

Safety and Enforcement Division

Risk Assessment Section

Staff Report

Pacific Gas and Electric Company

(PG&E)

2017-2019 General Rate Case

Application A.15-09-001

Ed Charkowicz

Amy Baker

Chris Parkes

Arthur O'Donnell, PPS



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1 EXECUTIVE SUMMARY

Risk Assessment is an evolving tool in the regulatory arena. The California Public Utilities Commission is in the process of advancing a new “risk-informed” process to support decision-making in the context of energy utility General Rate Cases (GRCs). The major goal is to improve safety performance of utility operations by applying a transparent and understandable set of utility processes to identify and prioritize significant safety risks, to determine appropriate mitigation programs and projects to reduce or avoid those risks, and to translate those priorities, programs and projects into the GRC budget requests.

The development of this process has been taking place via a 2013 rulemaking proceeding and subsequent applications for Safety Model Assessment Proceedings (S-MAP).¹ Even before the finalization of this new approach to ratemaking, however, California’s major investor-owned utilities have begun incorporating elements of evolving risk assessment models and mitigation programs into triennial GRCs and other rate cases.

The Risk Assessment Staff of the CPUC’s Safety & Enforcement Division (SED) has the responsibility for supporting the S-MAP proceedings and for working with the IOUs to help implement appropriate policies and approaches to accomplish this. As part of that responsibility, SED was directed to prepare this report on Risk and Safety aspects of Pacific Gas and Electric’s (PG&E) General Rate Case

¹ Order Instituting Rulemaking to Develop a Risk-Based Decision-Making Framework to Evaluate Safety and Reliability Improvements and Revise the General Rate Case Plan for Energy Utilities; R. 13-11-006.

application for 2017-2019.² This report provides a description of and analyzes how PG&E's current risk assessment and management process is evolving and how it is being used:

- to identify major risks;
- to determine potential mitigation plans and programs; and
- to inform PG&E's GRC budget requests in order to reduce or avoid those major risks.

Because this is an evolving program, this report is more concerned with describing PG&E's approach and offering useful insights to understand the process through illustrative examples rather than critiquing the particular process or outcomes of that process.

SED Staff is engaged in a parallel process in the S-MAP to apply a more critical evaluation of the utilities' risk models and to provide guidance for greater consistency among them, as well as working through the practical logistics of making risk assessment a more effective tool for regulatory oversight of utility operations and expenditures.³

As a result, this Staff report does not opine on funding levels associated with any project or the risk score ranking prioritizing projects and programs. That remains a process of the traditional rate case approach, allowing the utility and intervenors to advocate for their positions via testimony and evidentiary hearings.

² PG&E 2017 GRC CPUC Application A.15-09-001:
<http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M156/K128/156128660.PDF>

³ In A.15-05-002, et al., SED Staff is providing an analysis of the four major utilities' risk models, as presented in their May 2015 applications and refined via a series of workshops and working groups. The intent of that evaluation is to provide a deeper understanding of the risk scoring methodology and try to bring each of the IOUs' models into closer alignment with each other. It will also propose some changes to the existing models to move toward a more quantitative approach to risk scoring, and offer guidance for filings in future GRCs beginning, as well as raise issues that the Commission might address in future S-MAP proceedings. Because that S-MAP report is not finalized and has not been subject to comments by Parties or determinations by the Commission, this report will not apply the same type or level of critique to the model PG&E has employed in its 2017 GRC.

Staff recognizes that in this Application, PG&E employs new and evolving methods to assess risk and evaluate trade-offs across different lines of business. PG&E's Application makes strong use of qualitative risk assessments. There are many very sophisticated modeling choices available, and using the methods that provide reasonable and effective results – without burdening both intervenors and the utility with unnecessary complexity – should be weighed against the results.

In this GRC, PG&E explains in detail how it uses its modeling processes to assess risks and how its processes have changed over time. PG&E shares what it considers notable successes as it focuses on changing its risk assessment program and corporate culture to ensure that safety is in the forefront of its internal decision-making and operations.

This report will allude to some of these corporate efforts, but they are not the focus of our attention. For example, PG&E's relatively new Safety Culture Initiative is described in detail in GRC testimony, providing a context for infusing safe practices at all levels of the utility and its parent corporation. That Initiative will be examined thoroughly in a separate CPUC investigation,⁴ so it will not be described here. However, it should be recognized that through this effort, PG&E is making a claim as a utility industry leader in this regard.

PG&E's testimony on Safety, Risk and Integrated Planning included a third-party evaluation of the maturity of PG&E's efforts to integrate risk management, asset management and investment management in its decision making and operations. The issues covered in the report extend beyond the concerns of this SED analysis, but provide a useful context. The overall conclusion of the consultant report is that PG&E is progressing in the maturity of its methodologies to include

⁴ Order Instituting Investigation on the Commission's Own Motion to Determine Whether Pacific Gas and Electric Company and PG&E Corporation's Organizational Culture and Governance Prioritize Safety I. 15-08-019, issued September 2, 2015.

risk management as a tool for asset and operational investment. While PG&E appears about midway on the spectrum of maturity measures employed by this consultant, it is currently far ahead of other utilities in this regard.

SED Staff will not attempt to evaluate wither the methodology or conclusions of the Davies Consulting report,⁵ but expect that because it was offered in testimony that GRC Intervenors will have the opportunity to more thoroughly examine the report as part of evidentiary hearings, if they choose.

Somewhat more relevant to this report are executive management promises to strengthen and ingrain the cultural ethic of continuous improvement and identification of safety and compliance issues. This effort has resulted in utility certification under several international standards for asset management and safety management. These certifications are important and provide evidence to the CPUC that independent third-party organizations are reviewing the utility's adherence to a rigorous body of standards.

Though far from an exhaustive analysis of every aspect of PG&E's risk assessment and safety mitigation proposals, this report will attempt to describe in understandable terms what is a rather complex process employed by the utility to assess and prioritize its major risks.

It will highlight relevant portions of PG&E testimony to explain how PG&E is translating that risk effort into identification of mitigations that make up a significant portion of the revenue increases that the utility is seeking in this proceeding. It will also provide a few illustrative examples of major risks and mitigation proposals drawn from electric distribution operations (wildfire mitigation), natural gas operations (cross bore incidents that lead to hazardous gas

⁵ PGE-2, Chapter 5, "Risk Maturity and Integration of Risk, Asset, and Investment Management at PG&E: An Assessment Report" by Davies Consulting, August 2015

leaks) and energy supply (dam safety). Staff's hope is that these examples will provide a useful yardstick by which decision-makers and intervenors alike can assess the many other risk mitigations that PG&E proposes in its testimony.

In addition, Staff has compiled current data and statistics related to recent incidents reported by the utility, citations imposed by the Commission for violations of rules and general orders, and audits of operations conducted by CPUC enforcement staff. This represents a new element of GRC evaluation, as called for by recent legislation.⁶ As a first-time assessment, it is still unclear whether this information will have direct relevance in the Commission's eventual decisions on utility rate requests, but – much like the entire Risk Assessment program in its still nascent state – it provides a platform for the Commission and the utility to build upon in future GRCs.

⁶ PU Code Section 750, added by statute 2014, Ch. 552, Sec. 2 (SB 900, Hill).

1.1 OBSERVATIONS AND CONCLUSIONS

SED Staff has analyzed and evaluated the risk assessment framework and integrated planning processes used by PG&E to identify major risks, and determine potential mitigation plans and programs, and concluded that these methods and processes have, in fact, been effectively used to inform the 2017 GRC budget request.

PG&E, by virtue of having somewhat longer experience in applying sophisticated and complex Enterprise Risk Management practices to its utility operations, is clearly a utility industry leader. However, its processes are still evolving and will further evolve as a result of parallel CPUC proceedings to advance the risk-informed decision-making and risk assessment programs for use in rate cases.

At this time, it would be premature to accept PG&E's Risk-Informed Budget Allocation process as the sole basis for determining reasonableness of safety-related program requests. The current GRC, although partly subject to the new risk-informed decision-making approach, is essentially a transitional case. The traditional tools of intervenor testimony, evidentiary hearings and cross-examination of witnesses must still provide the Commission with a complete record for its decisions.

Risk Assessment is only one part of a comprehensive approach to improving utility safety. The new risk model should also be viewed in the context of a variety of safety initiatives and quality assurance programs that PG&E has described in its testimony. All these elements should work together to instill and foster an improved and visible safety culture among PG&E executives, management, employees, contractors and customers. This requires continuous improvement.

A primary difference in this current GRC is that there has been a concerted and largely successful effort to provide more transparency in both the risk assessment and mitigation process, and in mapping outcomes of that process to proposed expenditures for safety improvement programs. PG&E has also effectively moved safety to a fundamental consideration in its GRC. The testimony is structured in a way to better highlight safety and risk considerations, although more can be done in the future to assist decision makers and intervenors in following the trail from risk assessment to budget request.

There still appears to be differences in how the risk assessment process is conducted or articulated in natural gas operations versus electric distribution operations. Perhaps it is because the gas side of PG&E has been subjected to greater regulatory pressures in the wake of the San Bruno explosion, and the risk models have been applied in a variety of other rate and safety proceedings. Still, the explicit inclusion of risk “drivers” in the natural gas risk registry allows for more transparent matching to proposed mitigation projects. PG&E should continue to bring the process for electric distribution into consistency with the gas program.

With respect to third party accreditation, PG&E should consider seeking accredited third-party ISO 55001 Asset Management certification for PG&E Electric Operations (including Energy Supply). SED encourages utilities to obtain ISO 55001 certification as a means for utilities and the Commission to leverage third parties to improve utility asset and risk management programs. Staff believes that programs such as ISO 55001 force a detailed and thorough condition assessment of major assets, consider major failure modes, and mitigate safety risks from aging

infrastructure. SED also notes that while third party ISO 55001 certification is a useful tool it has limitations.⁷

Pursuant to PU Code Section 750, Staff reviewed data on incident reports and citations for electric and gas violations and considered how it should inform this GRC. Based on this review, Staff concluded that at this point in time, the complex risk prioritization described by PG&E in its GRC likely provides a much more complete picture of how funding should be prioritized and distributed than looking at incident and violation data alone. While this new risk framework is developing, it may be beneficial to identify the associated risks or risk drivers in incident, audit, and citation reports going forward, so utilities and parties can easily identify whether those risks are adequately accounted for in the risk prioritization process.

⁷ In PG&E-17 Supplemental Workpapers, dated January 22, 2016: SED's consultant states "SED audits still are finding records and mapping issues that PAS certification inspectors did not identify. This result brings into question how significant or valuable was the PAS certification and inspections if CPUC audits continue to find map and record issues." (Report dated Sept 30, 2015, submitted in the PG&E Distribution System Recordkeeping OII: I.14-11-008)

2 OVERVIEW

Figure 1⁸



Pacific Gas and Electric Company provides natural gas and electric service to approximately 16 million people throughout a 70,000-square-mile service area in

⁸ Service Territory Map is from PG&E's Electric System:

https://www.pge.com/resources/images/myhome/outages/reliability/460x415_map.jpg
<https://www.pge.com/en/myhome/outages/outage/reliability/index.page>.

northern and central California. Among the largest combined utilities in the United States, PG&E employs over 20,000 persons in a geographically diverse and sometimes challenging physical environment.

Electric: 5.4 million electric customer accounts, 141,215 circuit miles of electric distribution lines and 18,616 circuit miles of interconnected transmission lines.

Gas: 4.3 million natural gas customer accounts, 42,141 miles of natural gas distribution pipelines and 6,438 miles of transportation pipelines.⁹

3 PG&E'S EVOLVING RISK MANAGEMENT PROGRAM

In 2012, PG&E became the first utility under the Commission's initiative to incorporate risk assessment into rate case decision-making.¹⁰ Of California's jurisdictional energy utilities, PG&E now has the longest history of incorporating risk assessment into its rate cases.

3.1 RISK ASSESSMENT AND MITIGATION

PG&E's filed testimony and work papers describe the utility's Risk Assessment Program and its many associated features.¹¹ PG&E explains how it has embraced the state's guidance on risk-informed decision-making. PG&E may be the leader in California in this effort due to the many changes that resulted from the institutional failures that lead up to the San Bruno pipeline explosion. From that

⁹ <http://www.pge.com/en/about/company/profile/index.page>

¹⁰ In March, 2012 the Executive Director of the CPUC directed PG&E to incorporate risk assessment and industry best practices in developing and justifying programs its 2014 general rate case application: <http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=4522>

In November, 2013 the Commission initiated rulemaking R.13-11-006 to develop a common framework to incorporate risk assessment into all energy utility rate cases: <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M081/K856/81856126.PDF>

¹¹ Much of the discussion that follows is drawn from PGE-2, testimony on Safety, Risk and Integrated Planning and associate workpapers WP-2

point onward, PG&E has continued to improve risk assessment, both through internal processes and as an active participant in the CPUC's related rulemakings and proceedings to develop a new risk-informed decision-making process for rate cases.

PG&E testimony expresses a hope that it can continue to advance and mature its risk management practices and become an industry leader by engaging with the broader community of utilities and other asset intensive industries.

PG&E has made progress evolving its Enterprise and Operational Risk Management (EORM) Program since the 2014 GRC. The following outlines PG&E's the progress and future objectives.

3.2 MANAGING SAFETY THROUGH A RISK-BASED DECISION MODEL

PG&E's current and long-term goal is to fully integrate data-driven, risk-based decision-making into the planning process that is the foundation for regulatory rate cases. PG&E sees the risk-based decision-making ultimately supporting safe, reliable and efficient outcomes in all its lines of business (LOBs). PG&E recognizes that the structural foundation begins with establishing the cultural elements and ethos that drives business practices. PG&E sees the first step towards this goal is the establishment risk management infrastructure to create this foundation from which to begin integrating risk awareness and conceptual thinking into the Company's culture and business practices.

To evoke institutional change within PG&E there must be dedicated, sustained effort by management to continually make incremental change over time. Therefore, PG&E has embarked on a systematic iterative approach recognizing that sustained commitment overtime will be required to effect the gradual organizational and cultural changes.

This internal PG&E effort coincides with the California Public Utilities Commission (CPUC or Commission) Decision 14-12-025 that requires new risk informed budgeting methods for processing rate cases that will be fully in effect for PG&E's next GRC in 2020.

