0.000%	0.000%	0.000%	17.295%	-1.638%	6.880%	0.000%	5.242%			1.436%	3.806%

TABLE 2-O: ULTRASONIC METER SUMMARY

				SUB-COMPONENT LUAF CONTRIBUTION (MMCF) See Associated Lettered Appendicies for details									LUAF-ACC Allocation to Core and Non-Core			
			O-TOTAL	ACC-1	ACC-2	Q.1	K	Q.2	ACC-6	ACC-7	NOTE	LUAF-ACC				
Meter (Code), Type and Functional Group	# Meters in Category	Meter Volumes (MMCF)	Total LUAF Component (MMCF)	As-Found Meter Calib LUAF Component	Aux Factor LUAF Component	Electronic Corrector LUAF Component	Elevation/Altitude Zone LUAF Component	Transmitter Accuracy LUAF Component	Field Effects LUAF Component	Other LUAF Component	Other LUAF Component Note	LUAF Excluding Transmitter, Elec Corrector, Elevation (2006 method)	Core Allocation (%)	Non-Core Allocation (%)	Core Allocation (MMCF)	Non-Core Allocation (MMCF)
(O2) Ultrasonic - Non-Core	40	352,729	591	-	-	-	-	198	(247)	640	LG Customer Meter Problem	393	0.0%	100.0%	-	393
(O3) Ultrasonic Meter - Interstate Supplier	17	370,159	1,559	-	-	-	-	448	1,110	-	0	1,110	34.7%	65.3%	385	725
(O4) Ultrasonic Meter - California Producer	0	-	-	-	-	-	-	-	-	-		-	34.7%	65.3%	-	-
(O5-1) Ultrasonic Meter Storage Injection	4	14,221	35	-	-	-	-	(8)	-	43	Low Flow	43	34.7%	65.3%	15	28
(O5-2) Ultrasonic Meter - Storage Withdrawal	3	(2,948)	2	-	-	-	-	2	-	-	0	-	34.7%	65.3%	-	-
Total	**61**	**734,162**	**2,186**	**-**	**-**	**-**	**-**	640	864	682		**1,546**			**400.1**	**1,145.8**
% of 2022 System LUAF			23.062%	0.000%	0.000%	0.000%	0.000%	6.752%	9.111%	7.199%	0.000%	16.310%			4.222%	12.089%
% of 2022 Measurement LUAF			30.925%	0.000%	0.000%	0.000%	0.000%	9.054%	12.217%	9.654%	0.000%	21.872%			5.661%	16.211%

TABLE 2-P: TURBINE METER SUMMARY

				SUB-COMPONENT LUAF CONTRIBUTION (MMCF) See Associated Lettered Appendicies for details									LUAF-ACC Allocation to Core and Non-Core			
			P-TOTAL	ACC-1	ACC-2	Q.1	K	Q.2	ACC-6	ACC-7	NOTE	LUAF-ACC				
Meter (Code), Type and Functional Group	# Meters in Category	Meter Volumes (MMCF)	Total LUAF Component (MMCF)	As-Found Meter Calib LUAF Component	Aux Factor LUAF Component	Electronic Corrector LUAF Component	Elevation/Altitude Zone LUAF Component	Transmitter Accuracy LUAF Component	Field Effects LUAF Component	Other LUAF Component	Other LUAF Component Note	LUAF Excluding Transmitter, Elec Corrector, Elevation (2006 method)	Core Allocation (%)	Non-Core Allocation (%)	Core Allocation (MMCF)	Non-Core Allocation (MMCF)
(P-1) Turbine meters; Core with correctors	18	1,136	0.3	1.09705	0.66862	(1.1)	-	-	(0.4)	-	-	1	100.0%	0.0%	1	-
(P2) Turbine Meter Non-Core	196	130,993	436.1	126.5	77.1	(121.2)	-	-	-	353.7	Turbine low flow	557	0.0%	100.0%	-	557
(P5-2) Turbine Meter Storage Withdrawal	1	(596)	(0.9)	(0.6)	(0.4)	-	-	-	-	-	-	(1)	34.7%	65.3%	(0)	(1)
Total	**215**	**131,534**	**436**	**127.0**	**77.4**	**(122.2)**	**-**	**-**	**(0.4)**	**353.7**		**558**			**1.1**	**556.7**
															-	-
% of 2022 System LUAF			4.595%	1.340%	0.817%	-1.290%	0.000%	0.000%	-0.004%	3.731%	0.000%	5.884%			0.011%	5.873%
% of 2022 Measurement LUAF			6.161%	1.797%	1.095%	-1.729%	0.000%	0.000%	-0.005%	5.004%	0.000%	7.891%			0.015%	7.876%

Total Measurement LUAF M, N, O, P Integrated with All Othe Bias Sub-Components	**7,069**	**Total using 2006 method which excluded instrument/transmitter, elevation, MCAF and temperature biases. Equals sum of M, N, O and P Sub-Components**	**3,407**

Sub Component L summary:	LUAF (MMcf)
Total All Transmitters	**1,862.42**
Total all Electronic Correctors	**(209.57)**
TOTAL Electronic Transmitters/Instruments	**1,652.85**

LUAF COMPARISONS AND TRENDS:

LUAF Attribution Changes from Prior Study Years:

Refer back to Summary Table 1. This Table provides a comparison of LUAF for years 1991, 2006 and 2022 side-by-side to provide insight as to how LUAF has changed over time by comparative Sub-Component categories. This Section provides detail on the factors which have driven LUAF changes from 1991 to 2022. It builds on the summary notations provided under "2022 Process Notes" referenced for each LUAF Sub-Component provided in Table 1. Detail supporting those annotations follow with references to specific Line Item/Sub-Components, Meter Functional Groups and related Meter Codes: Tables 2-M , 2-N, 2-O and 2-P presented under the detailed Sub-component Chapter for Each Meter provide added breakdowns of LUAF by Meter types for positive displacement, orifice, ultrasonic and turbine meters respectively.

Key changes in 2022 from both 1991 and 2006 specifically affecting comparative LUAF results include the following:

1. LUAF Sub-Component (I) – Fixed-Factor Gas Temperature: Meter Codes M1-1, M1-2, M1-3, M1-4: **Year 2022 was much colder during the winter months than either 1991 or 2006**, resulting in a 1,758 MMCF increase in LUAF contribution from 2006 for Positive Displacement gas meters without gas temperature compensation. This is due to a lower average flowing gas temperature in 2022. For customers where 60° F is assumed for billing computation, the weighted average flow temperature in 2022 was 58.3 °F for small meters and 64.8 °F for larger meters in 2022. In 2006, associated small meter gas temperatures were 62.8 °F while large meters averaged 63.8 °F. In 1991 these average temperatures were 59.9 °F for small meters and 69.2 °F for large meters. Figure 5 shows a graph of LUAF by month-12 month rolling average. It shows a visible seasonal variance relationship between summer and winter LUAF, which is largely attributable to associated flowing gas temperatures. (See recommendation "E" for improving upon monthly LUAF calculations and customer billing accuracy.) LUAF Sub-Component (I) contribution can change dramatically from one year to the next as the average ambient temperature between winters varies. This change can be up to 1,500 MMCF between years. See Sub-Component (I) discussion and Appendix I.1 and I.2 for temperature based LUAF details.

2. LUAF Sub-Component (X-New); Meter Codes M1-1, M1-2: **A new process was approved by the CPUC and implemented in 2021 to allow small diaphragm meter families, over-registering as group, to remain in service longer than previously allowed**. As part of this capital asset life extension strategy and to provide customer equity, meter families which tested fast above prescribed accuracy parameters were slowed by 2% via the application of a "Meter Calibration Adjustment Factor" (MCAF) in the billing system. An average of 1.1 million customer meters were subject to this 2% downward registration adjustment in 2022 for meter families registering 1.17% fast on average. A 2% adjustment to these customer bills equates to a calculated 700 MMCF reduction in customer bills in 2022. This amount adds to the calculated system LUAF from prior years by the same amount. However, the net effect of this program has been to increase system LUAF by approximately 300 MMCF from true zero balancing for the customers billed in this category via over-crediting in billing for fast metering.

This LUAF Sub-Component has the potential to escalate by up to 300 MMCF in 2024 and beyond as more meter families move into the over-registration MCAF protocol. Replacement of meter families to remove them from the protocol can reduce this impact. But this must be weighed against capital asset life extension benefits for small meters achieved by the Program. Recommendation "H" discusses a secondary process improvement to consider related to the MCAF Program.

3. LUAF Sub-Component M; Codes M1-1, M1-2 Diaphragm Meters: **Roughly 87% of all 6 million small diaphragm meters active in 2022 meters were placed in-service after 1991**. This replacement reduced the amount of gas under-measured by specific meter families identified in 1991 and 2006 as operating slow at lower flow ranges. Specifically, certain common meter families measured slow or failed to register at flow rates ranging up to 20 cubic feet per hour in 2006 and 1991. The LUAF level associated with this element was 2,265 MMCF in 1991 and approximately 2,000 MMCF in 2006. It was reduced to 1,028 MMCF in 2022. Further low-flow testing of the newer meter families (in particular, Itron-Metris and newer American series) is needed for LUAF reports going forward to refine this estimate.

4. LUAF Sub-Component M; Codes M1-1, M1-2 Diaphragm Meters**: The base calibration (in-test results at 25% of rated capacity) of diaphragm meters in-service has shifted from 0.6% slow in 2006 to 0.39% fast in 2022**. This change in and of itself reduced the LUAF for positive displacement meters by 1,400 MMCF from 2006. It is a result of aging and specific groups of American meters not part of the statistical sampling program in 2006 registering faster in 2022. The MCAF program discussed earlier and low flow under-registration issues noted under "2" respectively offset most of this increase in diaphragm meter over-registration. See Appendix "M.2."

5. LUAF Sub-Components M: Codes M1-3, M1-4, M1-4 Rotary Meters: **The base calibration of rotary meters slowed down over the period from 1991 to 2006 and further in 2022:** This shifted the overall rotary meter LUAF from a reduction of 488 MMCF in 1991 to a positive contribution to LUAF of 546 MMCF in 2022.

6. LUAF Sub-Components N- 3,4,5: **The use of orifice meters for SoCalGas customer sales, storage and by the companies supplying gas to SoCalGas has been reduced.** The overall component of LUAF from orifice metering has dropped by 3,767 MMCF from 2006 levels. A large percentage of the 371 MMCF orifice meter-attributable LUAF in 2022 was from one of SoCalGas' largest receipt points over-registering due to some piping and operating profile issues.

7. LUAF Sub-Component N and O; Codes N3 and O3: **Shift in interstate pipeline delivery locations**. A shift of 130,000 MMCF per year between major receipt occurred between 2020 and 2022. This shift trends well with the escalating LUAF profile from 2018 to 2022 and appears to have contributed up to 130 MMCF of incremental LUAF when compared to year 2018. (See Figure 6). Minor bias between receipt points measurement accuracies is estimated based on historical observation, known errors, historical billing adjustments and related technical studies.

8. LUAF Sub-Component O (Ultrasonic Metering); Codes O2: **Non-Core Sales: SDG&E experience a significant drop in LUAF in 2022 from the prior two years, while SoCalGas' LUAF has increased significantly**. Based on 2018-2022 hourly data reviewed from the primary delivery point from SoCalGas to SDG&E, it is highly likely that intermittent operational and metering accuracy excursions at this metering site contributed to the counter-directional LUAF trends between SoCalGas and SDGE in 2022. It is believed this metering facility under registered by approximately 0.6% in 2022. See Figure 4 and Recommendation "I".

9. LUAF Sub-Component P: Meter Code P2: **Turbine meters registered slower on average in 2022 compared to 2006 due to aging.** Overall, net change was an increase of approximately 1,300 MMCF LUAF in 2022 for all turbine meters. This is primarily attributable to 2022 analysis placing less weighting on pulsation-related over registration effects than the 1991 Study. There have been no pulsation related-billing adjustments at SoCalGas metering sites in the last 20 years. Further, there has not been any significant pulsation identified at any of the Company's 215 turbine meter locations. It is believed pulsation effects identified in the 1991 and 2006 studies may have been over-estimated as a developing science in the 1990s.

10. LUAF Sub-Component Q**: Shift in estimated instrument/transmitter error bias for interstate pipeline suppliers.** LUAF associated with interstate pipeline suppliers is estimated to be 1,171 MMCF in 2022. This is based on observation and better understanding of Supplier calibration and operations practices note between 2006 and 2022. Overall, the LUAF contribution due to instrumentation calibration escalated from a negative LUAF (gas gain) of 262 MMCF in 2006 to a LUAF value of 1,652 MMCF in 2022. The LUAF from electronic measurement system bias on the SoCalGas System, not including interstate supplier metering, was an over-registration of 33.1 MMCF 2022.

5-Year Trends and Observations:

Figure 4 depicts a 5-year history of SoCalGas LUAF and a graph of SoCalGas and SDGE LUAF, and SoCalGas LUAF by measurement and non-measurement contributions. SoCalGas LUAF is shown on the blue line along with average temperature for the applicable 5-month heating season Dec-April in each year. This Figure shows two prominent trends:

- The clear impact of temperature on changes in LUAF year-to-year: When 2022 temperatures and customer loads by temperature zone are used in the 1991 estimation methodology, they produce an annual LUAF shift of approximately 590 MMCF per 1 °F change in weighted gas flow temperature for small and large meters without temperature compensation. See Appendix I.1 and I.2 entry entitled "LUAF (MMCF) per flowing gas average deviation from 60 °F."

- A general inverse relationship between SDGE LUAF and SDGE LUAF, indicative of metering Bias impact between 2020 and 2022. This is discussed in detail under "LUAF DETAILED SUB-COMPONENT ANALYSIS, sub-section "O-ACC-7 Other: Large Ultrasonic Meter Single site."

