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EXTERNAL MEMORANDUM

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FROM:	[redacted], Managing Engineer, Exponent [redacted], Corporate Vice President & Principal Engineer, Exponent
DATE:	February 15, 2023
PROJECT:	2209310.000 - Wildfire Mitigation RSE Verification
SUBJECT:	Findings from Review of Southern California Edison's 2023 Wildfire Mitigation Plan Risk-Spend Efficiency Calculations dated February 7, 2023

EXECUTIVE SUMMARY

This memorandum presents Exponent's salient findings and observations to-date from our review of Southern California Edison Company's (SCE) Risk-Spend Efficiency (RSE) calculations and our participation in SCE's RSE development activities over the duration of the scope of work from September 30, 2022, through February 15, 2023. Our review of SCE's RSE calculations concerns the verification of their accuracy as SCE prepares its 2023 Wildfire Mitigation Plan Update. Though this memorandum pertains to SCE datasets dated February 7, 2023, the review and remedy process has been iterative with Exponent providing preliminary recommendations on earlier datasets that SCE would subsequently address. Our observations regarding SCE's RSE development process pertain only to those activities we attended within the duration of the scope of work. We did not participate in input gathering or parameter assessment stages of SCE's development process as these activities preceded the scope of work. Key aspects of our approach and review including materials relied upon, assumptions, limitations, measures, findings, and recommendations are detailed in the main text.

The most pertinent findings from our review of SCE's RSE calculations are as follows:

- Every program that addresses the Wildfire risk has at least one influential risk driver with a frequency that is entirely zero throughout the provided dataset. In the absence of these inputs, Exponent can only verify if SCE has aligned with its forecasts and calculated the appropriate results based on the provided inputs, but it would be an overreach to characterize the RSE results as accurate. For programs whose asset selection criteria and risk reduction results would be affected by parameters still under development, we

recommend that SCE provide appropriate language, notifications, and disclaimers when discussing and presenting the results for these programs.

- Upon inspection of the current datasets, we find that there are many calculations that have updated inputs but retain SCE's output results from earlier datasets. Thus, many measures that were previously satisfied in preliminary reviews of earlier datasets are no longer satisfied. We recommend that SCE revisit the current datasets to update the recorded inputs, outputs, or both as appropriate and that they be subsequently reviewed to verify their accuracy.

Limitations

This memorandum summarizes work performed to-date and presents the findings resulting from that work. The findings presented herein are made to a reasonable degree of engineering certainty. Exponent reserves the right to supplement this report and to expand or modify opinions based on review of additional material as it becomes available through any additional work or review of additional work performed by others.

The scope of this work included review of calculation results evaluated by the client which required Exponent to carry out an analysis under certain conditions specified by the client. In the analysis, we have relied on data and usage conditions provided by the client. We cannot verify the correctness of this input data and rely on the client for their accuracy. Although Exponent has exercised usual and customary care in the conduct of this analysis, the responsibility for the evaluation of calculation results remains fully with the client.

It is noted that the Executive Summary cannot summarize all of Exponent's technical evaluation, analysis, conclusions, and recommendations. Hence, the main part of this memorandum is at all times the controlling document.

DESCRIPTION OF APPROACH

SCE provided Exponent with materials to be relied upon for our review and upon which our findings and recommendations are based. Exponent developed an analysis model using Analytica Enterprise Release 6.2.0.205 by Lumina Decision Systems, Inc. to perform RSE calculations and facilitate review of the datasets. We reviewed the datasets for their comprehensiveness, alignment with SCE's forecasted program implementation, and accuracy of results according to the inputs and scope defined by SCE. Materials provided by SCE, as well as limitations, assumptions, measures, and interim results of our review are described below.

Key Materials Provided by SCE

Amongst others, SCE provided Exponent three files dated February 7, 2023, to be reviewed and used as a basis for verification of the accuracy of SCE's RSE calculations:

- RSE_Input_Template - Exponent_20230207.xlsx
- WMP_2023_RSE_Granualr_Table_for_Exponent_20230207_non_PSPS.csv
- WMP_2023_RSE_Granualr_Table_for_Exponent_20230207_PSPS.csv

with the above files herein referred to as the "RSE Input Template", "Non-PSPS Dataset", and "PSPS Dataset", respectively. The Non-PSPS Dataset contains SCE's calculation basis and results for those programs addressing the Wildfire risk, while the PSPS Dataset contains those addressing the PSPS risk.

The RSE Input Template contains pertinent mitigation effectiveness parameters for 43 programs addressing the Wildfire and PSPS risks as identified by their WMP ID. It additionally contains the forecasted implementation and spend for deployment years 2023 through 2028 for these programs, those of foundational activities supporting these programs, and a mapping of foundational activities to applicable programs. The forecasted units in the RSE Input Template correspond to units modeled by SCE for its RSE calculations and are herein referred to as "model units". SCE additionally provided a file describing the conversions made from program units to model units. Though the RSE Input Template comprises 43 programs with implementations from 2023 through 2028, Exponent's scope of review pertains only to the 38 programs to be included in SCE's 2023 Wildfire Mitigation Plan Update for deployment years 2023 through 2025.

SCE referred Exponent to Chapter 2 of its 2022 Risk Assessment Mitigation Phase application in Application (A.)22-05-013 for its risk calculation methodology and related inputs for discount rates to be used in net present value calculations, its RSE readability multiplier, and its transformation functions for converting consequences from their natural units to their corresponding Multi-Attribute Risk Score (MARS). SCE verbally communicated to Exponent that the base year, or "Year 0", of net present value calculations should be taken as 2023 for these calculations. Additionally, SCE provided Exponent with "exponent_damper_2023-02-03.csv" containing sample RSE calculations for WMP ID SH-16, an activity supporting the Covered Conductor program that requires evaluation of its incremental benefits.

Key Assumptions and Limitations

Key assumptions and limitations of our review of SCE's RSE calculations are as follows:

- Exponent's scope of work omits review of SCE's internal data management systems and models. As such, Exponent's review of datasets provided by SCE omits some standard aspects of Data Quality reviews including accuracy (i.e., that the appropriate data was written to the appropriate field), contemporaneity (i.e., that the data is current), and consistency (i.e., that there are no conflicts in data in SCE's originating databases), and these are assumed to be assured by SCE through their internal quality assurance procedures. However, Exponent does check other aspects of dataset

comprehensiveness as described with our measures of review.

- Exponent assumes that model units (e.g., lengths of circuit mileage, counts of structures) as specified in the datasets provided by SCE should aggregate to within 1 model unit of those shown in the forecasts presented in the RSE Input Template.

- Exponent assumes that nominal spend as specified in the datasets provided by SCE should aggregate to within $1,000 of those shown in the forecasts presented in the RSE Input Template.

- WMP ID AT-8 has forecasted spend with no forecasted model units for deployment years 2023 and 2024 per the RSE Input Template, and no units appear in the datasets for this program in those deployment years. Thus, our review measures will show alignment in model units for these years, but not alignment in spend.