As might be expected in the development of new organizational processes, PG&E has also developed a new set of terms and jargon that describes the components, elements or tools it employs. Many of these terms are unique to PG&E, and while they will be described in more detail in the following pages, here is a short-hand description of some major terms:

- Integrated Planning Process -- An enterprise wide process that organizes the functions and processes used to assess risk and then integrate it into the GRC.
- Session D -- An annual session involving executives in reviewing the risk program from the previous year, discussing lessons learned and establishing strategies and plans for future years.
- Risk Registers -- A listing of all risks that have been identified either at the enterprise level or by the individual lines of business (LOB).
- Risk Evaluation Tool -- The RET (model) is used to establish a risk score for each risk in the Risk Register. RET is essentially a formula that factors in likelihood or probability of some adverse event and the potential consequence of that event in order to develop a risk score.
- Risk-Informed Budget Allocation (RIBA) -- A process to inform the prioritization of work for risk mitigation measures and other work in its project portfolio. RIBA should be differentiated from the Risk Register risk score derived under RET, which is calculated based on variables for the likelihood of failure and consequence of failure, to establish the risk ranking of an asset, event or process. The purpose of a RIBA score is to decide what project(s) to do, when or in what order.

3.2.1 PROGRESS TOWARD MEETING RISK PROGRAM GOALS

Beginning in the 2014 GRC, PG&E outlined its program goals for risk management in the 2013-2015-time frame. The following three tables, drawn directly

from PG&E’s 2017 GRC testimony, illustrate both the iterative nature of PG&E’s program development and the status of progress toward meeting established goals.¹²

Table 3.1

**TABLE 3-1
2013 RISK PROGRAM GOALS AND PROGRESS TO DATE**

Line No.	Goal	Progress
1	Have risk registers for all LOBs	This goal has been achieved. The development of formal risk registers began in 2012. Now all LOBs have risk registers. These risk registers are regularly refreshed to take into account any new data or progress made on risk mitigation activities.
2	Launch database for tracking risks and mitigations	This goal has been achieved. PG&E leveraged its existing compliance database – Electronic Compliance Tracking System (ECTS)-Risk, an Assurx-based database – that now houses all risk management information for all LOBs.
3	Senior officers engage in discussion of top risks in Session D, now the first step in PG&E's Integrated Planning process	This goal has been achieved. Session D was first implemented in 2013 and was conducted in 2014 and 2015 as well. Each year, officers discuss the progress they have made and anything new they have learned about risks in their business. Additionally, they discuss their risk management plans for the years to come.
4	Establish metrics for monitoring risk status	This work is underway. As of Session D 2015, approximately 25 percent of all risks in the corporate risk register have associated metrics. This includes having metrics in place for all top risks. The status of these metrics is monitored by the EORM team and by senior management as part of the BPR dashboard discussed above.
5	Strategies and resources to address risks and improve risk management are addressed in planning and budgeting sessions	This goal has been achieved. Following Session D, the Company establishes its strategy and execution plans, both of which are done in recognition of the risks discussed at Session D. Additionally, the Company uses Risk Informed Budget Allocation (RIBA) to prioritize expenditures within the operating units.

In Table 3-2, PG&E shows that of the six 2014 goals, three were achieved and the others must be continually updated. The three with ongoing work include:

¹² PG&E-02: Safety, Risk and Integrated Planning – Prepared Testimony GRC 2017, 9/1/2015, Pg. 3-4 thru 3-7.

- Identifying data needs, fulfill them by gathering information from PG&E and industry sources, and analyze it to better understand the risks. This is ongoing element within the risk assessment program where each LOB performance data and industry benchmarks continually change and affect the risk evaluation exercise.
- Mitigation actions are selected on benchmarking or alternative analysis. Benchmarking has been used for this purpose and will require ongoing efforts to update and monitor the impacts on mitigation actions. This is not a one and done goal.
- Metrics and benchmarking are used to quantify risks and progress in risk reduction. PG&E notes that 45% of top risks used data and models to evaluate the risk.

Table 3.2

TABLE 3-2
2014 RISK PROGRAM GOALS AND PROGRESS TO DATE

Line No.	Goal	Progress
1	Automate tracking and reporting of risk status	This goal has been achieved. ECTS-Risk reports are reviewed by LOB managers on a monthly basis. Additionally, risk management progress relative to plan is reported monthly as part of senior management's BPR dashboard review. The report includes status of key risk mitigations and monitoring metrics in place for top risks in each LOB.
2	Identify data needs, fulfill them by gathering information from PG&E and industry sources, and analyze it to better understand risks	This work—which will be an ongoing element of the risk program—is underway. LOBs use industry benchmarking data to better assess risk management performance. For example, average 911 response times, gas dig in performance, and number of gas leaks per line mile are metrics used by the Gas Operations organization to monitor risks on the gas system.
3	Mitigation actions are selected based on benchmarking or alternatives analysis	This work—which will be an ongoing element of the risk program—is underway. Benchmarking has been used extensively at PG&E over the past five years to help determine goals and objectives for the business. It is best management practices gleaned from others in the industry that often forms the basis of PG&E's risk response plans. Additionally, as of Session D 2015, approximately 60 percent of top risks had alternatives analysis associated with risk mitigation selection.
4	Metrics and benchmarking are used to quantify risks and progress in risk reduction (continuous improvement)	This work—which will be an ongoing element of the risk program—is underway. See Item 3 above. Additionally, as of Session D 2015, approximately 45 percent of top risks used data or models to evaluate the risk. PG&E continues to evaluate options for risk quantification and for measuring risk reduction and expects to further this effort in conjunction with the S-MAP and RAMP proceedings.
5	Use risk factors to help prioritize spending	This goal has been achieved. As described above, PG&E used RIBA in the operational LOBs to prioritize expenditures within the operating units.
6	Risk informs the foundation for regulatory rate cases	This goal has been achieved. Top risks, along with dedicated programs and initiatives intended to manage those top risks were described in the 2015 Gas Transmission and Storage (GT&S) rate case and are described in the 2017 GRC showing.

The 2015 and beyond program goals are categorized as a refinement strategy. Table 3-3 shows the three goals, noting its status. One goal is shown as completed with two underway as follows:

Table 3.3

**TABLE 3-3
2015 AND BEYOND RISK PROGRAM GOALS AND PROGRESS TO DATE**

Line No.	Goal	Progress
1	PG&E uses risk-informed prioritization methodology to underpin resource allocation	This goal is underway. PG&E uses the RIBA process in Electric Operations, Gas Operations, Nuclear Generation, and Power Generation. PG&E is considering expansion of the process to other LOBs. Corporate Real Estate is also taking a risk-based approach to facilities management.
2	Risk and benchmarking information better informs future regulatory cases	This goal is being achieved. PG&E will continue to improve upon this goal as it looks to continuously improve its risk program.
3	Risks move down the risk register as mitigation activities prove effective	This work—which will be an ongoing element of the risk program—is underway. There has been movement of the risks on the risk register, in part due to the introduction of risk mitigation and in part due to improved information and analysis that supports changing the scoring of the risk. The challenges in this area are discussed below.

Analysis

Staff recognizes that in this Application, PG&E employs new and evolving methods to assess risk and evaluate trade-offs across different lines of business. PG&E’s Application makes strong use of qualitative risk assessments. PG&E’s testimony clearly illustrates how its process has evolved over the past three years, how its iterative goals were developed and the current status.

3.3 FUTURE STRATEGIC GOALS

In 2016, according to PG&E, the process goal focus is to levelize risks across the LOBs and organization in a more consistent way, and begin using “risk tolerance” as a part of developing the response plan and alternatives analysis.

The inclusion of risk tolerance would involve the use of uncertainty and use of sensitivities in determining scoring risks and ultimately the relative risk reduction value.

The strategic plan for 2017 includes:

- Quantitatively evaluating asset investment strategies using and building on risk quantification data models and methods piloted in 2016.
- Develop a risk assessment mitigation phase filing that is aligned with Commission direction. (This appears to refer to the Commission proceeding for the Risk Assessment Mitigation Phase (RAMP) report on risk mitigation.)¹³ For top risks LOBs should continue to identify data gaps and develop plans to get data supporting risk quantification and assessment.
- Develop and establish risk tolerance guidance in each LOB's Risk and Compliance Committee (RCC). The guidance should be inculcated throughout the Session D process.
- The outcome from meeting the 2017 objectives should be that the value of risk reductions is factored into the investment planning decisions.

The strategic plan for 2018 includes:

- Include explicit uncertainty analysis in the process used to manage investments and "demonstrate As Low As Reasonably Practicable (ALARP)."¹⁴
- Implement process that consistently considers and documents risk tolerance discussions within each LOB. To quantify the successful implementation of risk tolerance processes the top operational risks and corresponding mitigations should be supported by data useful to demonstrate performance.
- The resultant risk reduction value will be incorporated into integrated planning sessions.

¹³ "...energy utility files its RAMP in the SMAP reporting format describing how it plans to assess its risks, and to mitigate and minimize such risks." Rulemaking 13-11-006, DECISION INCORPORATING A RISK-BASED DECISION-MAKING FRAMEWORK INTO THE RATE CASE PLAN AND MODIFYING APPENDIX A OF DECISION 07-07-004, Pg. 3.
<http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M143/K549/143549328.PDF>.

¹⁴ PG&E-02: Safety, Risk and Integrated Planning – Prepared Testimony GRC 2017, 9/1/2015, Pg. 3-9.

The strategic plan for 2019 includes:

- Establish the process for incorporating risk tolerance within regulatory process to serve as a guide for additional risk mitigation activities. (This appears to refer to incorporating probabilistic Risk Assessment methodology, ALARP concepts and assessment of the value from risk mitigation to form the basis of GRC funding requests.) To achieve this, top risks have quantified performance targets and progress is measured toward targets. The key risk indicators provide information and feedback on risk reduction in all PG&E's risk portfolios.
- As a result, the risk reduction value is explicit and understood and becomes the determining factor in the company's investment decisions.

The strategic plan for 2020 includes:

- Show actual risk reduction benefits. The appropriate quantification of top risks enables alternatives optimized risk informed decisions. Objective and explicit measurement of risk reduction takes place with effective communication to stakeholders.
- Portfolio management made better through institutionalized risk tolerance methods.

Analysis

Staff notes that this five-year strategic plan is an iterative document that gets updated annually. On the surface, it appears that progress comes slowly when steps are expressed incrementally on a year-to-year basis. It is not clear why some of the objectives could not be combined to achieve synergies within the organization. Some of the goals and processes outlined in the five-year strategic plan appear well suited for parallel development and work.

Where there are nexuses with regulatory requirements, there is nothing that prevents PG&E from completing the anticipated regulatory requirements sooner than may be specified through Commission Order. So far, PG&E has taken many proactive steps (e.g. developing and utilizing the SMAP for the 2017 GRC) and

should not let that momentum and energy lapse. By getting ahead of the curve additional refinements to the process can take place through the constructive sharing processes utilized within the regulatory construct.

Additionally, the 2017 effort to identify data gaps and acquire data for risk quantification and assessment should naturally flow into development of baselines, and key risk indicators. This effort would appear to seamlessly flow together and Staff is unsure why that process extends across three years rather than a shorter timeframe. Recognizing that this is an iterative process with built in feedback loops and that continual refinement being one of PG&E's tenets, Staff expects that PG&E's risk assessment and quantification processes and procedures will evolve and get better in time.

Additionally, PG&E could provide clearer explanations why the 2018 quantification goal to implement processes that quantify the data supporting the performance of top operational risks and corresponding mitigations to a baseline would need three years to implement. This also could be directed at the 2020 goal to measure risks mitigation and value reduction impact.

3.3.1.1 ORGANIZATION AND MANAGEMENT STRUCTURE TO SUPPORT RISK BASED DECISION-MAKING

PG&E's basic risk management and governance structure has not changed appreciably since the 2014 GRC. The following outlines the risk management and governance structure:

- A Board of Director-level committee that oversees safety, operational, and nuclear risks and associated mitigation activities.
- Chief Ethics and Compliance officer reports to CEO.
- Risk and Compliance Committees (RCC) for each LOB, chaired by the LOB's most senior officer. The RCC's actively manage LOB operational risks.
- Dedicated Risk Managers in each operational LOB.
- Companywide internal standard based on the ISO 31000 industry risk standard for consistency throughout the organization.

PG&E includes a risk management section in the senior management's monthly Business Plan Review (BPR) dashboard that provides a monthly progress report on the Company's most important priorities. PG&E utilizes centralized risk management staff who oversee and govern the EORM program which reports to the Chief Risk and Audit Officer, who in turn reports to the Senior Vice President and Chief Financial Officer. Risk management staff advises the LOBs to ensure consistent application of the risk assessment principles across the Company. The EORM staff also manages the Company's insurance program to effect financial risk transfer to manage PG&E's exposure to risk.

PG&E organized its efforts toward risk assessment and mitigation around its Enterprise and Operational Risk Management (EORM) program, which has been evolving since the 2014 GRC. PG&E's program is based on International Standards Organization (ISO) 31000 principles aimed at focusing extensive analysis of the inherent enterprise and operational risks, the state of internal and external controls to mitigate, prevent or detect those risks, and potential mitigations.

Analysis:

In general it appears that the changes in the management structure and hierarchy are an improvement and emphasize safety and risk assessment as high priority goals. The Company is in transition and evolving to meet the challenges of implementing risk assessment and integrated planning processes through continuous iterative improvements.

3.4 PROCESSES, METHODS AND TOOLS TO ASSESS RISKS

The Risk Assessment Framework resides in PG&E's Integrated Planning Process (IPP) which is an enterprise wide process that organizes the functions and processes used to assess risk and then integrate it into the GRC.

PG&E's testimony describes the entire Enterprise Risk Management process in great detail, so it would be redundant to try to comprehensively recount that explanation in this report. However, because it is critical to understanding how PG&E is applying risk-assessment tools to its GRC decisions, and how involved executive management is in the decision-making process, the following section will highlight major components of PG&E's process.

In summary, PG&E uses an organizationally complex system in which the individual steps can be described discretely. The Executive Guidance process establishes the Enterprise five-year goals, which then inform the Session D line of business (LOB) discussion of risk management within the LOB and creation of the risk register using the Risk Evaluation Tool (RET). The risk register feeds into the development of potential mitigations (via programs or projects), which are assessed using the Risk Informed Budget Allocation (RIBA).

3.4.1 THE INTEGRATED PLANNING PROCESS

PG&E's integrated planning and budgeting system integrates interconnected subsystems in an iterative phased approach. PG&E calls these subsystems "Sessions". These are legacy terms that only have meaning within PG&E's business.