Figure 4

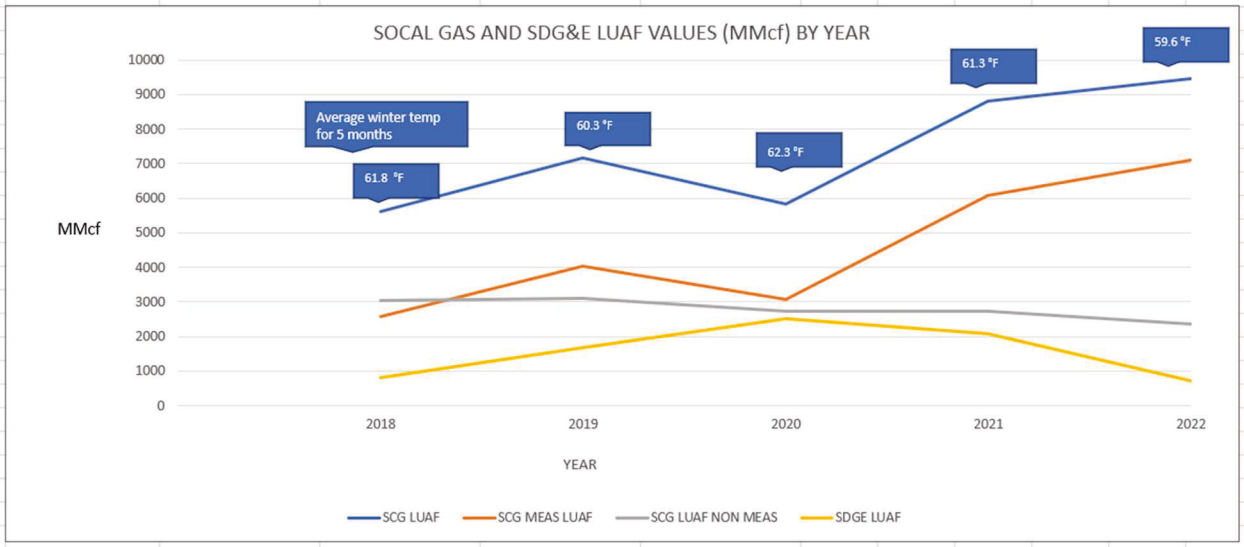


Figure 5

SCG LUAF Month and 12 month Rolling Average

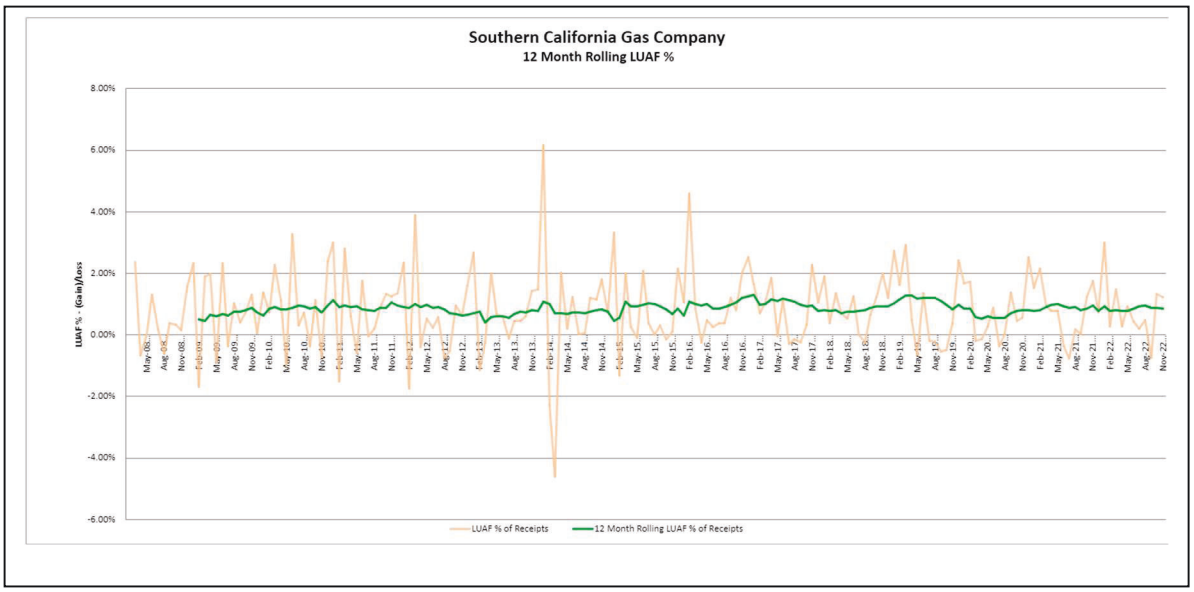
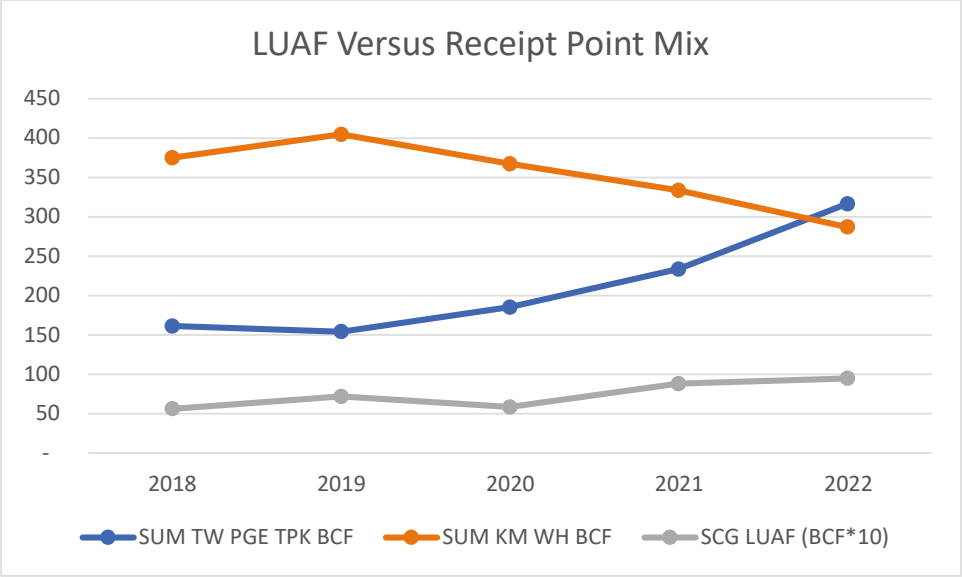


Figure 6
LUAF vs Interstate Supplier Receipt Point Volume Groupings



Base and Variable LUAF:

In this report there is a detailed breakdown as to how select biases impact LUAF volumes each year. LUAF contributing factors include two general types: 1) biases which hardly change from one year to the next or do so slowly 2) conditions which can which produce wide-ranging LUAF variation year-to-year. Some of the wide-ranging biases are shown in conjunction with Table 3.

Measurement related LUAF contributors which change very little in any operating year are:

- ACC-1 Meter calibrations – Core and Non-Core meters: they experience calibration shifts on average at less than 0.05% per year as a population. While this shows up clearly in a 20-30 year trend, there is no radical year-to-year change. The mix of core meters in service changes by less than 5% from any prior year.
- ACC-2 Auxiliary Factor: are set in meters and do not typically change until a meter is removed.
- Instrument: the average bias from modern electronic pressure/temperature shifts less than 0.01% per year as a population.
- Elevation and Barometric Pressure – the average elevation where meters reside and from where barometric pressure is nominally static for billing purposes, as it only changes when new customers are added or facilities close. Such customer additions/closures represent a change of less than 6% of the customer base annually.
- Fixed-Factor pressure: This customer population and volumes per altitude and elevation zone changes less than 5% year to year.

In consideration of the above, there appears to be a stable Core Customer metering LUAF base load of approximately 2,500 MMCF of very slowly changing system LUAF. Sitting atop this LUAF base load are more dynamic contributors described below:

- A component of LUAF for core meters that is highly dependent on ambient and thus gas temperature variation. This variation can swing LUAF for the Core Customers ±1,500 MMCF in any given year. This is discussed in greater detail under the detailed discussion for Sub-Component I (Fixed-Factor Temperature).
- A Non-Core customer baseline contribution to LUAF which appears to be approximately 400 MMCF. Ultrasonic meter deployment has worked to reduce this number in recent years. This baseline excludes one-time events where a large meter experiences an accuracy problem with no immediate reconciling billing adjustment. This can range up to 500 MMCF or more in LUAF impact.
- Interstate Pipeline Suppliers contributing a baseline LUAF of approximately 2,500 MMCF through biases in the 40 large meters used to deliver ~ 850,000-950,000 MMCF to SoCalGas each year. There is a secondary dynamic component of at least 300 MMCF depending on the relative mix where gas supplies are metered into the system- not all inter-connect meters are equal. As noted above, there was a notable shift in Interstate supply delivery points of 130,000 from year 2020 to 2022. It is believed this was part of the 3,646 MMCF overall LUAF shift from 2020 to 2022. Figure 6 shows LUAF posted against a shift in supplies for prominent receipt points over a 5-year period. Major events which are estimated to have changed LUAF from 2020 to 2022 are listed in Table 3.

Table 3
Estimated Changes in LUAF from 2020 to 2022 (MMCF)

DESCRIPTION	VOLUME (MMCF)
LUAF 2020-2022 Escalation	3,646
Subtract Known 2020-2022 Changes	
Meter Calibration Adjustment Factor	700
Lower Ambient Tempeature from Model	1,510
Large Customer Under-measurement	640
Interconnect Delivery Location Shifts	195
Total Known Changes:	**3,045**
Remainder (Unassigned)	601

RECOMMENDATIONS:

Based on the findings and observations uncovered in the course this Study, the following are recommendations for consideration to either reduce LUAF or to improve LUAF characterization and attribution to customer class:

A. Storage meters: correct/mitigate low differential pressure operation on orifice meters used for injection. Effect: avoid storage imbalance/skew over time. In review of storage metering records, it was noted that several injection meters routinely operated at less than 20” water column differential pressure, and often below 10”. This can lead to consistent under registration of injection volumes and skew storage inventory estimates.

B. Harmonize Storage Injection and Withdrawal metering by testing changes in storage field pressures during stretches in injection operations and during withdrawal period. Effect: Avoid accumulation of storage inventory skew over time, reduce inventory adjustments. (All fields).

C. Renew investigation of orifice meter pulsation characterization and mitigation at specific large Interstate Supplier 1 receipt point. Effect: Estimated 399 MMCF LUAF reduction and related transportation charges.

D. Interstate Supplier Ultrasonic: Improve meter and meter tube conditions at more frequent intervals at interstate Supplier 2. (0.3-0.5 BCF-LUAF reduction plus transportation charges).

E. Commission a study to determine if monthly gas temperature adjustments for small customers can be achieved to levelized/mitigate the Fixed-Factor Temperature adjustment swing each year. 400 MMCF – LUAF plus margin revenue at approximately $9/MCF. More Accurate Customer Billing.

F. Strengthen Border witness processing (300 MMCF LUAF reduction plus transportation charges).

G. Re-evaluate altitude/elevation zone averages with some statistical GPS data. Consider implementing smaller zones for small and large customers.

H. Re-evaluate the 2% credit percentage applied to customers for the MCAF customer billing adjustments. Consider matching the credit percentage to the average meter family bias from the statistical sampling from prior year test results. (Impact: potential 300 MMCF LUAF reduction, plus associated revenue increase.)

I. Pending: Rainbow Audit: conduct/complete a comprehensive audit of the Rainbow metering site as this site appears to have been under-reporting measured volumes by a minimum of 0.5%. as of 2022.

J. Develop clear and concise document which reports the 2% MCAF adjustment and its direct relationship to meter volumes under the program.

K. Amend this report to include 2023 data, complete 2023 LUAF detailed report.

L. This LUAF Study did not review all Accounting Ledgers for inclusion of meters. If not recently performed, it is suggested a review of all operational, storage, and exchange meters be conducted in 2025.

LUAF BY FUNCTIONAL GROUP & ASSOCIATED TABLES:

As noted earlier in this report, analyzing and compiling LUAF by Functional Group (FG) provides the most practical structure for applying error biases to volumes and associated allocations to Core and Non-Core Customer Classes. Tables FG1-A, FG1-B, FG2-A, FG-2B, FG3-A, FG-3B, FG4-A, FG-4B, FG5-A and FG5-B were specifically developed for this purpose. Tables post-scripted "-A" provide LUAF Bias Ratio Elements for each Meter Code and description for each Functional Group. The development and application of each "Bias Ratio" by meter code and Sub-Component bias is detailed in the next chapter and in the associated Appendix. The Bias Ratios are simply a coefficient which is multiplied by each Meter Code's "Metered Volume" column entry to arrive at a LUAF volume total presented in Tables designated "B" of the same FG-x descriptor. Individual Sub-Component biases are added in Tables post-scripted "A" and LUAF Sub-Component volumes are added in Tables post-scripted "-B". The data from these Tables are the foundation for all data in Tables 1,2, 2-A, 2-B 2-M, 2-N, 2-O, 2-P. The FG Tables are shown following the brief summaries of each Functional Group LUAF results below:

1. Core Sales Metering - Tables FG1-A and FG1-B: This Functional Group includes diaphragm, rotary and a small number of turbine meters serving residential, commercial and industrial customers. The deliveries to these 5.94 million active customers totaled 298,293 MMCF in 2022. LUAF attributable to this Functional Group was 2,723 MMCF. This value represents 38.3% of the Measurement LUAF total and 28.7% of all LUAF in 2022. Core Sales Metering LUAF was primarily attributable to altitude zone/barometric pressure bias, gas delivery temperatures below 60 °F and a new "Meter Calibration Adjustment Factor" Program which prescribes customers receive a billing adjustment (reduction of 2%) from meter registration totals based on being serviced with a gas meter that is part of meter families which over register by an average of 1.17%. The LUAF allocation to core customers is 100% for this Functional Group.

2. Non-Core Customer Transportation -Tables FG2-A and FG2-B: These are customers who purchase gas directly from 3rd parties and use SoCalGas' pipelines to transport their supplies. They are large rotary, turbine, and ultrasonic meters, along with a declining base of 19 orifice meters. A total of 1,170 Non-Core customers used 561,339 MMCF in 2022. The LUAF associated with measurement for these customers was 1,249 MMCF. This represents 17.7% of Measurement LUAF and 13.2% of all LUAF in 2022. Turbine meter under-registration contributed 436 MMCF of this total. Ultrasonic sales meters contributed 591 MMCF to LUAF, primarily due to under-registration which occurred at SoCalGas largest customer metering site in 2022. The LUAF allocation to this Functional Group is 100% Non-Core (1,249 MMCF); 0% to Core.

3. Interstate Supplier Metering – Tables FG3-A and FG3-B: This is a set of 40 large orifice and ultrasonic meters which registered 848,865 MMCF receipts into the SoCalGas pipeline system, excluding some gas delivered as fuel and exchange in 2022. The LUAF associated with Interstate Supplier Meters was 2,890 MMCF. This represents 40.9% of Measurement LUAF and 30.5% of all LUAF in 2022. It represents 0.34% of all gas volumes received from Interstate pipelines in 2022. Most interstate pipeline contracts specify that meters shall retain an accuracy tolerance within 1% of accepted reference standard registration. This LUAF contributing bias resides well within that tolerance. The allocation to customer class is 34.7% (1,003 MMCF) to Core and 65.3%

(1,887 MMCF) to Non-Core Customers, based on the ratio of volumes delivered to each customer class in 2022.

4. California Producer Metering – Tables FG4-A and FG4-B: There are 33 orifice meters which delivered 32,418 MMCF of California production gas into SoCalGas pipelines in 2022. These are gas supplies originating from gas and oil wells located within the SoCalGas service territory. The LUAF associated with these California Producer Meters was calculated as a 68 MMCF reduction to LUAF as the meters collectively under register by 0.2%. This represents minus 0.9% of Measurement LUAF and minus 0.7% of all system LUAF. The allocation to customer class is 34.7% (24 MMCF reduction) to Core and 65.3% (44 MMCF reduction) to Non-Core Customers, based on the ratio of volumes delivered to each customer class in 2022.

5. Underground Storage Metering-FG5-A and FG-5B: This group consists of a mix of 34 ultrasonic and orifice meters and one turbine meter at four (4) major storage fields. These meters recorded a total of 43,234 MMCF of gas injection (categorized as deliveries from the pipeline system) and 62,813 MMCF of gas withdrawn (categorized as receipts into the pipeline system) in 2022. Gas Storage meters registered slow for injection by 384 MMCF and fast for withdrawal by and 109 MMCF in 2022. The collective measurement bias (adding the two results together) was a 275 MMCF calculated LUAF contribution in 2022. The allocation to customer class is split 34.75% (95 MMCF) to Core Customers and -65.3% (179 MMCF) to Non-Core.

It is noteworthy that net LUAF calculated from Underground Storage meters is essentially an imbalance in the registration/calculation of gas in inventory. The calculated LUAF volume is not physically lost (or gained). Any long-term imbalance growth or shrinkage in storage inventory is eventually reconciled with an adjustment made to storage inventory.

TABLE FG1-A – CORE CUSTOMER METERING LUAF COMPONENTS AND CONTRIBUTION FACTORS (MMCF)

TABLE FG1-B – CORE CUSTOMER METERING LUAF COMPONENTS AND ASSOCIATED VOLUMES (MMCF)

TABLE FG1-A: CORE CUSTOMER METERING LUAF COMPONENTS AND CONTRIBUTION FACTORS - 2022

				LUAF BIAS RATIO - See Associated Letter Appendices							
			BIAS TOTAL	ACC-1	ACC-2	Q.1	J	I	K	X	ACC-4
Meter (Code), Type and Functional Group	# Meters in Category (Active in billing system)	Meter Volumes (MMCF)	Sum of Metering Bias Ratios	As-Found Meter Calib Bias Ratio	Aux Factor Bias Ratio	Electronic Corrector Bias Ratio	Fixed Factor Pressure Bias Ratio	Fix Factor Temperature Bias Ratio	Elevation and Barometric Pressure Bias Ratio	Meter Calib Adjustment Factor Bias Ratio	Meter Low Flow Bias Ratio
(M1-1) Core Diaphragm Meters not in Meter Calibration Adjustment Protocol Size 1-3	4,738,957	167,937	1.258%	-0.1428%	0.0000%	0.0000%	0.0280%	0.3370%	0.5276%	0.0000%	0.5081%
(M1-2) Core Diaphragm Meters in Meter Calibration Adjustment Factor Protocol Size 1-3	1,104,328	34,315	2.271%	-1.1700%	0.0000%	0.0000%	0.0280%	0.3370%	0.5276%	2.0400%	0.5081%
(M1-3) Core Rotary meters - Size 4+ without electronic pressure or temperature correction.	24,391	3,625	0.696%	0.3244%	0.0394%	0.0000%	0.0280%	0.3370%	-0.0324%	0.0000%	0.0000%
(M1-4) Core Rotary meters Size 5+ w/o Temperature correction (includes 3,111 electronic Pressure Correctors)	63,651	52,191	-0.551%	0.3244%	0.0394%	0.0000%	0.0280%	-0.9101%	-0.0324%	0.0000%	0.0000%
(M1-5) Core Rotary meters - with Temperature Correction or Temperature and Pressure Correction	1,954	39,090	0.239%	0.3244%	0.0394%	-0.0925%	0.0000%	0.0000%	-0.0324%	0.0000%	0.0000%
(N/A) Turbine Meters: Core without electronic correctors.	-	-	0.000%	0.0000%	0.0589%	0.0000%	0.0000%	**0.0000%**	-0.0324%	0.0000%	0.0000%
(P-1) Turbine meters; Core with correctors	18	1,136	0.030%	0.0966%	0.0589%	-0.0925%	0.0000%	0.0000%	-0.0324%	0.0000%	0.0000%
TOTALS - Active Core Meters	**5,933,298**	**298,293**									