Measures of Review

Exponent developed measures for our review and categorized them into three primary areas – Data Normality, Forecast Alignment, and Calculation Verification – to check that the datasets contain the applicable information and are free of abnormalities, that model units and spend are represented in the datasets as per the forecasts presented in the RSE Input Template, and that the correct results were obtained from the basis input values. These categories and their measures are described below.

Data Normality

Data Normality comprises five measures in absolute terms such that the item is either absolutely satisfied or not for a program's data subset. Data fields of the Non-PSPS and PSPS Datasets are reviewed for data presence, uniqueness, and overall normality to check that all applicable data have been written to the datasets, that no analysis has been duplicated, and that those data provided are not in conflict with expectations. These measures are intended to verify that informative data is present, to identify oddities and abnormalities, and to understand the limits, if any, to which the dataset can be reviewed, and calculations verified.

To inform the Data Normality measures, Exponent reviewed the unique data entries of each dataset field/column in the Non-PSPS and PSPS Datasets to identify suspect data entries. We identified "CHECK", null, and zero data entries in our review. The degree of data completion in the datasets was quantified by counting the number of occurrences of null and zero values for each field of each program's data subset and evaluating the corresponding percentage.

The five measures of Data Normality are described as follows:

- "Presence" refers to all applicable data being written to the dataset. Those programs that do not satisfy completeness have null or missing values where values are expected. This measure is assessed based on the count of null values found in the data fields of each program's data subset.

- "Uniqueness" refers to all rows of data, and thus RSE calculations, being non-duplicative for each program's data subset. This measure is assessed using standard query functions to identify duplicative rows – i.e., those rows where all dataset fields/columns had the exact same data entry.

- "Model Definition" refers to all rows having the anticipated informative risk inputs for RSE calculation and is informed by the assessed data completion. Informative risk inputs include identification of the applicable program, the considered deployment year, and necessary properties of the analyzed asset such as its mileage length or structure count, influential pre-mitigation risk driver frequencies and consequences that would inform RSE calculations.

  This measure is assessed considering the counts of null and zero values for each informative risk input, specifically to ensure that there are no null data entries and that data entries are not entirely zero in a program's data subset. For the Non-PSPS dataset, we consider only those Wildfire risk drivers needed to inform the risk reduction calculations according to each program's mitigation effectiveness as noted in the RSE Input Template.

- "Applicable Results" refers to all rows having the anticipated informative risk outputs for comparison of RSE calculations and is informed by the assessed data completion. SCE provides Risk Reduction, Pre-mitigation and Post-mitigation PSPS Risk, NPV Benefits, NPV Spend, and RSE. In general, we anticipate these values to be informative (i.e., non-zero) excepting that PSPS Risk Reduction (i.e., the difference between Pre- and Post-mitigation PSPS Risk) is zero for programs that do not address the PSPS risk.

- "Applicable Assets" refers to all rows of calculation resulting in a Risk Reduction and thus RSE for the assets selected by SCE for analysis. Otherwise, the selection of the asset is not sensible. This was assessed according to the results of our analyses as part of our Calculation Verification reviews and occurs if either a program's influential risk drivers are entirely zero, or if the potential consequences are entirely zero.

Forecast Alignment

Forecast Alignment comprises four measures quantified as the percentage of the 3 deployment years (2023, 2024, and 2025) in which the measure's criteria is satisfied. Based on our

discussions with SCE, Exponent understands that the model units and spend represented in the datasets should align with those forecasted in the RSE Input Template, and with consistent unit rates (spend per unit) aligning with the forecasts for each deployment year of each program.

The four measures of Forecast Alignment are as follows:

- "Total Model Units by Deployment Year" refers to the aggregated units from the datasets, as provided by SCE, matching the forecasted units from the RSE Input File to within 1 unit for each program's deployment year. This was assessed by aggregating the units from the Non-PSPS and PSPS Datasets by program and deployment year, and then comparing those values to the forecasts presented in the RSE Input Template.

- "Total Spend by Deployment Year" refers to the aggregated spend from the datasets, as inferred from SCE's NPV Spend results, matching the forecasted spend from the RSE Input File to within $1,000 for each program's deployment year. This was assessed by aggregating the NPV Spend provided in the Non-PSPS and PSPS Datasets according to program and deployment year, factoring out the corresponding NPV Spend Factor for each deployment year, and then comparing the resultant values to the forecasts presented in the RSE Input Template.

- "Consistent Unit Rate by Deployment Year" refers to the unit rates (spend per unit), as inferred from SCE's spend results and units for each row of calculation, being sufficiently close to not produce a variance exceeding $1,000 should either the maximum or minimum inferred unit rate be used for either the model units as provided in the datasets, or as forecasted in the RSE Input Template. This was assessed by evaluating the inferred unit rate used by SCE for each calculation row, and then evaluating if the difference between the maximum and minimum unit rates was substantive enough to produce variances exceeding $1,000 for the program's Total Spend by Deployment Year.

- Whereas the previous measure concerns the consistency of unit rates used in SCE's calculations, "Unit Rate by Deployment Year" refers to these unit rates also being sufficiently close to those unit rates inferred from the RSE Input Template to not produce a variance exceeding $1,000 should either unit rate be used for either the units as provided in the datasets, or as forecasted in the RSE Input Template. This was assessed by comparing identified consistent unit rates to those from the RSE Input Template to see if their differences were substantive enough to produce variances exceeding $1,000 for the program's Total Spend by Deployment Year.

Calculation Verification

Calculation Verification comprises the measures of comparison of the four primary results provided by SCE – Risk Reduction, NPV Benefits, NPV Spend, and RSE – with our corresponding evaluations, and are labeled as such. These measures are quantified as the percentage of rows (i.e., calculations) in the datasets for the specified program where our independent results and SCE's results either exactly match (for results that evaluated to zero) or where error between the results are less than 0.05% using SCE's result as the basis. As previously noted, SCE referred Exponent to Chapter 2 of its 2022 Risk Assessment Mitigation Phase application in Application (A.)22-05-013 for its risk calculation methodology, and our analyses are performed according to this methodology.

INTERIM RESULTS

As previously described, several of Exponent's measures of review, and thus our findings and recommendations, are either informed or evaluated from interim results. Specifically, most Data Normality measures are informed by, or ascertainable from, assessments of data completion. Similarly, Forecast Alignment measures are primarily evaluated from assessments of variances in model units, spend, or unit rates between the datasets and the RSE Input Template. These interim results and our salient observations are presented below.