The first part is called the Executive Guidance forum in January of each year. The Executive Guidance forum generates the five-year plan and areas for strategic importance. The five-year plan goes through an annual iteration and gets adjusted based on new information and inputs from the Session D. The areas of strategic importance drive each LOBs individual projects and programs in the sequential Sessions of the IPP.

Those three Sessions occur in this order:

1. Session D – Line of Business (LOB) Risk and Compliance Mitigation plan.
 - o Top Risks for LOB and PG&E associated with the LOB.

- Risk mitigation and reduction options and strategies.
- 2. Session 1 – (S-1) Strategic Planning - Five-year Operating Plan Review and Update.
 - Five-year LOB operating plan.
 - Objectives, goals and strategies for the LOB, which include risk management.
- 3. Session 2 – (S-2) Execution Planning.
 - Two year forward looking detailed work plan which goes through annual iteration to update and modify.
 - Establish targets and metrics for monitoring.
 - Financial prioritization of proposed work in the detailed plan (Risk Informed Budget Allocation (RIBA)).

Session D

As part of the IPP, Session D is the phase that takes place from January to April, that follows from the Executive Guidance and input from the LOB five-year plan. PG&E uses Session D that culminates in April to establish and revise the LOB risk register for the GRC process. The corporate Chief Risk Officer and the Chief Ethics and Compliance Officer participate with LOB Risk and Compliance Committee (RCC) and senior management to ensure that compliance risks as well as enterprise and operational risks are included in Session D. At the start of Session D, the key goals and objectives are reviewed by corporate senior management with each LOB in order to discuss top enterprise and LOB risks, risk reduction and mitigation to date, potential strategies or additional resources for managing difficult risk mitigations, risk management planning, and any synergies or collaboration across LOBs. In this phase each LOB goes through discussions with the responsible LOB management on risk management plans and progress. Following the overall approach to create, modify and update the risk register, each LOB uses its business specific methods for establishing and refining risks in the risk register.

Risk Register

Risk Register is a listing of all risk associated with enterprise and LOB that the LOB has identified. The risk receives a name, primary association as to whether it is an enterprise or a LOB risk, description of event or circumstance, and impact scenario. Each year the status is updated and the risk goes through the Risk Evaluation Tool (RET) where the scoring takes place.

Risk Evaluation Tool (RET)

It is at this stage that the Risk Evaluation Tool (RET) is used for scoring and ranking of risks in the risk register. RET is a Microsoft Excel spreadsheet-based risk evaluation model and consists of only operational risks that line of business Subject Matter Experts (SME) deem important enough to include for consideration in the RET model. The term “risk register” is used by PG&E to refer to the roster of all threat causes developed in RET. The RET has been under development for four years and is based on the foundational concepts that risk is a product of Consequence and Frequency to develop the risk score. PG&E uses six impact categories to define consequence (e.g. Safety, Environment, Compliance, Reliability, Trust, and Financial) and each risk receives an impact level (e.g. Catastrophic, Severe, Extensive, Major, Moderate, Minor, and Negligible).

To help differentiate the relative risks PG&E uses a weighting to stress certain impact categories over others. For example, Safety has a factor of 0.3 where Compliance has a factor of 0.05. To create greater separation in the scores PG&E uses a logarithmic factor rather than a linear multiplication of the impact category times impact level times frequency.

The output of RET and the risk scores are mapped to a 7x7 matrix with the frequency in the vertical axis and the impact (consequence) in the horizontal axis. PG&E does not have a definite cut-off risk score in RET below which a risk is deemed insignificant to warrant mitigation spending.

Figure 3.1

Frequency Level	Impact Levels						
	Negligible	Minor	Moderate	Major	Extensive	Severe	Catastrophic
	1	2	3	4	5	6	7
Common (7)	10	32	100	316	1,000	3,162	10,000
Regular (6)	6	18	56	178	562	1,778	5,623
Frequent (5)	2	7	23	74	234	740	2,340
Often (4.5)	2	7	21	67	211	668	2,113
Occasional (4)	2	6	18	56	178	562	1,778
Infrequent (3)	1	4	14	43	135	427	1,351
Rare (2)	1	3	10	32	100	316	1,000
Remote (1)	1	2	6	18	56	178	562

Because the initial score is often based on a subjective initial scoring due to the absence of good frequency or impact data the scores have an element of subjectivity. To ensure that subjectivity can be rationalized and that scores in each LOB maintain consistency and integrity PG&E goes through the scoring process “many” times to test sensitivities and different interpretation effects on the end score.

Each line of business maintains its own risk register where the Electric Operations Risk Register¹⁵ has 73 identified risks and Gas Operation’s Draft Risk Register¹⁶ has 195 risks, with 5 and 46 enterprise risks for each respective LOB.

¹⁵ PG&E-04: Electric Distribution – Prepared Testimony GRC 2017, 9/1/2015, Chapter 2, Figure 2-2, Pg. 2-5.

¹⁶ PG&E-03: Gas Distribution – Workpapers Supporting Chapters 2 - 5 and 6A GRC 2017, 9/1/2015, Chapter 3, WP 3-1 thru 3-16.

Risk Assessments

The LOBs management teams use a common framework to perform risk assessments and when completed management team submit the assessments to its respective Risk and Compliance Committee (RCC) who review and discuss the Risk Register scores and recommended mitigations. Any modifications are mutually agreed to before the RCC approve the Risk Register scores and mitigations.

The components of a risk assessment include:

- Risk definition and scope;
- A scoring scenario (worst case “P95”¹⁷ scenario) and the application of the RET to determine a Risk Register score;
- Identification of risk drivers and consequences;
- Identification and assessment of existing controls that bear on mitigation;
- Identification of gaps in control(s); and
- Consideration of alternative mitigation options.

SMEs perform the assessments led by a risk analyst from their respective LOB safety and risk management. The assessment team compiles and analyzes information (e.g. asset condition, event reports, and reliability data) to perform the assessment.

Existing controls are evaluated and any perceived gaps in controls identified. The team also explores and identifies potential new mitigations and enhancements to existing controls during the assessment. The team conducts reviews with the risk owner to discuss alternative mitigations and decisions as to which mitigations to recommend to the RCC. After the RCC approves a risk assessment, the approved mitigations are monitored to ensure completion.

¹⁷ The P95 scenario is based on the concept of plotting a range of outcomes along a distribution and choosing the 95th percentile event for the purposes of the risk discussion, unless quantitative data and evidence exists to support using event probabilities.

The aim is to create a consistent framework for RET scoring that provides a standard basis from which to evaluate relative risk scores for assets, processes, and events.

Session 1

PG&E's primary objective for Session 1 is to optimize the planning process where each LOB uses Session 1 as the review iteration for updating its five-year Strategic Plan. Annually from April through July each LOB reviews the five-year plan considering the risk assessment and RET risk score outflow from Session D as the basis for revising the Strategic Plan. The LOBs use the Executive Guidance in the process to refine LOB goals and its five-year Strategic Plan.

Key aspects of Session 1 include identification of anticipated funding levels for mitigating or managing each top risk using the Risk Informed Budgeting Assessment (RIBA) model, anticipated changes to risk status as implementation of mitigations and initiatives, and development of metrics for assessing progress towards addressing the risks.

Risk Informed Budget Allocation (RIBA)

RIBA is the main investment planning tool used by PG&E. Each LOB in PG&E uses the RIBA process to inform the prioritization of work for risk mitigation measures and other work in its project portfolio. Both capital and expense projects use the RIBA process of PG&E's Integrated Planning Process. LOBs use RIBA throughout the year for interim changes to budget or for trade-off decisions caused by circumstances. PG&E uses RIBA modeling along with other considerations to prioritize spending.

PG&E's Finance organization directs the LOBs use of RIBA. Depending on the purpose, the RIBA results can be sorted multiple ways, such as Major Work Category (MWC), total risk score, or highest to lowest forecast amount by program.

The LOB reviews the results accordingly and prepares a presentation to enterprise management as part of the Integrated Planning Process.

It is important to differentiate the risk score from the RET model for the Risk Register used in Session D and the RIBA program or project score. The main purpose of the Risk Register risk score, calculated based on variables for the likelihood of failure and consequence of failure, establishes the risk rank of an asset, event or process. The only purpose of a RIBA score is to decide what project(s) to do and when or what order. To do so RIBA must basically capture the relative safety, environmental, and reliability risks for each project or program in the portfolio scoring each considering the worst-case event that could credibly occur.

PG&E uses RIBA as tool to calibrate the risks defined by RET across all LOBs and using the common process that facilitates discussion

Session 2

In Session 2 the LOB develops the detailed two-year work plan that outlines how it will achieve the priorities and goals agreed to in Session 1. The work plans go into the detailed performance outcomes for each of the identified priorities and requires a showing of anticipated year-over-year changes in risk profile resulting from the implementation and management of risk mitigations. This analysis identifies specific effectiveness targets and action plans to mitigate each top risk.

Putting it All Together

The LOB leadership team does final review and revision (e.g. funding needs or prioritization) of the Session 2 work plan, finalizing the prioritized work plan and associated funding needs for its respective LOB.

In the fall the CEO and LOB senior officers meet to discuss each LOB's goal and risk management execution plan, alignment with performance metrics, and budget approval for the following year.

The risk and compliance effort from Session D, the strategic plans developed in Session 1, and the execution plans developed in Session 2 form the basis and supporting input to the GRC planning and forecasting process.

3.4.2 CLAIMED RESULTS

PG&E reports positive changes within its organization from its focus on continuous incremental change. PG&E noted the following four areas that provided the most significant drivers for change in its organization.

- Fostering open avenues of communication to give employees the opportunity and encouragement to raise issues or concerns about safety and compliance.
- Applying the Enterprise Corrective Action Program (ECAP), which was first developed and launched at the Diablo Canyon Power Plant (DCPP), to Gas Operations. ECAP provides a standardized and formalized process for employees to report, track and resolve safety and operational issues through corrective actions. PG&E reports that Gas Operations employee-reported issues grew exponentially since the program was rolled out in 2013. PG&E set a goal to implement ECAP across the rest of the Company by 2018.
- PG&E's cites the significant impact its risk management program had on nearly all aspects of PG&E culture.
- PG&E claims to have strengthened its culture around reducing costs. Efficiency initiatives across the entire organization resulted in hundreds of millions of dollars in savings, PG&E states.

3.4.3 MEASURED OPERATIONAL PERFORMANCE IMPROVEMENTS:

- According to PG&E it is in the top 10% response speed to gas odor calls, and increased the number of calls responded - to within an hour to 99.5% in 2014. PG&E said its average response time has been reduced to less than 20 minutes in 2014.
- Significantly improved its 911 response time to 94 percent within an hour.
- Company records on electric service reliability, reducing the frequency and duration of outages for six years running. PG&E has set a five-year goal to achieve first quartile performance in electric reliability amongst its peers.

- After the 2014 Napa Earthquake PG&E was praised by the community for its quick and organized response. The investments in emergency response capability with mobile communications and command units were instrumental in providing first responders a way to ensure minimal secondary damage and stabilize the situation. This made for quicker assessment of damage and potential hazards as well as a faster return to service.

Analysis

The risk assessment process does not rely directly on these performance improvements noted in the GRC, however, they are a lagging indication that internal processes are having an outward facing effect and reduce the probability of customer health and safety issues. The improvement in response time for these noted metrics show implementation of policies, processes and procedures that result in reduced probability of health and safety issues for PG&E customers, also improved customer satisfaction with PG&E service. Staff has not validated the savings claims as this is outside the scope of this report.

3.4.4 BEYOND RISK ASSESSMENT: PG&E'S APPLICATION OF INDUSTRY SAFETY STANDARDS AND BEST PRACTICES

PG&E believes that its Gas Operations LBO has been improved through achieving international certifications¹⁸ for best-in-class standards for asset management that require a high level of effort to achieve and maintain.

ISO 55001 Asset Management

In May, 2014 PG&E Gas Operations announced that it completed a third-party audit and received certification for compliance with Asset Management Standards: International Organization for Standardization (ISO) 550001 and Publicly

¹⁸ International Standards Organization (ISO), the ISO 55001 and PAS 55 certifications achieved by PG&E are considered industry leading standards.

Available Specification (PAS) 55. Risk Management is a component the ISO 55000 Series references Risk Management Standard ISO 31000 as part of Asset Management. ISO 55001 is an international suite of standards designed to provide guidance on asset management best practice. ISO 55001 is a successor to PAS 55. These two certifications show independent third-party validation of the efforts to change the utility operating paradigm and culture towards a more risk based and transparent organization. PG&E claims to be one of the first utility companies in the world to hold both these certifications.

API 1173 - Pipeline Safety Management System (PSMS) Standard

In December 2015, PG&E announced that a third-party auditor (Lloyd's Register) had assessed and found that PG&E's Gas Operations complied with the requirements of the American Petroleum Institute (API) Recommended Practice (RP) 1173 - Pipeline Safety Management System (PSMS) Standard. PG&E contributed towards the development of this Industry Safety Management System (SMS) Standard. API reports that this "provides operators with safety management system requirements that when applied provide a framework to reveal and manage risk, promote a learning environment, and continuously improve pipeline safety and integrity." API developed this standard in response to a National Transportation Safety Board (NTSB) recommendation after a 2010 oil pipeline accident in Michigan. API Adopted this standard in July 2015.

Lloyd's Register reported that most of the elements of API 1173 had already been covered by previous audits of PG&E under PAS 55/ISO 55001.

Performance Metrics:

PG&E measures certain performance metrics to gauge its progress and performance toward a more responsive and safe utility. Employee and Contractor safety metrics include; lost work day (LWD) rate, OSHA recordable incident rate, Near-Hits reported, preventable motor vehicle incidents (PVMI), severe PVMI,

timeliness of reporting work related injuries and accidents, and contractor safety (LWD; days away, restricted or transferred rate; OSHA total recordable injury rate). These metrics are lagging indicators to inform management how the organization is doing. There are no incentives tied to reducing the rates associated with these metrics and there are no targets set which would imply a level of acceptability. These metrics are industry standards, which help management understand how it is doing against its peers in these areas.

Analysis

Adhering to industry recognized safety and asset management standards should result in a positive impact on risk assessment and mitigation. The adherence to industry standards should also increase broad awareness of safety ethos and practices throughout the company when consistently applied and modeled.

