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May 31, 2013

California Public Utilities Commission
Energy Division
ED Tariff Unit, 4th Floor
505 Van Ness Avenue
San Francisco, CA 94102

Re: Response to Protest Received from Division of Ratepayer Advocates regarding PG&E's Advice Letter Filing 3379-G/4215-E, SCE's Advice Letter Filing 2887-E, and SDG&E's Advice Letter Filing 2473-E, California Energy Systems for the 21st Century Proposed Year One Research Projects and Cooperative Research and Development Agreement

Dear ED Tariff Unit:

In accordance with General Order (GO) 96B, Section 7.4.3, Advice Letter Disposition and Review, Replies, Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE), and San Diego Gas & Electric Company (SDG&E) (collectively referred to as the Joint Utilities) hereby respond to the protest submitted by the Division of Ratepayer Advocates (DRA) to PG&E's Advice Letter Filing 3379-G/4215-E, SCE's Advice Letter Filing 2887-E, and SDG&E's Advice Letter Filing 2473-E, the Joint Utilities' California Energy Systems for the 21st Century (CES-21) Proposed Year One Research Projects and Cooperative Research and Development Agreement (CRADA).

On April 19, 2013, in compliance with Ordering Paragraphs (OP) 8, 9, 12, and 14 of Decision (D.) 12-12-031, which directed the Joint Utilities to obtain approval of the CES-21 year one research projects, budget, and CRADA, and pursuant to a 30-day extension authorized by the California Public Utilities Commission's (Commission or CPUC) Executive Director on January 24, 2013, the Joint Utilities filed the above referenced Tier 3 Advice Letter requesting CPUC approval of the CES-21 Proposed Year One Research Projects and CRADA.

On May 16, 2013, DRA submitted a protest to above referenced Advice Letter. DRA's protest recommends that the Commission reject the Joint Utilities' AL for the following substantive reasons:

- The proposed research projects' business cases do not provide the necessary information required to satisfy the criteria imposed by the Commission.
- The Joint Utilities fail to demonstrate that the proposed research projects do not duplicate research undertaken by other utilities, research institutes, the California Energy Commission (CEC), the Electric Power Institute (EPRI), and the United States Department of Energy (DoE).
- The Joint Utilities fail to demonstrate quantifiable customer benefits or that the proposed budgets are just and reasonable; and
- The Joint Utilities' proposed common costs are vague and undetailed, making a reasonableness review impossible. (DRA protest, p. 1-2)

In addition to these criticisms of the proposed CES-21 projects, DRA also raises two procedural objections to the Advice Letter:

- The Joint Utilities' pending petition for modification does not affect the review of this advice letter.
- The Joint Utilities' proposed 18-month duration for the research portfolio of eleven business cases, administrative budget, and CRADA included in the advice letter does not comply with the directives in D.12-12-031.

The Joint Utilities respectfully respond in detail below to each of DRA's recommendations. The response is organized as follows:

Section 1: Response to DRA's criticisms of the business cases and other information on the individual CES-21 business cases (DRA Protest, Analysis and Recommendations, Sections 3, 4 and 5 and Attachment 1)

Section 2: Response to DRA's criticisms of CES-21 common costs (DRA Protest, Analysis and Recommendations, Section 6)

Section 3: Response to DRA's request that the Advice Letter be summarily rejected because of its reference to the Joint Utilities' Petition for Modification of D.12-12-031 and other modifications (DRA Protest, Analysis and Recommendations, Sections 1 and 2).

Section 1: Response to DRA's criticisms of the business cases and other information on the individual CES-21 business cases (DRA Protest, Analysis and Recommendations, Sections 3, 4 and 5 and Attachment 1)

DRA argues that the proposed business cases for each of the Research and Development (R&D) projects do not provide the necessary information required to satisfy the criteria for approval of R&D projects adopted by the Commission in D.12-12-031. DRA also argues that the proposed R&D projects may duplicate research currently, previously, or likely to be imminently undertaken by other utilities, research institutes, the California Energy Commission (CEC), the Electric Power Research Institute (EPRI), or the United States Department of Energy (DoE).

The Joint Utilities and Lawrence Livermore National Laboratory (LLNL) disagree with DRA and provide a point-by-point response to each of DRA's criticisms below.

The CES-21 Projects Do Not Duplicate Other Projects

First, DRA's argument that the CES-21 projects duplicate other R&D project is incorrect. The utilities and LLNL have conducted a thorough evaluation of various current, previous, and imminent work, reviewed papers, interviewed project and program directors, and in some cases received self-evaluations from other entities performing potentially duplicative work and have avoided duplication of work with all proposed projects. This is not accidental. The work proposed in CES-21 was selected, in part, "because" it seeks to solve challenges yet to be addressed by others. Evaluating potentially duplicative work is not simple, and in some cases requires an understanding of the specific research topic and technology involved to accurately assess. Often similar terms are used for very dissimilar work, and sometimes work that appears to use the same techniques, is actually being done with completely different objectives. Although hundreds of projects have been evaluated, for those projects claimed by DRA to be duplicative, a more detailed explanation of the basis by which it was determined that CES-21's proposed projects are different, and of direct benefit the Investor-owned Utilities (IOUs) and their customers, is provided below.

A. Geographic Data Integration for Enhanced Gas System Risk Management

The DRA did not understand the purpose and scope of the project, that it applies to both Transmission and Distribution pipelines. The Distribution system, approximately 10 times larger than the Transmission system (mileage of pipelines, number of records), faces an order of magnitude more difficult challenges for information management than the calculation of MAOP (Maximal

Allowable Operating Pressure) of Transmission pipelines covered by Pipeline Safety Enhancement Plan (PSEP).

Second, the project, in its initial phase, aims to develop tools to transform existing paper records in an electronic form that can feed automated and systematic quantitative risk analysis. The project includes neither the processing of actual records nor the collection of missing data as referred by the DRA from the D.12-12-031 decision. It focuses on developing tools that are needed to process existing records cost-effectively. The first phase of the project is an opportunity to leverage the experience and technologies developed on different projects by national laboratories to reduce costs and reach results that are out of reach through traditional methods.

Also, in its second phase, the project will develop methods and tools to support the effective use of granular data to support system-wide safety assessment of the natural gas infrastructure. This phase of the project, too, will leverage experience and tools developed by the national laboratories to manage very large amounts of data to support decisions.

Another point that was not understood by DRA is the objective of the project to provide tools to integrate multiple sources of data - the paper based records are just one of them - in an integrity management system that will avoid the reactionary acquisition of ad-hoc information and therefore accelerate integrity assessment studies and reduce cost for PG&E's customers.

The project will therefore transform the integrity assessment process of gas systems, distribution and transmission, from manual ad-hoc use of limited data to an automated traceable computation of large, comprehensive and granular information. This transformation is not a challenge specific to PG&E but is faced by the whole gas utility industry as well as many other industrial and commercial sectors.

B. Ensemble Weather Forecasting for Wind and Solar Generation project

DRA states that the Ensemble Weather Forecasting business case may be duplicative of other research that has been funded. This is not the case because of the unique combination of technologies and applications presented in the business case:

- Multi-physics ensemble forecasting
- Combined wind and solar prediction

- Optimization of statistical output to California-specific weather phenomena
- Integration of an operational system into California Utilities' workflow

None of the potentially duplicative projects referenced in DRA's Protest combines these four technologies. It is the integration of these technologies into a usable tool which will improve the utilities' ability to plan and operate the electric grid with a high fraction of renewable energy.

1. Claims of duplication with a research project LLNL conducted for the CEC

DRA claims that the Joint Utilities have not demonstrated that the Ensemble Weather Forecasting project is different from the research project LLNL conducted for the CEC. DRA claims that the Joint Utilities simply plan to extend and improve of the CEC project, and do not explain why the CEC funded project does not adequately address their needs and why more public funds need to be expended on that project. Further, DRA notes that the Joint Utilities do not describe the status of the CEC funded project, and whether any ratepayer benefits have been achieved as a result of LLNL's research, or how additional funding will result in incremental benefits. (DRA, p. 15)

The work that LLNL performed for the CEC was scoped to demonstrate, off-line, that an ensemble forecast of weather and renewable power production could contribute to optimized dispatch of renewable and non-renewable energy resources. It was designed to lay the groundwork for a real-time ensemble forecasting system, and the CES-21 Ensemble Weather Forecasting business case builds upon, and does not duplicate this work. As of this writing (late May, 2013), the final report for the CEC-funded work is being prepared. The CEC's own feedback on this business case was that the proposed work will "extend and improve the current work" in ways that go far beyond the scope of the current CEC/LLNL weather modeling project.

2. DRA claims that the Ensemble Weather Forecasting for Wind and Solar Generation project seems similar to a \$4.1 million DOE funded research project currently underway at the National Center for Atmospheric Research (NCAR) to design a prototype system to forecast sunlight and resulting power for specific solar facilities.

Discussions with Sue Haupt, Director of NCAR's Weather Systems and Assessments Program, revealed NCAR's solar forecasting program is also different from the Ensemble Weather Forecasting project. NCAR's solar forecasting project, funded by DOE and collaborating with SCE, SMUD and

CAISO, is combining advanced forecasting techniques (including some publicly available ensembles and 3-km WRF models) with real-time sensor data including total-sky imagers to predict the power output from utility-scale solar photovoltaic installations. In contrast, CES-21's Weather Forecasting business case will operationalize an optimal forecasting strategy (multi-physics and/or multi-analysis) for both wind and solar energy over California. The IOU's need an "operationalized" tool to improve the utilization of renewable resources and the combined wind and solar analysis being performed under CES-21 will do just that. The work being performed by NCAR is intended to focus on improving the science behind solar forecasting only. When complete, the NCAR work may be useful to incorporate with the broader scoped and applied tool being developed under CES-21.

3. **DRA claims that the Ensemble Weather Forecasting project shares the same characteristics and objectives as the following research projects listed in DRA Table 2, including PG&E's PG&E EPIC Project # 5: Demonstrate New Resource Forecast Methods to Better Predict Variable Output. (DRA, p. 16.)**

DRA's claim fails to recognize the differences between Ensemble Weather Forecasting Project and PG&E's EPIC Project 5. The Ensemble Weather Forecasting Project is intended to develop a methodology that forecast vendors can implement to provide not only a single point weather forecast but also a range of the forecast uncertainty operators may experience during the day. It is not limited to PG&E and the methodology will be applicable to SCE and SDG&E's service areas. The EPIC Project 5 applies only to PG&E sites and is intended to provide a near term single point deterministic forecast. The two projects are synergistic. We anticipate that the findings and results of the CES-21 project will enable us scale up the EPIC project.

4. **Claims of duplication with NCAR's Wind Forecasting Project**

DRA lists NCAR's Advanced Wind Forecasting Project as potentially duplicative of the Ensemble Weather Forecasting Business Case.

Discussions with Sue Haupt, Director of NCAR's Weather Systems and Assessments Program, revealed NCAR's wind prediction project is different from this business case in three ways. First, their program effectively operationalized a multi-physics ensemble approach, but did not necessarily consider a multi-analysis approach to forecasting. Second, it was undertaken in the Midwestern United States, and the results of any optimization and tuning of ensemble forecasting that was performed may not be applicable to

the unique weather phenomena present in California. Third, this project examined wind prediction only, and did not incorporate solar energy which is a major contributor to both utility and behind-the-meter generation. CES-21 will leverage the tools and publications that were produced by this research. However, further research and development under CES-21 is necessary to accomplish the goal of providing the California utilities an optimal forecasting system.