Data Normality – Data Completion

Figure 1 and Figure 2 depict the overall data completion of the Non-PSPS Dataset and PSPS Dataset, respectively. As shown in these figures, the only null/missing values are identifiers of the Anonymized Circuit Name, WMP Tranche, RAMP Tranche, and HF_Tranche data fields for some programs. Upon inspection of the datasets, the null/missing values for the Anonymized Circuit Name correspond to rows where the "Anonymized Circuit Segment ID or Structure #" data field is labeled as "CHECK", which was identified as a suspect data entry in our review. There are also several curiosities where PSPS risk reduction values were provided by SCE for programs that do not address the PSPS risk per the RSE Input Template, or where it appears that SCE calculated zero risk reduction and RSE for some – and for 5 programs, all – of its program analyses. However, most apparent is that much of the Wildfire risk driver data fields are entirely zero in the Non-PSPS Dataset.

As shown in Figure 1, there are 5 programs in the Non-PSPS Dataset with all Wildfire risk drivers completely zero, and 33 of the 60 Wildfire risk drivers are completely zero for every program throughout the Non-PSPS Dataset. Since not every risk driver influences risk reduction calculations, Figure 3 depicts the data completion of the informative Wildfire risk drivers of the Non-PSPS Dataset. As shown in Figure 3, all except the 5 programs previously noted have at least some informative Wildfire risk drivers. However, it is apparent that every program addressing the Wildfire risk has at least one influential risk driver frequency that is entirely zero for the program data subsets.

Forecast Alignment – Variances

Figure 4 depicts tables listing the variances in model units and spend between the datasets and the RSE Input Template, and Figure 5 depicts tables listing the variances in unit rates observed both within the datasets and between the datasets and the RSE Input Template. As shown in Figure 4, several model unit variances exceed 100 units, and there are several spend variances of several hundreds of thousands to millions of dollars. As for the unit rates shown in Figure 5, the tolerable precision is largely a function of how many units a program is forecasted to address. However, we do see some large differences between the maximum and minimum unit rates inferred from SCE's datasets on the order of hundreds to thousands of dollars per unit suggesting that different unit rates may have been used in some calculations. Additionally, even for those program deployment years with consistent unit rates, there are several which vary from those of the RSE Input Template by thousands to hundreds of thousands of dollars per unit.

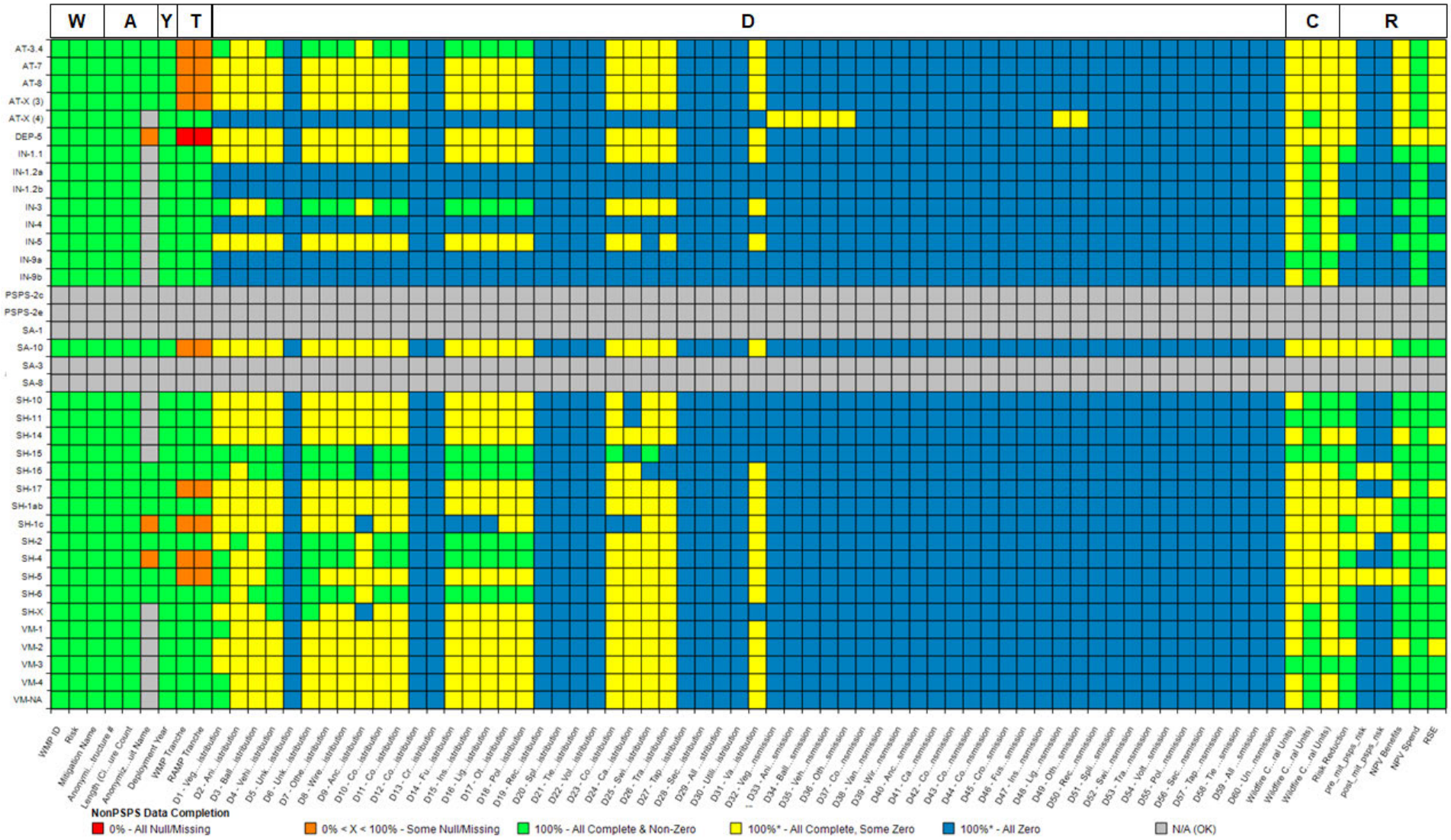


Figure 1. Data field completion of the Non-PSPS Dataset. Data fields describe the analyzed risk and WMP (W), asset and model unit (A), deployment year (Y), asset tranche (T), asset risk driver frequencies (D), asset consequences (C), and SCE analysis results (R). The color-coding indicates to what degree values are null/missing or zero for each data field (columns) of each WMP (rows).