Utility certifications under international standards for asset management and safety management are important and provide evidence to the CPUC that independent third-party organizations are reviewing the utility's adherence to a rigorous body of standards. However, Staff recognizes that certificate achievement does not guarantee that risks will be eliminated and continuous effort may be required to achieve risk mitigation and reduction.

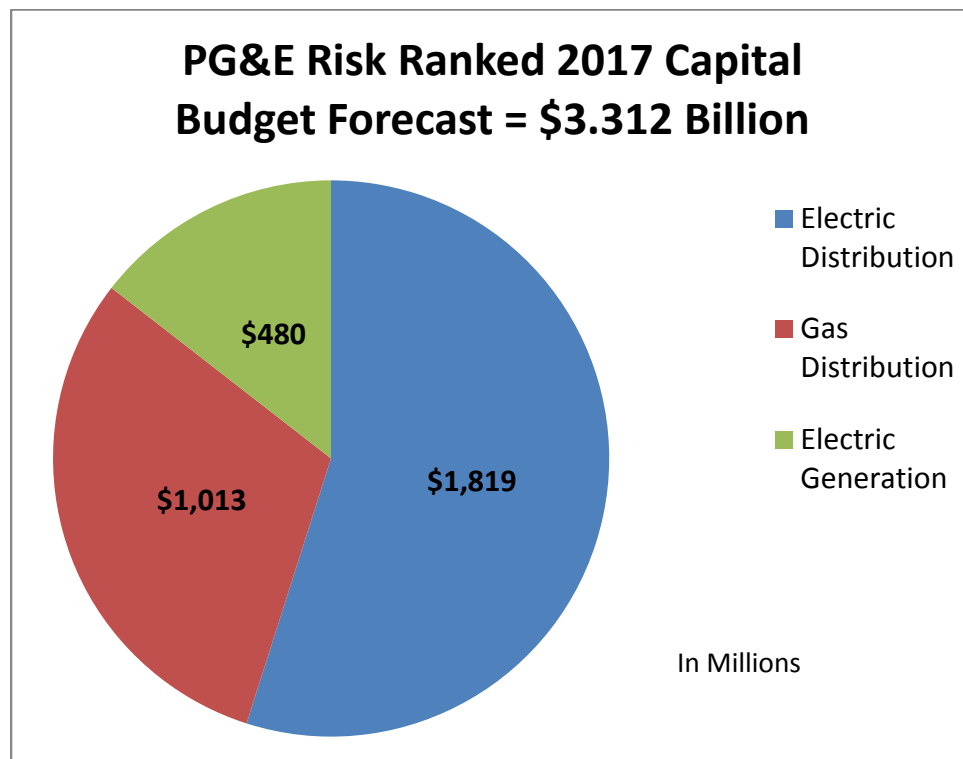
SED encourages PG&E to obtain ISO 55001 certification for its Electric Operations as well as a means for utilities and the Commission to leverage third parties to improve utility asset and risk management programs. This would force a detailed and thorough condition assessment of major assets, consider major failure modes, and mitigate safety risks from aging infrastructure.

4 PG&E 2017 ENTERPRISE RISK MAPPING TO EXPENDITURES

In this GRC PG&E asks for a total revenue requirement of \$8.373 billion, comprised of \$4.376 for Electric Distribution, \$2.170 for Electric Generation, and \$1.827 billion for Gas Distribution. Inclusive in these sums are each LOB's proportion of support function costs (e.g. Customer Care, HR, Administration and General, and IT).

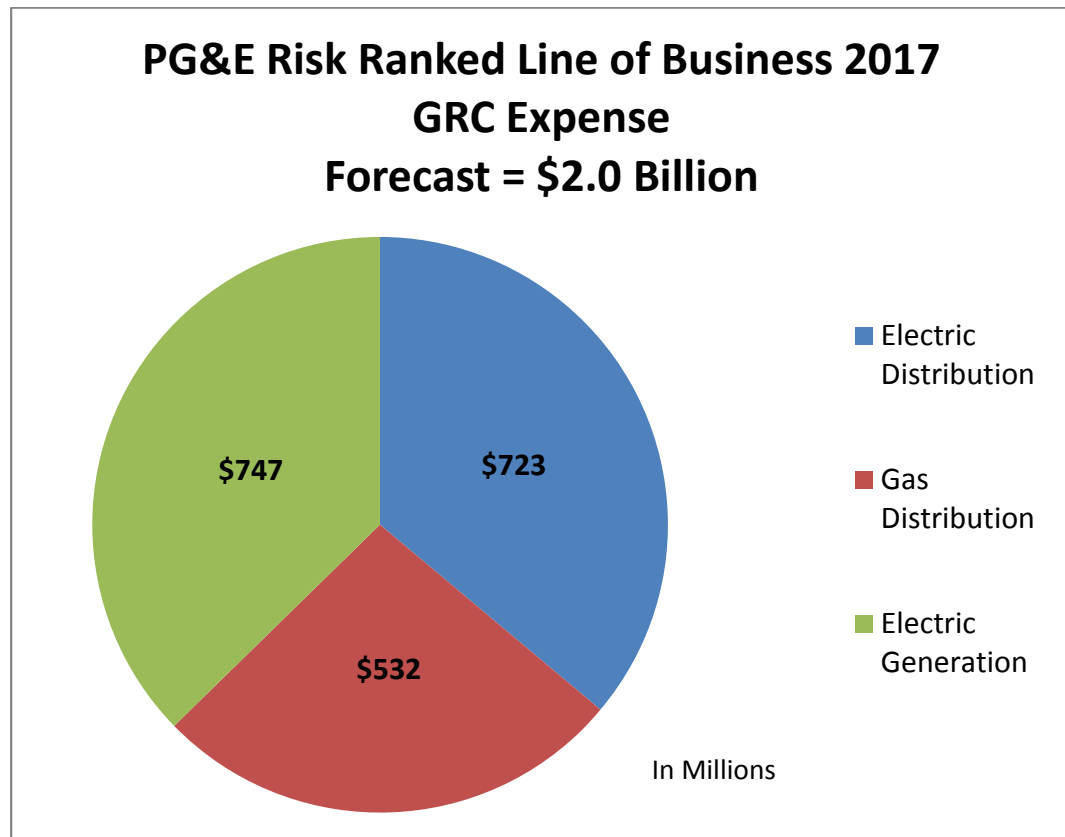
The capital spending requested in PG&E's GRC for the three operational lines of business (LOB) comes to \$3.312 billion, made up of \$1.819 billion for Electric Distribution, \$480 million for Electric Generation, and \$1.013 billion for Gas Distribution. The forecast capital spending increased by \$780 million from 2014 actual for these LOBs.

Figure 4.1



PG&E's operational LOB expense forecast for 2017 comes to \$2.002 billion, made up of \$723 million Electric Distribution, \$747 million Electric Generation, and \$532 million Gas Distribution expenses. This is a \$316 million increase from 2014 actual expenses.

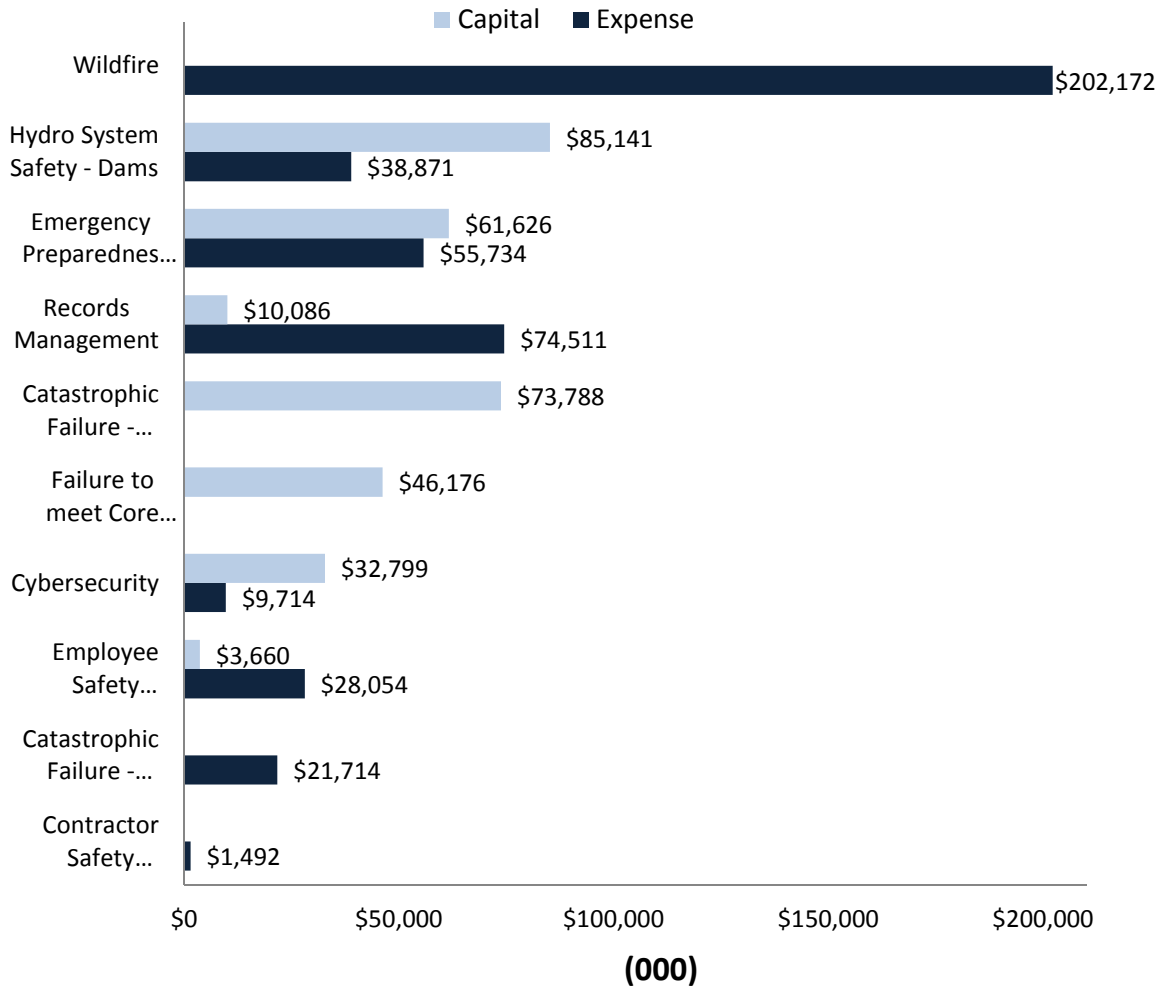
Figure 4.2



Based on figures provided by PG&E, the GRC amount of funding requested that directly relate to mitigation programs for the top identified Enterprise Risks are \$432 million for capital and \$313 million for expenses forecast in 2017. There are other Enterprise risk-related programs that are not subject to this GRC request, particularly funds approved through the Gas Transmission & Storage proceeding (GT&S), which are not included in these figures.

Figure 4.3¹⁹

2017 Forecast Risk Mitigation Related Expenditures Top Enterprise Risks



The Enterprise risk register shows 16 risks with some originating in only one line of business, or where the risk is shared by multiple LOBs, or functional area within the Company. For example, Catastrophic Failure of Compression and Processing is a risk associated with Gas transmission and storage and address within the GRC for Gas Transmission and Storage proceeding.

¹⁹ The chart of top enterprise risks does not include the Gas, Transmission and Storage (GT&S) enterprise risks included in the GT&S rate case.

Cybersecurity is an example of an Enterprise risk shared by Electric Distribution, Energy Supply, and Gas Distribution LOBs as well as IT, Customer Care and Corporate Affairs functional areas. Depending on the type of mitigation, a shared risk such as Cybersecurity would be managed centrally but expenditures allocated to the benefiting LOB's or functions. In general, each LOB or functional area develops mitigations and programs to address its discrete risks that it owns, as ranked in the RIBA process.

Table 4.1

Summary of PG&E Enterprise Risks - 2017 GRC Forecast (000)

	Enterprise Risk	Line of Business Where Included	Expense	Capital
1	Catastrophic Failure - Compression and Processing	GT&S	-	- 1)
2	Catastrophic Failure - Distribution Mains & Service - Cross Bore in Urban Area	Gas Dist.	21,714	-
3	Catastrophic Failure - Natural Gas Storage	GT&S	-	- 1)
4	Catastrophic Failure - Measurement and Control	Gas Dist.		73,788
5	Catastrophic	GT&S	-	- 1)
6	Contractor Safety Program	Safety and Shared Serv.	1,492	
7	Cybersecurity			
		Electric Distribution	500	-
		Energy Supply	1,800	9,300
		Gas Distribution	3,950	3,407
		IT	1,474	14,442
		Customer Care	1,990	3,650
		Corporate Affairs		

			-	2,000
	Total		9,714	32,799
8	Electric Grid Restoration	Electric Distribution	-	-
9	Emergency Preparedness and Response to Catastrophic Events.	Electric Distribution	55,734	61,626
10	Employee Safety Program			
		Electric Distribution	1,550	
		Energy Supply	570	
		Safety and Shared Serv. Admin. & General	25,934	3,660
	Total		28,054	3,660
11	Catastrophic Failure of Substation	Electric Distribution	-	-
12	Failure to meet Core Customer Demand for Design Standard APD	Gas Distribution	-	46,176
13	Hydro System Safety - Dams	Energy Supply	38,871	85,141
14	Nuclear Operations and Safety Core Damage	Energy Supply - DCPD	-	-
15	Records Management			
		Electric Distribution	10,596	
		Energy Supply	1,660	
		Gas Distribution	20,558	
		ERIM (S&SS)	41,697	10,086
	Total		74,511	10,086
16	Wildfire	Electric Distribution	202,172	-
			\$ 432,262	\$ 313,276