5. Claims of duplication with California Solar Initiative (CSI) Solicitation #1

DRA lists UCSD's project from the California Solar Initiative's Solicitation #1 as potentially duplicative of the Ensemble Weather Forecasting Business Case.

UCSD's project from CSI's Solicitation #1 is focused exclusively on forecasting solar generation. It is dependent on satellite data, and does not indicate that it will incorporate other data streams required to generate a multi-physics, multi-analysis ensemble forecast. No probabilistic forecast will be generated, which would be required for the utilities to optimize their generation under uncertainty.

6. Claims of duplication with California Solar Initiative Solicitation #3

DRA lists UCSD's project from the California Solar Initiative's Solicitation #3 as potentially duplicative of the Ensemble Weather Forecasting Business Case.

UCSD's project from CSI's Solicitation #3 is focused exclusively on forecasting solar generation within the distribution system (generally "behind the meter") and in a specific location within California (SDG&E Territory). They are also not seeking to operationalize this forecast data, but are instead seeking to provide proof-of principle that they can generate it with extremely high accuracy.

LLNL and the Joint Utilities have had numerous discussions with UCSD regarding these projects and have developed the following summary comparison:

The proposed LLNL effort is focused on providing weather and generation forecasts of both wind and solar for all of California. CAISO will use these forecasts to inform their unit commitment schedule and their reserves planning. Additionally, the 3 IOUs will receive the forecasts for planning within their service areas. As of 2011, wind generation in California was roughly 7

times total solar generation* and wind ramp events account for the bulk of planning uncertainty according to the CAISO operators. Thus it is critical that wind forecasting be included in this effort. Due to the finer length scales and greater number of physics parameters associated with wind uncertainty (relative to solar), it will be necessary in this project to use smaller grid cell size (1 km in certain regions) and more than 8 ensemble members. Additionally, in order to inform state-wide operations, a larger domain is needed. Key differences between the LLNL approach and the UCSD approach are:

	UCSD	LLNL
Domain	Part of CA	Western US
Smallest grid cell size	2.5 km	1 km
Ensemble members	8	30-60
Benchmarking	2 days in summer	Multiple months/ all seasons
Renewables	Solar (San Diego)	Solar and Wind (CA)
Recipients of forecasting	SDG&E	CAISO, PG&E, SCE, SDG&E

The Joint Utilities and LLNL intend to continue discussions with the UCSD group and incorporate their findings in terms of benchmarking their models/ensemble members against San Diego solar data in order to avoid overlapping work. If the UCSD group is still providing SDG&E with ensemble forecasts when we are running our forecasts with the WECC weather model, we will do a comparison between the two sets of forecasts to better understand the consequences of using the larger domain.

Each of these projects cited by DRA is demonstrating a subset of the components that will be integrated under CES-21's Ensemble Weather Forecasting BC. As with all CES-21 projects, the Ensemble Weather Forecasting project team will monitor the projects cited by DRA and explore opportunities to partner with entities engaged in these projects in order to take

advantage of synergies between these research projects. However, the project's economic dispatch and planning benefits can only be met by operationalizing an ensemble forecast of both wind and solar power in a framework optimized to California's unique meteorology.

C. Distribution Modeling and Optimization

1. Claim of duplication with Sandia National Laboratory (SNL)'s ARPA-E project, Probability-Based Software for Grid Optimization.

DRA cites an Advanced Research Projects Agency-Energy (ARPA-E) project being conducted by Sandia national Laboratories entitled "Probability-Based Software for Grid Optimization." DRA states "grid optimization seems similar to the Joint Utilities Distribution Modeling and Optimization project" (p. 18). The work Sandia is doing is concerning "electricity transmission" (p. 18) while the CES-21 Distribution Modeling and Optimization project is focused on the distribution system. The ARPA-E website that DRA references makes it clear that work being performed by Sandia is in a different research area than the CES-21 Distribution Modeling and Optimization project. A discussion with Dr. Ross Guttromson, the project contact from Sandia National Lab, confirmed that the Probability-Based Software for Grid Optimization project being performed for ARPA-E is a security constrained unit commitment research effort and not duplicative of distribution research.

2. Claim that the Joint Utilities' plans to leverage and achieve synergies with the CEC's EPIC projects are misleading.

DRA indicates that "the Commission has not yet made a determination on the CEC's proposed first EPIC triennial investment" (p. 19) and therefore questions the mention of CEC EPIC projects that could be synergistic to the Distribution Modeling and Optimization project. Since there is a possibility that the CEC's EPIC plan could be approved by the Commission as soon as June 2013, it seemed prudent to consider the CEC EPIC projects to be imminent research projects. DRA's assertion that these EPIC and CES-21 projects are duplicative is undermined by its acknowledgement that the EPIC projects "have not yet been scoped, solicited, and funded." The Joint Utilities will coordinate with the CEC to ensure there is no duplication and that the projects are coordinated. The Joint Utilities also expect the CEC to administer the EPIC projects efficiently and not duplicate work already performed by other research.

There will be ample opportunity to coordinate and leverage these research projects within the 30 month timeline.

As described in the Joint Utilities Advice Letter, the CEC's proposed work may result in findings from the work that could be beneficial to CES-21. The CES-21 work plan described in the Distribution Modeling and Optimization project is to "analyze the interactions amongst these emerging technologies to determine optimization opportunities and identify impacts to improve overall planning for the distribution system of the future" (Joint Utilities Advice Letter, Attachment 2, LLNL-PROP-632232 p. 5). There is a significant difference between individual emerging technology components being evaluated and a research effort to identify interactions across emerging technologies. DRA also suggests that the CEC work should occur before the CES-21 work commences. The CEC proposed work may be helpful to CES-21, but the Distribution Modeling and Optimization is not dependent on the CEC work. There is no reason to delay commencement of the CES-21 research; coordination can occur during implementation and after funding approval.

The CES-21 Projects Include Potential Quantifiable Customer Benefits

DRA argues that the CES-21 projects do not include any potential quantifiable customer benefits and that therefore the costs of the projects are not just and reasonable. (DRA, p. 20-22)

The Joint Utilities disagree with DRA. The cost-benefit standard for R&D funded by customers under Public Utilities Code Section 740.1(a) is that ratepayer funded research projects "should offer a reasonable probability of providing benefits to ratepayers." In implementing this mandate, D. 12-12-031 required CES-21 business cases for each research project to demonstrate that the potential benefits to ratepayers exceed costs to ratepayers and that the research does not duplicate other research conducted by the utilities. The Joint Utilities have submitted in their AL filing business cases for all proposed research project demonstrating that there is a high probability that the benefits of each of the eleven proposed projects will produce benefits that exceed their costs. Obviously, because these are research projects, and the benefits will not be known for several years, the utilities can only offer estimates of potential or illustrative benefits, some of which were presented in the Joint Utilities' initial application, as DRA acknowledges. However, those benefit estimates, contrary to DRA's assertions that they are vague or arbitrary, do show that there is a high probability that benefits will exceed costs for each and every one of the proposed research projects.

Some examples of methodologies used by the Joint Utilities for quantifying benefits for the CES-21 projects include:

Ensemble Weather Forecasting

Benefits are computed as described in Section 8 of the business case. The Xcel Energy study of the Public Service of Colorado (PSC) estimated \$6M/year savings for a 22% reduction in forecast error. PSC is about ¼ the size of CAISO, so scaling up the savings yields \$24M/yr for CAISO. The NREL study indicated a savings of \$100M/yr for 24% wind penetration and 10% forecast error improvement. CAISO is about 1/3 the size of WECC, so scaling the savings yields \$30M/year. This business case has a high probability of producing forecasting results within this range or better.

Flexibility Metrics

The Joint Utilities rebuttal testimony in A. 11-07-008 quantified \$552 million in potential savings for this research project. The Commission has already found this estimate reasonable and has stated that “The expected research benefits of this project include \$552 million in savings by 2020 from improved resource planning related to the integration of renewables into the grid...” (D.12-12-031, p. 2). While the Joint Utilities cannot guarantee that this research project will be successful, the Joint Utilities have certainly demonstrated that there is a reasonable probability of providing significant benefits to customers.

Planning Engine

Section 8 of the business case for the Planning Engine project provided an estimate of \$30 million benefits in reduced capital costs. The estimate is based on the capital cost for investments currently under consideration (\$2 billion for local reliability generation in Southern California, and \$1.3 billion for 36 transmission projects identified in the 2012-2013 CAISO transmission plan, and very modest 1% reduction in cost from better generation and transmission investment decisions resulting from this project. Therefore, the business case identifies potential benefits that far exceed the project’s cost.

The methodologies for calculating the benefits in the various business cases vary due to availability of data, maturity of the technologies involved in the projects, and general ability to quantify benefits given that safety and security benefits are more challenging to quantify. Every business case presents quantified information on benefits with supporting information. The Appendix below summarizes the benefits for each project.

Distribution Modeling and Optimization

DRA cites an Advanced Research Projects Agency-Energy (ARPA-E) project being conducted by Sandia national Laboratories entitled “Probability-Based Software for Grid Optimization.” DRA states “grid optimization seems similar to the Joint Utilities Distribution Modeling and Optimization project” (p. 18). The work Sandia is doing is concerning “electricity transmission” (p. 18) while the CES-21 Distribution Modeling and Optimization project is focused on the distribution system. The ARPA-E website, that DRA references, indicates that work being performed by Sandia is in a different research area than the CES-21 Distribution Modeling and Optimization project. A discussion with Dr. Ross Guttromson, the project contact from Sandia National Lab, confirmed that the Probability-Based Software for Grid Optimization project being performed for ARPA-E is a security constrained unit commitment research effort and not duplicative of distribution research.

DRA indicates that “the Commission has not yet made a determination on the CEC’s proposed first EPIC triennial investment” (p. 19) and therefore questions the mention of CEC EPIC projects that could be synergistic to the Distribution Modeling and Optimization project. . Since there is a possibility that the CEC’s EPIC plan could be approved by the Commission as soon as June 2013, it seemed prudent to consider the CEC EPIC projects to be an imminent research projects. DRA also stated that the “proposed Distribution Modeling and Optimization project is only scheduled for 30 months, it is unclear how the Joint Utilities will synergize and leverage EPIC projects that have not yet been scoped, solicited, and funded.” The Joint Utilities expect the CEC to administer the EPIC projects efficiently and that there will be ample opportunity to leverage this work within the 30 months.

As described in the Joint Utilities Advice Letter, the CEC proposed work may result in findings from the work that could be beneficial to CES-21. But the CES-21 work described in the Distribution Modeling and Optimization project is to “analyze the interactions amongst these emerging technologies to determine optimization opportunities and identify impacts to improve overall planning for the distribution system of the future” (LLNL-PROP-632232 p. 5). There is a significant difference between individual emerging technology components being evaluated and a research effort to identify interactions across emerging technologies. DRA also suggested that the CEC work should occur before the CES-21 work commences. The CEC proposed work may be helpful to CES-21, but the Distribution Modeling and Optimization is not dependent on the CEC work.