TABLE FG1-B: CORE CUSTOMER METERING LUAF COMPONENTS AND ASSOCIATED VOLUMES (ALL VALUES MMCF) - 2022

				SUB COMPONENT LUAF CONTRIBUTION (MMCF) See Associated Lettered Appendicies for details								LUAF-TOTAL Allocation: All Core Attributable as function of only Core Metering Components			
LUAF-Total			LUAF-Total	ACC-1	ACC-2	Q.1	J	I	K	X	ACC-4				
Meter (Code), Type and Functional Group	# Meters in Category (Active in billing system)	Meter Volumes (MMCF)	Total LUAF Bias Component Sum (MMCF)	As-Found Meter Calib LUAF Component	Aux Factor LUAF Component	Electronic Corrector LUAF Component	Fixed-factor Pressure LUAF Component	Fixed-Factor Temperature LUAF Component	Elevation and Barometric Pressure LUAF Component	Meter Calibration Adjustment Factor LUAF Component	Meter Low Flow Accuracy LUAF Component	Core Allocation (%)	Non-core Allocation (%)	Core Allocation (MMCF)	Non-Core Allocation (MMCF)
(M1-1) Core Diaphragm Meters not in Meter Calibration Adjustment Protocol Size 1-3	4,738,957	167,937	2,112.5	(239.9)	-	-	46.9	566.0	886.1	-	853.4	100%	0%	2,112.50	-
(M1-2) Core Diaphragm Meters in Meter Calibration Adjustment Factor Protocol Size 1-3	1,104,328	34,315	779.2	(401.5)	-	-	9.6	115.7	181.0	700.0	174.4	100%	0%	779.20	-
(M1-3) Core Rotary meters - Size 4+ without electronic pressure or temperature correction.	24,391	3,625	25.2	11.8	1.4	-	1.0	12.2	(1.2)	-	-	100%	0%	25.24	-
(M1-4) Core Rotary meters Size 5+ w/o Temperature correction (includes 3,111 electronic Pressure Correctors)	63,651	52,191	(287.5)	169.3	20.5	-	14.6	(475.0)	(16.9)	-	-	100%	0%	(287.46)	-
(M1-5) Core Rotary meters - with Temperature Correction or Temperature and Pressure Correction	1,954	39,090	93.4	126.8	15.4	(36.2)	-	-	(12.7)	-	-	100%	0%	93.35	-
(N/A) Turbine Meters: Core without electronic correctors.	-	-	-	-	-	-	-	-	-	-	-	100%	0%	-	-
(P-1) Turbine meters; Core with correctors	18	1,136	0.3	1.1	0.7	(1.1)	-	-	(0.4)	-	-	100%	0%	0.35	-
TOTALS - Active Core Meters	**5,933,298**	**298,293**	**2,723.2**	**(332.4)**	**38.0**	**(37.2)**	**72.1**	**218.9**	**1,035.9**	**700.0**	**1,027.7**			**2,723**	-
% of 2022 System LUAF			28.730%	-3.507%	0.401%	-0.393%	0.761%	2.310%	10.929%	7.385%	10.843%				
% of 2022 Measurement LUAF			38.526%	-4.702%	0.538%	-0.526%	1.021%	3.097%	14.656%	9.904%	14.540%				

TABLES FG2-A and FG2-B – NON-CORE CORE SALES METER LUAF BIAS RATIOS AND LUAF SUB-COMPONENTS (MMCF)

TABLE FG2-A : NON-CORE CUSTOMER METERING LUAF COMPONENTS AND CONTRIBUTION FACTORS - 2022

				LUAF BIAS RATIO - See Associated Letter Appendices							
			BIAS TOTAL	ACC-1	ACC-2	Q.1	K	Q.2	ACC-6	ACC-7	
Meter (Code), Type and Functional Group	# Meters in Category	Meter Volumes (MMCF)	Sum of Metering Bias Ratios	As-Found Meter Calib Bias Ratio	Aux Factor Bias Ratio	Electronic Corrector (instrument Calibration) Bias Ratio	Elevation and barometric Pressure Bias Ratio	Transmitter Instrument Calibration Bias Ratio	Field Effects - Fouling Bias Ratio	Other Bias Ratio	Other Bias Ratio Note
(M2-6) Rotary Meter Non-Core (presssure and temperature corrected)	915	55,309	0.239%	0.324%	0.039%	-0.093%	-0.032%	0.0000%	0.000%	0.000%	
(P2) Turbine Meter Non-Core	196	130,993	0.333%	0.097%	0.059%	-0.093%	0.000%	0.0000%	0.000%	0.270%	Turbine low flow
(N2) Orifice Meter Non-Core	19	22,305	0.406%	0.000%	0.000%	0.000%	0.000%	0.0561%	0.250%	0.100%	orifice fouling
(O2) Ultrasonic - Non-Core	40	352,729	0.167%	0.000%	0.000%	0.000%	0.000%	0.0561%	-0.070%	0.181%	large US mtr pbm
(M2-7) Diaphragm Non-Core	10	2	-0.175%	-0.143%	0.000%	0.000%	-0.032%		0.000%	0.000%	
Non-Core Transportation	**1170**	**561,339**									

TABLE FG2-B: NON-CORE CUSTOMER METERING LUAF COMPONENTS AND ASSOCIATED VOLUMES (ALL TABLE VALUES MMCF)- 2022

				SUB COMPONENT LUAF CONTRIBUTION (MMCF) See Associated Lettered Appendicies for details								LUAF TOTAL Allocation Method: All Non-Core as Computations are for Non-Core Customer meters only.			
			LUAF-Total	ACC-1	ACC-2	Q.1	K	Q.2	ACC-6	ACC-7					
Meter (Code), Type and Functional Group	# Meters in Category	Meter Volumes (MMCF)	Total LUAF Component (MMCF)	As-Found Meter Calib LUAF Component	Aux Factor LUAF Component	Electronic Corrector LUAF Component	Elevation/Altitude Zone LUAF Component	Transmitter Accuracy LUAF Component	Field Effects LUAF Component	Other LUAF Component	Other LUAF Component Note	Core Allocation (%)	Non-core Allocation (%)	Core Allocation (MMCF)	Non-Core Allocation (MMCF)
(M2-6) Rotary Meter Non-Core (presssure and temperature corrected)	915	55,309	132.1	179.4	21.8	(51.2)	(17.9)	-	-	-	-	0%	100%	-	132
(P2) Turbine Meter Non-Core	196	130,993	436.1	126.5	77.1	(121.2)	-	-	-	353.7	Turbine low flow	0%	100%	-	436
(N2) Orifice Meter Non-Core	19	22,305	90.6	-	-	-	-	12.5	55.8	22.3	orifice fouling	0%	100%	-	91
(O2) Ultrasonic - Non-Core	40	352,729	590.6	-	-	-	-	197.8	(246.9)	639.7	LG Customer Meter Problem	0%	100%	-	591
(M2-7) Diaphragm Non-Core	10	2	(0.0)	(0.0)	-	-	(0.0)	-	-	-	-	0%	100%	-	(0)
Total	**1,170**	**561,339**	**1,249.4**	**305.9**	**98.9**	**(172.4)**	**(17.9)**	**210.3**	**(191.1)**	**1,015.7**				**-**	**1,249**
														-	-
% of 2022 System LUAF			13.181%	3.228%	1.043%	-1.818%	-0.189%	2.219%	-2.017%	10.716%					
% of 2022 Measurement LUAF			17.676%	4.328%	1.399%	-2.438%	-0.254%	2.975%	-2.704%	14.370%					

TABLES FG3-A and FG3-B – INTERSTATE SUPPLIER METER LUAF BIAS RATIOS AND LUAF SUB-COMPONENTS (MMCF)

TABLE FG3-A : SUPPLIER METERING LUAF COMPONENTS AND BIAS RATIOS - 2022

				LUAF BIAS RATIO - See Associated Letter Appendices							
			BIAS TOTAL	ACC-1	ACC-2	Q.1	K	Q.2	ACC-6	ACC-7	
Meter (Code), Type and Functional Group	# Meters in Category	Meter Volumes (MMCF)	Sum of Metering Bias Ratios	As-Found Meter Calib Bias Ratio	Aux Factor Bias Ratio	Electronic Corrector (instrument Calibration) Bias Ratio	Elevation and barometric Pressure Bias Ratio	Transmitter Instrument Calibration Bias Ratio	Field Effects - Fouling Bias Ratio	Other Bias Ratio	Other Bias Ratio Note
Other	3	0	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	
(O3) Ultrasonic Meter - Interstate Supplier	17	370,159	0.4212%	0.0000%	0.0000%	0.0000%	0.0000%	0.1212%	0.3000%	0.0000%	
(N3) Orifice Meter - Interstate Supplier	23	478,706	0.2781%	0.0000%	0.0000%	0.0000%	0.0000%	0.2447%	-0.0500%	0.0834%	GLE/pulsation
Total	**40**	**848,865**									

TABLE FG3-B: SUPPLIER METERING LUAF (MMCF) BY CONTRIBUTING FACTORS - 2022

				SUB COMPONENT LUAF CONTRIBUTION (MMCF) See Associated Lettered Appendicies for details								LUAF TOTAL Allocation Method: based on the ratio of customer type usage to total sendout, SDGE treated as Non-Core Customer.			
			LUAF-Total	ACC-1	ACC-2	Q.1	K	Q.2	ACC-6	ACC-7					
Meter (Code), Type and Functional Group	# Meters in Category	Meter Volumes (MMCF)	Total LUAF Component (MMCF)	As-Found Meter Calib LUAF Component	Aux Factor LUAF Component	Electronic Corrector LUAF Component	Elevation/Altitude Zone LUAF Component	Transmitter Accuracy LUAF Component	Field Effects LUAF Component	Other LUAF Component	Other LUAF Component Note	Core Allocation (%)	Non-core Allocation (%)	Core Allocation (MMCF)	Non-Core Allocation (MMCF)
Other	0	0	0	-	-	-	-	-	-	-		34.7%	65.3%	-	-
(O3) Ultrasonic Meter - Interstate Supplier	17	370,159	1,559	-	-	-	-	448	1,110	-		34.7%	65.3%	541	1,018
(N3) Orifice Meter - Interstate Supplier	23	478,706	1,331	-	-	-	-	1,171	(239)	399	GLE/pulsation	34.7%	65.3%	462	869
Total	**40**	**848,865**	**2,890**	**-**	**-**	**-**	**-**	**1,620**	**871**	**399**				**1,003**	**1,887**
% of 2022 System LUAF			30.490%	0.000%	0.000%	0.000%	0.000%	17.089%	9.191%	4.211%					
% of 2022 Measurement LUAF			40.886%	0.000%	0.000%	0.000%	0.000%	22.916%	12.324%	5.646%					

TABLES FG4-A and FG4-B – CALIFORNIA PRODUCER METER LUAF BIAS RATIOS AND LUAF SUB-COMPONENTS (MMCF)

TABLE G4-A: CALIFORNIA PRODUCTION METERING LUAF COMPONENTS AND BIAS RATIOS - 2022

				LUAF BIAS RATIO - See Associated Letter Appendices							
			BIAS TOTAL	ACC-1	ACC-2	Q.1	K	Q.2	ACC-6	ACC-7	
Meter (Code), Type and Functional Group	# Meters in Category	Meter Volumes (MMCF)	Sum of Metering Bias Ratios	As-Found Meter Calib Bias Ratio	Aux Factor Bias Ratio	Electronic Corrector (instrument Calibration) Bias Ratio	Elevation and barometric Pressure Bias Ratio	Transmitter Instrument Calibration Bias Ratio	Field Effects - Fouling Bias Ratio	Other Bias Ratio	Other Bias Ratio Note
(P4) Turbine Meter - California Producer	0	0	0	0%	0%	0%	0%	0%	0%	0%	
(O4) Ultrasonic Meter - California Producer	0	0	0		0%	0%	0%	0%	0%	0%	
(N4) Orifice Meter - California Producer	33	32,481	-0.209%	0%	0%	0%	0%	0%	-0.1000%	-0.109%	low dp OP
Total	**33**	**32,481**	**-0.209%**								

TABLE FG4-B: CALIFORNIA PRODUCTION METERING LUAF (MMCF) BY CONTRIBUTING FACTORS - 2022

				SUB COMPONENT LUAF CONTRIBUTION (MMCF) See Associated Lettered Appendicies for details								LUAF TOTAL Allocation Method: based on the ratio of customer type usage to total sendout, SDGE treated as Non-Core Customer.			
			LUAF-Total	ACC-1	ACC-2	Q.1	K	Q.2	ACC-6	ACC-7					
Meter (Code), Type and Functional Group	# Meters in Category	Meter Volumes (MMCF)	Total LUAF Component (MMCF)	As-Found Meter Calib LUAF Component	Aux Factor LUAF Component	Electronic Corrector LUAF Component	Elevation/Altitude Zone LUAF Component	Transmitter Accuracy LUAF Component	Field Effects LUAF Component	Other LUAF Component	Other LUAF Component Note	Core Allocation (%)	Non-core Allocation (%)	Core Allocation (MMCF)	Non-Core Allocation (MMCF)
(P4) Turbine Meter - California Producer	0	0	0	0	0	0	0	0	0	0					
(O4) Ultrasonic Meter - California Producer	0	0	0	0	0	0	0	0	0	0		34.7%	65.3%	-	-
(N4) Orifice Meter - California Producer	33	32,481	-67.9	0	0	0	0	0	-32.5	-35.4		34.7%	65.3%	(23.6)	(44.3)
Total	**33**	**32,481**	**-67.9**	**0**	**0**	**0**	**0**	**0**	**-32.5**	**-35.4**				**(23.6)**	**(44.3)**
% of 2022 System LUAF			-0.716%	0.000%	0.000%	0.000%	0.000%	0.000%	-0.343%	-0.374%	0.000%				
% of 2022 Measurement LUAF			-0.960%	0.000%	0.000%	0.000%	0.000%	0.000%	-0.460%	-0.501%	0.000%				

TABLES FG5-A and FG5-B – UNDERGROUND STORAGE METER LUAF BIAS RATIOS AND LUAF SUB-COMPONENTS (MMCF)

TABLE FG5-A : UNDERGROUND STORAGE METERING LUAF COMPONENTS AND BIAS RATIOS - 2022

				LUAF BIAS RATIO - See Associated Letter Appendices							
			BIAS TOTAL	ACC-1	ACC-2	Q.1	K	Q.2	ACC-6	ACC-7	
Meter (Code), Type and Functional Group	# Meters in Category	Meter Volumes (MMCF)	Sum of Metering Bias Ratios	As-Found Meter Calib Bias Ratio	Aux Factor Bias Ratio	Corrector (instrument Calibration) Bias Ratio	Elevation and barometric Pressure Bias Ratio	Transmitter Instrument Calibration Bias Ratio	Field Effects - Fouling Bias Ratio	Other Bias Ratio	Other Bias Ratio Note
(N5-1) Orifice Meter Storage Injection	6	29,013	1.2031%	0.0000%	0.0000%	0.0000%	0.0000%	0.1031%	0.5500%	0.5500%	low DP Op Inj
(O5-1) Ultrasonic Meter Storage Injection	4	14,221	0.2439%	0.0000%	0.0000%	0.0000%	0.0000%	-0.0561%	0.0000%	0.3000%	low velocity Op Inj
(P5-1) Turbine Meter Storage Injection	0	0	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	fully developed flow
(N5-2) Orifice Meter Storage Withdrawal	20	(59,269)	0.1852%	0.0000%	0.0000%	0.0000%	0.0000%	-0.0148%	0.1000%	0.1000%	fully developed flow
(O5-2) Ultrasonic Meter - Storage Withdrawal	3	(2,948)	-0.0561%	0.0000%	0.0000%	0.0000%	0.0000%	-0.0561%	0.0000%	0.0000%	
(P5-2) Turbine Meter Storage Withdrawal	1	(596)	0.1554%	0.0966%	0.0589%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	
Total	**34**	**(19,579)**									

TABLE FG-5B: UNDERGROUND STORAGE PRODUCTION METERING LUAF (MMCF) BY CONTRIBUTING FACTORS - 2022

				SUB COMPONENT LUAF CONTRIBUTION (MMCF) See Associated Lettered Appendicies for details								LUAF TOTAL Allocation Method: Based on the Ratio of Storage Injection Annually for each customer Category Core and Non-Core. (check)			
			LUAF-Total	ACC-1	ACC-2	Q.1	K	Q.2	ACC-6	ACC-7					
Meter (Code), Type and Functional Group	# Meters in Category	Meter Volumes (MMCF)	Total LUAF Component (MMCF)	As-Found Meter Calib LUAF Component	Aux Factor LUAF Component	Electronic Corrector LUAF Component	Elevation/Altitude Zone LUAF Component	Transmitter Accuracy LUAF Component	Field Effects LUAF Component	Other LUAF Component	Other LUAF Component Note	Core Allocation (%)	Non-core Allocation (%)	Core Allocation (MMCF)	Non-Core Allocation (MMCF)
(N5-1) Orifice Meter Storage Injection	6	29,013	349	-	-	-	-	29.9	159.6	159.6	Low DP	35%	65%	121.1	227.9
(O5-1) Ultrasonic Meter Storage Injection	4	14,221	35	-	-	-	-	(8.0)	-	42.7	Low Flow	35%	65%	12.0	22.7
(P5-1) Turbine Meter Storage Injection	0	-	-	-	-	-	-	-	-	-		35%	65%	-	-
Total Injection	**10**	**43,234**	**384**	**-**	**-**	**-**	**-**	**22**	**160**	**202**					
(N5-2) Orifice Meter Storage Withdrawal	20	(59,269)	(110)	-	-	-	-	8.8	(59.3)	(59.3)		35%	65%	(38.1)	(71.7)
(O5-2) Ultrasonic Meter - Storage Withdrawal	3	(2,948)	2	-	-	-	-	1.7	-	-		35%	65%	0.6	1.1
(P5-2) Turbine Meter Storage Withdrawal	1	(596)	(1)	(0.6)	(0.4)	-	-	-	-	-		35%	65%	(0.3)	(0.6)
Total Withdrawal	**24**	**(62,813)**	**(109)**	**(1)**	**(0)**	**-**	**-**	**10**	**(59)**	**(59)**					
Total Net Injection	**34**	**(19,579)**	**275**	**(1)**	**(0)**	**-**	**-**	**32**	**100**	**143**				**95.3**	**179.4**
% of 2022 System LUAF			2.898%	-0.006%	-0.004%	0.000%	0.000%	0.341%	1.058%	1.508%	0.000%				
% of 2022 Measurement LUAF			3.886%	-0.008%	-0.005%	0.000%	0.000%	0.458%	1.419%	2.023%	0.000%				

LUAF DETAILED SUB-COMPONENT ANALYSIS:

A detail discussion follows on the bias factors and associated computed LUAF volumes for varying Meter types in each meter Functional Group for 2022. They are grouped in such manner as to add to the Sub-Component Totals shown in Table 1 of this report.