(1) Addressed in the G T & S Rate Case

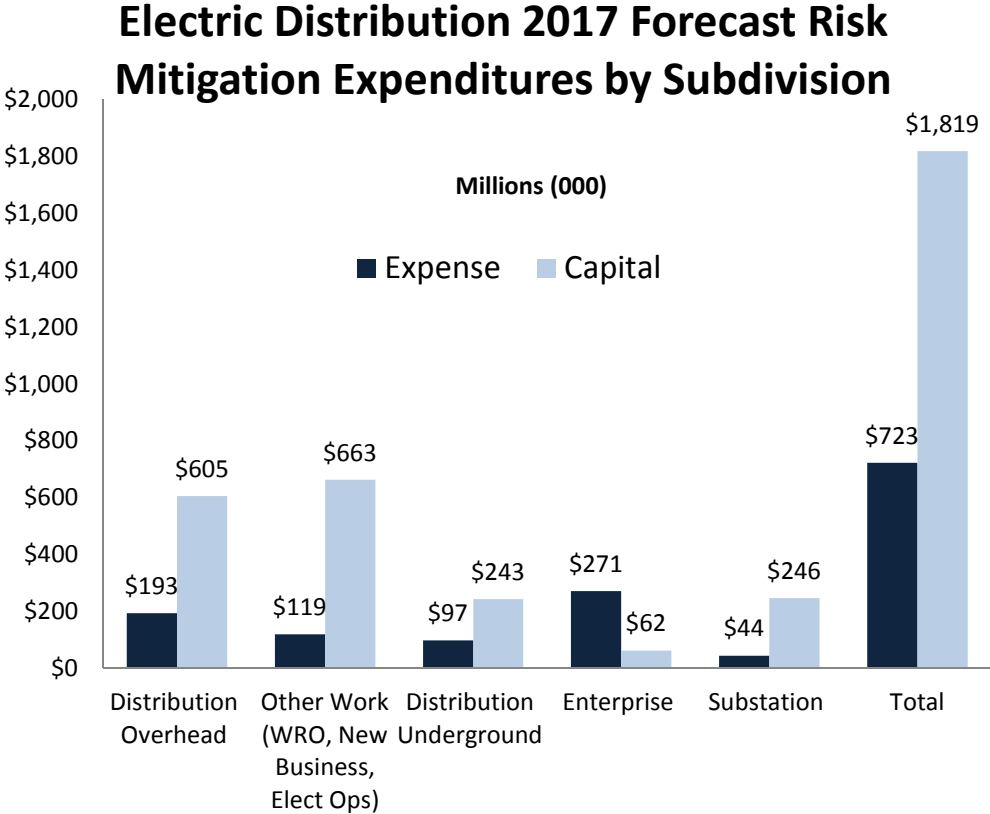
5 RISK ASSESSMENT IN PRACTICE

5.1 ELECTRIC DISTRIBUTION

5.1.1 RISK ASSESSMENT IN PRACTICE – ELECTRIC DISTRIBUTION

In PG&E’s 2017 GRC forecast the Electric Operations (E-Ops) comprised of Energy Supply and Electric Distribution. The Electric Distribution (E-Dist) LOB forecast \$723 million in expense and \$1,819 million in capital 2017 expenditures made up of 115 expense and 444 capital risk mitigation projects.²⁰

Figure 5.1



²⁰ PG&E GRC 2017, Exhibit PG&E-4 WPs supporting chapter 1A, and 2 - 12, Pg. Table 2-7 and Table 2-8, WP2-31 thru 44.

E-Ops identified 73 risks making up its risk register,²¹ five of which are enterprise risks. The E-Ops enterprise risks are Wildfire (Risk Evaluation Tool (RET) score 626), Failure of Substation –Catastrophic (401), Hydro System Safety – Dams (349), Electric Grid Restoration (283), and Emergency Preparedness and Response to Catastrophic Events (280).

The risk register groups the risks by asset or function (e.g. Enterprise (5), Process (12), Energy Procurement (10), Corporate Security (4), Transmission Overhead (6), Distribution Overhead (7), Transmission and Distribution Underground (5), Substation/Switch Yard (9), and Power Generation (17)).

Enterprise Risk includes the risks governed by the LOB or funded by the LOB but governed by corporate functions such as IT, HR, Admin or records management.

Table 5.1

Electric Distribution 2017 Forecast Expenditures Mapped to Risks

	Expense	Capital
Enterprise Risks	(000)	
Wildfire	\$ 202,172	\$ -
Failure of Substation - Catastrophic	-	-
Emergency Preparedness and Response - Catastrophic Events	55,734	61,626
Records Management	10,596	-
Cybersecurity	500	-
Employee Safety	1,550	-
Contractor Safety	-	-
Subtotal	270,552	61,626
Substation Risks		
General	28,783	115,490
Transformers & Voltage Regulators	4,278	39,955

²¹ PG&E GRC 2017, Exhibit PG&E-4, Testimony Chapter 2, Figure 2-2, pg. 2-5.

Protective Relays, Instrument Transformers, & Station Batteries	4,855	2,876
Voltage & Flow Control Equipment	455	6,209
Circuit Breakers & Switch Gear	4,983	73,506
Grounding Systems	-	577
Switches	382	665
Unit Substations	-	142
Bus Structures	-	6,028
Critical Equipment Procurement	-	-
Seismic Resiliency	-	530
Subtotal	43,736	245,978

Distribution Overhead Risk

General	136,171	278,866
Conductor Primary	8,988	74,030
Support Structures	26,498	147,153
Line Equipment - voltage Regulators, Boosters & Capacitors	10,076	27,872
Streetlight Structures	5,028	34,378
Conductor Secondary	-	1,234
Transformers	617	13,498
Line Equipment - Protective	5,191	5,841
Encroachment on EO Assets	-	-
Distributed Generation	-	22,509
Contact Voltage	-	-
Subtotal	192,569	605,381

Distribution Underground Risks

General	80,131	103,889
Network Components	7,056	13,209
Line Equipment	1,045	48,866
Cables	5,979	60,174
Subsurface & Pad-Mount Transformers	3,032	16,867
Subtotal	97,243	243,005

Other Work (Work Requested by Others, New Business, Electric Operations)

New Business, Work at the Request of Others, Rule 20A	32,488	612,157
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Distribution Operations	74,820	14,818
Electric Operations Technology	3,580	32,099
Distribution Support Activities	7,655	3,913
Subtotal	118,543	662,987
Total	\$ 722,643	\$ 1,818,977

5.1.2 ELECTRIC DISTRIBUTION – RISK ASSESSMENT PROCESS

In this example, we selected the Wildfire enterprise risk to follow it through risk assessment framework. The Electric Operation’s 2017 expenditures forecast for both Expense and Capital highlights the Major Program areas. The expenditure forecast for Wildfire is \$202.17 million in expense. Note that there are no capital forecast expenditures for Wildfires.

The Electric Distribution LOB is the owner of the wildfire risk is responsible for wildfire governance. The E-Dist breaks its LOB expenditures into six program categories:

1. Customer Connection, Demand Growth, and Franchise Obligation;
2. Emergency Response;
3. Safety, Maintenance and Compliance;
4. Operations, Automation and Support;
5. Asset Management and Reliability; and
6. Work Efficiency.

The wildfire risk is included in the Safety, Maintenance and Compliance program category. The definition of Wildfire risk is a wildfire²² started by a PG&E asset that endangers life, limb, public and/or private property, and/or sensitive lands.

²² A wildfire is not easily contained.

During Session 1 E-Dist maps its Major Work Categories (MWC), Major Asset Types (MAP), and activity/project to the identified risks. The risks are organized into five categories as follows:

- Enterprise Risk
- Substation Risk
- Distribution Overhead Risk
- Distribution Underground Risk
- Select Process Risk

E-Dist's Session 1 provides several charts in the workpapers to show the expenditure mapping to risks. Staff found E-Dist mapping of 2017 Expense Forecast to Risk Register in Table 6-2²³ and Testimony Figure 2-4²⁴, however, there were no project descriptions provided only the Major Work Category (MWC) and/or Major Asset Type (MAT) codes. Unless one has memorized the codes this chart would be meaningless. Staff does not include these workpapers and charts here, but refers the reader to the location in PG&E testimony in the workpapers discussed below.

E-Dist project/expenditure mapping in the workpapers takes two forms. First they map the mitigation projects, identified by its MWC, MWC Description, MAT and MAT Description to its associated risk. The chart used for this purpose marks the corresponding risk with an "X", and uses a single column for the project's forecast expenditures (See Table 2-5²⁵). Second, E-Dist maps the forecast expenditure for each project (MWC and MAT) to the risk by putting the forecast expenditure in the corresponding risk's column (this allows totaling the risk's project costs) (See Table 2-6²⁶). The charts show the iterative process of mapping the mitigation to the risk and

²³ PG&E GRC 2017, Exhibit PG&E-4, Testimony Chapter 6, Pg. 6-15

²⁴ Ibid. Chapter 2, Figure 2-4, pg. 2-19.

²⁵ PG&E GRC 2017, Exhibit PG&E-4 WPs supporting chapter 1A, and 2 - 12, Pg. WP2-13.

²⁶ Ibid., Pg. WP2-17

then the step where the forecast expenditure is mapped to the risk. Expenditures for both expense and capital projects are mapped in this way.

5.1.3 ELECTRIC DISTRIBUTION – RISK DRIVERS

E-Dist identified four mitigations to address the wildfire risk. The main mitigation is vegetation management and the other smaller mitigation projects involve patrols and inspections, two of which are mandated to be conducted in specific areas on an annual basis.

1. ENVIRONMENTAL- VEGETATION MGMT
2. SYSPLN-BFM-UWF & OWF OH INSPECTIONS (Urban & Other Wildfire Inspections)
3. SYSPLN-BFL-SBWF Patrols (Santa Barbara Wildfire Patrols)
4. SYSPLN-KAP-OH PRJS > \$2SK PERF TAG (Overhead Maintenance Projects)

Staff reviewed the risk register for risk drivers associated with these four mitigation programs. Risk drivers are mentioned in its specific risk program testimony and workpapers. For instance, in the chapter on Vegetation Management E-Dist discusses activities, costs, program description, risks mitigated, organization structure, key metrics and performance measures, cost drivers, and project components. In the risks mitigation section E-Dist notes that... “(t)he Routine Tree Work includes routine inspections of overhead distribution lines to identify trees that need pruning or removal in order to reduce the risk from fires and electrical contact. The inspection and subsequent tree work prevents trees from coming in contact with overhead conductors. This work decreases the likelihood of a vegetation-related ignition and/or incidences of downed wires.”²⁷

It appears the risk drivers for wildfire indicated the E-Dist testimony and workpapers are:

²⁷ PG&E Prepared Testimony, Exhibit PG&E-4, Electric Distribution, pg. 7-3.

- Drought conditions
- Quantity and diversity of trees
- Proximity of urban areas to high risk fire areas
- Fuel load
- Tree condition (re disease and infestation)
- Emergency response capability
- Trees falling into high voltage lines
- Limbs contact with primary and secondary overhead conductors
- Downed lines in wildfire areas
- Wildfires caused by third parties or external forces affecting overhead assets
- Third party tree workers and public
- Non-Compliance to environment rules
- Non-Compliance to clearance regulation
- Reliability – loss of service to vegetation issues (not necessarily wildfire related)
- Wildfire liability costs – firefighting, life and property costs not covered by insurance

The annual inspections and patrols in high fire locals such as Santa Barbara and other urban areas are mandated based on past wildfire experiences, where other areas are only required to be patrolled every five years. Staff had difficulty identifying the risk drivers for the MWC Patrols and Inspections (code 'BF'). E-Dist describes the activities to be performed as “Infrared inspections of overhead equipment, both system wide to look for failed conductor splices and faulty switches, and in selected areas at high risk for wildfire.”²⁸

The implication is that these conditions could cause wildfires and need to be mitigated. It would be helpful if E-Dist explicitly identified risk drivers in supporting workpapers, testimony and in the risk register details²⁹ as well as the risk register summary³⁰ to make them more easily accessible.

²⁸ PG&E Prepared Testimony, Exhibit PG&E-4, Electric Distribution, pg. 6-20 & 21.

²⁹ PG&E GRC 2017, Exhibit PG&E-4 WPs supporting Chapter 1A, and 2 - 12, Pg. WP2-2.

³⁰ PG&E GRC 2017, Exhibit PG&E-4, Testimony Chapter 6, Pg. 6-15

5.1.4 ELECTRIC DISTRIBUTION – RISK MITIGATION AND BUDGET ALLOCATION

The risk mitigation and budget allocation process identified Vegetation Management (VM) as the primary mitigation program for Wildfire and VM has the corresponding highest RIBA score (16,325) for any mitigation identified for E-Dist. Wildfire RET risk score is driven by high scores in all consequence areas (safety, environment, compliance, reliability, trust and financial).

Table 5.2

(In Millions)

Project Name	MWC	MAT	MAT Description	RIBA Score	Flag	2017 Forecast	Program
ENVIRONMENTAL-VEGETATION MGMT	HN	N/A	n/a	16325	Compliance	\$ 200.00	Tree Trimming
SYSPLN-BFM-UWF & OWF OH INSPECTIONS - Urban and Other Wildfire Pole Inspection	BF	BFM	Urban and Other WF Inspection	412	Mandatory	\$ 1.89	Maintenance
SYSPLN-BFL-SBWF Patrols - Santa Barbara – Wildfire Pole Patrol	BF	BFL	SB WF Patrols	412	Mandatory	\$ 0.08	Maintenance
SYSPLN-KAP-OH PRJS > \$25K PERF TAG - Overhead Expenditures Projects	KA	KAP	OH EXP Projects	11	No flag	\$ 0.20	Maintenance
						\$ 202.17	

[MWC = Major Work Category; MAT = Major Asset Type]

Vegetation management mitigation program is designed to minimize or eliminate vegetation contact with PG&E Overhead transmission and distribution lines.

The components of this mitigation include:

- Routine tree work (line patrols, trimming, and removal),
- LiDAR patrols to identify potential and actual vegetation contact issues,
- Vegetation Control,
- Quality Assurance – E-Dist follow up on contractor work,
- Environmental compliance, and

- Public Education.

Other wildfire controls/activities employed by PG&E related to mitigate wildfire risk include:

- Incorporation of wildfire models into annual plans.
- Annual fire preparedness exercises and coordination with Cal Fire and Fire Chiefs.
- Distribution Maintenance and Asset Management –infrared inspections in both urban and wildfire prone areas; install and test existing SCADA system operability; replace equipment in accordance with protocols; and targeted corrective maintenance based on asset condition, location, and fire risk.

PG&E notes that a 2014 governor declaration of emergency due to the drought, and a 2015 CPUC directive to utilities to take “extended measures to address drought –related fire risk”³¹. In response to the 2015 directive PG&E set up a Catastrophic Event Memorandum Account (See Application - A.15-05-016) to include the following activities³²:

- Enhanced vegetation inspections and mitigation,
- Wild land urban interface protection ,
- High fire-risk tree identification and mitigation,
- Fuel reduction and emergency response access,
- Early detection of forest disease and infestation, and
- Early response to wild fires.