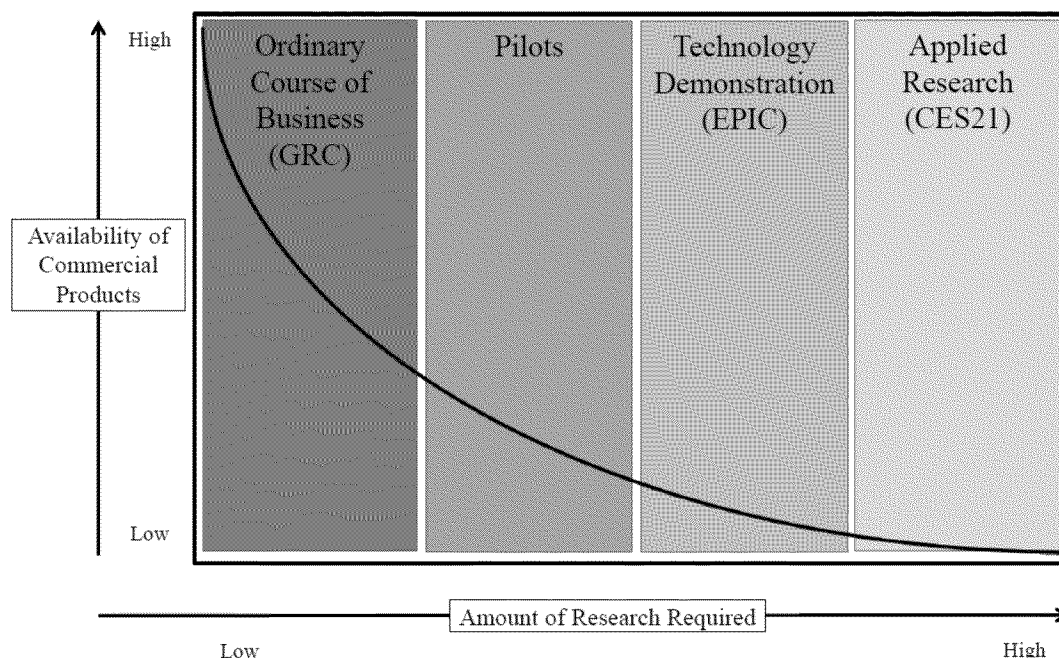
The CES-21 Business Cases are Detailed and Fully Comply with the Commission's Criteria for R&D Projects

In developing the business cases for each of the CES-21 projects, the Joint Utilities have followed the established guidelines pursuant to 740.1 and CPUC decisions approving R&D projects generally, as summarized in D.12-12-031 and other decisions. Throughout the business cases the Joint Utilities provide support to: 1) demonstrate a reasonable probability of providing benefits to ratepayers, 2) avoid duplication of research undertaken by other electrical or gas corporations or research organizations, 3) support the objectives of conservation by efficient resource use or by reducing or shifting system load, enabling the development of new resources and processes, particularly renewable resources and processes which further supply technologies and 4) improve the operating efficiency and reliability or otherwise reduce operating costs.

As DRA recognizes, the purpose of the CES-21 program is to conduct research activities and that the "objective of the CES-21 Project is to apply computationally-based problem solving resources to the emerging challenges of the 21st century energy system (electric and natural gas) for California."

It is important to understand where the CES-21 initiative fits within the overall R&D lifecycle and in relation to other parallel initiatives. The results from these modeling solutions will help implement and utilize systems that will actually produce the benefits. These modeling tools alone cannot produce the benefits without further investment (for instance a Volt/VAR optimization system that actually controls the grid). These tools help utilize the Volt/VAR system, help determine where it is best applied and helps set the system for optimal benefits but cannot replace the need for a Volt/VAR control system. To better understand these dynamics, the CES-21 initiative should be understood as early stage applied research, critical to a prudent development of subsequent R&D stages that take those findings and apply them to developing and implementing technology on the field.

The Joint Utilities acknowledge that certain concepts span multiple projects and/or initiatives. However, the technologies being tested and research being performed for those concepts are distinctly different. The following graph depicts how a concept can span multiple areas along the research spectrum.



Activities that occur during the Ordinary Course of Business utilize commercially available technologies that have been proven within the marketplace or industry. The materials, systems, and equipment utilized as part of Ordinary Course of Business can be implemented with an extremely high confidence of their performance, reliability and benefits.

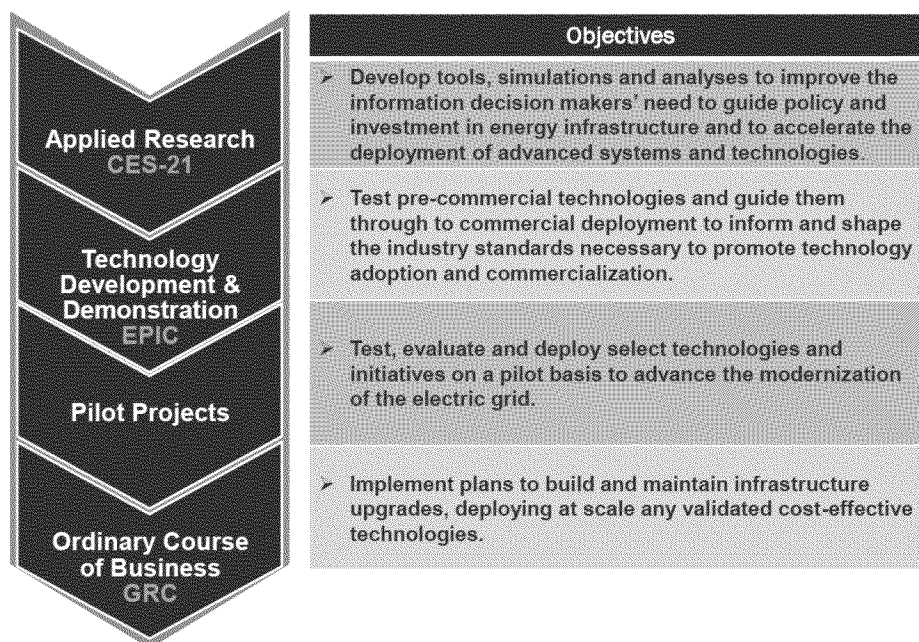
Pilots are undertaken to test commercially available technologies. In some cases, the pilots may be piloting technologies which other utilities have proven the benefits. The purpose of the pilots is to determine whether similar benefits can be achieved in the Joint Utilities' operating areas and systems. The goal of the pilots is to evaluate the technologies within the Joint Utilities' systems to determine whether the technologies provide sufficient cost-benefit for full deployment. Since the technologies are currently available, and in some cases deployed at other utilities, the confidence in the performance, reliability, and benefits is fairly high.

Technology Demonstration projects are used to test emerging technologies within the industry whose performance, reliability, and benefits haven't been fully tested or proven. These technologies are the result of recent research and product development and may even include "beta" versions of the technologies or a 'proof of concept'. In most cases, the technologies are first generation technologies. The purpose of Technology Demonstration projects is to evaluate the emerging technologies to determine the benefits and implementation and maintenance costs. Often times, technology demonstration projects are worked in partnership with the technology vendors so that the vendors can conduct additional research and gather performance data to be used in

developing future version of the technologies. Technologies whose benefits are proven to provide a positive business case may subsequently move to a Pilot for further testing or Ordinary Course of Business. The confidence in the performance, reliability, and benefits of Technology Demonstration projects is less high than for Pilots or Ordinary Course of Business Projects because the projects are testing emerging technologies.

Applied Research (CES-21) projects focus in areas where commercially available technologies are not yet available. The projects may focus in areas where significant research hasn't been performed or in areas that are specific to the Joint Utilities. Applied Research projects typically address specific business challenges with a hypothesis and a way to test that hypothesis. Considerable time and thought has been put in to identify the business challenge and developing the hypothesis to be tested. The projects require significant research due to the lack of commercially available or emerging technologies. The projects typically include the development of the technology—whether it is an algorithm, computer program, or piece of hardware—to evaluate and test the hypothesis. In most cases, Applied Research projects are very iterative as modifications are made based upon the lessons are learned with each iteration. Because Applied Research projects are testing new theories or concepts, the confidence in the performance, reliability, and benefits is the lowest, but the significance of the benefits, if successful are very high. Finally, it is noteworthy to recognize that given the overwhelming amount of data and processing needed to carry out such sophisticated research, partnering with LLNL offers access to unparalleled computing power that could not be reproduced by the Joint Utilities current resources alone.

Following the above rationale, the Joint Utilities intent is to streamline the development of projects following this sequence and CES-21 will inform the subsequent R&D stages as depicted below:



Proposed Project 1 – Advanced Threat Analysis Capability

1. Is there a “Positive business case”?

Yes. The positive business case is based on the fact that the reliability, resiliency, and safety of the grid are in jeopardy from advanced threats and cyber-attacks. The proposed research will improve the resiliency of the power grid against cyber-attacks (mostly based on avoided costs of potential outages) but, like safety, cyber security benefits are difficult to quantify making a positive business case difficult to prove. The proposed research will help protect the grid against these threats and the resulting tools, deliverables, etc. will help the state avoid costly outages due to cyber-attacks.

2. Have the utilities demonstrated that quantifiable customer benefits, including safety and environmental benefits exceed costs on a net present value basis, using a Commission approved methodology?

Yes, to greatest extent possible. In the CPUC CES-21 December 2012 decision the CPUC notes “As with safety, the Joint Applicants did not monetize cyber security privacy and system reliability benefits, which are difficult to quantify.”

Providing quantifiable benefits other than cost avoidance, as shown in later responses, is difficult. As research develops, potential quantifiable benefits to the California IOU customer should be forthcoming but may still be difficult to quantify. For example, if a cybersecurity component successfully prevents an attack that could

have caused an outage, the thwarted attack may go unnoticed. It is always going to be difficult to demonstrate that a negative impact did not occur.

3. What is the overall value of the results from the potential research to ratepayers and to the utility system's safety and reliability?

This research project is to develop advanced Cybersecurity technology to protect the security of California's critical infrastructure. The value to the ratepayers and to the utility system, safety and reliability is to avoid costs associated with recovering from a cyber-event and reduce the impact of outages resulting from a cyber-event. A cyber-attack on California utilities critical infrastructure could have a negative impact on computing systems, field devices like transformers and automated controls that could result in unreliable service.

The impact of a cyber-attack that results in an outage would be devastating on California's economy and result in significant impact on public safety.

Below are is just one of many examples of the types of costs that would be avoided by proactively advancing cyber technology to protect California's ability to defend against cyber-attacks.

- 1) The cost and economic impact of electric outages resulting from the 2004 northeastern United States and Canada blackout
- 2) The estimated cost to include in business cases to recover from a cyber-attack on a regional power system
- 3) The cost of mitigation associated with a cyber-attack on systems

Example 1

September 2004

In a report from Ernest Orlando Lawrence Berkeley National Laboratory:

- "Our base-case estimate of the national cost of power interruptions is approximately \$80 billion annually."