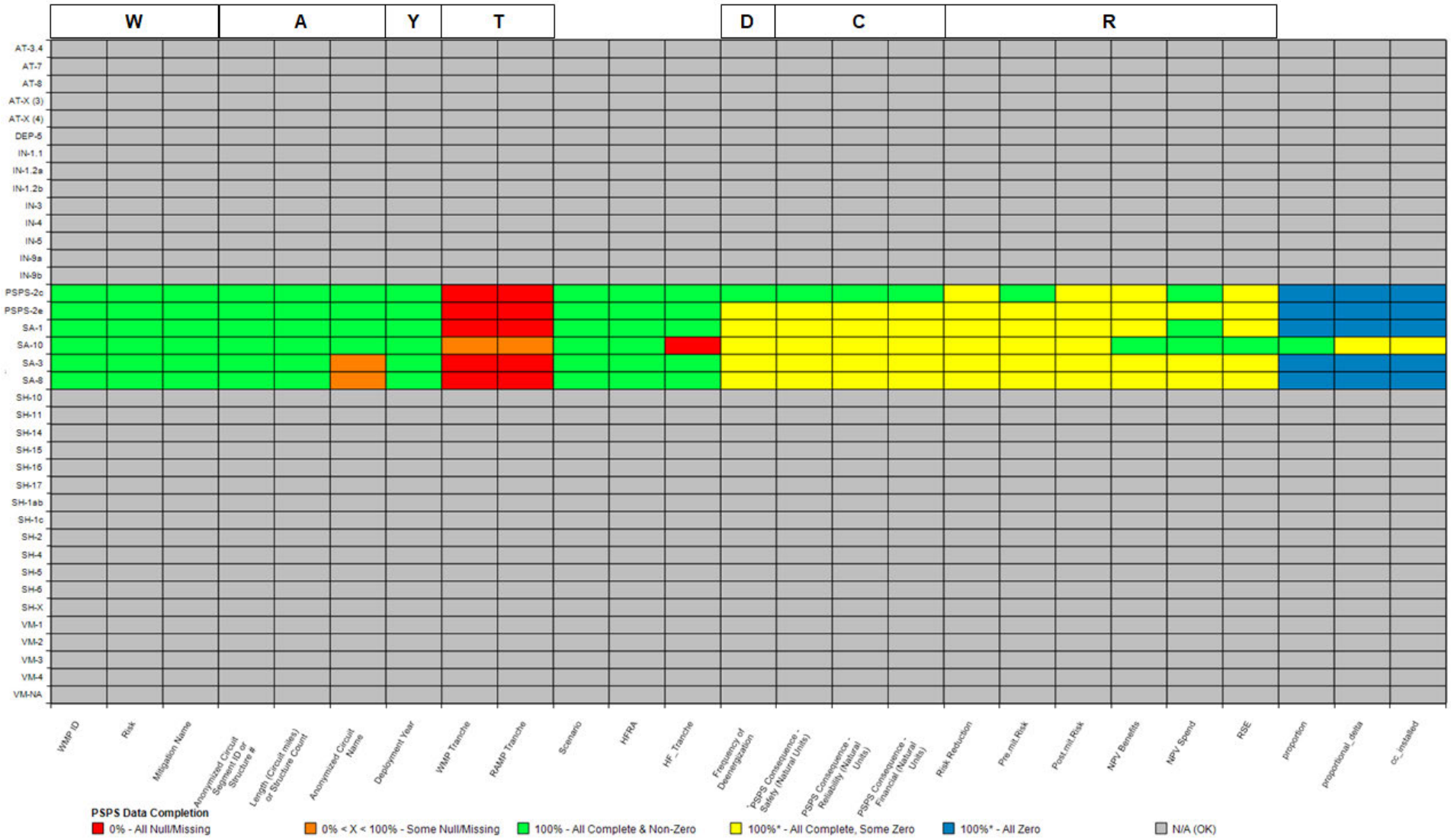


Figure 2. Data field completion of the PSPS Dataset. Data fields describe the analyzed risk and WMP (W), asset and model unit (A), deployment year (Y), asset tranche (T), asset risk driver frequencies (D), asset consequences (C), and SCE analysis results (R). The color-coding indicates to what degree values are null/missing or zero for each data field (columns) of each WMP (rows).

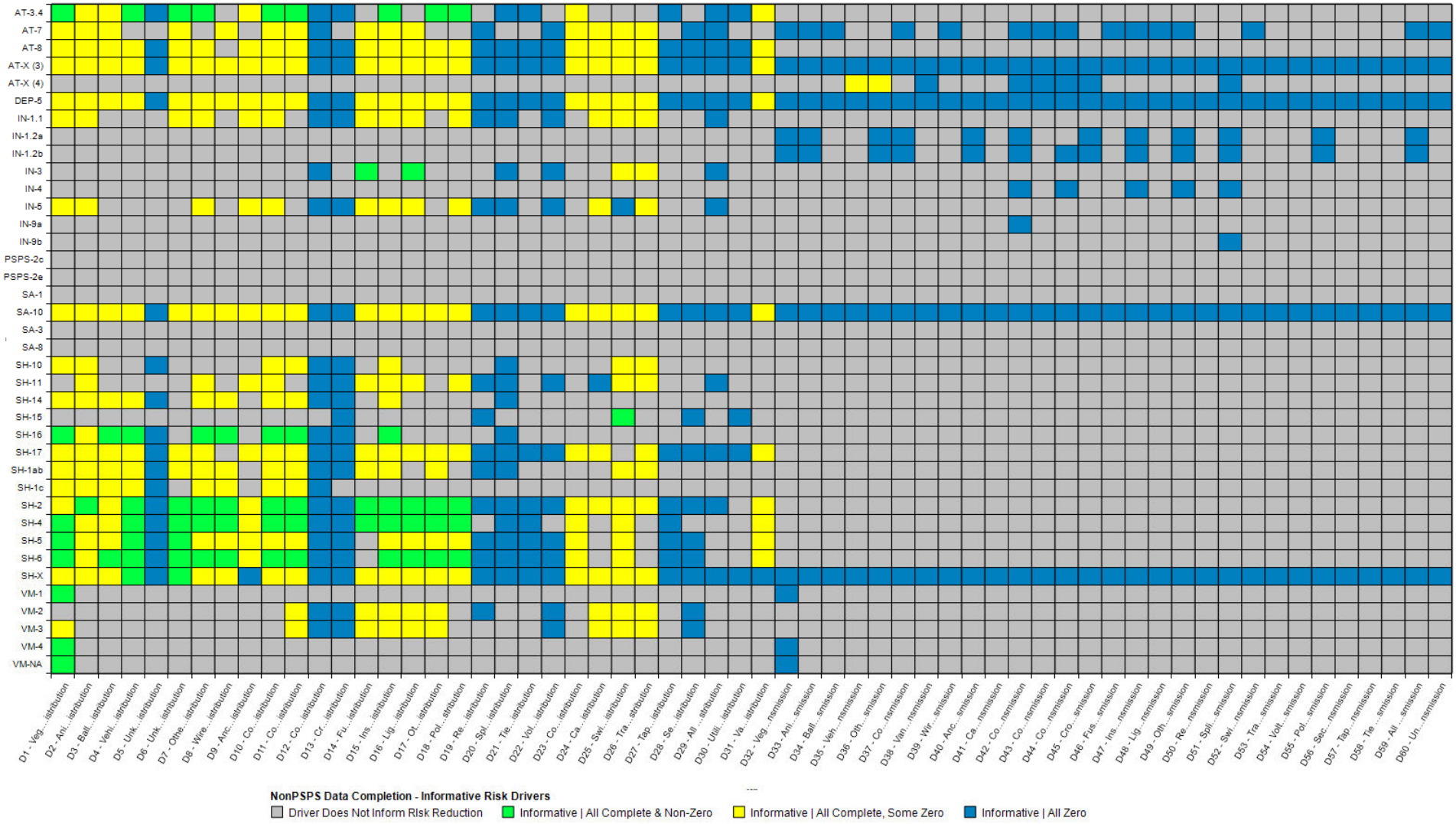


Figure 3. Data field completion of risk driver frequencies (columns) in the Non-PSPS Dataset that inform the risk reduction calculations for a WMP (rows). Risk driver frequencies inform risk reduction calculations if they are mitigated by a WMP or if the WMP mitigates any consequence – in which case all inform the risk reduction calculations. The color-coding indicates to what degree values are zero for the informative risk driver frequencies of each WMP.