These controls and activities help inform the RIBA process. They also highlight drought as a wildfire risk driver, drought conditions, the size of PG&E’s electric system, and the quantity and diversity of trees in the Company’s service territory.

Due to historical wildfire experience and the impact and frequency of wildfires in California it appears PG&E has a good qualitative basis for determining the relative risk scores used in the RET and RIBA. The input from SME’s would help nuance the fire impact and frequency given the dynamic changes to fuel density, wildland

³¹ PG&E Prepared Testimony, Exhibit PG&E-4, Electric Distribution, pg. 2-11.

³² Ibid.

moisture content, location of past fires, location and topology of PG&E's assets in California's wildlands at risk for fires. The amount of funding (\$202.2 million) has not been evaluated only that the budget allocation is supported by the risk assessment process utilized by PG&E.

Though it was apparent that E-Dist used the risk assessment process and RIBA model, Staff could not easily determine how the RIBA scores were determined in the workpapers.

The Workpaper Table 2-7³³ provided the RIBA scores listed the mitigation programs highest to lowest score. This table was difficult to use because the project names, which except for vegetation management, were not easily identifiable to the other risk register, and risk mapping charts used in E-Dist's testimony and workpapers. It would be helpful for PG&E to use a consistent common nomenclature (besides the MWC/MAT code) throughout the GRC to identify projects, especially where tables use extracts from data bases using project short hand, MWC or MAT code to identify projects.

The key metrics employed by E-Dist may indicate whether risk mitigation efforts have an impact on safety and reliability. The primary metrics used by PG&E to measure its vegetation management performance include:

- Number of Vegetation related fires annually. Changes are investigated and explained.
- Compliance to vegetation clearance requirements using statistical sampling.
- Number of vegetation caused service interruptions.
- Customer satisfaction – survey customers who had vegetation work done.
- Cost effectiveness - benchmarking cost per circuit mile, etc....
- Vegetation practices better than industry standards.

³³ PG&E GRC 2017, Exhibit PG&E-4 WPs supporting chapter 1A, and 2 - 12, Pg. WP2-31.

5.1.5 ELECTRIC DISTRIBUTION – CONCLUSION

SED Staff analyzed and evaluated the risk assessment framework and integrated planning processes used by PG&E's Electric Distribution LOB to identify major risks, determine potential mitigation plans and programs, and determined that these methods and processes have, in fact, been used to inform the 2017 GRC budget request.

It appears Electric Distribution's processes are still evolving and will further evolve as a result of parallel CPUC proceedings to advance the risk-informed decision-making and risk assessment programs for use in rate cases.

Staff relied on assertions in PG&E's testimony and workpapers. Based on the documentation it appears that the Risk Informed Budget Allocation RIBA model relies on subject matter experts to effect prioritization scoring of risk mitigation projects. Staff has been unable to fully determine how the RIBA model risk ranks projects and cannot render an opinion on its efficacy. At this time, it would be premature to accept PG&E's Risk-Informed Budget Allocation process as the sole basis for determining reasonableness of safety-related program requests.

It appears the Electric Distribution LOB made a concerted and generally successful effort to provide greater transparency in the risk assessment and mitigation process as well as mapping outcomes of that process to proposed expenditures for safety improvement programs. However, small improvements in documentation and nomenclature would help intervenors and decision makers follow the identified risks, risk drivers and risk mitigations through the GRC to risk expenditure mapping. Staff noted that risk drivers were not explicitly included in the risk register detail. It would be helpful if Electric Operations explicitly identified risk drivers in supporting workpapers, testimony and in the risk register details as well as the risk register summary to provide better matching to the proposed risk mitigation projects and activities.

5.2 GAS OPERATIONS

5.2.1 RISK ASSESSMENT IN PRACTICE – GAS OPERATIONS

In this example, we will walk through PG&E's proposal to fund approximately \$22 million³⁴ in expenditures in 2017 for its Cross Bore Program, and how PG&E presented it within the risk prioritization framework described in this report.³⁵ A cross bore is a gas distribution pipeline inadvertently placed through a sewer line during trenchless construction. When a third party clears the sewer line, it can damage the distribution pipeline, and cause migration of gas into a home or other building. This can lead to significant property damage, as well as injuries and fatalities.

Table 5.3

Gas Operations 2017 Summary Expenditures Mapped to Risks

Enterprise Risks - Only	Expense	Capital
	(Millions)	
Catastrophic Failure: Distribution Mains and Services - Cross Bore in Urban Area	\$ 22	\$ -
Catastrophic Failure: Measurement and Control	-	74
Failure to Meet Core Customer Demand: Abnormal Peak Day (APD)	-	46
Records Management - Gas Distribution	21	-
Cybersecurity - Gas Distribution	4	3
Subtotal	47	123

Gas Operations 2017 GRC

Gas Operations 2017 Summary Expenditures Mapped to Risks with Enterprise Risks included in its functional or asset category.

Loss of Containment	Expense	Capital
	(Millions)	
Cross Bore Program	\$ 22	\$ -
Locate and Mark	40	-
Aldyl-A-Main Replacement	-	249

³⁴ PG&E WP 4-6 lists the expense as \$21,714,000 in nominal dollars.

³⁵ PG&E does not request any capital expenditures for the Cross Bore Program.

Distribution Regulation Upgrades	-	74
Plastic Tee Cap Replacement Program	2	-
LNG/CNG Upgrades and Maintenance	5	4
Corrosion Control	64	22
Gas Pipeline Replacement Project (GPRP)	-	160
System Reliability Mains and Services	-	59
Leak Survey and Repair	132	116
Distribution Integrity Management Program	16	25
Subtotal	281	709

Loss of Supply

Distribution System Capacity	-	46
Work at the Request of Others (WRO)	6	144
Subtotal	6	190

Emergency Response

Emergency Shutdown Zones	-	16
Subtotal	-	16

Support Work

Gas Operations Technology	21	34
Operations and Maintenance	26	-
Field Services	134	4
Gas System Operations	29	39
Other Distribution Support Plans	18	19
Subtotal	228	96

Total	\$ 515	\$ 1,011
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[Unknown difference of \$16mm in Expenses. Differences in Capital expenditure due to rounding.]

5.2.2 GAS OPERATIONS - RISK ASSESSMENT PROCESS

PG&E's divides its gas assets into eight separate asset families, including five that contain natural gas distribution assets. PG&E assigns each asset family an Asset Family Owner (AFO). The AFO is responsible for the asset family, including understanding and managing the health of the assets within its assigned family. AFOs also propose mitigations to Investment Planning.

PG&E then optimizes mitigations at a portfolio level across all assets and programs. The Cross Bore Program is included in the Distribution Mains and Services asset family. According to PG&E, “the Distribution Mains and Services asset family is comprised of approximately 42,000 miles of mains and nearly 3.4 million gas services, which together provides natural gas to the Company’s 4.4 million residential, commercial, and industrial customers.” In addition to the Cross Bore Program, this asset family includes the following programs: Distribution Integrity Management Program, Main Replacement Program, Service Replacement Program, Overbuild remediation, and other gas reliability capital work. PG&E identifies the Cross Bore Program as its own program, but also represents it under the umbrella of the Distribution Integrity Management Program (DIMP) when describing the DIMP funding increase. The DIMP contributed to a \$4.5 million increase in funding from 2014. This increase is partially due to an increase in proposed inspections as part of the Cross Bore Program, from 33,570 inspections in 2014 to 45,000 inspections in 2017.

PG&E identified eight total Enterprise Risks for Gas Operations, five of which are GRC related risks. Some of the risks are related to the Gas Transmission & Storage (GT&S) proceeding only. The eight Enterprise Risks are listed from highest risk score to lowest risk score as follows:

- Cybersecurity (GRC & GT&S)
- Catastrophic Failure – Pipeline (GT&S only)
- Catastrophic Failure – Natural Gas Storage (GT&S only)
- Catastrophic Failure – Distribution (GRC only)
- Failure of Compression & Processing (GT&S only)
- Records Management (GRC only)
- Catastrophic Failure – Measurement & Control (GRC & GT&S)
- Failure to Meet Core Customer Demand for Design Standard Abnormal Peak Day (GRC GT&S)

The highest Enterprise Risk Score was Cybersecurity, which is addressed in both the GRC and GT&S, with a score of 811. Cybersecurity is considered a cross-cutting risk,

meaning it affects other LOBs besides gas. The highest ranked GRC and Gas Operations only related Enterprise Risk is Catastrophic Failure – Distribution, with a risk score of 617. PG&E scored the risks and ranked them using the Risk Evaluation Tool (RET). This exercise takes place as part of Session D. PG&E identified this risk score as primarily safety impact related. The lowest of the Enterprise Risk scores was 537 related to Failure to Meet Core Customer Demand for Design Standard Abnormal Peak Day.

5.2.3 GAS OPERATIONS - RISK DRIVERS

PG&E identified a total of 46 risk drivers across the eight enterprise risks, listed below.³⁶ The top six enterprise risks are highlighted in bold font.

³⁶ PG&E-03 Gas Distribution Testimony, Page 3-16
<https://pgera.azurewebsites.net/Regulation/ValidateDocAccess?docID=346360>

Figure 5.2

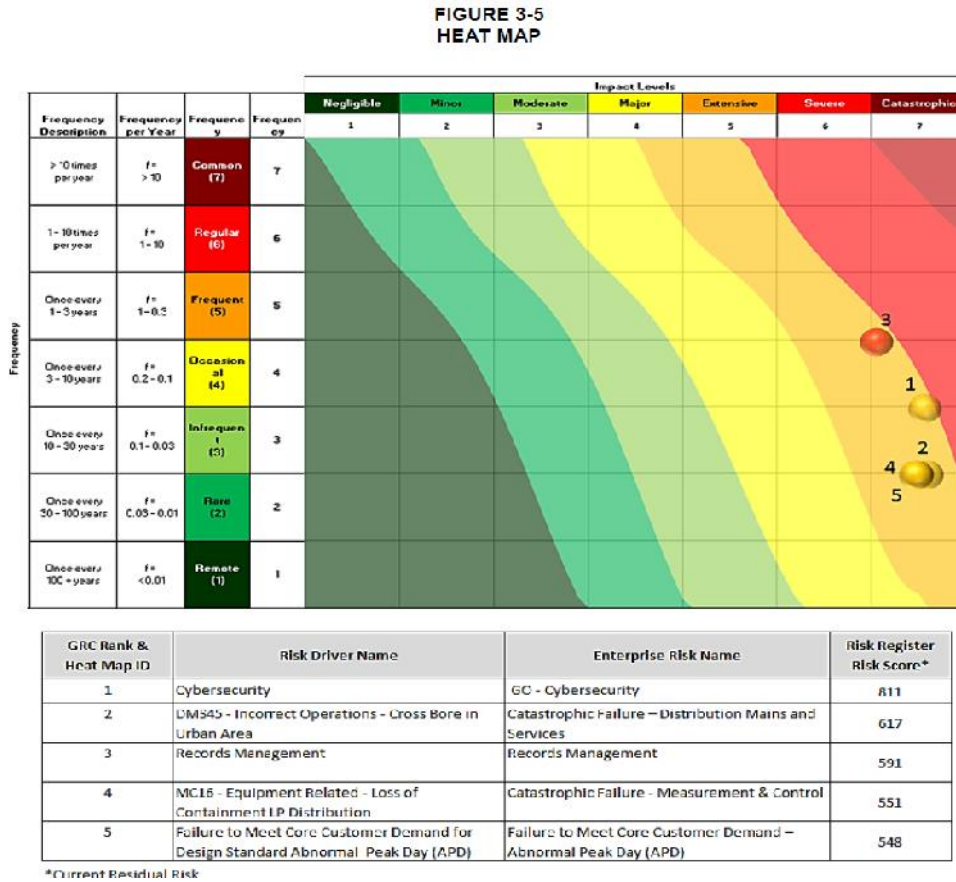
**FIGURE 3-4
GAS OPERATIONS ENTERPRISE RISK AND RISK DRIVERS**

8 Enterprise Risks	46 Gas Operations Risk Drivers	2015 Residual Risk Score	2015 Gas Operations Rank
Cybersecurity (GRC and GT&S)	GO - Cybersecurity	811	1
Catastrophic Failure - Pipeline (GT&S only)	TRA4 - Catastrophic Pipeline Failure - Manufacturing Related Defects	807	2
	TRA8 - Catastrophic Pipeline Failure - Internal Corrosion	807	2
	TRA1 - Catastrophic Pipeline Failure - External Corrosion	807	2
	TRA3 - Catastrophic Pipeline Failure - Welding / Fabrication Related - Pre-1962 Construction with Land Movement	806	5
	TRA12 - Catastrophic Pipeline Failure - Weather Related & Outside Forces - Land Movement	579	11
	TRA11 - Incorrect Operations - Over pressurization	348	22
	TRA9 - Stress Corrosion Cracking	326	23
Catastrophic Failure - Natural Gas Storage (GT&S only)	TRA16 - Equipment Related - Over-Pressure Event	311	33
	STO16 - Internal Corrosion and/or Erosion - Pipeline	804	6
	STO26 - Weather and Outside Forces - Seismic	551	14
	STO17-External Corrosion-Pipeline	313	25
	STO20-Manufacturing-Pipeline	312	30
	STO15-Erosion-Valves	311	33
	STO12 - Erosion - Meters	311	33
	STO18-Fatigue-All Segments	311	33
	STO19-Third Party Damage - Pipeline	310	41
	STO30-1st, 2nd, 3rd Party-All Segments	310	41
STO3 - Construction by 1st & 2nd Party - Reservoir	310	41	
Catastrophic Failure Distribution (GRC only)	DMS45 - Incorrect Operations - Cross Bore in Urban Area	617	7
Failure of Compression & Processing (GT&S only)	CP22 - Weather Related/Outside Forces - Seismic (Manned)	596	8
	CP19 - Third Party/Mechanical Damage - Vandalism	596	8
	CP12 - Manufacturing Defects	551	14
	CP8 - Welding/Fabrication Related	551	14
	CP6 - Incorrect Operations	548	18
	CP10 - Internal Corrosion & Erosion	310	41
	CP5 - Manufacturing Defects - Pipe Quality	310	41
	CP18 - Stress Cracking Corrosion	310	41
	CP1 - External/Internal Corrosion	310	41
	CP2 - External Corrosion - Under Pipe Insulation	310	41
CP7 - Incorrect Operations - Odorization	308	52	
Records Management (GRC only)	DMS40 - Records Management - Distribution Mains & Services	591	10
Catastrophic Failure - Measurement & Control (GRC and GT&S)	MC32 - Weather Related/Outside Forces - Seismic	573	12
	MC15 - Equipment Related - LoC Complex/Simple Station	573	12
	MC1 - Incorrect Operations - LoC LP Distribution	551	14
	MC16 - Equipment Related - LoC LP Distribution	548	18
	MC14 - Welding/Fabrication - Overpressure Complex Station	313	25
	MC4 - Incorrect Operations - Complex Stations	313	25
	MC6 - Incorrect Operations - Backbone (PLS) Stations	313	25
	MC10 - Incorrect Operation - Terminal/Large Complex	313	25
	MC3 - Incorrect Operations - LoC Simple Stations	312	30
	MC13 - Welding/Fabrication - LoC Simple Station	312	30
	MC36 - Equipment Related - Terminal/Large Complex	311	33
	MC19 - Equipment Related - Backbone (PLS) Stations	311	33
	MC18 - Equipment Related - LoC Complex/Simple Station	311	33
Failure to Meet Core Customer Demand for Design Standard Abnormal Peak Day (APD) (GRC and GT&S)	GSO1 - Failure to Meet Core Customer Demand for Design Standard Abnormal Peak Day (APD)	537	20

Once the RET scores are completed, PG&E produces a heat map of the Risk Register risks and RET scores illustrating frequency and impact levels. PG&E identified one risk driver for Catastrophic Failure – Distribution Risk, which was Incorrect

Operations – Cross Bore in Urban Area.³⁷ This risk is identified in the heat map as number 2.