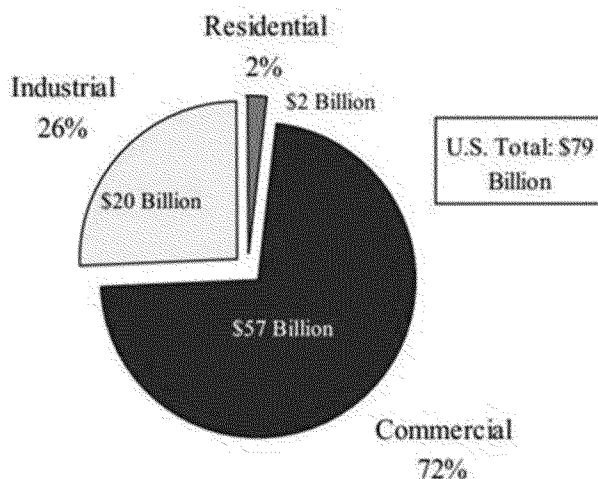


Figure ES- 1. LBNL Base-Case Estimate of the Cost of Power Interruptions by Customer Class

- Between August 14-15, 2004 a massive blackout in the northeastern United States and Canada. The blackout cut electrical power to more than 50 million people in the US and Canada, exacted a heavy toll—causing not only widespread inconvenience but threatening the safety, lives and economic well-being of residents, as well as small and medium-sized businesses.

<http://certs.lbl.gov/pdf/55718.pdf>

This incident underscored a key vulnerability that makes the nation's power grid a marquee target for cyber intruders bent on exploiting existing weaknesses.¹

4. How do the costs of the research compare to potential benefits?

The cost of the proposed cybersecurity research over 5 years is estimated at \$26.5 million. As previous outages have shown (Northeastern US and Canada, 2003 and Southwest, 2011), economic impact will be many multiples of the R&D cost.

5. Would the results of the research have an impact on the ability of the grid to support the competitive provision of electric power or on the ability to integrate non-utility assets and distributed generation onto the grid?

There is no anticipated negative impact on the ability of the grid to support the competitive provision of electric power or on the ability to integrate non-utility assets and distributed generation onto the grid.

¹ Other examples of the costs of system-wide outages or disruptions caused by a cyber attack can be found at <http://smartgridix.com/costs-of-a-cyber-security-attack-on-a-regional-power-system/> and <http://www.networkworld.com/news/2012/100812-ponemon-cyberattacks-263113.html>.

Results of the research from this project could benefit integrated non-utility assets and distributed generation. In several ways:

- 1) This research project could result in the development of commercially available tools that may be leveraged and benefit the security of systems outside of the utilities critical infrastructure.
- 2) During the research effort learning will be shared in public forums, early findings could benefit security of systems outside of the utilities critical infrastructure.

6. Does the proposed research align with CPUC policies?

Yes. CES-21 will conform to CPUC policies as appropriate for a research and development program.

7. Does the proposed research produce specific benefits concerning utility resources including transmission, distribution, generation, system operations, management, and oversight?

The benefit of thwarting a cyber-attack on the state's electric grid is difficult to quantify in terms of utility resources such as generation, transmission and distribution. Cyber-attacks are more likely to negatively impact the reliability of the grid as a whole rather than its individual components. When we consider the effects of a successful cyber-attack on the state's grid as a whole, the results and the cost associated with such an attack can be devastating.

Although the causes may differ, the effects on grid reliability from natural disasters, human errors, or cyber-attacks have the same results – electric outages. If we were to consider the avoided cost of an extended outage as a benefit of the proposed cyber security research, it becomes easier to quantify the potential benefits.

We do not have to go very far to ascertain the order of magnitude in cost of an extended statewide outage. There are many examples of extended outages but probably none as well studied as the 2003 Northeast Blackout. In its April 2004 "Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations" (see #1 below), the US-Canada Power Systems Outage Task Force estimated the cost of the outage between \$4 billion and \$10 billion (dollars). Fortunately, not all outages are as large or occur as often as the 2003 Northeast Blackout. A 2004 Berkeley National Laboratory (see study #2 below) estimates the annual cost of power interruptions in the US at \$80 billion. These costs pertain to the current grid and can be attributed mostly by natural disasters and human error. However, with the creation of a Smart Grid through the addition of Communications and Information Technology, the reliability of the grid is likely to

degrade unless something can be done to protect against and reduce the risk of cyber-attacks.

The proposed research is intended to improve the grid's resiliency against cyber-attacks. Although cybersecurity research benefits are difficult to quantify, it is not difficult to imagine that the avoided cost of outages can amount to billions in savings to the California economy.

1. Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations
<https://reports.energy.gov/BlackoutFinal-Web.pdf>

2. Understanding the Cost of Power Interruptions to U.S. Electricity Consumers

<http://certs.lbl.gov/pdf/55718.pdf>

8. Does the research help foster safe, reliable service at just and reasonable costs?

Yes. This research is aimed at developing technologies that will prevent cyber-attacks and detect latent cybersecurity vulnerabilities in fielded systems. Cybersecurity attacks have affected utilities around the world and the President of the United States emphasized the importance of protecting our electrical grid and other critical infrastructure systems with the recent issuing of Presidential Policy Directive 21 (PPD-21). The 5-year cost of cybersecurity R&D in CES-21 is estimated to be ~\$26M. This cost is far less than even a brief outage caused by a cyber-attack (see widely circulated costs of blackouts in Northeastern US and Canada, 2003 and Southwest, 2011).

Proposed Project 2 – Modeling and Simulation to Identify Cyber Security Vulnerabilities

1. Is there a “Positive business case”?

Yes. The positive business case for the research and development as proposed for the Modeling and Simulation to Identify Cyber Security Vulnerabilities is derived from research that will defend against potential Cyber threats to the California IOU networks that are persistent, or may not have been developed to date. These threats could cause a catastrophic curtailment of IOU supplied resources, therefore, causing business losses across the State if not discovered.

2. Have the utilities demonstrated that quantifiable customer benefits, including safety and environmental benefits exceed costs on a net present value basis, using a Commission approved methodology?

Yes, to the greatest extent possible. Several customer benefits have been enumerated in the Cybersecurity business cases. These fall into categories including

enhancing public safety, proactively protecting against potentially catastrophic and costly cyber events, and developing defenses against unforeseen next generation cyber attacks. By nature these benefits are difficult to quantify, though outage costs from regional blackouts (Northeastern US and Canada, 2003 and Southwest, 2011) are the most pertinent. Measuring Cybersecurity is a difficult R&D problem and "Enterprise Level Metrics" was one of eleven Hard Problems in INFOSEC Research identified by DHS in "A Roadmap for Cybersecurity Research." (<http://www.cyber.st.dhs.gov/docs/DHS-Cybersecurity-Roadmap.pdf>)

3. What is the overall value of the results from the potential research to ratepayers and to the utility system's safety and reliability?

This research will result in tools, techniques, and procedures that will have significant impact on securing CA's grid and thereby improving safety and reliability. By nature these benefits are difficult to quantify, though outage costs from regional blackouts (Northeastern US and Canada, 2003 and Southwest, 2011) are the most pertinent.

4. How do the costs of the research compare to potential benefits?

The costs of the proposed Cybersecurity research over 5 years is estimated to be \$26.5 million. As previous outages have shown (Northeastern US and Canada, 2003 and Southwest, 2011), the economic impact will be many multiples of the R&D cost.

5. Would the results of the research have an impact on the ability of the grid to support the competitive provision of electric power or on the ability to integrate non-utility assets and distributed generation onto the grid?

At this point, we have no way to answer this question definitively. However, it is the IOUs responsibility to ensure a competitive market place as well as ensure new smart grid enabled devices will not introduce vulnerabilities. An example of a program already in place similar to this is the Home Area Network (HAN) device compatibility validation. In this program, each of the 3 CA IOUs validate that vendor technology will not introduce disruption, reliability issues, or cyber security vulnerabilities. The vulnerability analysis proposed will focus on Integrated Control Systems across the California Grid.

SDG&E's program can be found here: <http://www.sdge.com/home-area-network-device-compatibility-validation>

6. Does the proposed research align with CPUC policies?

Yes. CES-21 will conform to CPUC policies as appropriate for a research and development program.

7. Does the proposed research produce specific benefits concerning utility resources including transmission, distribution, generation, system operations, management, and oversight?

Yes, to the greatest extent possible. As stated in the DRA protest, there are six operational benefits that may be realized as a product of the proposed work. By nature these benefits are difficult to quantify, though outage costs from regional blackouts (Northeastern US and Canada, 2003 and Southwest, 2011) are the most pertinent. The proposed work is research and, by nature, it is difficult to predict exact outcomes and/or cost savings, though previous outages have shown that costs are many times the investment proposed for this research.

8. Does the research help foster safe, reliable service at just and reasonable costs?

Yes. This research will generate tools for instantiating and testing high-fidelity models of the CA grid. Researchers, analysts, and operators will be able to test cyber hypotheses affecting the state's grid in ways not previously possible. We expect that emerging threats and large-scale behaviors will be revealed by the research illuminating problems not yet identified by grid operators. The IOUs will be able to identify and mitigate these potential emerging issues before they occur thereby resulting in increased safety and reliability. As previous outages have shown (Northeastern US and Canada, 2003 and Southwest, 2011), the economic impact will be many multiples of the R&D cost.

Proposed Project 3 – Ensemble Weather Forecasting for Wind and Solar Generation

1. Is there a “Positive business case”?

Yes, DRA fails to recognize the cost and benefit information provided in this business case. The business case estimates the project costs as \$2.4 million. This is a one-time cost. Compared to this one-time cost, the business case indicated the project having illustrative benefits of \$30 million per year, which are referenced in D.12-12-031 based on testimony provided by the Joint Utilities. The illustrative benefits are 10 times larger than the one-time project cost and are per year, extending several year out. The Joint Utilities recognize that the referenced \$30 million per year benefit is an illustrative estimate, with assumptions documented in the Joint Parties' testimony. (March 19, 2012 Joint Utilities' Rebuttal Testimony, p. 3-4) That testimony was sufficient for the Commission to approve LLNL partnership in D. 12-12-031.

The Joint Utilities' business case also provided other references to similar size benefits from improved forecasting of wind and solar from past NREL studies which demonstrate the positive business case of this research project. A simple

comparison of the \$2.4 million vs. benefits of potentially 10 times larger per year should provide sufficient evidence of the positive business case of this project.

2. Have the utilities demonstrated that quantifiable customer benefits, including safety and environmental benefits exceed costs on a net present, using a Commission approved methodology?

Yes, Contrary to DRA's protest, this business case did provide quantifiable customer benefits, which demonstrated customer benefits have a high probability of exceeding costs on a net present value basis. See response to first question.

3. What is the overall value of the results from the potential research to ratepayers and to the utility system's safety and reliability?

DRA conveniently ignores the information provided by the business case. For example, the business case explains that "[t]his project is aimed at saving operational system costs, improving grid reliability [emphasis added], and giving generation owners information relevant to bidding decisions." The business case goes on to explain that "[g]rid reliability can be bolstered on days when conditions are truly uncertain through the purchasing of additional reserves. Ensemble forecasting will also give generation owners probabilistic information about their potential generation scenarios in the day-ahead time frame, which can assist them in making bidding decisions." (See p. 3 of business case.) This same reliability benefit is mentioned both in the context of improvements in operation by both CAISO and the utilities. For example, the business case explains that "CAISO can use these forecasts to bracket their uncertainties, committing more ancillary services on days when the uncertainty is high and less on days when the forecasts are relatively more certain. This will have the net result of both lowering costs and ensuring reliability." (See p. 10 of business case.)

4. How do the costs of the research compare to potential benefits?

Contrary to DRA and as noted before, a very simple comparison of the cost and benefits presented in the business case shows that benefits should exceed costs for this project.