Variance in Total Model Units by Deployment Year (RSE Input Template - Datasets)

WMP ID	Deployment Year			Totals
	2023	2024	2025	
AT-3.4	0.0	0.0	0.0	0.0
AT-7	0.6	-0.5	-99.9	-99.7
AT-8	0.0	0.0	0.0	0.0
AT-X (3)	-0.8	-0.9	-0.8	-2.5
AT-X (4)	-1178.0	0.0	0.0	-1178.0
DEP-5	0.1	0.1	0.0	0.2
IN-1.1	0.0	0.3	0.1	0.3
IN-1.2a	0.0	0.0	0.0	0.0
IN-1.2b	0.0	0.0	0.0	0.0
IN-3	0.0	0.0	0.0	0.0
IN-4	0.0	0.0	0.0	0.0
IN-5	0.0	0.0	0.0	0.0
IN-9a	0.0	0.0	0.0	0.0
IN-9b	0.0	0.0	0.0	0.0
PSPS-2c	-2.2	-1.7	-1.7	-5.6
PSPS-2e	47.3	44.0	47.0	138.3
SA-1	-0.5	-0.3	0.4	-0.3
SA-10	-0.8	-0.9	0.0	-1.7
SA-3	0.5	0.5	0.4	1.3
SA-8	0.5	0.5	0.4	1.3
SH-10	0.0	0.0	0.0	0.0
SH-11	0.0	0.0	0.0	0.0
SH-14	91.0	8.0	51.0	150.0
SH-15	0.0	0.0	0.0	0.0
SH-16	0.0	0.1	0.1	0.1
SH-17	-25.7	-25.1	-29.6	-80.4
SH-1ab	0.0	-1.9	-0.9	-2.7
SH-1c	0.0	1.2	0.9	2.0
SH-2	0.0	0.0	5.3	5.3
SH-4	-1.2	0.0	0.0	-1.2
SH-5	-0.3	-0.1	0.0	-0.4
SH-6	0.0	0.0	0.0	0.0
SH-X	0.0	0.0	0.0	0.0
VM-1	0.0	0.0	0.0	0.0
VM-2	0.0	0.0	0.0	0.0
VM-3	0.0	0.0	0.0	0.0
VM-4	0.0	0.0	0.0	0.0
VM-NA	0.0	0.0	0.0	0.0

Variance in Total Spend ($000) by Deployment Year (RSE Input Template - Datasets)

WMP ID	Deployment Year			Totals
	2023	2024	2025	
AT-3.4	0.0	0.0	0.3	0.3
AT-7	0.0	0.0	-1526.2	-1526.2
AT-8	100.0	125.0	0.0	225.0
AT-X (3)	-0.4	-0.6	-0.5	-1.6
AT-X (4)	0.0	0.0	0.0	0.0
DEP-5	295.1	295.3	295.0	885.4
IN-1.1	-15.7	-3.3	-2.9	-21.9
IN-1.2a	-1.7	-0.5	-0.4	-2.6
IN-1.2b	-1.3	-0.4	-0.3	-2.0
IN-3	0.0	0.0	0.0	-0.1
IN-4	0.0	0.0	0.0	0.0
IN-5	0.0	0.0	0.0	0.0
IN-9a	0.0	0.0	0.0	0.0
IN-9b	0.0	0.0	0.0	0.0
PSPS-2c	0.8	0.2	0.6	1.6
PSPS-2e	28.1	33.8	33.2	95.1
SA-1	21495.8	11561.7	9363.6	42421.0
SA-10	0.7	0.6	0.0	1.3
SA-3	140.2	131.6	180.8	452.6
SA-8	53.7	66.1	105.4	225.2
SH-10	-1.2	-0.4	-0.2	-1.8
SH-11	0.0	0.0	0.0	0.0
SH-14	828.7	68.9	413.5	1311.0
SH-15	0.0	0.0	0.0	0.0
SH-16	-11107.6	-15772.9	-23143.5	-50023.9
SH-17	0.4	-1.0	-1.1	-1.7
SH-1ab	-40.5	-1320.9	-645.4	-2006.8
SH-1c	0.0	-3.6	2.4	-1.2
SH-2	-2.1	-1.4	-4.8	-8.3
SH-4	-16.7	0.0	0.0	-16.7
SH-5	-0.2	-0.1	-0.1	-0.4
SH-6	-0.3	0.0	0.0	-0.3
SH-X	0.0	0.0	0.0	0.0
VM-1	0.7	-1.5	-1.1	-2.0
VM-2	0.1	-0.2	-0.2	-0.3
VM-3	0.0	0.0	0.0	0.0
VM-4	0.5	-0.9	-0.7	-1.2
VM-NA	0.2	-0.3	-0.2	-0.3

Figure 4. Variances in Total Model Units (left) and Total Spend (right) by Deployment Year for each WMP. Variances are presented to indicate the remedy for the Datasets to align with the forecasts presented in the RSE Input Template.

Range of Unit Rates ($000 / Unit) from Datasets (Max - Min)

WMP ID	Deployment Year		
	2023	2024	2025
AT-3.4	0	0	9.5E-12
AT-7	3.9E-12	1.3E-11	9.0E-12
AT-8	0	0	4.2E-06
AT-X (3)	2.4E-12	2.8E-12	3.0E-12
AT-X (4)	0	0	0
DEP-5	7.2E+00	7.2E+00	7.2E+00
IN-1.1	0	0	0.0E+00
IN-1.2a	0	0	0.0E+00
IN-1.2b	0	0	0.0E+00
IN-3	0	0	0.0E+00
IN-4	0	0	0.0E+00
IN-5	0	0	0.0E+00
IN-9a	0	0	0.0E+00
IN-9b	0	0	0.0E+00
PSPS-2c	1.5E-12	5.6E-13	5.9E-13
PSPS-2e	2.2E-01	7.5E-01	2.7E-01
SA-1	9.8E-14	4.7E-14	2.2E-14
SA-10	6.9E-13	1.1E-12	0
SA-3	8.8E-01	8.1E-01	1.1E+00
SA-8	3.4E-01	4.1E-01	6.6E-01
SH-10	0	0	0
SH-11	0	0	0
SH-14	0	0	0
SH-15	0	0	0
SH-16	7.7E-12	2.2E-11	2.5E-11
SH-17	1.5E-11	3.7E-11	4.8E-11
SH-1ab	3.1E-10	4.4E-10	3.3E-10
SH-1c	0	1.3E-11	2.1E-11
SH-2	1.1E-10	4.2E-10	1.9E-09
SH-4	1.9E-12	0	0
SH-5	6.2E-12	8.7E-12	3.1E-11
SH-6	5.6E-11	2.5E-12	0
SH-X	0	0	0
VM-1	0	0	0
VM-2	0	0	0
VM-3	0	0	0
VM-4	0	0	0
VM-NA	0	0	0