Figure 5.3³⁸



5.2.4 GAS OPERATIONS - RISK MITIGATION AND BUDGET ALLOCATION

The Asset Family Owner for DMS identified the Cross Bore Program to mitigate this risk. Through its Cross Bore Program, established in 2011, PG&E inspects, identifies, and remediates cross bores on the gas distribution system. PG&E estimated that approximately 500,000 sewer lateral inspections would be completed within a 10-year period. As stated earlier, once an Asset Family Owner proposes mitigations, the

³⁷ Also referred to as DMS45.

³⁸ PG&E-03 Gas Distribution Testimony, Figure 3-5, Pg. 3-23.

mitigations are optimized at a portfolio level across all assets and programs as part of Investment Planning. The Risk Informed Budget Allocation tool is used to score projects and prioritize spending. PG&E states that the “objective of this optimization is for Gas Operations to invest in its higher risks with the most effective mitigation programs given constraints including, compliance obligations, obligations to serve, resources, system availability, executability and cost.”

Through its Investment Planning process, the Cross Bore Program received a Program and Project risk score of 1,389, the second highest Program and Project risk score for Gas Distribution. According to PG&E, “the purpose of the Program and Project risk score is to relatively capture the consequence and likelihood scores for Safety, Environmental, and Reliability to determine the worst credible event that could occur if PG&E does not invest in the program or project.” Based on the PG&E RIBA scoring matrix provided below, a score of 1,389 falls in the catastrophic category, somewhere between the occasional and infrequent categories.

Figure 5.4

Frequency Level	Impact Levels						
	Negligible	Minor	Moderate	Major	Extensive	Severe	Catastrophic
	1	2	3	4	5	6	7
Common (7)	10	32	100	316	1,000	3,162	10,000
Regular (6)	6	18	56	178	562	1,778	5,623
Frequent (5)	2	7	23	74	234	740	2,340
Often (4.5)	2	7	21	67	211	668	2,113
Occasional (4)	2	6	18	56	178	562	1,778
Infrequent (3)	1	4	14	43	135	427	1,351
Rare (2)	1	3	10	32	100	316	1,000
Remote (1)	1	2	6	18	56	178	562



Although the RIBA results and risk register scores are different, PG&E describes its methodology to align them in its workpapers. PG&E states that “Program and Project Risk scores are ranked relatively from largest to smallest. These are then grouped into 5 range groups with each range group representing twenty percent of the total population of programs and projects (i.e. the first range group contains the highest twenty percent of program and project risk scores and so on and so forth).

The Risk Register Risk scores for each risk register ID is similarly ranked relatively from largest to smallest and then grouped 1-5 into range groups. The range group of the program and project is then compared to the range group of the top two risks each program or project is aligned to. We consider there to be alignment if one of the risk register 10 range groups match the program and project risk score range group.” Our example project falls into Range Group 1 for both the risk register score and project score, which means the scores are aligned.

PG&E then uses the RIBA results to develop materials for Session 1. Session 1 produces funding recommendations. Finally, PG&E based the proposed costs for the Cross Bore Program on the 2014 costs for performing records reviews and conducting approximately 33,570 inspections. The 2017 costs include assumptions from PG&E about efficiency savings driven by process improvements as well as effective work force strategy and resource management. A breakdown of the Cross Bore Program estimates is provided below:

Table 5.4

Major Project Spending Estimates ²
(Thousands of Nominal Dollars)

MWC JQK - Cross Bore Program	Recorded	Forecast		
	2014	2015	2016	2017
Expense				
Cross Bore Records (Total \$)[*]	\$ 6,276	\$ -	\$ 7,300	\$ 7,300
Number of Inspections	33,570	24,000	40,000	45,000
Cost per inspection ^{**}	\$ 308	\$ 300	\$ 287	\$ 287
Cross Bore Inspection (Total \$)	\$ 10,331	\$ 9,196	\$ 11,460	\$ 12,893
Number of Repairs	186	144	240	270
Cost per repair ^{**}	\$ 5,600	\$ 5,900	\$ 5,635	\$ 5,635
Cross Bore Repair (Total \$)	\$ 1,042	\$ 3,375	\$ 1,352	\$ 1,521
Total Forecast - JQK	\$ 17,649	\$ 12,570	\$ 20,112	\$ 21,714

* 2015 forecast did not break out records review as a separate line item.

** The 2015 unit and unit costs for inspections and repairs do not equate to the expenditure for inspection and repairs because crossbore records review costs were included in those activities.

5.2.5 GAS OPERATIONS - CONCLUSION

Through this example, we conclude that PG&E identified gas operations risks, ranked those risks, identified programs to mitigate risks, and ranked those programs. In the case of the Cross Bore Program, which addresses a highly ranked risk, PG&E chose to increase funding to accelerate inspections associated with the program. With some effort, we were able to take a program funding proposal and determine how PG&E analyzed it within the risk prioritization framework described in the GRC.

While we were able to complete this exercise with the information provided in the testimony and workpapers, PG&E distributed the relevant information throughout its documents with varying terminology and identifications. For example, PG&E describes the Cross Bore Program independently from the Distribution Integrity Management Program in most places, but as a part of the Distribution Integrity Management Program when summarizing expense increases.³⁹

³⁹ Table 4-1 in PG&E Testimony Page 4-2.

Additionally, PG&E uses Distribution Integrity Management Program as the program name for the Cross Bore Program in its GRC Risk Register and Investment Planning Alignment spreadsheet. The only way to identify it as the Cross Bore Program is by its code – JQK. Further, PG&E describes this code as the Maintenance Activity Type (MAT) in the testimony, but in the spreadsheet, PG&E lists this code under the Tier Name column. This spreadsheet is key because it provides the program risk scores and shows whether the program risk score aligns with the RET score.

Finally, PG&E describes the Cross Bore Program in different parts of the testimony and workpapers as Cross Bore Program, Cross Bore Sewer and Cross-Bored Sewer. This can make it difficult to map and track the program throughout the risk assessment process.

In summary, PG&E does not present a tidy explanation justifying funding of a program due to the risk prioritization results, but the information is contained within the testimony and workpapers and we were able to distil this information with some work. Parties may benefit from PG&E providing an explicit conclusion and narrative demonstrating how its risk prioritization process affected funding for a particular program.

6 PG&E RISK MITIGATION PROGRAMS EXAMPLE

6.1 DAM INTEGRITY

PG&E operates 170 dams in Northern and Central California:⁴⁰

⁴⁰ <http://www.pgecurrents.com/2015/05/26/as-national-dam-safety-awareness-day-nears-pge-urges-those-living-downstream-to-have-a-preparedness-plan/>



PG&E ranked Hydro System Safety as one its top five Electric Operations enterprise risks with a risk score of 349. PG&E defines Hydro System Safety risk as “The risk of failure of a PG&E dam or other water storage or conveyance facility that may result in significant damage to third parties, the environment, and/or the Company.” The risk scenario used to score this risk is a low-probability, high-consequence event: A dam develops a major breach causing significant uncontrolled water spillage resulting in multiple lives lost, and major facility, road, and environmental damage with outages lasting more than 6 months.

PG&E forecast capital costs of \$69.8 million for 2017-2019 for Hydro Safety and Regulatory (MWC 2L).

PG&E describes these capital costs as “primarily related to employee or public safety, and regulatory requirements that are not connected with relicensing. The work identified in this category has a high priority and is typically addressed before competing reliability-related work.” PG&E reports this excludes separate capital cost forecasts for reliability related work such as dam and waterway improvements necessary for reliable hydro facility generation (such as water conveyance canal improvements).

PG&E forecast 2017 expenses of \$33.1 million for Dams and Waterways projects (MWC AX). PG&E describes these as specific risk reduction expense projects and exclude routine dam and waterway maintenance.

As examples, these hydro capital cost forecasts include safety risk management mitigation programs for Helms pumped storage generation station and Fordyce Dam:

Helms Pumped Storage

PG&E forecasts \$8.2 million in 2017 to reinforce a Helms access tunnel. Total forecast for the project is \$8.8 million: “This project is necessary to protect workers from rocks falling from the tunnel walls and ceiling.” The project scope is expected to include installation of shotcrete over rock bolted mesh to reinforce the tunnel structure.

Fordyce Dam Leakage Reduction

PG&E forecasts \$5.3 million in 2017 capital improvements for Fordyce dam. Total capital forecast for the project is \$15.9 million: “Lake Fordyce Dam is a composite,

concrete-faced earth-fill and rock-fill dam constructed in stages between 1873 and 1926. PG&E has been closely monitoring leakage in this dam and has been testing to determine the leakage mechanism and path. The dam has a long history of seepage, ranging from 23-60 cubic feet per second at full reservoir (about 10,000-27,000 gallons per minute). This level of seepage would not generally be concerning for a rock fill only embankment, but Lake Fordyce dam contains, as a remnant of its earliest construction phase, about 10,000 cubic yards of erodible soil in the upstream toe. Erosion of this material could result in cracking and damage of the concrete liner that holds water in the reservoir, resulting in an **uncontrolled release of water**. PG&E is continuing to evaluate the best alternative for mitigating the leakage.” [bolding added]

To get a better understanding of PG&E’s dam safety issues, Staff met with the California Division of Safety of Dams (DSOD) in January 2016. DSOD explained some of the challenges it encounters with dam operators in California. Specifically with respect PG&E’s dam risk management program, DSOD expressed concerns with delays in dam mitigation work, and with PG&E’s Energy Supply’s organizational structure that organizes the mitigation work.⁴¹

DSOD based this, in part, upon its assessment of two aspects of PG&E’s dam risk management program:

1. PG&E appeared to lack a structured risk portfolio management program to assess, rank, and effectively mitigate risks at its dams in a timely manner. DSOD considers development of a comprehensive risk portfolio an emerging best practice, and a more effective approach for ensuring mitigation of dam risks.
2. Although PG&E has hired additional staff, its current organizational structure generally impeded expedient and accountable mitigations of issues pertaining to inspections, dam-related assessments, and design/construction projects. PG&E assigns licensing coordinators to interface with regulators and inspectors. Since these Licensing Coordinators generally do not have a dam engineering background, they must arrange for the necessary engineering support to respond to issues raised by DSOD’s engineers. DSOD found the current structure generally leads to a

⁴¹ Staff confirmed their understanding through email dated February 9, 2016, with the Field Engineering Branch of DSOD.

reactive culture rather than a proactive one. DSOD considers permanent assignment of an engineer responsible for specific dams to be a more effective and accountable best practice. DSOD has found operators that engage in that practice are more proactive in addressing and mitigating risks.

Analysis

The 2017 GRC highlights several Energy Supply risk projects associated with dam licensing and mitigation work. It appears PG&E has identified the risk factors and ranked the non-nuclear⁴² generation risks and risk mitigations in accordance with its risk assessment program.

It appears that Energy Supply management should undertake additional communication and coordination with DSOD to ensure that transparency of potential issues are explored in a timely manner and both parties are on the same page regarding risk profiles and evaluation.

7 SENATE BILL 900 – INCIDENTS AND AUDITS

7.1 PUBLIC UTILITIES CODE SECTION 750

PU Code Section 750 states that “The commission shall develop formal procedures to consider safety in a rate case application by an electrical corporation or gas corporation. The procedures shall include a means by which safety information acquired by the commission through monitoring, data tracking and analysis, accident investigations, and audits of an applicant’s safety programs may inform the commission’s consideration of the application.”

⁴² Nuclear generation is under federal jurisdiction and subject to very stringent risk analysis and assessment protocols outside the scope of this report.

The Commission collects data from electric and gas utilities through audits, investigations, and incident reports that utilities are required to submit.

Electric Utilities must report any incident that results in:

- A fatality or personal injury rising to the level of in-patient hospitalization;
- Significant public attention or media coverage; or,
- Damage to property of the utility or others estimated to exceed \$50,000 and attributable or allegedly attributable to utility owned facilities.

Within twenty business days of a reportable incident, the utility must provide a written account of the incident, including a detailed description of the utility's response to the incident and the measures the utility took to repair facilities and/or remedy any related problems on the system which may have contributed to the incident.

7.2 INCIDENT REPORTING

Gas Incidents

Gas utilities must report any incident which results in:

- A fatality or personal injury rising to the level of in-patient hospitalization;
- Public attention or significant news media coverage, including events that are suspected to involve natural gas, which occur in the vicinity of the operator's facilities, regardless of whether or not the operator's facilities are involved;
- Estimated property damage of \$50,000 or more;
- Unintentional estimated gas loss of three million cubic feet or more;
- An event that results in an emergency shutdown of an LNG facility. Activation of an emergency shutdown system for reasons other than an actual emergency does not constitute an incident;
- Incidents which require DOT notification; and
- An event that is significant in the judgment of the operator, even though it did not meet the criteria previously listed.

Utilities must follow up with a fuller report within 30 days.