5. Would the results of the research have an impact on the ability of the grid to support the competitive provision of electric power or on the ability to integrate non-utility assets and distributed generation onto the grid?

Yes. Contrary to DRA's protest, the information presented in the case does explain how the results of the research have an impact on the ability of the grid to support the competitive provision of electric power or on the ability to integrate non-utility

assets and distributed generation onto the grid. DRA, however, characterizes as simply “passing assertions” the information presented in the business case about how new forecasting approach developed by this project can: a) facilitate the integration of large amounts of weather-based electricity generation, b) improve the prediction of relevant weather parameters and renewable production, c) provide a measure of the uncertainty associated with weather and renewable generation forecasts, and d) that such improvements would be useful to CAISO, the IOUs, and most importantly benefit customers.

6. Does the proposed research align with CPUC policies?

Yes. DRA fails to acknowledge that improving the prediction and quantification of the uncertainty of wind and solar generation, which are mentioned all throughout the business case, are closely aligned with 33% RPS policy.

7. Does the proposed research produce specific benefits concerning utility resources including transmission, distribution, generation, system operations, management, and oversight?

Yes. DRA acknowledges but downplays the benefit to utilities from both improvements in the overall accuracy of the wind and solar generation forecasts, as well as defining uncertainty bounds of the forecasts. For example, DRA references that these improvements in renewable generation forecasting and associated uncertainty quantification will better prepare the IOUs for the daily bidding of renewable resources as well as load affected by behind the meter or distributed renewable generation.

8. Does the research help foster safe, reliable service at just and reasonable costs?

Yes. DRA ignores the information presented in this case about quantifiable benefits and improved reliability and indicated in response to Question 3.

Proposed Project 4 – Flexibility Metrics and Standards

1. Is there a “Positive business case”?

Yes. DRA’s evaluation ignores the illustrative \$552 million present value benefits discussed in the business case resulting from improving the accuracy of flexible resource need determination. (See business case, p. 15.) On the cost side, the business case estimated costs for this project of \$1.4 million for the first 18 months and \$5.2 million over three and a half years (AL, p. 5). Therefore, the project costs, compared to the illustrative benefits are about 1% of the benefits and provide sufficient evidence of the positive business case of this project. The calculation of the illustrative benefits was presented in the Joint Utilities’ March 19, 2012 Rebuttal

Testimony at p. 3-4 and 3-5. These benefits were referenced in D.12-12-031 in support of the Commission's approval of the LLNL partnership.

2. Have the utilities demonstrated that quantifiable customer benefits, including safety and environmental benefits exceed costs on a net present, using a Commission approved methodology?

Yes. As noted in response to the prior question, the business case shows the project's benefits are many times larger than the project costs.

3. What is the overall value of the results from the potential research to ratepayers and to the utility system's safety and reliability?

DRA's evaluation fails to mention the information presented in the business case about how current reliability metrics and standards fail to account for the system need for operating flexibility, and how this project proposes to develop new metrics to measure the probability that the system will be unable to ramp quickly enough to meet the ramping events that are possible with high levels of renewables, and to assess the system's adequacy, and to provide insight as to the most efficient approaches to improving the system's ability to meet ramping events. (Business Case, p. 1-6.) Clearly the results from this project will improve the system's reliability.

4. How do the costs of the research compare to potential benefits?

DRA acknowledges but dismisses as hypothetical the benefits of this project of improving the accuracy of flexible resource need determination, which could result in substantial benefit to California. DRA provides no reasons for dismissing these benefits. It is however clear that new flexibility metrics and standards and improved models produced by this project should produce better estimates of resource need, save customers costs and improve service reliability, as explained in response to question 3.

5. Would the results of the research have an impact on the ability of the grid to support the competitive provision of electric power or on the ability to integrate non-utility assets and distributed generation onto the grid?

Yes. Contrary to DRA's assertion, the information presented in the case does explain how the current reliability metrics and targets were developed for an electric grid that did not have as much non-dispatchable and intermittent resources as the future grid envisioned, and that there is a need to update planning criteria. The new criteria is needed not only to integrate intermittent renewables, but to also accommodate the greater volatility of demand due to price-sensitive customers

using “smart meters”, as well as understand the potential for flexibility benefits from price-sensitive customers that should be considered. (Business Case, p. 4-5.) DRA also does not acknowledge that the new or improved tools develop by the proposed research project will improve the understanding of flexibility needs and provide an insight into the how to best take advantage of existing and new alternatives such as energy storage. (Business Case, p. 15.)

6. Does the proposed research align with CPUC policies?

Yes. As noted before, the business case explains how new flexibility metrics and standards are needed to integrate renewables in support of the 33% RPS goals, but also improved our understanding of flexibility needs and how to best take advantage of existing and new alternatives included in California aggressive green energy plan.

7. Does the proposed research produce specific benefits concerning utility resources including transmission, distribution, generation, system operations, management, and oversight?

Yes. DRA fails to recognize in responding to this question that the proposed project improves the accuracy of the need for flexible resources, and the understanding of how to best take advantage of existing and new alternatives to integrate renewables and other preferred resources, which are both utility and customer resource benefit.

8. Does the research help foster safe, reliable service at just and reasonable costs?

Yes. DRA ignores the benefits of new metrics to measure the probability that the system will be unable to ramp quickly, to assess the system’s adequacy, and to provide insight as to the most efficient approaches to improving the system’s ability to meet ramping events. Clearly the results from this project will improve the system’s reliability, as indicated in response to Questions 3.

Proposed Project 5 – Planning Engine

1. Is there a “Positive business case”?

Yes. DRA ignores the benefit and cost information provided in this business case. The business case estimates a \$2.4 million project cost. This is a one-time cost. Compared to this one-time cost, the business case identifies potential benefits that far exceed this cost from improved investment decisions in generation and transmission.

2. Have the utilities demonstrated that quantifiable customer benefits, including safety and environmental benefits exceed costs on a net present, using a Commission approved methodology?

Yes. As explained in the business case (p. 3), this project proposes to improve the planning tools to reduce costs and improve reliability of the grid by:

- Optimizing the use of existing capital equipment
- Identifying the most cost effective generation and transmission additions
- Facilitating the evaluation and design of effective demand response resources
- Ensuring a reliable power grid under extreme weather conditions and component failures.

The potential benefits of this project are many times larger than the project cost given the size of the generation and transmission investments under consideration. The potential for even a 1% savings in cost from better generation and transmission investment decisions could save about \$30 million in capital cost for investments currently under consideration. (At a minimum \$2 billion for local reliability generation in Southern California, and \$1.3 billion for 36 transmission projects identified in the 2012-2013 CAISO transmission plan.)

3. What is the overall value of the results from the potential research to ratepayers and to the utility system's safety and reliability?

Again, as noted before, the Joint Utilities have provided supportive information about the potential benefits of this project that demonstrates the potential value of the proposed research.

4. How do the costs of the research compare to potential benefits?

Beyond the discussion about the benefits, the business case explains that “[t]he analysis of common planning tools proposed in Phase 1 of this business case will identify areas for improvements in planning processes and potential savings. The production simulation model with enhanced representation of the transmission system proposed in Phase 2 in this business case will likely reduce customer costs by enabling CAISO, and the utilities to make better decisions regarding future investment in new transmission, demand response programs, or generation, including energy storage. Given the large capital investment required by the industry, the potential for even a 1% savings in cost from better decisions could save about \$30 million in capital cost for investments currently under consideration. Hence, the potential savings are over ten times the \$2.4M cost of this project.” (Business Case, p. 12.)

5. Would the results of the research have an impact on the ability of the grid to support the competitive provision of electric power or on the ability to integrate non-utility assets and distributed generation onto the grid?

Yes. As explained in response to the prior question, this business case will identify areas for improvements in planning processes and potential savings, enabling the utilities to make better decisions regarding future investment in new transmission, demand response programs, or generation, including energy storage. (Business Case, p. 12.)

6. Does the proposed research align with CPUC policies?

Yes. DRA fails to acknowledge that improvements in investment decisions associated with this project will reduce cost and improve reliability for customers, as explained before.

7. Does the proposed research produce specific benefits concerning utility resources including transmission, distribution, generation, system operations, management, and oversight?

Yes. Again, DRA ignores the basic facts presented in the business case that the business case identifies and quantifies potential benefits that far exceed this cost from improved investment decisions in generation and transmission.

8. Does the research help foster safe, reliable service at just and reasonable costs?

Yes. Contrary to DRA's position, the business case mentions many times the potential reduction in cost and improvement in reliability from the proposed research. For example, page 1 of the business case says "this project aims to provide utilities with a modeling tool that will enable system planners to evaluate the cost and reliability impacts of various transmission and/or generation capacity expansions, as well as to help them seek optimal solutions to existing or potential grid reliability issues."

Proposed Project 6 – Distribution Modeling and Optimization

1. Is there a "Positive business case"?

Yes. DRA ignores the benefit and cost information provided in this business case (LLNL-PROP-632232 P11 and 12). The business case estimates \$5.07 million project cost. The business case identifies benefits that include:

- Improved design of voltage and VAR control systems that if implemented would reduce electricity losses and improve power quality

- Improved planning and consequently reduced costs through better understanding of technology adoption scenarios across the state
 - More accurately identified Energy Efficiency and Demand Response opportunities across the State
 - Increased ability to identify rate impacts to different customer classes and technology adopters
 - More accurate quantification of the value from control of smart inverters
 - Improved ability to identify market and control systems to optimize resources and demand within a region
2. Have the utilities demonstrated that quantifiable customer benefits, including safety and environmental benefits exceed costs on a net present value basis, using a Commission approved methodology?

Yes. DRA fails to recognize the cost and benefit information provided in this business case (LLNL-PROP-632232 Page 11 and 12), as explained in response to question 1.

As detailed in the Advice Letter, the Joint Utilities describe how the projects meet the 740.1 criteria. There is not a Commission approved methodology for evaluating research projects, such as that used in calculating a Market Price Referent. This project as described in the AL offers a reasonable probability of providing benefits to ratepayers.

3. For instance, from the benefit of reduced electricity losses perspective as discussed on the page 12 of LLNL-PROP-632232, this project will identify 1) Peak feeder loads; 2) Opportunities to locate electricity production closer to the load; 3) Customer voltages within service tolerances; and 4) Opportunities to minimize the amount of reactive power provided. Identifying these opportunities, targeted locations and prioritized applications will inform the decision to support and implement control systems (as approved by the CES-21 board of director) to improve the power factor and reduce line losses for a given load served. In 2010, a total of \$33.5 billion was spent on electricity in California. The average transmission and distribution loss is around 6% in California, which results in approximately \$2 billion in losses each year. The objective of this project is to improve power factor and reduce line losses. What is the overall value of the results from the potential research to ratepayers and to the utility system's safety and reliability?

Yes. Again, as noted before, DRA fails to recognize the provided supportive information about the benefits of this project that demonstrates the value of the

proposed research to ratepayers and to the utility system's safety and reliability. As detailed in the Advice Letter, the Joint Utilities describe that the projects meet the 740.1 criteria - Improve operating efficiency and reliability or otherwise reduce operating costs (LLNL-PROP-632232. Page 2).

4. How do the costs of the research compare to potential benefits?

DRA provides no reasons for dismissing a list of benefits to California, as explained in response to question 2.