Variance in Consistent Unit Rates ($000 / Unit) (RSE Input Template - Datasets)

WMP ID	Deployment Year		
	2023	2024	2025
AT-3.4	0	0	-3.2E-06
AT-7	-3.1E-02	3.6E-02	3.4E-02
AT-8	N/A	N/A	-1.6E-04
AT-X (3)	4.7E-03	4.6E-03	4.6E-03
AT-X (4)	2.1E+02	0	0
DEP-5	N/A	N/A	N/A
IN-1.1	-5.1E-04	-1.7E-04	-1.1E-04
IN-1.2a	-1.1E-03	-3.4E-04	-2.3E-04
IN-1.2b	-1.8E-03	-5.5E-04	-3.6E-04
IN-3	-7.1E-04	-2.2E-04	-1.5E-04
IN-4	-2.5E-03	-7.9E-04	-5.2E-04
IN-5	1.1E-07	-5.2E-08	-3.4E-07
IN-9a	3.0E-04	-3.2E-04	-3.5E-04
IN-9b	2.5E-06	-2.6E-06	2.4E-06
PSPS-2c	1.6E-02	1.5E-02	1.6E-02
PSPS-2e	N/A	N/A	N/A
SA-1	1.3E+01	1.4E+01	1.6E+01
SA-10	1.6E-03	1.6E-03	0
SA-3	N/A	N/A	N/A
SA-8	N/A	N/A	N/A
SH-10	-2.5E-03	-8.1E-04	-5.4E-04
SH-11	3.2E-12	4.3E-13	-1.7E-13
SH-14	-5.6E-04	-1.8E-04	-1.2E-04
SH-15	-4.4E-03	0	0
SH-16	-7.5E+02	-7.0E+02	-7.4E+02
SH-17	1.7E+00	5.4E+00	4.2E+00
SH-1ab	-5.6E-02	-1.6E-02	-1.1E-02
SH-1c	0	-2.3E+00	-2.4E+00
SH-2	-2.0E+00	-6.5E-01	-4.3E+02
SH-4	-9.9E-04	0	0
SH-5	9.5E-01	5.0E-01	6.5E-04
SH-6	-8.1E-02	4.4E-02	0
SH-X	0	-2.1E-07	0
VM-1	9.8E-05	-1.7E-04	-1.4E-04
VM-2	1.1E-06	-1.8E-06	-1.5E-06
VM-3	1.2E-14	-4.1E-14	0
VM-4	5.7E-05	-1.0E-04	-8.3E-05
VM-NA	4.5E-06	-7.7E-06	-6.2E-06

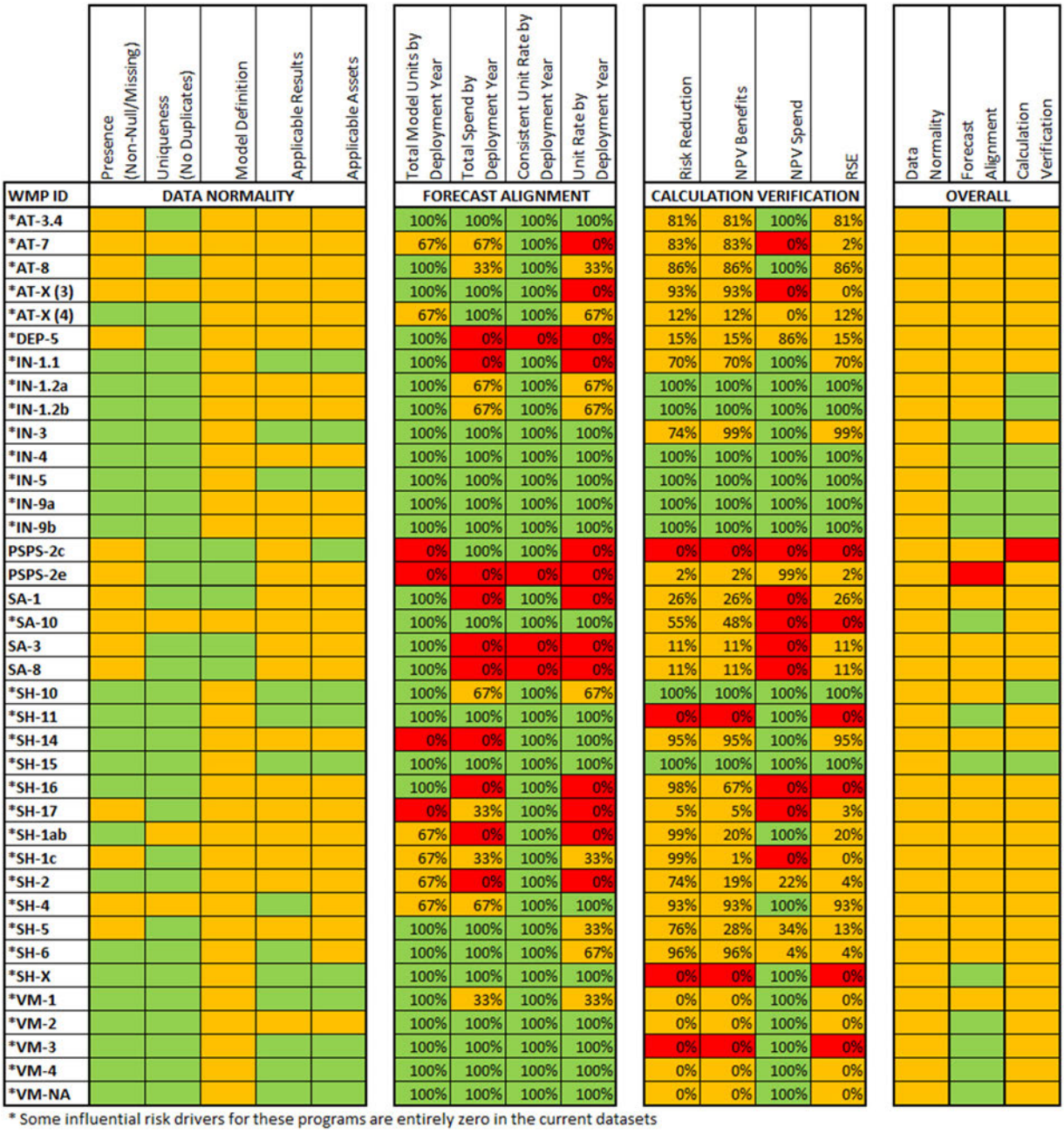
Figure 5. Range of Unit Rates inferred from the Datasets (left) and their corresponding Variances (right), where applicable, by Deployment Year for each WMP.