SUB-COMPONENT LUAF DETAILS:

The development of LUAF Sub-Component values in this Chapter discussed in conjunction with Tables FG1-A, FG1-B, FG2-A, FG-2B, FG3-A, FG3-B, FG4-A and FG4-B. In these Tables, Bias Ratios (expressed as percentages) are presented in Tables sub-scripted "-A" for a variety of Meter Types designated with a Code. These Bias Ratios are then multiplied by the "Metered Volumes" listed for the respective Meter Code types to produce the LUAF volumes show in Companion tables Sub-scripted "-B". Detailed discussion follows. Each Sub-Component has an accompanying Appendix showing relevant base data, calculations and/or assumptions as appropriate.

SUB-COMPONENT I: Fixed-Factor Temperature:

This Sub-Component is the LUAF introduced due to actual flowing gas temperature in gas meters deviating from a fixed 60° F gas temperature factor applied in the billing system to produce final corrected volumes and energy. It impacts virtually all diaphragm meters and a subset of company size 5 and larger rotary meter sets without temperature correction capability. Small meters are impacted by temperature differently than larger meters principally due to operating pressure and usage profile over the course of the year. Larger meters usage is more levelized during the year while small meters operate with volumetric use weighted toward colder months and cold hours within those months.

Because of these differences, two different "models" were developed in 1991 using the results from recorded ambient, ground and meter temperatures and flow relationships at over 400 small and large metering sites to establish the temperature biases and LUAF impacts for both small and large meter types. These adjustment models were updated with 2022 temperature and volumes in each of six Temperature Zones to calculate the average flowing gas temperatures in 2022. The specific calculation results are shown in Appendix I.1 (small meters) and Appendix I.2 (large meters) and summarized below and in Tables FG1-A and FG1-B under the Applicable Meter Codes:

- Meter Codes M1-1, M1-2 M1-3 : Diaphragm and small Rotary Meters. Year 2022 experienced much colder winter months than years 2006 or 1991. In 2022, the annual flow-weighted average gas temperature for small meters was calculated at 58.4 °F, while it was 62.8 °F in 2006 and 59.9 °F in 1991. The 58.3 °F average resulted in a net LUAF bias of 0.52935% meter under-registration in 2022 for small core PD meters. Applying this under-registraton bias to the 5,867,675 meters measuring 205,876 MMCF in 2022, the resultant LUAF contribution is 694 MMCF for small PD meters. See Appendix I.1.

- Meter Code M1-4: Core Meters (size Size 5+): The average flow-weighted gas temperature for larger non-temperature compensated meters was 64.77 °F in 2022. This compares with 69.2° F in 1991 and 63.8 °F in 2006. This results in an over-registration bias of 0.918% for this meter

Catgory in 2022. Applying the bias factor to 63,651 size 5+ Core meters registering 52,191 MMCF yields a LUAF reduction (over-registration) of 475 MMCF in 2022. See Appendix I.2.

The collective impact of Fixed-Factor Temperature Biases for small and large meters was a LUAF contribution of 219 MMCF in 2022. This compares with a net LUAF reduction of (1,539 MMCF) in 2006. This change of 1,751 MMCF is predominantly due to temperature changes.

Fixed-Factor Temperature LUAF Summary 2022

Applicable Meters:	5,931,326
Applicable Volumes: (MMCF)	258,067
Applicable Bias Multiplier(s)	-0.918 and 0.5332
LUAF Contribution: (MMCF)	219
LUAF Contribution: (MDth)	226
Percentage of total system LUAF:	2.2%
Percentage of 2022 measurement LUAF	3.0%
Associated recommendation (s):	E
Allocation to Core customers @100%: (MMCF)	219
Allocation to Non-Core customers@0%: (MMCF)	0

SUB-COMPONENT J: Fixed-Factor Pressure:

This Sub-Component represents the bias due to gas pressure regulator set points being field-set slightly higher than the pressure which is standardized for use in the billing system for small and medium-sized PD meters. It applies to PD meters which do not have pressure correction. Refer to Tables FG1-A and FG1-B.

The same methodogy was used in 2022 as in the 1991 and 2006 studies for Fixed-Factor Pressure LUAF computation. This methodology examined data collected from routine field site checks of regulators when work is conducted on the associated meter sets. The results were compiled and averaged for 3,114 field visits to standard pressure accounts in 2022 where the average billing pressure is assumed to be 8.0 psig. The as-found test results yielded an average flowing reg pressure of 8.115 psig. The absolute pressure difference between these two values, when adding 14.5 psig as nominal atmospheric pressure across SoCalGas territory, is 0.028% under-registration. This bias was applied to sales gas volumes delivered to customers without pressure correction: Specific results are shown below for applicable Meter Code Types.

- Meter Codes: M1-1, M1-2, M1-3, M1-4 (all Core): The under-registration bias was evaluated for, and applied to 5,931,326 Core PD meters registering 258,067 MMCF in 2022. The result is a Core LUAF contribution of 72 MMCF in 2022.

There are no Non-Core meters and volumes included in this Sub-Component, as Non-Core meters all have pressure correction instrumentation.

Fixed Factor Pressure Bias LUAF Summary Table 2022

Applicable Meters:	5,931,326
Applicable Volumes:	258,076
Applicable Bias Multiplier	0.028%
LUAF Contribution: MMCF	72
LUAF Contribution: MDth	74
Percentage of Total system LUAF:	0.761%
Percentage of 2022 measurement LUAF	1.020%
Associated recommendation:	none
Allocation to core @100%: (MMCF)	72
Allocation to non-core @0%: (MMCF)	0

The 2022 LUAF result for this Sub-Component is an improvement from 1991 and 2006 due to field tech training and operational execution post - 2007.

See Appendix J and Tables FG1-A and FG1-B for more information.

SUB-COMPONENT K: Elevation and Barometric Pressure:

SoCalGas has eight Elevation Zones set at 1,000 foot increments for establishing mean barometric pressure to be applied (added) to metering gauge pressure readings for all small standard pressure meters. For above standard pressure customers, there are 19 Altitude Zones set in smaller 400 foot increments for barometric pressure assignment. Customers residing below the mean elevation within an Elevation /Altitude Zone benefit from barometric pressure (and gas delivery pressure) greater than that used to caculate their gas deliveries. The opposite is true for customers residing above the mean billing altitude associated with their zone. In 1993/4 a field survey was conducted which concluded that small customers in the SoCalGas service territory averaged 85 feet below Zone A mean billing altitude level and approximately 200 feet below Zone B mean billing elevation. These two zones cover elevations up to 2,000 feet above sea level and in 2022 contained 90%+ of SoCalGas small customers and related core usage.

The 1991 data was updated in 2006 by applying new volumes to the each of the elevation zones. The results show that small meters bias, which changed very little from 1991 to 2006, were under-registering by 0.5276% and large meters were over-registering by 0.0324% in 2006. These bias values were re-used to calculate small and large meter elevation zone LUAF contribution in 2022. There has been no update to the elevation zone mean pressure billing factor and no survey has been conducted to update mean customer elevation in each Zone since 1991. This should be further studied in 2025. Application of the 2006 bias factor to each meter category is summarized below.

- Meter Codes M1-1, M1-2: Core Diaphragam Meters. 5,843,284 small diaphragm meter volumes totaling 202,251 MMCF in 2022 were multiplied by 0.5276% and yielded a calculated LUAF contribution of 1,067 MMCF.

- Meter Codes M1-3, M1-4, M1-5: Core Rotary Meters: 89,996 Core rotary meters volumes totaling 94,906 MMCF in 2022 were multiplied by -0.0342% to compute a LUAF reduction of 36 MMCF.

- Meter Code P1: Core Turbine Meter: Application of the elevation bias factor of -.0342% to 18 Core turbine meters registering 1,036 MMCF in 2022 is negligible at (0.4 MMCF) LUAF reduction.

- Meter Code M2-1: Non-Core Rotary Meters: All 915 Non-Core Rotary Meters which delivered volumes totaling 55,309 MMCF were multiplied by -0.0342% to produce a LUAF reduction of 18 MMCF.

Because so many changes have occurred for the 200 very largest non-core customer sites between 2006 and 2022, those customers were excluded from application of 1991 data elevation bias calculations. It is recommended these customers be individually surveyed for elevation in 2024 or 2025 to accurately assign an elevation bias for these approximately 200 very large sales metering sites. Also, some of these customers are equipped with psia pressure transmitters which compensate for elevation/barometric pressure biases.

Elevation and Barometric Pressure LUAF Summary Table

Applicable Meters:	5,934,213
Applicable Volumes:	353,603
Applicable Bias Multipliers	0.5276 and (-0.0324)
LUAF Contribution: (MMCF)	1,018
LUAF Contribution (MDth)	1,049
Percentage of Total system LUAF:	10.7%
Percentage of 2022 measurement LUAF	14.4%
Associated recommendation(s):	G
Allocation to core@102%: (MMCF)	1,036
Allocation to non-core @-2%: (MMCF)	(18)

See Appendix K for details.

SUB-COMPONENT M: Positive Displacement Meters Base Accuracy (LUAF-ACC):
This Sub-Component is LUAF associated with the base mechanical accuracy of Positive Displacement Meters as they operate in the field, with the impacts of basic calibration, operating curve shifts and bias with electronic pressure/temperature correctors considered. Refer to Tables FG1-A and FG1-B for a summary of Core Customer meters bias elements and FG2-A and FG2-B for similar Non-Core meter discussions.

Base meter accuracy and associated LUAF for Positive Displacement Meters is calculated by the addition of several bias elements, all beginning with “ACC-x” column headings in the Tables referenced above. These additions are Columns headed by ACC-1, ACC-2, and ACC-4 for diaphragm and Rotary meters. Sub-Components I, J, K, Q.1 and X are not included in the base mechanical accuracy (LUAF-ACC) for PD Meters.

The LUAF for diaphragm meters is established using bias factor for As-Found calibration accuracy (ACC-1) plus a bias which exists when some diaphragm meter families under-register at low flow rates, denoted (ACC-4) in Tables FG1-A and FG1-B. Rotary meter overall base accuracy includes these same elements but with the additional biases from Auxiliary (Aux) factors (ACC-2). A discussion of each of these factors and LUAF impact for the relevant Positive Displacement Meter Codes follows.

Bias Ratio Category ACC-1: (As-found Calibration Bias for PD Meters):

When meters are returned from the field, they are tested for accuracy. This accuracy data was used in 2022 to establish the As-found Meter Calibration Bias Ratios (ACC-1) for Diaphragm and Rotary meters as described below.

- ACC-1 for Meter Code M1-1: Core Diaphragm Meters Not in the MCAF Program: The diaphragm meter bias ratio of 0.1428% shown under Column ACC-1 in Table FG1-1 is based on the results of 43,644 meters removed from service and tested at the Company's Pico Rivera meter shop in 2022. The average "in-test" for 37,501 of these meters not associated with meter families under the Company's MCAF program, representing 4,738,957 meters and 166,862 MMCF in "Metered Volumes" was calculated at 0.313% over registration. This value was further adjusted downward to 0.1428% to account for the fact that meters less than 10 years old are greatly under-represented in the Company's statistical sampling program for small meters, as required statistical sampling of meters does not begin until after a meter has been in service for that period. Applying a 0.1428% bias to 166,862 MMCF results in a LUAF reduction of (240) MMCF as computed/shown in Table FG1-B, column ACC-1. This LUAF is 100% allocated to Core customers. See Appendix M.1.1. and M.2

- ACC-1 for M1-2: Core diaphragm meters in the MCAF Program: There are 1,104,328 diaphragm meters which delivered 35,389 MMCF included in the 2022 MCAF program. A sorted file extract (file name) from the meter records system showed that over 7,000 diaphragm meters in this program tested at an average accuracy bias of 1.17% over-registration in 2022. Applying a 1.17% bias to 35,389 MMCF results in a LUAF reduction of 401 MMCF as computed/shown in Table FG1-B, column ACC-1 for Meter Code entry M1-2. This LUAF bias element is 100% attributable to Core customers. See Appendix M.1.1 and Appendix X.

- ACC-1 for Meter Codes M1-3, M1-4, M1-5: Core Rotary Meters: Over 7,000 individual accuracy in-test were performed on rotary meters removed from the field in 2022. Averaging those test results yielded an as-found calibration bias of 0.3244% under-registration for rotary meters. (See Appendix M.2) This bias value is applied to all system rotary meters including Core/Non-core and all other Functional Groups. When this factor is applied to the "Metered Volumes" to Core Meter Code Types M1-3, M1-4 and M1-5 in Table FG1-B the results are 12 MMCF, 169 MMCF and 127 MMCF, respective LUAF contributions. See Appendix "M.2" for details on rotary meter test results.

- ACC-1 for Meter Code M2-1: Non-Core Rotary Meters: See Tables FG2-A and FG2-B. The same value of 0.3244% under registration was applied to 55,309 MMCF metered volumes yields a LUAF contribution of 179 MMCF for 915 non-core rotary meters.

Bias Ratio Category ACC-2 – Meter Auxiliary Factor for PD Rotary Meters:

Auxilary (Aux) factor is the coefficient applied to raw meter test registration biases to either speed up a meter registration (value greater than 1.0) or slow down a meter's registration in either the billing system or in a flow computer attached to the meter in the field and subsequently feeding the billing system. Auxiliary Factor is used for Rotary, Turbine and Ultrasonic meters on the SoCalGas system. The average Aux Factor to be applied to rotary meters was derived from emperical data. A total of 660 rotary meter Aux factors were recorded during techician field visits over the period 2019-2022 and the results show that the average Aux Factor for rotary meters in the field was 0.999606, indicating that the average Aux factor was slowing rotary meter registered volumes down by 0.0394%. Applying this result to the different Meter Code populations is as follows:

- ACC-2 for Meter Codes M1-3, M1-4, M1-5: Core Rotary Meters. When the 0.0394% bias factor is applied to the subject Core rotary Meter Categories M1-3, M1-4 and M1-5 to Metered Volumes totaling 94,906 MMCF, the respective LUAF contributions as shown in Table FG1-B are 1 MMCF, 21 MMCF and 15 MMCF, respectively.

- ACC-2 for Meter Codes M2-1: Non-Core Rotary Meters: See Tables FG2-A and FG2-B. Applying the 0.394% rotary meter under-registration to Metered Volumes totaling 55,309 MMCF yields a LUAF contribution of 22 MMCF for Non-Core rotary meters.

Bias Category ACC-4: Meter Low Flow Accuracy for PD Meters:

This Bias Category is associated with diaphragm meters which experience under-measurement at low flow rates. In 1991, a study was conducted to determine the accuracy of the diaphragm meter population across a flow range from 0 to 20 cubic feet per hour (CFH), in 5 CFH gradations. The conclusions of that study were that 10.3% of all meters installed at that time significantly under-registered (and sometimes not at all) at lower flow rates. The results of average error for multiple flow rates were integrated with field test data showing how many hours per year the small meters were operating at 5 cubic feet per hour intervals. See Appendix "M.1.2." The under-measurement due to this inaccuracy as a proportion of all diaphragm meter registered volumes in 1991 was 0.899% (LUAF/Metered volumes); this is the equivalent base LUAF Bias Factor for applicable meters.

However, in 2022, only 13% of the total diaphragm meters in service were of pre-1992 vintage. The average 1991 LUAF Bias factors was applied to those meter volumes for 2022. For the population of post-1991 meters in service, no detailed testing has been performed, in particular, for Itron meters – of which over 1.5 million units have been installed since 2006. Therefore a 50% reduction factor to the post-1991 meter population and volume registration bias was applied to estimate the 2022 of low-flow meter related LUAF for that population. This merging of pre-1991 and post-1991 methods yielded a composite 0.5081% LUAF Bias factor when averaged for all diaphragm meters in-service in 2022. LUAF results for the two-meter categories with this bias applied are:

- ACC-4 for Meter Code M1-1: Diaphragm meters not in MCAF program: Meter under registration of 0.5081% applied to a volume of 176,273 MMCF results in 853 MMCF LUAF contribution. Allocated 100% to Core Customers.

- ACC-4 for meter Code M1-2: Diaphragm meters in MCAF program: Meter under-registration 0.5081% applied to 35,389 MMCF yields 174 MMCF of LUAF. Allocated 100% to Core Customers.

Rotary meters were not included in this bias ratio element analysis in 2022.

Total LUAF from Bias Category ACC-4 for Diaphragm Meters: 1,028 MMCF. See Appendix M.1.2

Summary of Sub – Component M LUAF: PD Meter Base Accuracy Results (LUAF-ACC):

Table M-2, shows the results of all PD meter base accuracy LUAF Bias Element contributions noted in this Section. The LUAF contribution attributable to PD meter mechanical Accuracy Bias is shown to be 933 MMCF in the Column Entitled "LUAF-ACC", totals row.