5. Would the results of the research have an impact on the ability of the grid to support the competitive provision of electric power or on the ability to integrate non-utility assets and distributed generation onto the grid?

Yes. Contrary to DRA's assertion, on the executive summary of this project proposal (LLNL-PROP-632232, page 3), it is described that development of a representative model will require detailed emulation of not only the transformers, tap changers, conductors, and capacitors normally modeled for distribution planning purposes, but would also include a representation of behind-the meter devices and systems (e.g. PV; HAN and associated load – AC, Pool Pumps; PEV load, Energy Storage) as well as the thermal characteristics of residential houses, apartments, condominiums, and commercial buildings. The research proposal is not proscribing who would own assets, but rather identifying ways to optimize the assets connected to the distribution grid. The customer is generally the owner of behind-the-meter devices (an exception would be leasing of solar panels from a third party provider).

6. Does the proposed research align with CPUC policies?

Yes. DRA fails to recognize a specific section on this business case discusses how this project proposal supports current policy objectives including (LLNL-PROP-632232 Page 13):

- Order Instituting Rulemaking on Residential Rate Structures: "Smart Grid" investments will support the growth in distributed generation technologies, increased penetration of electric vehicles, and growth in third party offerings for demand response, energy efficiency and other energy management services by providing the utility with greater visibility into the distribution grid in real-time and near-real-time." This research initiative will assist in identifying the growth opportunities of emerging technologies and increased understanding of the opportunities to incorporate and optimally manage these technologies.
- Order Instituting Rulemaking on Storage: "Due to the variety of applications for storage and the lack of a cohesive regulatory framework, it would be difficult if

not impossible to develop a single unifying policy for energy storage. However, the proposed scenarios in the Final Proposal would allow focused analysis of barriers and policy options. This approach will also allow us to consider whether one ownership model (i.e., ownership of the ESS by utility, end-use customer, third-party entity or some combination via joint ownership) is more beneficial in certain situations than others.” This research initiative will assist in the understanding of optimal control systems and usage of storage within the distribution grid.

- Decision Adopting Demand Response: “In particular, we recognize with the implementation of a 33 percent renewables portfolio standard (RPS), we may need additional flexibility from the grid to integrate intermittent renewable resources.¹² The need for this flexibility is not fully determined, but we can easily envision a scenario in which DR can complement renewable integration” This research initiative will assist in the deployment of more active demand response to balance renewable energy integration into the distribution grid.

7. Does the proposed research produce specific benefits concerning utility resources including transmission, distribution, generation, system operations, management, and oversight?

Yes. DRA fails to recognize that this project proposal supports the following objectives identified in Public Utilities Code §740.1

- Development of new resources and processes, particularly renewable resources and processes which further supply technologies
- Improve operating efficiency and reliability or otherwise reduce operating costs

8. Does the research help foster safe, reliable service at just and reasonable costs?

Yes. DRA fails to recognize that this project proposal supports the following objectives identified in Public Utilities Code §740.1

- Development of new resources and processes, particularly renewable resources and processes which further supply technologies
- Improve operating efficiency and reliability or otherwise reduce operating costs

Proposed Project 7 – Real Time Electromagnetic and Electromechanical Hybrid Transient Simulation

1. Is there a “Positive business case”?

Yes. DRA ignores the benefit and cost information provided in this business case. The business case estimates \$11.4 million project cost. The business case identifies potential benefits that include 1) improved ability to assess system stability; 2) reduced wide-scale service interruptions; and 3) improved testing of critical utility assets.

2. Have the utilities demonstrated that quantifiable customer benefits, including safety and environmental benefits exceed costs on a net present value basis, using a Commission approved methodology?

Yes. The Joint Utilities identify benefits that are possible from the research and identify the scale of these potential benefits. Since this hybrid computer solution has not been created, the benefits cannot be guaranteed. The project as described in the Advice Letter offers a reasonable probability of providing benefits to ratepayers.

3. What is the overall value of the results from the potential research to ratepayers and to the utility system's safety and reliability?

Again, as noted before, the Joint Utilities have provided supportive information about the potential benefits of this project that demonstrates the potential value of the proposed research. These benefits include improved system stability assessment, reduced wide-scale blackouts, and improved testing.

4. How do the costs of the research compare to potential benefits?

Yes. The business case describes the potential benefits on pp. 2-3. The ability to assess stability, reduce outages, and improve testing of control systems are key processes in successfully integrating intermittent resources and enhancing the use of transmission assets.

5. Would the results of the research have an impact on the ability of the grid to support the competitive provision of electric power or on the ability to integrate non-utility assets and distributed generation onto the grid?

Yes. Generation is a competitive business and most generators into the future will be non-utility assets. This project seeks to improve the integration of these non-utility assets. The stability of the grid's frequency has traditionally relied on the mechanical inertia resulting from rotating machines, which represent the majority of conventional generation serving California. Consistent with efforts to meet the state's Renewable Portfolio Standard, the California Solar Initiative, an increasing amount of PV and wind generation in California feed the grid through solid-state, switch-controlled electronics (inverters). Fundamentally, these systems lack the mechanical inertia associated with traditional generation from rotating machines and have a

different dynamic behavior, which detracts from the stability of the grid. At high levels of PV and wind penetration, the capacity of a conventional synchronous (rotating) generator may have to be reduced to maintain the power supply and demand in balance, further lowering system inertia and decreasing stability. Decreased stability could be further impacted when many PV systems disconnect during voltage sag (i.e. inability to distinguish between a temporary voltage condition and “ride through” the voltage transient and an outage that would require disconnection – “anti-islanding”). In order to prevent potential cascading failures and to minimize outages, operators increasingly need real-time visibility and control of the system. (p. 1)

6. Does the proposed research align with CPUC policies?

Yes. The alignment of the project with California’s Renewable Portfolio Standard goals and policies justifies the research.

7. Does the proposed research produce specific benefits concerning utility resources including transmission, distribution, generation, system operations, management, and oversight?

Yes. The business case identifies and quantifies potential benefits in transmission congestion, generation ancillary services, and reduced interruptions on the transmission and distribution systems.

8. Does the research help foster safe, reliable service at just and reasonable costs?

Yes. Contrary to DRA’s position, the business case mentions many times the potential reduction in cost and improvement in reliability from the proposed research.

Proposed Project 8 – Integrated Transmission and Distribution Model

1. Is there a “Positive business case”?

Yes. DRA ignores the benefit and cost information provided in this business case (LLNL-PROP-632234 P12 and 13). The business case estimates \$6.7 million project cost. The business case identifies potential benefits that include 1) Reliability and Power Quality – reduction in interruptions and power quality events; 2) Reduced wide-scale blackouts and avoid customer costs of outage; 3) This project may help avoid unnecessary capacity buildup through more representative modeling and simulation.

2. Have the utilities demonstrated that quantifiable customer benefits, including safety and environmental benefits exceed costs on a net present value basis, using a Commission approved methodology?

Yes. The Joint Utilities identify benefits that are possible from the research and identify the scale of these potential benefits (LLNL-PROP-632234, P13). For example, Page 13 of the LLNL-PROP-632234 identifies reduced electricity losses as a potential benefit.- This project may help manage peak feeder loads, locate electricity production closer to the load and ensure that customer voltages remain within service tolerances, while minimizing the amount of reactive power provided. This improves the power factor, and reduces line losses for a given load served. In 2010, total electricity costs in California were \$33.5 billion. The average transmission and distribution loss is around 6% in California, which results in equivalently approximate \$2 billion each year. Assuming that this project has a 1% positive contribution to the transmission and distribution loss reduction, the benefits would amount to \$200 million each year.

3. What is the overall value of the results from the potential research to ratepayers and to the utility system's safety and reliability?

Again, as noted before, the Joint Utilities have provided supportive information about the potential benefits of this project that demonstrates the potential value of the proposed research. See page 13 of LLNL-PROP-632234.

4. How do the costs of the research compare to potential benefits?

The business case describes the potential benefits on page 13 of LLNL-PROP-632234.

5. Would the results of the research have an impact on the ability of the grid to support the competitive provision of electric power or on the ability to integrate non-utility assets and distributed generation onto the grid?

Yes. DRA acknowledges the difficulties presented by accommodating DG in the traditional T&D system and reiteration of the intent of this project to (DRA, Appendix, p. 33.):

- Expand the transmission network model to include distribution network and model distributed generation as a generator;
- Use results to analyze reliability impacts of increased renewable penetration in the distribution network;
- Identify the restoration impacts due to the increased penetration of renewable energy; and
- Identify the value of distributed resources and energy storage on transmission reliability

The second paragraph in the Executive Summary describes that the key driver for the research is to manage integration of non-utility assets and distributed generation (LLNL-PROP-632234, P1):

As more renewable generation comes online, utilities will increasingly have portfolios of resources lacking dynamic reactive power, essential to control voltage and frequency during grid restart and restoration. Other related scenarios will simulate the value of integrating larger amounts of distributed resources, injection of reactive power and energy storage to inform decisions before making large capital investments for reliability. Using the proposed integrated transmission and distribution model is also essential for adequate operation of the grid within a cost-effective range, while enabling emerging and pre-commercial resources and technologies.

6. Does the proposed research align with CPUC policies?

Yes. The Integrated Transmission & Distribution Model considers integration of renewable resources as a primary objective, critical to meeting the 33% Renewable Portfolio targets by 2020. The Joint Utilities believe alignment with the State RPS policies is sufficient to justify the research.

7. Does the proposed research produce specific benefits concerning utility resources including transmission, distribution, generation, system operations, management, and oversight?

Yes. The business case identifies and quantifies potential benefits in transmission congestion, generation ancillary services, and reduced interruptions on the transmission and distribution systems (LLNL-PROP-632234, P13 and 14).

In addition it was highlighted that the results of this project will add to parallel projects, such as providing key inputs to the Distribution Model and the Advanced Threat Analysis and the Modeling and Simulation cyber-security models, essential to the security of the California grid.

8. Does the research help foster safe, reliable service at just and reasonable costs?

Yes. Contrary to DRA's position, the business case mentions many times the potential reduction in cost and improvement in reliability from the proposed research. For example: page 13 of LLNL-PROP-632234 clearly indicates the benefits of reduced wide-scale blackouts and avoid customer costs of outage – this project could help improve grid stability, and help grid operators avoid conditions that could lead to generator tripping or other results that could cause outages.

Proposed Project 9 – Electric System Monitoring and Control

1. Is there a “Positive business case”?

Yes. DRA ignores the benefits and cost information provided in this business case. The business case estimates \$1.9 million project cost. The business case identifies potential benefits that include 1) improved monitoring capability and system dynamics understanding to advance efforts to reduce overall system outages through early warning and mitigation plans; 2) reduced generation and load disconnection through implementation of specific application-focused protection schemes; 3) increased wide-area system awareness to improve capabilities in enabling increased transmission capacity.

2. Have the utilities demonstrated that quantifiable customer benefits, including safety and environmental benefits exceed costs on a net present value basis, using a Commission approved methodology?

Yes. DRA does acknowledge that there are potentially-quantifiable customer benefits identified (DRA, Attachment, p. 36). The Joint Utilities identify benefits that are feasible from the research and identify the scale of these potential benefits. Cited data are based on published reports and demonstrate the scale of benefits. This project as described in the Advice Letter offers a reasonable probability of providing benefits to ratepayers.