FINDINGS AND RECOMMENDATIONS

Figure 6 depicts the measures of our review to-date for each program according to the pertinent category – Data Normality, Forecast Alignment, and Calculation Verification. Currently, 5 of the 38 programs (~13%) satisfy the Forecast Alignment and Calculation Verification reviews, though it must be noted that the risk reduction calculations for 3 of these programs are trivial as all informative risk driver frequencies for these programs were entirely zero in the datasets. 9 programs satisfy Forecast Alignment alone, 3 satisfy Calculation Verification alone, and no programs satisfy Data Normality. Of those 3 programs satisfying Calculation Verification alone, the risk reduction calculations for 2 of the programs are trivial.

Notable findings and recommendations from our reviews are as follows:

- Programs that did not satisfy Presence were missing some or all the Anonymized Circuit Name, WMP Tranche, RAMP Tranche, and HF_Tranche identifier fields:
  - The missing Anonymized Circuit Name fields correspond to calculations where assets were identified as "CHECK", and so can be addressed by removing these "CHECK" calculations from the datasets.
  - Though the WMP Tranche and RAMP Tranche identifiers do not inform calculations, they may potentially be used when aggregating data either by SCE or others, and so we recommend that these be included where currently absent.
  - The HF_Tranche identifier was not present in previous datasets and does not inform calculations. If this field may potentially be used when aggregating data either by SCE or others, then we recommend that these be included where currently absent.
- AT-7, AT-X(3), SA-10, SH-1ab, and SH-4 did not satisfy Uniqueness and collectively contain ~2,100 duplicates within the Non-PSPS Dataset. We recommend duplicate rows be removed from the dataset and replaced as appropriate.



	DATA NORMALITY					FORECAST ALIGNMENT				CALCULATION VERIFICATION				OVERALL		
WMP ID	Presence (Non-Null/Missing)	Uniqueness (No Duplicates)	Model Definition	Applicable Results	Applicable Assets	Total Model Units by Deployment Year	Total Spend by Deployment Year	Consistent Unit Rate by Deployment Year	Unit Rate by Deployment Year	Risk Reduction	NPV Benefits	NPV Spend	RSE	Data Normality	Forecast Alignment	Calculation Verification
*AT-3.4						100%	100%	100%	100%	81%	81%	100%	81%			
*AT-7						67%	67%	100%	0%	83%	83%	0%	2%			
*AT-8						100%	33%	100%	33%	86%	86%	100%	86%			
*AT-X (3)						100%	100%	100%	0%	93%	93%	0%	0%			
*AT-X (4)						67%	100%	100%	67%	12%	12%	0%	12%			
*DEP-5						100%	0%	0%	0%	15%	15%	86%	15%			
*IN-1.1						100%	0%	100%	0%	70%	70%	100%	70%			
*IN-1.2a						100%	67%	100%	67%	100%	100%	100%	100%			
*IN-1.2b						100%	67%	100%	67%	100%	100%	100%	100%			
*IN-3						100%	100%	100%	100%	74%	99%	100%	99%			
*IN-4						100%	100%	100%	100%	100%	100%	100%	100%			
*IN-5						100%	100%	100%	100%	100%	100%	100%	100%			
*IN-9a						100%	100%	100%	100%	100%	100%	100%	100%			
*IN-9b						100%	100%	100%	100%	100%	100%	100%	100%			
PSPS-2c						0%	100%	100%	0%	0%	0%	0%	0%			
PSPS-2e						0%	0%	0%	0%	2%	2%	99%	2%			
SA-1						100%	0%	100%	0%	26%	26%	0%	26%			
*SA-10						100%	100%	100%	100%	55%	48%	0%	0%			
SA-3						100%	0%	0%	0%	11%	11%	0%	11%			
SA-8						100%	0%	0%	0%	11%	11%	0%	11%			
*SH-10						100%	67%	100%	67%	100%	100%	100%	100%			
*SH-11						100%	100%	100%	100%	0%	0%	100%	0%			
*SH-14						0%	0%	100%	100%	95%	95%	100%	95%			
*SH-15						100%	100%	100%	100%	100%	100%	100%	100%			
*SH-16						100%	0%	100%	0%	98%	67%	0%	0%			
*SH-17						0%	33%	100%	0%	5%	5%	0%	3%			
*SH-1ab						67%	0%	100%	0%	99%	20%	100%	20%			
*SH-1c						67%	33%	100%	33%	99%	1%	0%	0%			
*SH-2						67%	0%	100%	0%	74%	19%	22%	4%			
*SH-4						67%	67%	100%	100%	93%	93%	100%	93%			
*SH-5						100%	100%	100%	33%	76%	28%	34%	13%			
*SH-6						100%	100%	100%	67%	96%	96%	4%	4%			
*SH-X						100%	100%	100%	100%	0%	0%	100%	0%			
*VM-1						100%	33%	100%	33%	0%	0%	100%	0%			
*VM-2						100%	100%	100%	100%	0%	0%	100%	0%			
*VM-3						100%	100%	100%	100%	0%	0%	100%	0%			
*VM-4						100%	100%	100%	100%	0%	0%	100%	0%			
*VM-NA						100%	100%	100%	100%	0%	0%	100%	0%			

* Some influential risk drivers for these programs are entirely zero in the current datasets

Figure 6. Summary of review measures to-date for each WMP. Data Normality reviews are measured as satisfied (green) or not (amber). Forecast Alignment reviews are measured as the percentage of deployment years satisfied. Calculation Verification reviews are measured as the percentage of calculations satisfied. Absolutes are designated by red and green, and partials by amber.

- For Model Definition, we find the following:

  – Every program addressing the Wildfire risk (i.e., those found in the Non-PSPS Dataset) has at least one influential risk driver with a frequency that is entirely zero throughout the dataset, and so these programs do not satisfy this check. For programs whose asset selection criteria and risk reduction results would be affected by parameters still under development, we recommend that SCE provide appropriate language, notifications, and disclaimers when discussing and presenting the results for these programs.

  – IN-1.2a, IN-1.2b, IN-4, IN-9a, and IN-9b, all influential risk driver frequencies were entirely zero for these programs, thus resulting in zero Risk Reduction and RSE. If there are non-zero risk driver frequencies for these programs, we recommend they be included in the dataset.

  – In the RSE Input Template, the noted rationale for SH-16 indicates that its mitigation effectiveness parameters should be the same as used for covered conductor (SH-1ab) though they are currently different. We recommend updating either the parameters or noted rationale for SH-16 as appropriate.

- For Applicable Results, we find the following:

  – SH-16, SH-1ab, SH-1c, SH-2, and SH-5 indicate a PSPS risk reduction, though the programs do not address the PSPS risk per the RSE Input Template. If the programs do address the PSPS risk, then we recommend their mitigation effectiveness parameters be updated in the RSE Input Template, otherwise, we would anticipate the PSPS risk reduction for these programs to be zero.