The total Sub-Component M Core component allocation is 890 MMCF while the Non-Core is 43 MMCF.

M – Positive Displacement Meter LUAF Summary Table

Applicable Meters:	**5,934,205**
Applicable Volumes:	**352,469**
Applicable Bias Multiplier (of adjusted volume)	
LUAF-ACC Contribution: (MMCF)	933
LUAF-ACC Contribution: (MDth)	962
Percentage of Total System LUAF:	9.8%
Percentage of 2022 Measurement LUAF	13.2%
Associated recommendation:	Low Flow Testing for newer meters
Allocation to Core Customers @95.4% (MMCF):	890
Allocation to Non-Core Customers @4.6%: (MMCF)	43

When the effects of ALL Sub-Component categories are added together for PD meters, the associated "LUAF-TOTAL" is 2,855 MMCF. Of this total, 132 MMCF is attributable to Non-Core and 2,723 MMCF is attributable to Core Customers.

SUB-COMPONENT N: Orifice meters (LUAF-ACC):

This Sub-Component is LUAF associated with the base accuracy (LUAF-ACC) of orifice meters as they operate in the field. Orifice meters are used for measurement in 4 Functional Groupings: Non-Core Customers, Interstate Suppliers, California Gas Production and Storage Operations.

Refer to Tables FG2-A/B, FG3A/B, FG4-A/B and FG5-A/B for a summary of bias element and associated LUAF calculation results. The results of those tables are summarized under Table N-2 for Orifice Meter Code Types pre-fixed with "N."

Orifice meter base mechanical accuracy is impacted by the following factors as shown in the FG tables noted above:

- ACC-6 Field Effects – Accuracy bias due to plate fouling/condition.

- ACC-7-Other Special Conditions – shift introduced by operation at low-flow or other special condition, such as pressure pulsation and related system imperfections at one Interstate Supplier location.

Results for orifice meters are discussed by Functional Group since the values for ACC-6 and ACC-7 vary for the 4 Functional Groups containing orifice meter measurement.

Orifice Metering: Non-Core Customers: Meter Code N2: Tables FG2-A and FG2-B

SoCalGas has been systematically replacing Customer orifice metering since Year 2000 as part of its measurement integrity program. There were only 19 active orifice meter sites in service in 2022 delivering 22,305 MMCF. Two biases impacted LUAF-ACC for Non-Core Customer meters as noted below and shown in Table 2-N and Tables FG-2A and FG2/B.

- ACC-6: Field Effects Orifice Sales Meters: SoCalGas inspects orifice plates each quarter, or monthly depending on historical conditions noted. Bore scope of meter runs are conducted at not less than 5-year intervals. Even with this diligence, conditions are occasionally found indicating potential under-measurement due to plate conditions. A conservative value of 0.25 % under-registration was assigned to Non-Core sales meters for this bias element. Applied to 22,305 delivered volumes yields a LUAF-ACC contribution of 56 MMCF. The allocation is 100% (56 MMCF) to Non-Core customers.

- ACC-7: Low Flow and Differential Pressure Operations: Many of SoCalGas remaining orifice meters, installed over 50 years ago, experience operation at under 10” water column at times due to changes in the electrical generation market. Accordingly, a bias of 0.1% under registration is applied. The LUAF result is 22.3 MMCF, allocated 100% to Non-Core Customers.

See Appendix “N.2” for additional information.

Orifice Metering: Interstate Suppliers: Meter Code N3, Tables FG3-A and FG3-B

There are a total of 23 Interstate Supplier orifice meters which delivered 478,706 MMCF into the SoCalGas pipeline system in 2022 at 4 locations. LUAF bias elements and associated volumes for these meters were estimated/computed as follows:

- ACC-6: Field Effects-Fouling: The under-measurement bias for Interstate Supplier orifice plate and meter-run fouling is estimated 0.05%. Interstate suppliers typically maintain clean orifice plates, but some fouling is noted on inspection reports and witness observations. Applying a modest 0.05% under measurement bias to 478,706 MMCF results in a net LUAF reduction of 239 MMCF.

- ACC7-Other: Pulsation: Pulsation in orifice metering sites produces errors in measured differential pressure. This condition has been observed at SoCalGas’ single largest Interstate

Pipeline receipt point employing orifice meters. Pulsation triggered a billing investigation and subsequent adjustment of over 1,000 MMCF as recent as 2020 for phantom measurement registering in closed meter runs. While some mitigation measures have been employed by the Interstate Pipeline Operator to ensure closed meter runs registrations are zeroed out, it is believed this same pulsation affects flowing meter runs as SoCalGas understands it has not been completely mitigated. It is SoCalGas' finding that a minimum upward bias of 0.5" water column over registration measurement may affect orifice metering differential transmitters at this site in flowing meter runs. Applying 0.5" w/c error to this site equates to an over registration of 0.357%. for the specific site where this in known to exist. See Appendix "N.3" for additional information. The equivalent volume over-registration was calculated at 399 MMCF LUAF contribution. Back calculated as part of all orifice meter deliveries from pipeline suppliers the applied ratio is 0.0834%. This value is shown in Table FG3-A and the associated volume show in Table FG3-B.

Combining the effects of ACC-6 and ACC-7 for Interstate Supplier orifice meters results in a net LUAF contribution of 160 MMCF. The allocation to Core Customers is 34.7% (56 MMCF) and 65.3% (104 MMCF) to Non-Core Customers, based on the ratio of customer volumes for each class as a fraction of total system deliveries.

Orifice Metering: California Producers, Meter Code N4, Tables FG4-A and FG4-B

All 32,481 MMCF of California Production volumes were delivered via 33 orifice meters in 2022. These meters are biased by field conditions-plate fouling and low-flow operation as follows:

- ACC-6: Plate Fouling: A 0.1% under-registration bias factor was estimated for California production gas metering sites based on the results of field observations during monthly/quarterly inspections. These meters measure gas which has been separated and filtered but which has a higher ratio of heavier hydrocarbons than Interstate Supplier deliveries and thus, more propensity for condensate formation and liquid carry-over. Applying this 0.1% bias to 32,481 MMCF volumes received into the SoCalGas system results in a LUAF contribution of 32 MMCF.

- ACC-7: Other- Low DP Operation: This bias is a result of 22% California production meter volumes operating at below 20" water column. This is a result of declining California production and some legacy meters having oversized plates/meter runs. It is calculated at an under registration of 1.09% of all producer volumes. See Appendix "N.4." When applied to 32,481 MMCF, the resultant LUAF contribution is 36 MMCF. A review of all California production sites plate sizes is recommended to see if differential pressures can be elevated to 20" water column as a minimum threshold.

The California Production total orifice meter LUAF-ACC contribution is 68 MMCF for 2022. Allocation to Core Customers is 24 MMCF (34.7%) and 44 MMCF (65.3%) to Non-Core Customers based on the ratio of customer volumes for each class as a fraction of total system deliveries.

See Appendix N.4 for supporting information.

Orifice Metering: Underground Storage: Meter Codes N5-1 and N5-2. Tables FG5-A and FG5-B

SoCalGas operates four Underground Storage fields which provide for daily system balancing and seasonal storage to serve winter heating loading. These are typically depleted oil and gas production formations converted to storage operational use. Typical flows into and out of storage can range up to 100 BCF in any given year. There are a total of 6 orifice meters used for measuring gas injection volumes into three of four Storage fields (Honor Rancho, Aliso and Goleta). These meters measured a total of 29,013 MMCF into storage in 2022: There are a total of 20 orifice meters measuring withdrawal from all four Underground facilities (including Playa Del Rey). These meters registered 59,269 MMCF (over 90%) of storage withdrawal volumes in 2022. Several orifice meters are bi-directional in operation.

Flows vary widely day-to-day for both for storage and injection operations, posing challenges for orifice meter accuracy, which ideally should function with a maximum flow turndown ratio of 5:1 for optimum performance, with an accompanying differential pressure above 10" water column.

Measurement biases impacting Underground Storage Orifice metering falls into two categories as shown in Table FG5-A, volume-calculated in FG5-B and discussed below:

- ACC-6; Field Effects from fouling resulting in under-registration. Fouling of injection metering between plate inspections was assigned an under-registration bias of 0.55% based on inspection intervals and observations. Applying this bias to all 29,013 MMCF orifice metered injection volumes yields a LUAF contribution of 160 MMCF in 2022.

  Fouling of withdrawal metering estimated lower, at 0.10% based on distribution among a greater number of meters and in consideration and that withdrawal gas is processed through multiple and effective liquid separators and dehydration units before entering metering meter runs. When applied to 59,269 MMCF withdrawal volumes registered by orifice metering in 2022, the LUAF-ACC total is 59 MMCF LUAF reduction.

- ACC-7 Other: Field Effects – Low differential pressure operation. In examining storage field injection and withdrawal meter operating data from 2022, it is noted that both are subject to low differential pressure transmitter registration. See Appendix "N ACC-6,7 Storage." For instance, Honor Rancho meter 4546I registered approximately 15,139 MMCF of injection with an average reported differential pressure of 0.82" water column. It estimated that resulted in a minimum under registration bias of 2% for this metered volume. The Bias Ratio applied to all orifice injection volumes in 2022 for low flow and low differential is 0.55%. The associated LUAF-ACC is 160 MMCF when applied to 29,013 MMCF.

  Low differential pressure operation on withdrawal metering is less impactful and estimated at 0.1%, as there are days when meters register below 10" water column differential pressure, but the averages for most withdrawal metering is greater than 20" water column. Applied to withdrawal volumes in 2022, this bias results in a calculated LUAF reduction of 59.3 MMCF.

The combined effect of all Underground Storage orifice injection meter biases for ACC-6 and ACC-7 biases LUAF contribution of 319 MMCF. This is partially offset by withdrawal orifice metering LUAF reductions totaling 119 MMCF. The net is 200 MMCF of LUAF attributable to Underground Storage orifice metering base accuracy LUAF-ACC. This is before instrumentation calibration is considered. See Appendix N.5.

Summary of Sub – Component N: Orifice Meter LUAF-ACC

Table N-2 shows the results of all orifice meter base accuracy LUAF Bias Element contributions noted in this Section. The LUAF contribution attributable to orifice meter accuracy bias is shown to be 371 MMCF in the Column entitled "LUAF-ACC" Total row. Of this total, 102 MMCF (32.7%) is allocated to Core and 259 MMCF (67.3%) is allocated to Non-Core Customers. Non-Core Customer metering based LUAF is 100% allocated to Non-Core customers, while all other orifice metering LUAF categories are allocated based on the ratio of Core and Non-Core Customer volumes to the total customer deliveries in 2022.

Summary of Orifice Meter LUAF-ACC

Applicable Meters:	81
Applicable Volumes: (MMCCF)	621,773
Applicable Bias Multiplier (of adjusted volume)	multiple
LUAF-ACC Contribution: (MMCF)	371
LUAF-ACC Contribution: (MDth)	382
Percentage of Total system LUAF:	3.9%
Percentage of 2022 Measurement LUAF	5.2%
Associated recommendation:	Audit Storage Injection metering
Allocation to Core Customers@32.7% (MMCF):	102
Allocation to Non-Core Customers @67.3%: (MMCF)	269

When the effects of ALL Sub-Component categories are added together for Orifice meters, the associated "LUAF-TOTAL" is 1,593 MMCF. Of this total, 521 MMCF is attributable to Non-Core and 1,072 MMCF is attributable to Core customers.

SUB-COMPONENT: O – Ultrasonic Meters (LUAF ACC)

Ultrasonic meters are used for Non-Core Customer Sales, Interstate Supplier Receipts and Underground Storage Operations. They operate on the principal of measuring the time for ultrasonic waves to cross a pipe section with and against the flow of gas in the pipe. In the simplest terms, the most common errors which ultrasonic meters are subject to are 1) changes in the path length due to fouling, 2) disturbances in the flow profile due to obstruction, 3) uncertainty when operating at very low flow rates, 4) transmitter biases (P/T) and 5) errors in computation of the proper speed of sound in a gas due to composition. On board diagnostics in these meters help mitigate speed of sound issues and help identify the other issues when they are significant. Errors/biases in the 0.25-0.5% range are not easily discerned from on board diagnostics. Ultrasonic meters are placed in service with an accuracy bias correction process which includes manufacturer testing at a flow calibration lab for accuracy biases over 5 different operating ranges. The meters are then "zeroed" at each of these points by 5 individual "Aux Factors" applied across the flow range. These values don't change unless the meter is re-tested at approximate 10-year intervals. A discussion of biases and resultant LUAF introduced by Ultrasonic Meters in 2022 follows.

Ultrasonic Metering: Non-Core Customers Meter Code O2: Tables FG2-A and FG2-B

Deliveries to Non-Core Customers via 40 ultrasonic meters in 2022 totaled 352,729 MMCF, representing over 60% of all Non-Core sales. LUAF contributions associated with these Non-Core meters by bias element are discussed below:

- ACC-6 Field Conditions – Fouling: SoCalGas performs borescope inspections on ultrasonic metering sites at 3–5-year intervals to determine if fouling of the meter runs maybe impacting meter accuracy. There are typically small deposits observed during these inspections, and where that deposition occurs in excess, the meter tubes and meters are scheduled for cleaning. It is estimated, based on observations and historical testing of as-found meter and tubes with deposition, that the average bias due to minor fouling between cleaning intervals is approximately 0.07% for well-maintained ultrasonic metering sites. Applied to 352,729 MMCF of sales volumes the effect is a LUAF reduction of (246) MMCF due to over-registration.

- ACC-7 Other: Large Ultrasonic Meter Single site: There was one specific meter condition noted in 2022 which is estimated to have contributed 640 MMCF to SoCalGas overall LUAF. Specifically, a review of 2022 SoCalGas hourly/daily meter data from SoCalGas' largest ultrasonic metering customer. Data shows the meter set was experiencing intermittent and significant flow deviation from normal conditions in a switching meter run equipped with pressure regulation. This meter was under investigation at the time of this writing. Preliminary interpretation of data suggests the customer volumes through the meter were under registering at minimum 0.6% slow in 2022. An inversion of SoCalGas SDGE LUAF trending in 2022 supports this bias and LUAF estimate. Refer back to Figure 5.

  All LUAF from Ultrasonic sales Meters is allocated to Non-Core Customers at 100%. Refer to Appendix "O.2" for additional information.

Ultrasonic Metering: Interstate Suppliers: Meter Code O3: Tables FG3-A and FG3-B.

ACC-6: Fouling Bias: Based on historical witnessing, multiple billing adjustments and other technical data, an average of 0.2% over-registration bias has been applied interstate supplier ultrasonic meters for fouling effects. This is well within typical contract allowable error bias of 1%. While interstate suppliers strive to keep orifice meter and tubes, fouling is intermittently noted during inspections. Applying 0.3% to metered volumes of received supplies totaling 370,159 MMCF from Interstate Supplier Ultrasonic meters, the result is a LUAF contribution of 1,110 MMCF. Allocation to customer Class is 34.7% to Core and 65.3% to Non-Core Customers.

Refer to Appendix "O.3" for additional information.

Ultrasonic Metering: Underground Storage: Meter Codes N5-1 and N5-2:

There are a total of 4 injection and 3 withdrawal ultrasonic meters operating in Storage. Injection meters are noted in hourly data to experience some operations at less than 5 feet per second and have been assigned a bias ratio of 0.3% in acknowledgement of this intermittent operating profile. Applied to 14,221 MMCF of injection via ultrasonic meters in 2022, the net LUAF impact is a 43 MMCF contribution to calculated LUAF due to under-registration of gas injected into Storage. As is the same for orifice meters in storage, this gas is not physically lost and ultimately reconciled via a storage field inventory adjustment.

Refer to Appendix "O.5" for additional details.

Summary of Sub – Component O: Ultrasonic Meter LUAF-ACC

Table 2-O, shows the results of all ultrasonic meter base accuracy LUAF-ACC Bias contributions noted in this Section. The LUAF contribution attributable to ultrasonic meter accuracy bias is shown to be 1,546 MMCF in the column entitled "LUAF-ACC" in the row labeled "Total" row. Of this total, 400 MMCF (25.9%) is allocated to Core and 1,147 (74.1%) is allocated to Non-Core. Non-Core Customer metering based LUAF is 100% allocated to Non-Core customers, while all other ultrasonic metering LUAF categories are allocated based on the ratio of Core and Non-Core Customer volumes to the total customer deliveries in 2022. Ultrasonic meter-based LUAF represents 17.7% of all 2022 LUAF and 23.3% of all Measurement LUAF in 2022.

Summary of Ultrasonic Meter LUAF-ACC

Applicable Meters:	61
Applicable Volumes: (MMCCF)	734,162
Applicable Bias Multiplier (of adjusted volume)	n/a
LUAF-ACC Contribution: (MMCF)	1,546
LUAF-ACC Contribution: (MDth)	1,594
Percentage of Total system LUAF:	16.3%
Percentage of 2022 Measurement LUAF	21.9%
Associated recommendation:	Border witnessing
Allocation to Core 25.9%: (MMCF):	400
Allocation to Non-Core Customers @74.1%: (MMCF)	1,146

When the effects of ALL Sub-Component categories are added together for ultrasonic meters, the associated "LUAF-TOTAL" is 2,186 MMCF. Of this total, 1,632 MMCF is attributable to Non-Core and 554 MMCF is attributable to Core customers.