3. What is the overall value of the results from the potential research to ratepayers and to the utility system's safety and reliability?

Again, as noted before, the Joint Utilities have provided supportive information about the potential benefits of this project that demonstrates the potential value of the proposed research. These benefits include improved monitoring capability, improved management of system instability and mitigation strategies, reduced generation and load disconnection through improved protection systems, and increased transmission usage.

4. How do the costs of the research compare to potential benefits?

The business case describes the potential benefits on page 2 and quantifies the benefits on pp. 9 -11.

5. Would the results of the research have an impact on the ability of the grid to support the competitive provision of electric power or on the ability to integrate non-utility assets and distributed generation onto the grid?

Yes. DRA goes on to say there is a brief mention of the difficulties presently encountered with increasing amount of intermittent resources (DRA, Attachment, p38). The first paragraph in the Executive Summary describes that one of the key operational issues faced by California utilities is the ability to manage intermittent resources effectively while utilizing grid assets efficiently:

- With the increasing amount of intermittent resources, stability analysis becomes more critical than ever to understand associated potential issues and to develop an appropriate portfolio mitigation plans for the relevant use cases.
- The goal of this project is to develop methods to monitor and control the bulk power system in the presence of these renewable resources and methods to increase the analytical capabilities of tools which will be of meaningful value to planners and operators of the participating California utilities, as well sector-wide stakeholders.

6. Does the proposed research align with CPUC policies?

Yes. The paragraph of the Executive Summary identifies that the project is aligned with following objectives in Public Utilities Code §740.1:

- Public and employee safety
- Improve operating efficiency and reliability or otherwise reduce operating costs

The Joint Utilities believe these alignments are sufficient to justify the research.

7. Does the proposed research produce specific benefits concerning utility resources including transmission, distribution, generation, system operations, management, and oversight?

Yes. The first paragraph in the Executive Summary identifies the goal of this project is to develop methods to monitor and control the bulk power system in the presence of renewable resources and methods to increase the analytical capabilities of tools which will be of value to planners and system operators. The business case identifies and quantifies potential benefits in optimized system operation, reduced congestion (increased transmission capacity), reduced electricity losses (increased transmission capacity), reduced wide-area blackouts (reliable system operation), and appropriate utilization of PMU infrastructure that are being deployed by California utilities.

8. Does the research help foster safe, reliable service at just and reasonable costs?"

Yes. DRA acknowledges that business case discusses present difficulties in maintaining system reliability and benefits resulting from this research. Contrary to

DRA's position, the business case mentions many times the potential reduction in system operation costs and improvement in reliability from the proposed research.

Proposed Project 10 – Geographic Data Integration for Enhanced Gas System Risk Management

1. Is there a "Positive business case"?

Yes. The Business Case document provided in section 8 a quantitative evaluation of the cost/benefit ratio of the project. It referred to actual data and used conservative assumptions that led to a positive benefit of \$90M.

2. Have the utilities demonstrated that quantifiable customer benefits, including safety and environmental benefits exceed costs on a net present value basis, using a Commission approved methodology?

Yes. Sections 8 and 1f of the business case states that the project will allow granular and comprehensive data integration, simply out-of-reach through existing approaches, to optimize the safety assessment of distribution and transmission gas systems. Utility rate payers will benefit from this transformation.

3. What is the overall value of the results from the potential research to ratepayers and to the utility system's safety and reliability?

The DRA missed the point stated by the business case that the project will allow granular and comprehensive data integration impossible in current approaches to optimize the safety assessment of distribution and transmission gas systems. Utility rate payers will benefit from this transformation as stated by PHMSA in its 2012-2016 Strategic Plan p. 10: "A systematic approach to risk management requires a comprehensive understanding of the factors contributing to risk and the ability to focus resources in those areas that pose the greatest risk. There is considerable research needed to build our analytical capacity and improve the quality of our data."

4. How do the costs of the research compare to potential benefits?

The business case in section 8 demonstrated benefits much higher than the cost of the project. This calculation was based on actual data observed by the utility supplemented by very conservative assumptions.

5. Would the results of the research have an impact on the ability of the grid to support the competitive provision of electric power or on the ability to integrate non-utility assets and distributed generation onto the grid?

This topic was not included in the objectives of the projects that focus on gas infrastructure. However, the gains in reliability and cost effectiveness of the gas system will contribute to facilitate deployment of gas powered DG.

6. Does the proposed research align with CPUC policies?

Yes. This project specifically addresses the second priority listed in Public Utilities Code §740.1: Public and Employee Safety.

7. Does the proposed research produce specific benefits concerning utility resources including transmission, distribution, generation, system operations, management, and oversight?

Yes. The business case explained in section 1a the benefit for the utility provided by new capabilities of management of large amount of data within its risk assessment process. "The success of the pilot will provide the foundation for an automated, comprehensive and dynamic management of all assets of the utility in interaction with its environment. This effort will advance the approaches used in the industry to understand risk to and from natural gas infrastructure."

8. Does the research help foster safe, reliable service at just and reasonable costs?

Yes. The business case addresses this in Section 8. The project will improve safety while maintaining low costs of energy for PG&E's customers by developing tools that will allow information management that is very expensive or even impossible to assure without them. Details are provided in Section 2 on the approach that will be taken to develop these tools and Section 3 demonstrates how this effort will leverage recent technology improvement and LLNL's experience on similar challenges to optimize its cost benefits.

Proposed Project 11 – Advanced Modeling and Simulation Environment for Gas System Planning and Operation

1. Is there a "Positive business case"?

Yes. In section 8, the quantifiable cost benefits were evaluated by including cost savings based on PG&E's actual infrastructure improvement cost figures of \$40M/year. As documented, conservatism was used for the estimate, which points to a 5% reduction in maintenance costs attributed to a more accurate modeling tool. This translates to a reduction of \$2M/year. In addition, it was estimated that it would be feasible to increase efficiency by 5% for system model building, which is currently a very laborious task. With a team of roughly 50 analysts, this increase in efficiency

translates to a savings of 2.5 FTEs worth of effort per year, or about \$0.43M/year. The total cost savings amounts to \$2.43M/year.

2. Have the utilities demonstrated that quantifiable customer benefits, including safety and environmental benefits exceed costs on a net present value basis, using a Commission approved methodology?

Yes. See response to question #1.

3. What is the overall value of the results from the potential research to ratepayers and to the utility system's safety and reliability?

Section 8 of the business case specifically addresses the safety benefits of an advanced modeling tool, which improves accuracy of flow calculations resulting in the assurance of sufficient capacity on the system to meet customer demand. During a Cold Weather Day event or Abnormal Peak Day Event, the tool will allow PG&E to better assess system constraints and avoid unplanned disruptions of gas service. In addition, the improved modeling and visualization tools will ensure that planners will be able to diagnose emergencies, such as a gas leak, with confidence and offer immediate repair solutions as a part of emergency response.

4. How do the costs of the research compare to potential benefits?

Section 8 provides a quantitative estimate of cost savings based on PG&E's actual infrastructure improvement cost figures of \$40M/year. As documented, conservatism was used for the estimate, which points to a 5% reduction in maintenance costs attributed to a more accurate modeling tool. This translates to a reduction of \$2M/year. In addition, it was estimated that it would be feasible to increase efficiency by 5% for system model building, which is currently a very laborious task. With a team of roughly 50 analysts, this increase in efficiency translates to a savings of 2.5 FTEs worth of effort per year, or about \$0.43M/year. The total cost savings amounts to \$2.43M/year.

Considering that the total project cost is \$5M, it would take less than 3 years to capture the cost of the research and start to yield a return on investment.

5. Would the results of the research have an impact on the ability of the grid to support the competitive provision of electric power or on the ability to integrate non-utility assets and distributed generation onto the grid?

This topic was not included in the objectives of the projects that focus on gas infrastructure. However, the improvement of the simulation tools used for gas planning will facilitate integration of gas powered DG in the system.

6. Does the proposed research align with CPUC policies?

Yes. The scope of the project includes the integration of renewable energy sources into the modeling and simulation environment (sections 1a, 1f, 2a, and 6a), which would help support the CPUC's 33% renewable goal by 2020. The business case specifically states that the advanced model will effectively aid in the evaluation of a broad range of renewable deployment scenarios to the grid. The deployment of the tool in no more than 5 years will aid in the planning of renewable sources well before the 2020 deadline.

7. Does the proposed research produce specific benefits concerning utility resources including transmission, distribution, generation, system operations, management, and oversight?

Yes. Section 6, which lists the Implementation Plan and Schedule of the proposed research, specifies that in Phase 1 of the project, the automated process for calibration will be developed for the backbone model using PG&E's data. This automated capability will be used to develop models for the transmission and distribution pipeline systems. This automated calibration capability and quantified model accuracy will allow for more frequent calibration, resulting in more accurate and updated models for system planning.

The benefits listed in Section 8 concerning Modeling Accuracy, Safety, Emergency Response, Environmental, and Visualization are backed with logical, qualitative assessments made by PG&E's planning group. The quantitative benefits of Cost Savings and Efficiency are taken from actual data on maintenance costs and labor costs from the PG&E's planning group, leading to high fidelity estimates.

8. Does the research help foster safe, reliable service at just and reasonable costs?

Yes. In section 1f, a description of the potential customer benefits is provided. It states that the result of the research project will be an improved understanding of the operational state of their pipeline system. In addition to saving the utility money by automating resource intensive model calibrations, advanced modeling techniques have the potential to reduce risk posed by the consequences associated with possible pipeline failure by identifying potential problems early. The combination of these effects leads to benefits to customers, which include an anticipated increase in reliability and reduction in cost for gas services. Section 8 provides specific examples of increasing safety and reliability of service, such as by reducing service disruptions during Cold Weather Days and enabling faster response in an emergency. Furthermore, Section 8 also describes cost reductions enabled by increased efficiency in both modeling and maintenance planning, which would recoup the cost of this research with 3 years.

Section 2: Response to DRA's criticisms of CES-21 common costs

In its protest, DRA argues that the CES-21 program management budget lacks sufficient detail and includes funding proposals that seem unnecessary and duplicative. As follows, the Joint Utilities respond to the questions raised by DRA in its protest.

a) Program Management

i) Office of the Executive Director

- What is the executive director's annual salary?

The Executive Director will be under contract for \$18,750/month or \$225,000 on an annual basis. There are no additional benefits such as health care and retirement benefit expenditures.

- Is the executive director a full time position? If no, how much time does the position entail?

It is expected that the Executive Director will contribute an average of 40 hours/week plus whatever is required beyond that number of hours.

- Will the Executive Director receive per diem expenses? If so, what is the per diem expense limit?

There will be no per diem expenses

- Will the Executive Director receive a travel allowance? If so, how much?

The Executive Director will receive re-imbusement for reasonable actual expenses such as hotel costs, costs of rental cars, and actual costs of meals while traveling on business related to the CES-project.

- Will the director rent or lease a work-space? If so, where is the workspace located and how much does it cost to rent or lease the work-space?

It is anticipated that LLNL and the utilities will contribute administrative office and meeting spaces as needed at no cost to the Project.

- Will the Executive Director employ administrative staff? If so, what are the salaries of administrative staff?