  – Excepting SH-16 and SH-1c, all remaining programs that did not satisfy Applicable Results had at least some analyses for which SCE presents results of zero, as shown in Figure 1. In general, we recommend to revisit any analyses resulting in zero risk reduction to verify its inputs and, if verified as correct, to replace these analyses with those for assets that would be applicable for the program.

- Programs that did not satisfy Applicable Assets had a subset of rows that evaluated to zero risk reduction. In general, we recommend to revisit any analyses resulting in zero risk reduction to verify its inputs and, if verified as correct, to replace these analyses with those for assets that would be applicable for the program.

- For those programs that did not satisfy Total Model Units by Deployment Year, variances ranged from ~1.2 to ~1,200 model units, though were predominantly in the range of ~2 to ~50 model units. We recommend revisiting the deployment years of these programs and removing or adding applicable assets to the datasets as appropriate.

- For those programs that did not satisfy Total Spend by Deployment Year, variances ranged from ~$1,000 to ~$23M, with many exceeding variances of $100,000. We recommend first ensuring that Total Model Units by Deployment Year aligns with the forecast for each deployment year of these programs, and then re-evaluating spend using a consistent unit rate that aligns with forecast.

- For those programs that did not satisfy either the Consistent Unit Rate by Deployment or Unit Rate by Deployment Year, we find the following:

  - For those programs that did not satisfy Consistent Unit Rate by Deployment Year, the difference between maximum and minimum unit rates ranged from ~$200 per model unit to ~$7,000 per model unit, though were typically on the order of hundreds of dollars per model unit (Figure 5, left).

  - For those programs that did not satisfy Unit Rate by Deployment Year, the variances ranged from < $1 per model unit to ~$750,000 per model unit and were approximately log-linearly distributed over this range (Figure 5, right).

  - In general, where a program does not satisfy either the check for Consistent Unit Rate or Unit Rate by Deployment Year, we recommend that SCE revisit the calculations for these programs for the impacted deployment years and ensure a consistent unit rate of sufficient precision that aligns with the forecast is used for calculations. The tolerable precision is largely a function of how many model units a program is forecasted to address such that it may be prudent to use full precision for all unit rates.

- For Calculation Verification, it is important to note that the results provided by SCE for comparison are aggregates of other interim results such that, where our results do not align, it cannot always be precisely pinpointed as to what factor needs to be addressed. As such, we note findings and offer guidance as follows:

  - As previously noted, all influential risk driver frequencies for IN-1.2a, IN-1.2b, IN-4, IN-9a, and IN-9b were entirely zero, thus resulting in zero Risk Reduction and RSE. Though SCE and Exponent attained

similar results for these analyses, the risk reduction results are trivial.

- It was very surprising to see the measures of Risk Reduction and NPV Benefits to have dropped substantively across most of the programs in the Non-PSPS Dataset as these were well aligned in preliminary reviews of earlier datasets. Upon inspection of the current dataset, we find that there are many calculations throughout the entire dataset that have updated risk driver frequencies but retain the output results from earlier datasets. We recommend that the current datasets be revisited to update the recorded inputs, outputs, or both as appropriate and that the review of Calculation Verification be revisited.

We recommend that SCE address recommendations made herein in the priority of Data Normality, Forecast Alignment, and Calculation Verification. Addressing findings related to Data Normality may result in changes to the assets considered for analysis, and these in turn may affect program alignment with forecasts and the ensuing RSE calculations.

OBSERVATIONS ON SCE'S RSE PROCESS

Exponent's observations regarding SCE's RSE development process pertain only to those activities we attended within the duration of the scope of work. These activities primarily concerned review, validation, and implementation of SCE's mitigation effectiveness parameters for use in its assessments. Exponent did not observe input gathering or parameter assessment stages of SCE's development process, as these occurred prior to the scope of work. Exponent attended weekly team meetings from October 2022 through November 2022, five challenge sessions held from October 19-21, 2022, and weekly check-in meetings with the recipients of this memorandum for the duration of our scope of work.

Challenge sessions focused on review and validation of mitigation effectiveness parameters and preliminary RSEs for mitigation programs with SCE management, and weekly team meetings focused on incorporating updates in impacted models and ensuring team members had appropriate resources. In addition to SCE management, challenge sessions were attended by the program managers, engineers, and data scientists who could speak to the RSE parameters and evaluations with appropriate detail in terms of reasoning, methodologies, data sources relied upon, and concluding justifications. SCE additionally utilized a recently developed dashboard that facilitated these challenge sessions by allowing side-to-side comparisons between the inputs and results obtained for various programs. Both participant engagement and the rigor with which RSE development was scrutinized were exceptional.

Following the challenge sessions, Exponent provided the following recommendations for SCE's consideration as part of its continuous improvement for future challenge sessions and preparations of future Wildfire Mitigation Plans:

- Add a "QC Factor Rationale" for each activity to the developed dashboard for ease of access to this information.

- Add descriptions and/or appropriate conversions of program units implemented to the corresponding units modeled within the developed dashboard for ease of access to this information – e.g., if a program addresses spans, but is modeled according to structures, then note the appropriate conversion as X spans = Y structures or similar.

- Catalog the data sources informing the risk models and in evaluating mitigation effectiveness related inputs and indicate relied upon data sources within the developed dashboard.

- Supplement narrative rationales with graphical illustrations within the developed dashboard – e.g., formulas, fault trees, event trees, influence diagrams, etc. – to facilitate communication of rationales.

- Explore incorporating uncertainty into data-derived mitigation effectiveness evaluations.

The success of the challenge sessions can be attributed in large part to the meetings' facilitators, [redacted], with whom we had regular check-in meetings over the duration of our scope of work. Our interactions have been collaborative as iterations of SCE's datasets have been produced, with [redacted] being receptive and responsive to our comments and preliminary recommendations. Overall, we are impressed with their command of both the technical and procedural aspects in preparing the Wildfire Mitigation Plan, organizing supporting teams, and execution of tasks, and we believe these responsibilities are in very capable hands.

CONCLUSIONS

Exponent observed the latter stages of SCE's RSE development process concerning validation, and we were impressed with the organization, execution, technical content, participant engagement, and rigor in these meetings. Regarding SCE's RSE calculations, there is some work to be done in aligning units and spend in the datasets with those forecasted in the RSE Input Template, and we recommend addressing abnormalities identified in the datasets prior to doing so. We also recommend the current datasets be revisited as there are many calculations with updated inputs that retain outputs of prior SCE datasets. Remaining items can be addressed per our findings and recommendations made herein. However, it appears that there are at least some models that are anticipated to inform SCE's RSE calculations for addressing the Wildfire risk that may still be under development. Thus, we recommend exercising caution when considering the evaluated RSEs of these affected programs for decision-making purposes until the informative models are complete and implemented.