SUB-COMPONENT P Turbine Meters:

There are 215 Turbine Meters operating on the SoCalGas system excluding internal fuel meters. Of these, 214 are dedicated to delivering gas to Core (1,136 MMCF) and Non-Core Customers (130,993 MMCF). One turbine meter measures Underground Storage gas delivered to SoCalGas Distribution (596 MMCF/d). Major bias components affecting turbine meter registration are as-found accuracy, Aux Factor application, Instrument (electronic corrector) Calibration and operation at low flow.

Turbine Metering: Core Meters: Meter Code P1 Tables FG1-A and FG1-B.

- ACC-1/P1: Core Turbine Meters: A total of 67 turbine meters (approximately 1/3 of the total population) were removed from service and "in-tested" at the Pico Rivera Meter Shop over the period 2020-2022. See Appendix P. The (check) in-test averages for turbine meters are established on average flowrates of approximately 25% of design capacity. The average meter-in-test result was 0.0966% mechanical under-registration bias. Applying this bias to the 18 core turbine meters in service registering 1,136 MMCF was negligible at 0.6 MMCF and omitted from LUAF inclusion in 2022. Refer to Appendix "O.1" for further information.

- ACC-2 Aux factor: Core Turbine Meters: The Aux Factor for Turbine meters was derived from the average Aux Factor computed for 67 Turbine meters out-tested at Pico Rivera in 2022. Out test is the accuracy noted when a meter is to be placed in service. The Aux factor is established as the numerical off-set to the meter out-test before placement in service- to zero the net registration. In 2022, the average turbine meter placed in service had a registration bias of 0.058857% fast. This means the Aux Factor for these meters was set on average in the billing system/flow computers at 0.99941 or 0.058857% slow down of the meter registration. Applying the 0.058857% factor to 1,136 MMCF used by Core Turbine meters in 2022, the associated LUAF is less than 1 MMCF.

Turbine Metering: Non-Core Meters: Meter Code P2: Tables FG2-A and FG2-B.

- ACC-1: As-Found Accuracy: Non-Core Turbine Meters: Applying the same 0.0966% Meter under-registration bias to 130,993 MMCF Non-Core Metered Volumes yields a LUAF contribution 126.5 MMCF.

- ACC-2: Aux Factor: Non-Core Turbine Meters:. Applying the same Aux Factor bias of 0.058857% to 130,993 MMCF Metered Volumes registered by this meter category yields a LUAF contribution of 77.1 MMCF.

- ACC-7: Other – Turbine Meter low flow: SoCalGas had a number of turbine meters operating at less than 20% of rated capacity in 2022. Turbine meters typically operate in a range from ½%-2% slower than their check proof registration when operated at low flow. The cumulative registration bias for 2022 related to this condition is estimated at 0.27% under-registration on all 130,993 MMCF Non-Core turbine meter volumes. The resulting LUAF is 353 MMCF.

Turbine Metering: Underground Storage: Meter Code P-5: Tables FG5-A and FG5-B.

The overall impact of all categories noted in the Non-Core Metering discussion above yield a total impact 1 MMCF LUAF reduction when applied to 584 MMCF of Storage withdrawal. The break down is shown in Table FG5-B.

Summary of Sub – Component P: Turbine Meter LUAF

Table 2-P, shows the results of all turbine meter base accuracy LUAF Bias Element contributions noted in this section. The LUAF contribution attributable to turbine meter accuracy bias is shown to be 558 MMCF in the Column entitled "LUAF-ACC" in the row labeled "Total". Of this total, a 1.7 MMCF reduction (1%) is allocated to Core and 343.8 MMCF is allocated to Non-Core. Turbine meter-based LUAF represents 3.6% of all 2022 LUAF and 4.8% of all Measurement LUAF in 2022.

Summary of Turbine Meter LUAF-ACC

Applicable Meters:	215
Applicable Volumes:	115,534
Applicable Bias Multiplier (of adjusted volume)	n/a
LUAF-ACC Contribution: (MMCF)	558
LUAF-ACC Contribution: (MDth)	575
Percentage of Total System LUAF:	5.9%
Percentage of 2022 Measurement LUAF	7.9%
Associated Recommendation:	none
Allocation to Core Customers @minus 0.2% (MMCF):	1
Allocation to Non-Core Customers @99.8%: (MMCF)	557

When the effects of ALL LUAF Sub-Component categories are added together for turbine meters, the associated "LUAF-TOTAL" is 436 MMCF.

SUB-COMPONENT Q: Instrument and Transmitter Accuracy:

This LUAF Sub-Component is bifurcated into two parts:

- Q.1 which explains LUAF and associated biases for electronic correctors and flow computers on small to medium sized measurement systems.
- Q.2 which covers transmitters on the largest meter sets including orifice and ultrasonic meters.

The Table Q below provides a summary of all Electronic Corrector and Instrument – Related LUAF meter Type.

Table Q Totals for Instrument Calibration (MMCF)

Meter Type	Q.1 Electronic Corrector Calibration LUAF (MMCF)	Q.2 Transmitter/ Instrument Calibration LUAF (MMCF)	Total Q.1 plus Q.2 (MMCF)
Diaphragm	0	0	0
Rotary	(87)	0	(87)
Orifice	0	1,222	1,222
Ultrasonic	0	640	640
Turbine	(122)	0	(122)
TOTALS	(210)	1,862	1,652
Note: rounding may effect totals			

Bias Category Q.1 (Electronic Corrector Bias Ratio for PD Meters):

Q.1 represents the bias introduced by deviation of pressure and/or temperature senors from a measurement zero reference standard as noted in field calibrations, specifically for flow computers and electronic correctors.

Based on a review of 1,096 technician visits to measurement sites in 2022, the blended average electronic corrector bias noted for 660 sites where pressure and temperature accuracy was 0.092514% over-registration. See Appendix Q.1 for details. This result is applied to all system rotary and turbine meters with electronic correctors in Tables FG1, FG2 and FG5. A breakdown is a follows.

- Q.1 for Meter Code M1-5: Core Rotary meters: A LUAF reduction of 36 MMCF results when the 0.092514% over-registration bias is applied to 1,954 Core rotary meters having correcting instruments measuring 39,090 MMCF in 2022. Allocation to Core is 100%.

- Q.1 for Meter Code M2-1: Non-Core Rotary Meters: LUAF reduction of 51.2 MMCF results when the 0.092514% over-registration bias is applied to 915 Non-Core rotary meters having correcting instruments measuring 55,309 MMCF in 2022. Allocation is 100% to Non-Core Customers at 100%.

- Q.1 for P1, P2, P5 – Turbine Meters: The average -0.093% Electronic Corrector Bias Ratio is also used for Core, Non-Core and Storage withdrawal Turbine meters. A 0.093% under-registration bias applied to 130,993 Non-Core turbine metered volumes yields a LUAF reduction of 121.2 MMCF. Storage and Core Turbine meters contributed another 1 MMCF of LUAF reduction due to electronic corrector biases. Total Turbine meter LUAF from Instrument Calibration Bias is 122 MMCF. Allocation is 100% to non-core

Bias Category Q.2 Transmitter Calibration Bias Ratio

Bias value development for SoCalGas transmitters is shown under Appendix Q.2. (Transmitter Instrument Calibration). Multiple transmitter Bias Ratios from this Appendix were applied to SoCalGas' orifice meter and ultrasonic meters volumes in Tables FG2-A, FG3-A and FG5-A based on the review and averaging of as-found calibration results. Summaries provided below.

- Q.2: Transmitter Accuracy Customer Orifice Meters: As-found calibration records were obtained from 8 customer orifice meters calibrations by operations personnel, with the results showing a net bias of 0.0561% under-registration. This impact was determined by re-calculating volumes based on differential pressure, gauge/absolute pressure and temperature values adjusted for as-found biases. When multiplied by 22,305 MMCF delivered volumes, the LUAF contribution is 13 MMCF. Allocation is 100% to Non-Core Customers.

- Q.2: Transmitter Accuracy – Interstate Suppliers Orifice Meters: This category is for as-found and as-left pressure, temperature and differential pressure registration noted during calibration witnessing. SoCalGas has witnessed biases, which are well within contract measurement accuracy allowances but biased upward, in any regard. This bias is due to suppliers being allowed to forego re-zeroing transmitters when as-found conditions are reading at slight over-registration conditions, but withing tolerances allowed in contracts. When transmitters are found at readings resulting in under-measurement, they are typically reset to calibration reference. For purposes of modeling this systematic bias, and average of +0.25" water column (w/c) out of 70" W/C was used for differential pressures, minus 0.4°F low bias for temperature at 60 ° F, +0.2 psig out of 1000 psig for pressure readings. Applying these biases to volume re-calculation results in a Bias Ratio of 0.2447%. When multiplied by 478,706 MMCF delivered by orifice meters to SoCalGas in 2022 the associated LUAF contribution is 1,171 MMCF over-registration.

- Q.2: Transmitter Bias Ratio – Storage Injection Orifice Meters. Evaluation of 30+ random Underground Storage orifice meter calibration sheets show that injection meter average pressure, temperature and differential pressure biases resulted in an average under-under registration bias of 0.1031%. When applied to 29,013 MMCF injection volumes the LUAF contribution is 29.9 MMCF. Allocation is 34.7% Core/65.3% Non-Core.

- Q.2 Transmitter Bias Ratio – Storage withdrawal Orifice meters: Withdrawal metering transmitter bias ratio averaged -0.0148% (over-registration). Applied to 59,269 orifice meter withdrawal volumes yields an 8.8 MMCF calculated LUAF contribution. Allocation is 34.7% Core/65.3% Non-Core.

Q.2 Transmitter Bias Ratio - California Producers Orifice meters: Not modeled.

- Q.2 : Transmitter Bias-Ultrasonic Sales Meters: Random calibration as-found results for pressure and temperature transmitters resulted in average biases calculated at 0.0561% under-registration. When this is applied to 352,729 MMCF delivered by SoCalGas via ultrasonic metering in 2022, it yields a LUAF contribution of 198 MMCF. Allocation is 100% Non-Core.

- Q.2 Transmitter Bias Ratio Interstate Suppliers Ultrasonic Metering: Based on knowledge of field practices associated with interstate Supplier metering sites, an error bias of 0.1212% over-registration is attributable to electronic pressure and temperature transmitters. This factor was developed estimating the average gas temperature used for calculating Interstate Supplier Ultrasonic meter volumes is biased low by 0.5 °F and the pressure measurement is registering 0.25 psig high on a 1000 psig transmitter. See Appendix Q.2. When 0.1212% is applied to 370,159 MMCF metered ultrasonic meter volumes for Interstate Supplier Receipts into SoCalGas pipelines via ultrasonic meters, the result is a 448 MMCF LUAF contribution. Allocation is 34.7% to Core customers and 65.3% to Non-Core customers.

- Q.2 Transmitter Bias Underground Storage injection – ultrasonic Meters: Not modeled.

- Q.2 Transmitter Bias Underground Storage injection – ultrasonic Meters: Not modeled

Sub-Component (Q) Instrument and Transmitter Calibration Bias LUAF Contributions – Summary:

Applicable Meters:	6,342
Applicable Volumes:	1,463,329
Applicable Bias Multiplier (of adjusted volume)	
LUAF-ACC Contribution: (MMCF)	1,652
LUAF-ACC Contribution: (MDth)	
Percentage of Total System LUAF:	23.2%
Percentage of 2022 Measurement LUAF	17.4%
Associated recommendation:	
Allocation to Core Customers @31.6% (MMCF):	552
Allocation to Non-Core Customers @68.4%: (MMCF)	1,100

SUB-COMPONENT X: Meter Calibration Adjustment Factor:

In 2021, SoCalGas obtained CPUC approval to modify its meter policy to allow families of meters (grouped by year built and manufacturer) where more than 10% of the test population register more than 2% fast under statistical accuracy sampling, to remain in service. As part of the "Meter Calibration Adjustment Program" (MCAF), SoCalGas must reduce the bills of individual customers by 2% from their

registered meter volumes if their meter is part of the identified fast meter families. This program applies to small diaphragm meters only (size 1-3). The impact to LUAF for the single meter category is shown below.

- Meter Code M1-2: Core Diaphragm Meters-in the MCAF Program : A review of data provided by SoCalGas billing department (Appendix X) shows that in 2022 there were 1.1 millon small meters subject to monthly proration of their bills under the MCAF program. These are the Meters shown under Meter Code M1-2 in Table FG1-A. The total downward billing adjustment for these 1.1 milion meters was calculated at 700 MMCF in 2022, based on information provided directly from the Company's billing department data systems and subesequently compiled.

It is noteworth that average test accuracy for the 1.1 million meters in the protocol was 1.17% fast, based on over 7,000 tests conducted in 2022. Translating this data, the actual meter over-registration for the customers in this MCAF program totals 414 MMCF for the 35,389 MMCF measured by these meters. When taken together with the customer billing credits, the data shows that SoCalGas is over-compensating for its fast meters with credits exceeding measured meter bias by 286 MMCF in 2022. This figure is expected to escalate in 2023 and 2024. SoCalGas may want to consider modification of its policy to credit its MCAF customers at a percentage equivalent to the prior years average accuracy test results for meters (or individual meter families) in the MCAF program.

Refer to Appendix X for associated assumptions, data and calculations.

Meter Calibration Adjustment Factor LUAF Summary:

Applicable Meters:	1,104,328
Applicable Volumes:	35,389
Applicable Bias Multiplier (of adjusted volume)	0.0262
LUAF Contribution: (MMCF)	700
LUAF Contribution: (MDth)	722
Percentage of Total system LUAF:	7.4%
Percentage of 2022 measurement LUAF	9.9%
Associated recommendation:	H
Allocation to Core Customers @100%(MMCF):	700
Allocation to Non-Core Customers: (MMCF)	0

A Study of the 2022 Lost and Unaccounted For Gas at Southern California Gas Company

Final Report

MDTH TABLES

Content: All Report Data LUAF Tables Expressed in Thousands of Decatherms (MDth)

Table 1- MDth (Table expressed in Dth)

SoCalGas Measurement LUAF - Contributions by Study Year (Dth)						
	LUAF REPORTING YEAR	1991	2006*	2022	Diff	2022 PROCESS NOTES
LINE ITEM	LUAF MEASUREMENT SUB-COMPONENT	(Dth)	(Dth)	(Dth)	2006-2022	
I	Fixed-Factor Temperature	(1,372,408)	(1,587,947)	225,716	1,813,663	Employed 1991 Method: Apply 2022 volumes and temperature data. Year 2022 was a colder when gas was flowing than 1991 and 2006. Less Net LUAF gain in 2022 than 1991 and 2006.
J	Fixed-Factor Pressure	279,412	322,501	74,379	(248,122)	2022 pressure data from 3,114 field tests. Improved field process for calibrations have reduced pressure by 0.1" on average for standard svcs small meters.
K	Elevation and Barometric Pressure	1,652,930	1,243,910	1,049,569	(194,341)	Year 1994 method and elevation was applied to 2022 customers by elevation zone. Volume shift to pressure corrected meters.
L	Super Compressibility	(439,142)	(46,371)	-	46,371	Not studied in 2022. Contribution negligible in 2006.
X	Meter Calibration Adjustment Factor	-	-	721,730	721,730	New process began in 2021. Reduce recorded meter volumes for 1.1 million small meters by 2% for final billing. Average accuracy of meters in program 1.17% fast. Ensuing over crediting.
M-DIA	PD Meter Accuracy - Diaphragm Meters (M1)	3,552,545	2,471,292	398,336	(2,072,956)	Results from 60,000+ as found in-test in 2022. Review 1100 of as-found Aux factors in Electronic Correctors. Meters tested faster in 2022 than prior LUAF Study years. Reduced population of slow running meters at
M-ROT	PD Meter Accuracy Rotary (M-2)	(503,526)	(155,718)	563,396	719,114	Rotary meters tested ~0.3% slow on in-test and Aux Factor also slowed meter down.
N	Orifice Meter Accuracy	6,030,957	4,268,399	382,031	(3,886,368)	Updated estimates with 2022 flow data. Significant customer, storage and supplier volumes shifted to Ultrasonic metering. Supplier meters main LUAF contributor.
O	Ultrasonic Meter Accuracy	-	(212,298)	1,593,908	1,806,206	Year 2022 larger customer use, replacing orifice meters, More LUAF from gas suppliers due to fouling - multiple supplier rebillings. Under registration of storage field injection volumes at low flow. Interstate supplies shift to US meters 2018-2022 trends with increased LUAF. SDGE US meter running slower than 2020. (Trend with LUAF)
P	Turbine Meter Accuracy	(940,447)	(823,111)	574,567	1,397,678	2022 Turbine meter in-test slower than 2006. Deviation from as-found Aux factor. Also Bias between mfg meter test curve meter factor and Pico Intest standard prover results.
Q	Instrument Calibration	(28,900)	(270,259)	1,704,113	1,974,372	1,643 MMcf in 2022 attributable to interstate suppliers. SoCalGas meters average bias very low based on as found tests.
R	Ambient Temperature on Instrument Accuracy	119,610	-	-	-	Negligible in both 2006 and 2022 due to instrument accuracy improvements
S	Chart Integration Bias	(52,581)	-	-	-	No Charts in system in 2022
	TOTAL Measurement LUAF (Dth)	8,298,450	5,210,398	7,287,743	2,077,345	
	GO112 Reported Measurement LUAF (Dth)	-	-	7,338,764		
	Difference reported GO112 vs 2022 Measurement Study results (MDth)			(49,486)		Assigned to Non-Study Components
	TOTAL Reported System LUAF - Measurement, Accounting, Leakage, Theft, Other (MDth)	-	-	9,772,433		
	Total Receipts into Pipeline System (Dth)			###########		
	TOTAL Volumes Delivered for Year	-	-	###########		Adjusted for off-system use and fuel set asides
	Total LUAF as % of Total Deliveries	0.997%	0.732%	1.005%	0.274%	
	Total LUAF as % of Total Receipts			0.995%		
	Total LUAF Allocation to Core Customers (%)	N/A	71.1%	58.4%		Includes Measurement, Theft, Accounting and Leakage Components.
	Total LUAF Allocation to Non-Core Customers (%)	N/A	28.9%	41.6%		Includes Measurement, Theft, Accounting and Leakage Components.
	Allocation to Core Customers (Dth)	N/A	-	5,707,209		Includes Measurement, Theft, Accounting and Leakage Components.
	Allocation to Non-Core Customers (Dth)	N/A	-	4,066,256		Includes Measurement, Theft, Accounting and Leakage Components.
	2022 Measurement LUAF to Core (%)	N/A		53.7%		
	2022 Measurement LUAF to Non-Core (%)	N/A		46.3%		
	2022 Measurement LUAF to Core (Dth)	N/A		3,941,028		
	2022 Measurement LUAF to Non-Core (Dth)	N/A		3,398,519		