It is hoped that no additional administrative staff will be required. However, given the fact that nothing quite like this project has been implemented to date, there may indeed be a justifiable need for additional administrative staff for such tasks as scheduling, preparation of presentations, processing invoices, etc. If it is required, normal hiring standards will be implemented, and the CPUC will be advised of the hiring as appropriate.

- Will the Office of the Executive Director receive funds for administrative supplies? If so, how much?

The utilities and LLNL will provide office supplies as needed and when available. If not readily available, the Office of the Executive Director will be responsible for such items.

- Will the Office of Executive Director receive funds for any other purposes that are not identified above? If so, identify those purposes and associated costs.

The Joint Utilities anticipate no additional funds at this point, but any additional funds will be subject to the CES-21 budgeting and CPUC approval process.

ii) External Communications and Outreach

Transparency of the work research being performed as part of CES-21 is a high priority of the program. These funds are designated for “communication and outreach” to external entities to maximize transparency with those outside the partnership who will gain the most value from the research efforts. The value of the research is much greater if all stakeholders in the results are kept well informed of the progress and conclusions of the work. These stakeholders include regulators, legislators, other research institutions, and media outlets when that is most effective at reaching a large trade or customer specific audiences.

The purpose of the communication and outreach effort is to provide maximum benefit to the customer. These funds will not be used for “lobbying” or for IOU or LLNL “publicity”.

iii) Joint Utilities and LLNL Program Oversight and Coordination

Contrary to DRA, the Program Oversight and Coordination budget items do not overlap with or duplicate other budget items for individual CES-21 projects. As a prudent matter and as required by the CPUC, the Joint Utilities and LLNL must actively govern and oversee the overall R&D program on a day-to-day basis, in addition to their other duties of developing, reviewing and approving CES-21 strategic plans and budgets; managing and overseeing the day-to-day activities of the program; and ensuring that the multi-year planning, budget and CPUC review schedule and compliance requirements are met. Day-to-day management and coordination of the CES-21 program and projects will require time, materials and resources over and above the compensation of the single Executive Director and the time of Directors at Board meetings. The amount proposed for these management and coordination tasks is minimal, representing less than 4 percent of the overall annual CES-21 budget.

iv) Third Party Management

Contrary to DRA, nominal funding for third party management and collaboration is an ongoing task and activity of CES-21, not just a task that takes place when the annual budget and strategic plan are developed and approved. The Joint Utilities expect that, as CES-21 projects move forward, there will be continuous opportunities to leverage and collaborate with third-parties on the individual projects or on the overall program throughout the life of the projects. The amount proposed for this activity (\$100,000) is minimal when compared to the potential benefits of such ongoing collaboration and leveraging with third parties.

v) Board of Directors Compensation and Reimbursement

- What is the annual salary for each non-utility Director?

There will be no salary. Each will receive a retainer of \$1,000/month, a payment of \$1,000 for each in-person appearance at a Board meeting; an in lieu payment of \$500 for each telephonic call appearance at a regularly scheduled Board meeting; \$250/board member for participation in non-scheduled board conference calls; and reimbursement for normal travel, hotel, and meal expenses related to participation as a Board member.

- Is the non-utility Director a full time position? If not, how much time does the position entail?

The position of non-utility Director is not designated as full time (40 hours/ week), but is understood to take whatever time is required moving forward.

- Will the Directors receive per diem expenses? If so, what is the per diem expense limit?

There is no per diem. Refer to explanation above.

- Will the Directors receive a travel allowance? If so, how much?

Direct travel expenses based on receipts will be reimbursed.

- Will the Board of Directors rent or lease a work-space? If so, where is the workspace located and how much does it cost to rent or lease the work-space?

As noted elsewhere, we will first obtain any needed office and meeting spaces from the participating utilities and LLNL from existing resources on an as needed basis. Should this approach not work out over time, other actions will be taken, and the CPUC will be notified, most likely in the course of the annual Advice Letter filing.

- Will the Board of Directors receive funds for any other purposes that are not identified above? If so, identify those purposes and associated costs.

No, except perhaps for reimbursement of normal administrative costs such as related telephone calls, etc.

vi) Preparation of Second Program Year Research Portfolio and Budget

Contrary to DRA, the Joint Utilities have provided sufficient information to support the request for funding to prepare the second year CES-21 research portfolio and budget. Among other tasks, the second year program development will involve extensive interaction and planning by the entire CES-21 program, including not only the Executive Director, Board of Directors and in-house staff of the Joint Utilities, but also the sponsors and managers of the individual projects and program areas from both LLNL and the Joint Utilities. In addition, the CES-21 program, per the CPUC's direction and the overall program goals, needs to engage in

extensive outreach to third-parties, stakeholders and R&D experts in California and nationwide, in order to solicit the best possible recommendations for additional projects and for CES-21's updated strategic plan and budgets. As the time for the second plan gets closer, the Joint Utilities and LLNL would be able to provide a more detailed breakdown of the specific categories of costs for this effort, and all such expenditures would be subject to CPUC audit and verification.

b) Workforce Preparedness

Preparing the current and incoming workforce to use the tools developed in the CES-21 program is the most effective way of ensuring the value of the research is sustained for the long term. Each project proposed as part of the CES-21 program will introduce new concepts and tools which will be implemented by the joint utilities. The process of preparing the workforce (reading material, coursework, etc.) is the same and only differentiated by its content and therefore is treated as a stand-alone budget item. All workforce preparedness effort is limited to the four approved research areas: cyber security, electricity operations, gas operations, and electric resource planning.

c) Advanced Computing Services

Below is a table summarizing the activities and costs of providing high performance computing services to the projects in the four research areas.

Research Area	Proposed Project	HPC for simulation	Virtualization Testbed	Porting and Tuning	Data Science Services	Storage and Security	Visualization	Commercial S/W License Mgmt	Collaboration Tools	Deployment Strategy and Product Delivery	
Cyber	ATAC	XX		X	XXX	XXX	XXX		XXX	X	
	Mod-Sim	XX		X	XXX	XXX	XXX		XXX	X	
Elec Ops	Dist Mod	XX	X	XX		X	X	X	X	X	
	TnD	XX	X	XX		X	X	X	X	X	
	Hybrid Sim	XXX	XX	XXX				XX	X	X	
	Monit Cont		XXX		XXX	XXX	XXX	X	X	X	
Gas Ops	Geog Data Fusion	X	X	X	XXX	XX	XXX	XXX	XX	XX	
	UQ	X	XXX	XXX	XX	X	XXX	XXX	X	XX	
Elec Planning	Hydro										
	Engine	XXX	X	XXX	XXX	X	X	XXX	X	X	
	Metrics		X		X	X	X	X	X	X	
	Weather	XXX		XX	XXX	XXX	XXX		X	X	Total:
	Project Year 1 Costs:	930	460	960	570	240	890	650	300		5000

HPC for Simulation

This involves deploying a multitude of approaches to help the CES-21 projects achieve success, including: operating system emulation, parallelization, workload scheduling, and exploring the current and near-term computing needs for success of the CES-21 program. Livermore Computing resources (cycles on high performance computers) are included here, based on project needs.

Virtualization Testbed

As much of the software (particularly on the commercial side) envisioned being used in CES-21 would not initially be HPC-enabled or compile-able from source code, this area provides resources for running software using virtualization technology (e.g. runs on a high performance computer but is a “capsule” that makes the software think it is still running on commodity computers). The goal is to integrate those software products into the Advanced Computing workflow, and allow input and output directly to shared disks, and common CES-21 databases. This is an intermediary step for migrating codes to run natively on HPC resources.

Porting and Tuning

In addition to parallelizing codes, getting them *ported and tuned* on specific HPC platforms is an important task. This will ensure that new HPC versions of codes are efficient as possible, thus producing results more quickly. This is vital to many projects’ goals of scaling models and simulations to California-size problems.

Data Science Services

This area will provide platforms for doing advanced data analytics, as well as prototype data analytic algorithms that can be leveraged across multiple CES-21 projects. Topics include machine learning algorithms, data informatics routines, geographical information systems, etc. Much of this science is emerging and it is critical to several CES-21 projects to develop a solid well-tested foundation of platforms and algorithms that these projects can rely on in the later part of PY1 and the years to come.

Storage and Security

This area will provide CES-21 with a large amount of dedicated storage for raw data and ensure that best practices are developed and/or used to maintain complete understanding of the origin and sharing of data (often referred to as *provenance*). The efficient transfer of data between Livermore Computing, the Joint Utilities, and other partners will benefit greatly from the development of a data sharing portal that is also provided in this area. Furthermore, data agreements that describe restrictions or controlled access will be developed, and the technical implementations will also be instantiated in this area.

Visualization

This area will provide the “window” into many of the CES-21 results. Whether a project needs traditional simulation data visualization tools (like those developed at LLNL for decades), or prototype user interfaces to demonstrate results and get user feedback, this area provides those services.

Commercial Software License Management

Many CES-21 projects will utilize commercial software, but will need innovative licensing due to the unique nature of HPC resources. This area will provide license negotiation and license management and provisioning for non-desktop platforms. The costs shown include the projected initial costs of the licenses themselves as well.

Collaboration Tools

This area will provide all the CES-21 partners a secure and access controlled web-based tool suite for managing documents and software and provide services such as issue tracking, version control, task assignments, and review process.

Deployment Strategy and Product Delivery

Any newly developed software intended for use outside LLNL will need to be transferred to some entity for operationalization, maintenance, and productization. This may be the Utilities themselves, but more likely independent software vendors. This area focuses on documenting software for tech transfer and identifying transfer partners and mechanisms. It is a low level effort in PY1 but will increase throughout the duration of CES-21.

Note that no capital equipment purchases will utilize CES-21 funds. Costs to CES-21 are for use of platforms only.

Section 3: Response to DRA's request that the Advice Letter be summarily rejected because of its reference to the Joint Utilities' Petition for Modification of D.12-12-031 and other modifications

DRA notes that the Joint Utilities' advice letter (AL) must be reviewed based on the requirements of Ordering Paragraphs 8-14 of D.12-12-031, unless and until the Commission modifies those requirements pursuant to the Joint Utilities' Petition for Modification of the decision or the Commission on its own motion modifies or clarifies D.12-12-031. The Joint Utilities agree with DRA's procedural point, but disagree with DRA's request that the Commission reject the AL summarily because of its reference and support for the pending Petition for Modification. The Commission may or may not grant the Petition for Modification, and it may or may not modify D.12-12-031 on its own motion in a further decision or resolution. Therefore, it is premature for the Commission to summarily reject the AL while the Petition for Modification is pending in parallel with consideration of the AL.

Similar to its objections to the Joint Utilities' Petition for Modification, DRA raises a procedural objection to the Commission considering the Joint Utilities' request for approval of an 18-month budget in the AL. DRA argues that the 18-month budget proposal is contrary to Ordering Paragraphs 10, 13 and 14 of D.12-12-031 and therefore may not be approved as part of the AL. Again, it is premature for the Commission to summarily reject these proposals in the AL while the Joint Utilities' Petition for Modification is pending or while the Commission on its own motion may modify or clarify D.12-12-031 to permit an 18- month budget.

Conclusion

DRA's protest is without merit and should be rejected. However, the Joint Utilities and LLNL will offer to meet with DRA to discuss informally DRA's objections and to respond to any additional questions DRA may have.



Vice President – Regulatory Relations

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Commissioner Catherine Sandoval, CPUC
Commissioner Mark Ferron, CPUC
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