Incident information reported to the CPUC includes, but is not limited to the following:

- general nature of the incident
- causes
- estimated damage
- time and date
- location
- casualties
- property damage

As one part of our efforts to address PU Code Section 750, we reviewed the SED electric and gas incident databases for PG&E data from 2011-2015.

Number of Gas Incidents

The table below summarizes data on the causes of incidents that involved fatalities and injuries from 2011-2015.⁴³

Table 7.1

Number of Gas Incidents with Injuries and/or Fatalities by Cause	2011	2012	2013	2014	2015	Total
Other	1	3	2	2	1	9
Vehicle	1	0	1	3	3	8
Fire	0	1	0	2	2	5
Digin	0	0	0	0	2	2
Unknown	1	1	1	0	0	3
Total	3	5	4	8	10	27

There were 27 gas incidents reported involving fatalities or injuries from 2011-2015. Seven involved fatalities and 22 involved injuries. Two of those incidents involved both fatalities and injuries. Fatalities and injuries are most frequently associated with

⁴³ It's important to note that the gas incidents database has not been double checked for accuracy. The database has not typically been used to aggregate data and assess trends, and is typically used to review individual incidents and their associated report.

vehicle accidents (eight incidents over five years) and fires (five incidents over five years).

Many of these incidents are reported because they exceed \$50,000 in damage and/or have media coverage. No violations were found for any of the 27 incidents. It is important to note that serious violations and safety problems can be identified without an injury or fatality occurring. Serious violations can be addressed through the citation programs, discussed later. Because the majority of incidents with fatalities and injuries are not related to utility operations, it would be difficult to use this data to support any GRC funding requests.

Electric Incidents

There were fewer than twenty violations found in incident reports that resulted in injuries or fatalities over those five years.⁴⁴ The database shows that five incidents with fatalities, or approximately 25% of incidents with fatalities, involved violations. In addition, eight incidents with injuries, or 20% of incidents with injuries in that same time period involved violations. A fatality was related to a violation in only one incident. Many of the violations found were unrelated to the cause of the incident and several violations were related to late reporting of the incident.

PG&E addresses this in its GRC testimony, stating:

“We will continue to analyze and review leading indicators and work to formally reflect these metrics in our performance management process. An example of this is the work performed regarding Serious Injury and Fatality 24 (SIF) incidents. Our team has gone back and reviewed any incidents that were either serious in nature or had the potential to be serious, with “serious” meaning life-threatening, life-altering or fatal.

⁴⁴ It’s important to note that the electric incidents database has not been double checked for accuracy. The database has not typically been used to aggregate data and assess trends, and is typically used to review individual incidents and their associated report.

From this historical analysis, we were able to identify trends in job processes and groups of employees, and are now able to focus our work on the specific activities that have the most SIF exposure (i.e., the possibility to create a SIF incident). With this targeted insight, we will now be able to create controls, provide specific job checklists and create specific communications to help employees.”

Number of Electric Incidents

The table below summarizes data on the causes of incidents that involved fatalities and injuries from 2011-2015.

Table 7.2

Number of Electric Incidents with Injuries and/or Fatalities by Cause	2011	2012	2013	2014	2015	Total
Vehicle/Aircraft/ Other Object Contact	6	7	5	7	5	30
Other	2	5	4	3	6	20
Utility Work	7	1	3	5	4	20
Vegetation	0	0	2	1	4	7
Equipment Failure	0	0	2	0	1	3
Fire	0	2	0	0	0	2
Natural Cause	0	1	0	0	0	1
Digin	0	0	0	0	0	0
Unknown	0	0	0	0	0	0

Fatalities and injuries are most frequently associated with a vehicle, airplane, or other object (such as a ladder, irrigation pipe, or crane) coming into contact with electrical facilities. These are generally a result of vehicle accidents or non-utility workers/contractors inadvertently contacting an electric line in the course of construction or maintenance. These types of incidents happen on average six times per

year. PG&E identifies third party damage including car-pole incidents and vandalism as key risk drivers for pole failure in its testimony.

Fatalities and injuries are also commonly associated with utility work. Although these incidents many times do not result in a violation, it is possible that injuries and fatalities could be reduced from utility work if workers and subcontractors followed PG&E's guidelines and procedures more closely. Utility work incidents occur on average four times per year over 5 years.

7.3 ELECTRIC AND GAS AUDITS

In addition to incident data, the CPUC regularly audits the electric and gas systems of utilities to insure the utilities are complying with the law and the Commission's general orders. Staff normally conducts audits of the large electric utilities regional units every five years. The gas audit schedule is developed considering the following criteria: the length of time since the unit was last inspected, the safety and compliance history of the inspection unit, the results of Staff's most recent inspections, any activities undertaken by the operator of particular note or interest (such as construction), any significant incidents that indicate systemic problems, weather patterns, and availability of resources.

In the event violations are found, letters listing detailed issues with relevant rules are issued requesting corrective actions. Follow-up audits may be conducted to verify compliance.

The Electric and Gas Audits databases are not currently structured to be able to view aggregated data and determine trends. SED Staff will consider how this data can be organized so that it can be analyzed in a meaningful way. Although this data cannot be viewed in aggregate, serious safety violations can be escalated to a Staff citation or investigation, which we have reviewed in the next section.

7.4 CITATION PROGRAMS

In December of 2011, the Commission adopted a Gas Safety Citation Program. Under the citation program, CPUC Staff has the authority to issue a written citation to gas companies when during the course of an inspection a violation of General Order 112-E or federal standards is found. General Order 112-E contains specific rules governing the design, construction, testing, maintenance, and operation of utility gas gathering, transmission, and distribution pipeline systems and supplements compliance with the federal standards in the Code of Federal Regulations, Title 49, Parts 190, 191, 192, 193, and 199.

The Commission adopted a decision⁴⁵ in December of 2014 establishing an electric safety citation program for General Orders 95, 128, 165, 166, 174, or other decision, code or regulation allegedly violated, satisfying the requirement in Senate Bill 291 (Stats. 2013, Ch. 601).

These citation programs provide important data on serious safety violations by a utility.

Gas Citations

SED has issued a total of seven gas safety citations to PG&E since the inception of the program.⁴⁶ For comparison, SoCalGas has received two citations, and West Coast Gas received one. No other gas companies have received citations. PG&E received three of the citations in 2015.

The citations issued by SED summarize the nature of the violation(s), the risk level of the violations, whether the utility cooperated, and what steps were taken to

⁴⁵ Decision 14-12-001 (D1412001)

⁴⁶ <http://www.cpuc.ca.gov/General.aspx?id=2494>

remedy the situation. Most citations were either identified as low risk or posing unnecessary risk.⁴⁷

One citation issued to PG&E was identified as high risk. The citation identifying the high risk was a result of a natural gas explosion that destroyed a house located in Carmel-by-the-Sea. There were no injuries or fatalities as a result of this incident. SED's investigation found that PG&E failed to follow procedures to update records and failed to provide PG&E's welding crew with accurate information. Records Management is identified as a top GRC related Enterprise Risk in PG&E's testimony. In PG&E's heat map, it is identified as happening occasionally with catastrophic impact (see Figure 5.3 above).

Electric Citations

SED has issued two safety citations to PG&E since the inception of the program.⁴⁸ For comparison, no other electric utilities have received citations. One citation related to a break-in at the Metcalf substation facility. This break-in resulted in a loss of equipment, but no outages, injuries, or fatalities. The second citation found two violations.

One violation was a result of PG&E not marking its underground facilities completely. The second was due to electric facilities located within a sewer pipe (instead of with the minimum clearance of six inches), causing a hazard to third parties. This particular incident resulted in an explosion and injuries to a third party. PG&E assigns a risk score of 245 to the risk of a third party being injured by contacting an underground facility. This score is not particularly high or low.

⁴⁷ Violations include, but are not limited to: late reporting, lack of written quality control and quality assurance procedures to guide its personnel during normal operation and maintenance activities, failure to set pipeline relief valve within the allowable pressure limit, non-standard pipeline testing, and missed leak survey.

⁴⁸ <http://www.cpuc.ca.gov/General.aspx?id=1965>

This appears consistent with how the RET scoring was conducted by PG&E. In contrast, wildfire risk received a score of 626. It happens less frequently, but the impact is catastrophic.

It is important to note that the citations detail immediate corrective actions taken by the utility, as opposed to actions to be taken at a later date in a proceeding such as the GRC.

7.5 SEC. 750 ANALYSIS

Information from the incident reports and citation programs may be used to inform the review of PG&E's risk assessment methodologies, but this data should not entirely drive the risk prioritization. Specifically, the lack of a citation or reported incident may not indicate the likelihood of a risk occurring or not occurring.

At this point in time, the complex risk prioritization described by PG&E in its GRC likely provides a much more complete picture of how funding should be prioritized and distributed. From our review, there are no obvious repeated offenses that would warrant a departure from the risk assessment described in the GRC testimony; however, we do believe it is important to continue to monitoring the data to determine if pervasive problems occur in the future that could inform the risk assessment framework.

While this new framework is developing, it may be beneficial to identify the associated risks or risk drivers in incident, audit, and citation reports going forward, so utilities and parties can easily identify whether those risks are adequately accounted for in the risk prioritization process.

8 CONCLUSION

In this GRC, PG&E explains in detail how it uses its modeling processes to assess risks and how its processes have changed over time and in differing proceedings. PG&E shares what it considers notable successes as it focuses on changing its risk assessment ethos and corporate culture to ensure that safety is in the forefront of its internal decision-making and operations.

The major goal is to improve safety performance of utility operations by applying a transparent and understandable set of utility processes to identify and prioritize significant safety risks, to determine appropriate mitigation programs and projects to reduce or avoid those risks, and to translate those priorities, programs and projects into the GRC budget requests.

SED Staff has analyzed and evaluated the risk assessment framework and integrated planning processes used by PG&E to identify major risks, and determine potential mitigation plans and programs, and concluded that these methods and processes have, in fact, been effectively used to inform the 2017 GRC budget request.

PG&E, by virtue of having somewhat longer experience in applying sophisticated and complex Enterprise Risk Management practices to its utility operations, is clearly a utility industry leader. However, its processes are still evolving and will further evolve as a result of parallel CPUC proceedings to advance the risk-informed decision-making and risk assessment programs for use in rate cases.

At this time, it would be premature to accept PG&E's Risk-Informed Budget Allocation process as the sole basis for determining reasonableness of safety-related program requests. The current GRC, although partly subject to the new risk-informed decision-making approach, is essentially a transitional case. The traditional tools of intervenor testimony, evidentiary hearings and cross-examination of witnesses must still provide the Commission with a complete record for its decisions.

9 APPENDIX A – ELECTRIC OPERATIONS RISKS REGISTER



EO Risk Register – Grouped (73 Total Risks)

As of 7/21/15

<p>ENTERPRISE RISKS</p> <p>ENT1 Wildfire ENT2 Emergency Preparedness and Response to Catastrophic Events ENT3 Failure of Substation (Catastrophic) ENT4 Hydro System Safety – Dams ENT5 Electric Grid Restoration</p>	<p>CORPORATE SECURITY RISKS</p> <p>CSEC1 Asset Security CSEC2 Fairfield Security Control CSEC3 Insider Threat CSEC4 Workplace Violence</p>	<p>SUBSTATION/SWITCHYARD RISKS</p> <p>SS2 Substation Transformers & Voltage Regulators SS3 Substation Protective Relays, Instrument Transformers & Station Batteries SS4 Substation Voltage & Flow Control Equipment SS5 Substation Circuit Breakers and Switchgear SS6 Substation Grounding Systems SS7 Substation Switches SS8 Unit Substations SS9 Substation Bus Structures</p>
<p>PROCESS RISKS</p> <p>PROC2 Critical Equipment Procurement PROC4 Encroachment on EO Assets PROC5 Lack of Transmission Project Delivery PROC6 Workforce Planning PROC7 Lack of Real-time Operational Workaround for Loss of Critical Systems PROC8 Control Room Operational Awareness PROC9 Cover-up/ Fraud PROC10 Risk of Non-Compliance PROC12 Distributed Generation PROC13 Seismic Resiliency PROC14 Voltage Planning and Operation PROC15 Contact Voltage</p>	<p>TRANSMISSION OVERHEAD RISKS</p> <p>ETOH1 Transmission Overhead Conductors ETOH2 Transmission Overhead Steel Support Structures ETOH3 Transmission Overhead Wood Support Structures ETOH4 System Integrity Protection Schemes (SIPS) ETOH5 Transmission Overhead Switches ETOH6 Loss of Transmission Corridor</p>	<p>POWER GENERATION RISKS</p> <p>PG1 Hydro Public Access PG2 Hydro Material Release Into Water PG3 Failure of Generation Facility (Catastrophic) PG4 Fossil High Energy Systems PG5 Fossil Turbine – Generation Systems PG6 Fossil Protection and Control Systems PG7 Fossil Balance of Plant PG8 Fossil Chemical Systems PG9 Fossil Fuel Systems PG10 Hydro Pressure Integrity Systems PG11 Hydro Turbine – Generation Systems PG12 Hydro Protection and Control Systems PG13 Hydro Balance of Plant PG14 Hydro Support Infrastructure PG15 Hydro In-Stream Flow Release (IFR) Valve and Bypass PG16 Fuel Cell Systems PG17 Photovoltaic Systems</p>
<p>ENERGY PROCUREMENT RISKS</p> <p>EP1 AB 32/ Cap-and-Trade EP2 Market Flaws/ Manipulation EP3 New Policy and Market Design EP4 Bulk Power Operations EP5 Portfolio Mix EP6 Above-Market Stranded Costs EP7 Changing GHG Regulations EP9 Safety Standards for PPAs EP10 Significant Natural Gas Price Increase</p>	<p>DISTRIBUTION OVERHEAD RISKS</p> <p>EDOH1 Distribution Overhead Conductor Primary EDOH2 Distribution Overhead Support Structures EDOH3 Distribution Overhead Line Equipment – Voltage Regulators, Boosters, and Cap. EDOH4 Distribution Overhead Streetlight Struc. EDOH5 Distribution Overhead Conductor Secondary EDOH6 Distribution Overhead Transformers EDOH7 Distribution Overhead Line Equipment – Protective</p>	
	<p>T&D UNDERGROUND RISKS</p> <p>EDUG1 Distribution Underground Line Equipment EDUG2 Distribution Underground Cables EDUG3 Distribution Underground Subsurface and Pad-Mount Transformers EDUG4 Network Components (In Urban/ High Density Areas) ETUG1 Transmission Underground Cables and Equipment</p>	