Table 2-MDth

TABLE 2 - MDth												
SUMMARY OF MEASUREMENT SYSTEMS LUAF								LUAF ALLOCATION TO CUSTOMER CLASS			
Meter Category	Active Meter Counts	Meter Energy (MDth)	Measurement LUAF 2022 (MDth)	LUAF % of Meter Category	LUAF % of Receipts Total	LUAF as % Deliveries	% of Total Measurement LUAF	Core LUAF Allocation (%)	Non-Core Allocation (%)	Core LUAF (MDth)	Non-Core LUAF (MDth)
Diaphragm Sales Meters MD	5,843,284	208,526	2,981	1.430%	0.3037%	0.3067%	40.6266%	100.0%	0.0%	2,981.39	-
Rotary Sales Meters CORE MD	89,996	97,850	(174)	-0.178%	-0.0177%	-0.0179%	-2.3725%	100.0%	0.0%	(174.11)	-
Rotary Sales Meters N/C MD	915	57,025	136	0.239%	0.0139%	0.0140%	1.8557%	0.0%	100.0%	-	136
Turbine Meters Sales MD	196	136,227	450	0.330%	0.0458%	0.0463%	6.1269%	0.0%	100.0%	-	450
Orifice Meter Sales MD	19	22,996	93	0.406%	0.0095%	0.0096%	1.2725%	0.0%	100.0%	-	93
Ultrasonic Sales Meters	40	363,669	609	0.167%	0.0620%	0.0626%	8.2979%	0.0%	100.0%	-	609
SALES TOTAL(Core plus Non-Core) MD	**5,934,450**	**886,294**	**4,095**		0.4171%		55.8071%			**2,807**	**1,288**
Storage Injection Meters (US and orifice net inj including bi-directional) MD	10	44,575	396	0.888%	0.0403%	0.0407%	5.3912%	34.7%	65.3%	137.29	258
Storage Withdrawal meters MD	22	64,761	(112)	-0.174%	-0.0115%	-0.0116%	-1.5320%	34.7%	65.3%	(39.01)	(73)
Interstate Supply Pipelines (US and Orifice) MD	40	875,192	2,980	0.340%	0.3035%	0.3065%	40.6025%	34.7%	65.3%	1,033.93	1,946
California Producers MD	33	33,489	(70)	-0.209%	-0.0071%	-0.0072%	-0.9538%	34.7%	65.3%	(24.29)	(46)
Metered TOTALS (MDth)	**5,934,555**	**1,904,310**	**7,288**		**0.7424%**	**0.7498%**	99.3151%	**53.7%**	**46.3%**	**3,915**	**3,373**
Other/Non- Study Measurement			50		0.005%	0.0052%	0.6849%	50.0%	50.0%	25	25
TOTAL 2022 Measurement (Inc Non-Study)	**5,934,555**		**7,339**		**0.747%**	**0.755%**	100.0000%	**53.7%**	**46.3%**	**3,940**	**3,398**
Sales Total plus inj (MD)		930,869	4,095								
Other deliveries Adj		41,161									
Total System Deliveries		972,030									
Receipts Total (IS/WD/P-MD)		973,442									
Other Receipts Adjustment FERC		8,335									
TOTAL RECEIPTS (Metered plus other FERC adjusted)		981,777									
CALCULATED LUAF (MDth)		9,747									
Net Storage Injection		(20,186)									
			MDth								
2022 MEASUREMENT LUAF (STUDY)			7,288								
2022 GO112 REPORT TOTAL LUAF (ACCT, MEAS, LEAK, THEFT)			9,772								
2022 GO112 REPORT TOTAL NON-MEASUREMENT LUAF			2,434								
2022 GO112 REPORT MEASUREMENT LUAF			7,339								
2022 MEASUREMENT NON-STUDY COMPONENTS			50								

Table 2-M-MDth

TABLE 2-M-MDth: POSITIVE DISPLACEMENT METERS																
				SUB-COMPONENT LUAF CONTRIBUTION (MDth) See Associated Lettered Appendicies for details												
			M-TOTAL	ACC-1	ACC-2	Q.1	J	I	K	X	ACC-4	LUAF-ACC	LUAF-ACC Allocation to Core and Non-Core Customers			
Meter (Code), Type and Functional Group	# Meters in Category (Active in billing system)	Delivered Meter Energy (MDth)	Total LUAF Bias Component for Meter Code (MDth)	As-Found Meter Calib LUAF Component	Aux Factor LUAF Component	Electronic Corrector LUAF Component	Fixed-factor Pressure LUAF Component	Fixed-Factor Temperature LUAF Component	Elevation and Barometric Pressure LUAF Component	Meter Calibration Adjustment Factor LUAF Component	Meter Low Flow Accuracy LUAF Component	LUAF due to mechanical registration factors only. (1991, 2006 method)	Core Allocation (%)	Non-Core Allocation (%)	Core Allocation (MMCF)	Non-Core Allocation (MMCF)
(M1-1) Core Diaphragm Meters not in Meter Calibration Adjustment Protocol Size 1-3	4,738,957	173,145	2,178	(247)	-	-	48	584	914	-	880	632	100.0%	0.0%	632	-
(M1-2) Core Diaphragm Meters in Meter Calibration Adjustment Factor Protocol Size 1-3	1,104,328	35,379	803	(414)	-	-	10	119	187	722	180	(234)	100.0%	0.0%	(234)	-
(M1-3) Core Rotary meters - Size 4+ without electronic pressure or temperature correction.	24,391	3,737	26	12	1	-	1	13	(1)	-	-	14	100.0%	0.0%	14	-
(M1-4) Core Rotary meters Size 5+ w/o Temperature correction (includes 3,111 electronic Pressure Correctors)	63,651	53,810	(296)	175	21	-	15	(490)	(17)	-	-	196	100.0%	0.0%	196	-
(M1-5) Core Rotary meters - with Temperature Correction or Temperature and Pressure Correction	1,954	40,302	96	131	16	(37)	-	-	(13)	-	-	109	100.0%	0.0%	109	-
(M2-6) Rotary Meter Non-Core (presssure and temperature corrected)	915	57,025	136	185	22	(53)	(19)	-	-	-	-	155	0.0%	100.0%	-	155
(M2-7) Diaphragm Non-Core	10	2	(0)	(0)	-	-	(0)	-	-	-	-	(0)	0.0%	100.0%	-	(0)
TOTALS - Active Core Meters	**5,934,205**	**363,401**	**2,943**	**(159)**	**61**	**(90)**	**56**	**226**	**1,068**	**722**	**1,060**	**872**			**717**	**155**
% of 2022 System LUAF			31.054%	-1.676%	0.643%	-0.950%	0.589%	2.381%	11.272%	7.614%		9.197%			7.565%	1.632%
% of 2022 Measurement LUAF			41.643%	-2.247%	0.862%	-1.274%	0.790%	3.193%	15.116%	10.211%	14.991%	12.332%			10.144%	2.188%

Table 2-N-MDth

TABLE 2-N-MDth: ORIFICE METER SUMMARY																
				SUB-COMPONENT LUAF CONTRIBUTION (MDth) See Associated Lettered Appendicies for details									LUAF-ACC Allocation to Core and Non-Core Customers			
			N-TOTAL	ACC-1	ACC-2	Q.1	K	Q.2	ACC-6	ACC-7	NOTE	LUAF-ACC				
Meter (Code), Type and Functional Group	# Meters in Category	Delivered Meter Energy (MDth)	Total LUAF Component (MMCF)	As-Found Meter Calib LUAF Component	Aux Factor LUAF Component	Electronic Corrector LUAF Component	Elevation/Altitude Zone LUAF Component	Transmitter Accuracy LUAF Component	Field Effects LUAF Component	Other LUAF Component	Other LUAF Component Note	LUAF due to mechanical registration factors only. (1991, 2006 method)	Core Allocation (%)	Non-Core Allocation (%)	Core Allocation (MMCF)	Non-Core Allocation (MMCF)
(N2) Orifice Meter Non-Core	19	22,996	93	-	-	-	-	13	57	23		80	0.0%	100.0%	-	80
(N3) Orifice Meter - Interstate Supplier	23	493,553	1,372	-	-	-	-	1,208	(247)	411		165	34.7%	65.3%	57	108
(N4) Orifice Meter - California Producer	33	33,489	(70)	-	-	-	-	-	(33)	(37)		(70)	34.7%	65.3%	(24)	(46)
(N5-1) Orifice Meter Storage Injection	6	29,912	349	-	-	-	-	30	160	160		319	34.7%	65.3%	111	208
(N5-2) Orifice Meter Storage Withdrawal	20	(61,107)	(110)	-	-	-	-	9	(59)	(59)	-	(119)	34.7%	65.3%	(41)	(77)
Total	**81**	**518,843**	**1,635**	**-**	**-**	**-**	**-**	**1,259**	**(122)**	**498**		**376**			**102**	**273**
															-	-
% of 2022 System LUAF			17.250%	0.000%	0.000%	0.000%	0.000%	13.285%	-1.292%	5.257%		3.965%			1.081%	2.884%
% of 2022 Measurement LUAF			23.131%	0.000%	0.000%	0.000%	0.000%	17.814%	-1.733%	7.049%		5.317%			1.450%	3.867%

Table 2-O-MDth

TABLE 2-O-MDth: ULTRASONIC METER SUMMARY																
				SUB-COMPONENT LUAF CONTRIBUTION (MDth) See Associated Lettered Appendicies for details									LUAF-ACC Allocation to Core and Non-Core Customers			
			O-TOTAL	ACC-1	ACC-2	Q.1	K	Q.2	ACC-6	ACC-7	NOTE	LUAF-ACC				
Meter (Code), Type and Functional Group	# Meters in Category	Delivered Meter Energy (MDth)	Total LUAF Component (MMCF)	As-Found Meter Calib LUAF Component	Aux Factor LUAF Component	Electronic Corrector LUAF Component	Elevation/Altitude Zone LUAF Component	Transmitter Accuracy LUAF Component	Field Effects LUAF Component	Other LUAF Component	Other LUAF Component Note	LUAF due to mechanical registration factors only. (1991, 2006 method)	Core Allocation (%)	Non-Core Allocation (%)	Core Allocation (MMCF)	Non-Core Allocation (MMCF)
(O2) Ultrasonic - Non-Core	40	363,669	609	-	-	-	-	204	(255)	660	LG Customer Meter Problem	405	0.0%	100.0%	-	405
(O3) Ultrasonic Meter - Interstate Supplier	17	381,639	1,607	-	-	-	-	462	1,145	-	0	1,145	34.7%	65.3%	397	748
(O4) Ultrasonic Meter - California Producer	0	-	-	-	-	-	-	-	-	-	0	-	34.7%	65.3%	-	-
(O5-1) Ultrasonic Meter Storage Injection	4	14,663	36	-	-	-	-	(8)	-	44	Low Flow	44	34.7%	65.3%	15	29
(O5-2) Ultrasonic Meter - Storage Withdrawal	3	(3,040)	2	-	-	-	-	2	-	-	0	-	34.7%	65.3%	-	-
Total	**61**	**756,931**	**2,253.7**	**-**	**-**	**-**	**-**	**659.8**	**890.3**	**703.6**		**1,593.9**			**412.6**	**1,181.4**
% of 2022 System LUAF			23.777%	0.000%	0.000%	0.000%	0.000%	6.961%	9.393%	7.423%		16.816%			4.353%	12.464%
% of 2022 Measurement LUAF			31.884%	0.000%	0.000%	0.000%	0.000%	9.334%	12.596%	9.954%		22.550%			5.837%	16.713%

Table 2-P-MDth

TABLE 2-P-MDth: TURBINE METER SUMMARY

				SUB-COMPONENT LUAF CONTRIBUTION (MDth) See Associated Lettered Appendicies for details								
			P-TOTAL	ACC-1	ACC-2	Q.1	K	Q.2	ACC-6	ACC-7	NOTE	LUAF-ACC
Meter (Code), Type and Functional Group	# Meters in Category	Delivered Meter Energy (MDth)	Total LUAF Component (MMCF)	As-Found Meter Calib LUAF Component	Aux Factor LUAF Component	Electronic Corrector LUAF Component	Elevation/Altitude Zone LUAF Component	Transmitter Accuracy LUAF Component	Field Effects LUAF Component	Other LUAF Component	Other LUAF Component Note	LUAF due to mechanical registration factors only. (1991, 2006 method)
(P-1) Turbine meters; Core with correctors	18	1,171	0	1	1	(1)	-	-	(0)	-	-	1
(P2) Turbine Meter Non-Core	196	135,056	450	130	79	(125)	-	-	-	365	Turbine low flow	436
(P5-2) Turbine Meter Storage Withdrawal	1	(614)	(1)	(1)	(0)	-	-	-	-	-	-	-
Total (MDth)	**215**	**135,613**	**449.0**	**131.0**	**79.8**	**(126.0)**	**-**	**-**	**(0.4)**	**364.7**		**449.0**
% of 2022 System LUAF			4.737%	1.382%	0.842%	-1.330%	0.000%	0.000%	-0.004%	3.847%		4.737%
% of 2022 Measurement LUAF			6.353%	1.853%	1.129%	-1.783%	0.000%	0.000%	-0.005%	5.159%		6.353%

Total Measurement LUAF M, N, O, P Integrated with All Othe Bias Sub-Components (MDth)	**7,281**	**Total Measurement LUAF using only Meter Accuracy Sub-Components M, N, O, P. To Align with 2006 Method for comparison.**	**3,290**

Tables FG1-A and FG1-B -MDth

				LUAF BIAS RATIO - See Associated Letter Appendices							
				ACC-1	ACC-2	Q.1 (ACC-3)	J	I	K	X	ACC-4
Meter Category	# Meters in Category (Active in billing system)	Meter Energy (MDth)	Bias Ratios Sum for Meter Category(%)	As-found Meter Calib Bias Ratio (2022 in-tests)	Aux Factor Bias Ratio	Electronic Corrector Bias Ratio	Fixed Factor Pressure	Fix Factor Temperature	Elevation and Barometric Pressure	Meter Calib Adjustment Factor Bias Ratio	Meter Low Flow Bias Ratio
(M1-1) Core Diaphragm Meters not in Meter Calibration Adjustment Protocol Size 1-3	4,738,957	173,145	1.258%	-0.1428%	0.0000%	0.0000%	0.0280%	0.3370%	0.5276%	0.0000%	0.5081%
(M1-2) Core Diaphragm Meters in Meter Calibration Adjustment Factor Protocol Size 1-3	1,104,328	35,379	2.271%	-1.1700%	0.0000%	0.0000%	0.0280%	0.3370%	0.5276%	2.0400%	0.5081%
(M1-3) Core Rotary meters - Size 4+ without electronic pressure or temperature correction.	24,391	3,737	0.696%	0.3244%	0.0394%	0.0000%	0.0280%	0.3370%	-0.0324%	0.0000%	0.0000%
(M1-4) Core Rotary meters Size 5+ w/o Temperature correction (includes 3,111 electronic Pressure Correctors)	63,651	53,810	-0.551%	0.3244%	0.0394%	0.0000%	0.0280%	-0.9101%	-0.0324%	0.0000%	0.0000%
(M1-5) Core Rotary meters - with Temperature Correction or Temperature and Pressure Correction	1,954	40,302	0.239%	0.3244%	0.0394%	-0.0925%	0.0000%	0.0000%	-0.0324%	0.0000%	0.0000%
(N/A) Turbine Meters: Core without electronic correctors.	-	-	0.000%	0.000%	0.059%	0.000%	0.000%	0.000%	-0.032%	0.000%	0.0000%
(P-1) Turbine meters; Core with correctors	18	1,171	-0.125%	0.0000%	0.0000%	-0.0925%	0.0000%	0.0000%	-0.0324%	0.0000%	0.0000%
TOTALS - Active Core Meters	**5,933,298**	**307,545**									

TABLE FG-1B-Dth: CORE CUSTOMER METERING LUAF COMPONENTS AND ENERGY (ALL VALUES MDth) - 2022

				SUB COMPONENT LUAF CONTRIBUTION (MDth) See Associated Letter Appendicies for details								LUAF-TOTAL Allocation: All Core Attributable as function of only Core Metering Components			
				ACC-1	ACC-2	Q.1 (ACC-3)	J	I	K	X	ACC-4				
Meter Category	# Meters in Category (Active in billing system)	Meter Energy (MDth)	LUAF-TOTAL for Meter Category (MDth)	As-Found Meter Calib LUAF Component	Aux Factor LUAF Component	Electronic Corrector LUAF Component	Regulator Set Pressure LUAF Component	Gas Temperature LUAF Component	Altitude/Elevation LUAF Component	Meter Calibration Adjustment Factor LUAF Component	Meter Low Flow Accuracy LUAF Component	Core Allocation (%)	Non-core Allocation (%)	Core Allocation (MDth)	Non-Core Allocation (MDth)
(M1-1) Core Diaphragm Meters not in Meter Calibration Adjustment Protocol Size 1-3	4,738,957	173,145	2,178	(247)	-	-	48	584	914	-	880	100%	0%	2,178.0	-
(M1-2) Core Diaphragm Meters in Meter Calibration Adjustment Factor Protocol Size 1-3	1,104,328	35,379	803	(414)	-	-	10	119	187	722	180	100%	0%	803.4	-
(M1-3) Core Rotary meters - Size 4+ without electronic pressure or temperature correction.	24,391	3,737	26	12	1	-	1	13	(1)	-	-	100%	0%	26.0	-
(M1-4) Core Rotary meters Size 5+ w/o Temperature correction (includes 3,111 electronic Pressure Correctors)	63,651	53,810	(296)	175	21	-	15	(490)	(17)	-	-	100%	0%	(296.4)	-
(M1-5) Core Rotary meters - with Temperature Correction or Temperature and Pressure Correction	1,954	40,302	96	131	16	(37)	-	-	(13)	-	-	100%	0%	96.2	-
(N/A) Turbine Meters: Core without electronic correctors.	-	-	-	-	-	-	-	-	-	-	-	100%	0%	-	-
(P-1) Turbine meters; Core with correctors	18	1,171	-	-								100%	0%	-	-
TOTALS - Active Core Meters	**5,933,298**	**307,545**	**2,807**	**(344)**	**39**	**(37)**	**74**	**226**	**1,068**	**722**	**1,060**			**2,807.3**	-
% of 2022 System LUAF			28.727%	-3.518%	0.394%	-0.382%	0.761%	2.310%	10.933%	7.385%	10.843%				
% of 2022 Measurement LUAF			38.518%	-4.718%	0.528%	-0.512%	1.021%	3.097%	14.660%	9.903%	14.538%				

Tables FG2-A and FG2-B-MDth

TABLE FG-2A-MDth : NON-CORE CUSTOMER METERING LUAF COMPONENTS AND CONTRIBUTION FACTORS - 2022

				LUAF BIAS RATIO - See Associated Letter Appendices								
				ACC-1	ACC-2	Q.1 (ACC-3)	K	Q.2 (MA-5)	MA-6	MA-7	MA-4	
Meter Category	# Meters in Category	Meter Energy (MDth)	Sum of Metering Bias Ratios Sum 900-1500 (%)	As-found Meter Calib Bias Ratio (2022 in-tests)	Aux Factor Bias Ratio	Electronic Corrector Bias Ratio	Elevation Zone Bias Ratio	Transmitter Bias Ratio	Field Effects - Fouling Bias Ratio	Other Bias Ratio	Other Bias Ratio Note	
(M2-6) Rotary Meter Non-Core (presssure and temperature corrected)	915	57,025	0.239%	0.324%	0.039%	-0.093%	-0.032%	0.000%	0.000%	0.000%		
(P2) Turbine Meter Non-Core	196	135,056	0.333%	0.097%	0.059%	-0.093%	0.000%	0.000%	0.000%	0.270%	Turbine Low flow	
(N2) Orifice Meter Non-Core	19	22,996	0.406%	0.000%	0.000%	0.000%	0.000%	0.056%	0.250%	0.100%	orifice fouling	
(O2) Ultrasonic - Non-Core	40	363,669	0.167%	0.000%	0.000%	0.000%	0.000%	0.056%	-0.070%	0.181%	Large US mtr pbm	
(M2-7) Diaphragm Non-Core	10	2	-0.175%	-0.143%	0.000%	0.000%	-0.032%	0.000%	0.000%	0.000%		
Non-Core Transportation	**1170**	**578,749**										
		886,294	=check of total core plus non core									

TABLE FG-2B-MDth: NON-CORE CUSTOMER METERING LUAF COMPONENTS AND ASSOCIATED ENERGY (ALL TABLE VALUES MDth) - 2022

				SUB COMPONENT LUAF CONTRIBUTION (MDth) See Associated Letter Appendicies for details								LUAF-TOTAL Allocation Method: All Non-Core as Computations are for Non-Core Customer meters only.			
				ACC-1	ACC-2	Q.1 (ACC-3)	K	Q.2	MA-6	MA-7	MA-4				
Meter Category	# Meters in Category	Meter Energy (MDth)	LUAF-TOTAL for Meter Category (MDth)	As-Found Meter Calib LUAF Component	Aux Factor LUAF Component	Electronic Corrector LUAF Component	Elevation/Altitude Zone LUAF Component	Transmitter Accuracy LUAF Component	Field Effects LUAF Component	Other LUAF Component	Other LUAF Component Note	Core Allocation (%)	Non-core Allocation (%)	Core Allocation (MDth)	Non-Core Allocation (MDth)
(M2-6) Rotary Meter Non-Core (presssure and temperature corrected)	915	57,025	136	185	22	(53)	(19)	-	-	-	-	0%	100%	-	136
(P2) Turbine Meter Non-Core	196	135,056	450	130	79	(125)	-	-	-	365	Turbine Low flow	0%	100%	-	450
(N2) Orifice Meter Non-Core	19	22,996	93	-	-	-	-	13	57	23	orifice fouling	0%	100%	-	93
(O2) Ultrasonic - Non-Core	40	363,669	609	-	-	-	-	204	(255)	660	LG Customer Meter Problem	0%	100%	-	609
(M2-7) Diaphragm Non-Core	10	2	(0)	(0)	-	-	(0)	-	-	-	-	0%	100%	-	(0)
Total	**1,170**	**578,749**	**1,288**	**315**	**102**	**(178)**	**(19)**	**217**	**(197)**	**1,047**				-	**1,288.1**
			1,086												
% of 2022 System LUAF			13.181%	3.228%	1.043%	-1.818%	-0.189%	2.219%	-2.017%	10.716%	0.000%				
% of 2022 Measurement LUAF			17.674%	4.328%	1.399%	-2.438%	-0.254%	2.975%	-2.704%	14.369%	0.000%				

Tables FG3-A and FG3-B-MDth

TABLE FG-3A-MDth : SUPPLIER METERING LUAF COMPONENTS AND BIAS RATIOS - 2022

				LUAF BIAS RATIO - See Associated Letter Appendices							
				ACC-1	ACC-2	Q.1 (ACC-3)	K	Q.2	MA-6	MA-7	
Meter Category	# Meters in Category	Meter Energy (MDth)	Sum of Metering Bias Ratios	As-found Meter Calib Bias Ratio (2022 in-tests)	Aux Factor Bias Ratio	Electronic Corrector Bias Ratio	Elevation Zone Bias Ratio	Transmitter Bias Ratio	Field Effects - Fouling Bias Ratio	Other Bias Ratio	Other Bias Ratio Note
Other	3	0	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	
(O3) Ultrasonic Meter - Interstate Supplier	17	381,639	0.4212%	0.0000%	0.0000%	0.0000%	0.0000%	0.1212%	0.3000%	0.0000%	PGE, TW US mtrs
(N3) Orifice Meter - Interstate Supplier	23	493,553	0.2781%	0.0000%	0.0000%	0.0000%	0.0000%	0.2447%	-0.0500%	0.0834%	Ehbrg and Topock
Total	43	**875,192**									

TABLE FG-3B-MDth: SUPPLIER METERING LUAF COMPONENTS AND ASSOCIATED ENERGY (ALL TABLE VALUES MDth) - 2022

				SUB COMPONENT LUAF CONTRIBUTION (MDth) See Associated Letter Appendicies for details								LUAF-TOTAL Allocation Method: based on the ratio of customer type usage to total sendout, SDGE treated as Non-Core Customer.			
				ACC-1	ACC-2	Q.1 (ACC-3)	K	Q.2	MA-6	MA-7					
Meter Category	# Meters in Category	Meter Energy (MDth)	LUAF-TOTAL for Meter Category (MDth)	As-Found Meter Calib LUAF Component	Aux Factor LUAF Component	Electronic Corrector Bias Ratio	Operating Pressure Bias	Transmitter Bias (Press, temp, DP)	Field Effects - Fouling	Other Bias Ratio	Other Bias Ratio Notes	Core Allocation (%)	Non-core Allocation (%)	Core Allocation (MDth)	Non-Core Allocation (MDth)
Other	0	0	0	-	-	-	-	-	-	-		35%	65%	-	-
(O3) Ultrasonic Meter - Interstate Supplier	17	381,639	1,607	-	-	-	-	462	1,145	-	PGE US mtrs TW TPK	35%	65%	558	1,050
(N3) Orifice Meter - Interstate Supplier	23	493,553	1,372	-	-	-	-	1,208	(247)	411	Ehbrg and Topock	35%	65%	476	896
Total	**43**	**875,192**	**2,980**	-	-	-	-	1,670	898	411				**1,033.9**	**1,945.7**
% of 2022 System LUAF			30.490%	0.000%	0.000%	0.000%	0.000%	17.089%	9.191%	4.211%	0.000%				
% of 2022 Measurement LUAF			40.882%	0.000%	0.000%	0.000%	0.000%	22.913%	12.323%	5.646%	0.000%				

Tables FG4-A and FG4-B-MDth

TABLE FG-4A-MDth : CALIFORNIA PRODUCTION METERING LUAF COMPONENTS AND BIAS RATIOS - 2022

				LUAF BIAS RATIO - See Associated Letter Appendices							
				ACC-1	ACC-2	Q.1 (ACC-3)	K	Q.2	MA-6	MA-7	
Meter Category	# Meters in Category	Meter Energy (MDth)	Sum of Metering Bias Ratios Sum 900-1500 (%)	As-found Meter Calib Bias Ratio (2022 in-tests)	Aux Factor Bias Ratio	Electronic Corrector Bias Ratio	Elevation Zone Bias Ratio	Transmitter Bias Ratio	Field Effects - Fouling Bias Ratio	Other Bias Ratio	Other Bias Ratio Note
(P4) Turbine Meter - California Producer	0	0	0	0%	0%	0%	0%	0%	0%	0%	
(O4) Ultrasonic Meter - California Producer	0	0	0		0%	0%	0%	0%	0%	0%	
(N4) Orifice Meter - California Producer	33	33,489	-0.209%	0%	0%	0%	0%	0%	-0.1000%	-0.109%	low dp OP
Total	**33**	**33,489**	**-0.209%**								

TABLE GG-4B: CALIFORNIA PRODUCTION METERING LUAF COMPONENTS AND ASSOCIATED ENERGY (ALL TABLE VALUES MDth) - 2022

				SUB COMPONENT LUAF CONTRIBUTION (MDth) See Associated Letter Appendicies for details								Allocation Method: based on the ratio of customer type usage to total sendout, SDGE treated as Non-Core Customer.			
				ACC-1	ACC-2	Q.1 (ACC-3)	K	Q.2	MA-6	MA-7					
Meter Category	# Meters in Category	Meter Energy (MDth)	LUAF Total for Meter Category (MDth)	As-Found Meter Calib LUAF Component	Aux Factor Bias Ratio	Electronic Corrector Bias Ratio	Operating Pressure Bias	Transmitter Bias (Press, temp, DP)	Field Effects - Fouling	Other Bias Ratio	Other Bias Ratio (See Notes)	Core Allocation (%)	Non-core Allocation (%)	Core Allocation (MDth)	Non-Core Allocation (MDth)
(P4) Turbine Meter - California Producer	0	0	0	0	0	0	0	0	0	0					
(O4) Ultrasonic Meter - California Producer	0	0	0	0	0	0	0	0	0	0		35%	65%	-	-
(N4) Orifice Meter - California Producer	33	33,489	-70	0	0	0	0	0	-33	-37		35%	65%	(24)	(46)
Total	**33**	**33,489**	**-70**	**0**	**0**	**0**	**0**	**0**	**-33**	**-37**				-	-
			-69.9											**(24)**	**(46)**
% of 2022 System LUAF			-0.716%	0.000%	0.000%	0.000%	0.000%	0.000%	-0.343%	-0.374%	0.000%				
% of 2022 Measurement LUAF			-0.961%	0.000%	0.000%	0.000%	0.000%	0.000%	-0.460%	-0.501%	0.000%				

Tables FG5-A and FG5-B-MDth

TABLE FG-5A-MDth: UNDERGROUND STORAGE METERING LUAF COMPONENTS AND BIAS RATIOS - 2022

				LUAF BIAS RATIO - See Associated Letter Appendices							
				ACC-1	ACC-2	Q.1 (ACC-3)	K	Q.2	MA-6	MA-7	
Meter Category	# Meters in Category	Meter Energy (MDth)	Sum of Metering Bias Ratios Sum 900-1500 (%)	As-found Meter Calib Bias Ratio (2022 in-tests)	Aux Factor Bias Ratio	Electronic Corrector Bias Ratio	Elevation Zone Bias Ratio	Transmitter Bias Ratio	Field Effects - Fouling Bias Ratio	Other Bias Ratio	Other Bias Ratio Note
(N5-1) Orifice Meter Storage Injection	6	29,912	1.2031%	0.0000%	0.0000%	0.0000%	0.0000%	0.1031%	0.5500%	0.5500%	low DP Op Inj
(O5-1) Ultrasonic Meter Storage Injection	4	14,663	0.2439%	0.0000%	0.0000%	0.0000%	0.0000%	-0.0561%	0.0000%	0.3000%	low velocity Op Inj
(P5-1) Turbine Meter Storage Injection	0	-	0%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	fully developed flow
(N5-2) Orifice Meter Storage Withdrawal	20	(61,107)	0.1852%	0.0000%	0.0000%	0.0000%	0.0000%	-0.0148%	0.1000%	0.1000%	fully developed flow
(O5-2) Ultrasonic Meter - Storage Withdrawal	3	(3,040)	-0.0561%	0.0000%	0.0000%	0.0000%	0.0000%	-0.0561%	0.0000%	0.0000%	
(P5-2) Turbine Meter Storage Withdrawal	1	(614)	0.1554%	0.0966%	0.0589%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	
Total	**34**	**(20,186)**									

TABLE FG-5B-MDth: UNDERGROUND STORAGE PRODUCTION METERING LUAF COMPONENTS AND ASSOCIATED ENERGY (ALL TABLE VALUES MDth) - 2022

				SUB COMPONENT LUAF CONTRIBUTION (MDth) See Associated Letter Appendicies for details								LUAF-TOTAL Allocation Method: based on the ratio of customer type usage to total sendout.			
				ACC-1	ACC-2	Q.1 (ACC-3)	K	Q.2	MA-6	MA-7					
Meter Category	# Meters in Category	Meter Energy (MDth)	LUAF Total for Meter Category (MDth)	As-Found Meter Calib LUAF Component	Aux Factor Bias Ratio	Electronic Corrector Bias Ratio	Operating Pressure Bias	Transmitter Bias (Press, temp, DP)	Field Effects - Fouling	Other Bias Ratio	Other Bias Ratio (See Notes)	Core Allocation (%)	Non-core Allocation (%)	Core Allocation (MDth)	Non-Core Allocation (MDth)
(N5-1) Orifice Meter Storage Injection	6	29,912	360	-	-	-	-	30.8	164.5	164.5	Low DP	35%	65%	124.9	235
(O5-1) Ultrasonic Meter Storage Injection	4	14,663	36	-	-	-	-	(8.2)	-	44.0	Low Flow	35%	65%	12.4	23
(P5-1) Turbine Meter Storage Injection	0	-	-	-	-	-	-	-	-	-		35%	65%	-	-
(N5-2) Orifice Meter Storage Withdrawal	20	(61,107)	(113)	-	-	-	-	9.0	(61.1)	(61.1)		35%	65%	(39.27)	(74)
(O5-2) Ultrasonic Meter - Storage Withdrawal	3	(3,040)	2	-	-	-	-	1.7	-	-		35%	65%	0.59	1
(P5-2) Turbine Meter Storage Withdrawal	1	(614)	(1)	(0.6)	(0.4)	-	-	-	-	-		35%	65%	(0.33)	(1)
Total net injection	**34**	**(20,186)**	**283**	**(1)**	**(0)**	**-**	**-**	**33**	**103**	**147**				**98.3**	**184.9**
			96												
% of 2022 System LUAF			2.898%	-0.006%	-0.004%	0.000%	0.000%	0.341%	1.058%	1.508%	0.000%				
% of 2022 Measurement LUAF			3.886%	-0.008%	-0.005%	0.000%	0.000%	0.458%	1.419%	2.022%	0.000%				

END OF REPORT

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APPENDIX PREPARED SEPARATELY