Application No: A.15-09-013
Exhibit No.:
Witness: S. Ali Yari

In The Matter of the Application of San Diego Gas & Electric Company (U 902 G) and Southern California Gas Company (U 904 G) for a Certificate of Public Convenience and Necessity for the Pipeline Safety & Reliability Project	Application 15-09-013 (Filed September 30, 2015)

PREPARED DIRECT TESTIMONY OF

S. ALI YARI

ON BEHALF OF

SAN DIEGO GAS & ELECTRIC COMPANY

AND

SOUTHERN CALIFORNIA GAS COMPANY

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

March 21, 2016

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I. PURPOSE AND OVERVIEW

The purpose of my testimony is to explain why the proposal of San Diego Gas & Electric Company (SDG&E) and Southern California Gas Company (SoCalGas) (collectively, the Utilities) for a new approximately 47-mile, 36-inch diameter natural gas transmission pipeline (Line 3602) and associated facilities between the Rainbow Metering Station (Rainbow Station) and a tie-in point with Line 2010 on Marine Corps Air Station (MCAS) Miramar (the Proposed Project or Pipeline Safety & Reliability Project (PSRP)) [1] should be approved. The Proposed Project is needed from an electric reliability standpoint. My testimony supplements the testimony of other witnesses who testify as to why the Proposed Project is needed from a gas safety and reliability standpoint.

Although the Application primarily focuses on gas issues, there is significant reliance on gas by electric generation in the region served by SDG&E.

A key issue of my testimony is that curtailment of gas supply to electric generation can result in the loss of firm electric customers. This conflict arises because the competitive generation market is not incentivized to ensure that firm electric demand is met during periods of gas curtailment. There is currently no requirement for electric generators to elect a firm gas supply to provide for a firm electric supply.

SDG&E is a regulated public utility that provides electric service to 3.4 million people through 1.4 million electric meters in San Diego County and southern Orange County.[2] The electric service area spans 4,100 square miles. As a regulated public utility, SDG&E has an obligation to serve its customers safely and reliably. Although the North American Electric

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[1] The Utilities use these terms interchangeably throughout the testimony and Application.

[2] SDG&E provides natural gas service to San Diego County. SoCalGas provides natural gas service to southern Orange County.

Reliability Corporation (NERC), pursuant to the Federal Power Act and Federal Energy Regulatory Commission (FERC) regulation, already has an extensive set of reliability standards for the electric transmission system, issues involving the interdependency between the gas systems and electric systems are also being considered to improve reliability.[3]

The interdependency and need for coordination between electric and gas systems is also recognized by the California Energy Commission (CEC). In its 2015 Natural Gas Act Report prepared pursuant to Assembly Bill (AB) 1257, the CEC determined that approximately 40 percent of the natural gas in California is used in electric generation (EG) and as such, more discussions and studies are needed for more effective coordination between the gas and electric industries, as described in more detail below.[4]

The Utilities raise these issues to the attention of the California Public Utilities Commission (CPUC or Commission), because the Proposed Project is vital not only for the reliability of gas service, but also for the reliability of electric service. My testimony will explain the following key risk issues with respect to the Proposed Project's relationship to electric reliability:

- SDG&E's firm electric customers are at risk for electric curtailment when gas curtailments occur, due to the vast majority of electric in-basin[5] generation power

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[3] *See* FERC Final Rule 809, issued April 16, 2015. *See also* NERC Special Reliability Assessment "Accommodating an Increased Dependence on Natural Gas for Electric Power" (NERC Report), at 38 (dated May 2013), *available at* http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_PhaseII_FINAL.pdf; and FERC webpage, at http://www.ferc.gov/industries/electric/indus-act/electric-coord.asp . However, these efforts involving gas scheduling issues and improving the timing of the "Gas Day" do not alleviate the gas-electric interaction issues involved in this testimony.

[4] CEC Final Staff Report, AB 1257 Natural Gas Act Report: Strategies to Maximize the Benefits Obtained From Natural Gas as an Energy Source, November 2015 (AB 1257 Report), at 29-30.

[5] The term "in-basin" generation refers to local generation, meaning generation in the SDG&E service territory.

plants relying on gas as a fuel source on an interruptible basis. As a result, gas curtailments can result in a reduction of electric supply.

- Conflicting priorities exist between gas and electric operations. As discussed in the Prepared Direct Testimony of Mr. David Bisi, gas curtailments could require the interruptible electric generating plants to be curtailed to continue to serve core gas customers. However, as discussed in my testimony, such curtailment of gas-fueled[6] generation could require firm electric customer outages to prevent a widespread blackout.[7]
- With 90 percent of the gas capacity in the SDG&E system supplied by Line 3010, a 30-inch diameter pipeline, any number of potential outage scenarios on this single gas pipeline could place firm electric load at risk due to gas curtailment of EG leading to electric outages. *See* the Prepared Direct Testimonies of Mr. Bisi and Mr. Jani Kikuts.
- The FERC/NERC, Western Electricity Coordinating Council (WECC), California Independent System Operator Corporation (CAISO) and SDG&E reliability standards require that the electric system must withstand the largest single electric contingency without the need to drop firm electric customer load. However, the situation is such that the loss of a single gas facility, Line 3010, could result in a loss of firm electric customer load. There is clearly a reliability interaction between the gas and electric systems. In the absence of construction of the Proposed Project, these persistent gas-electric interdependency issues could require constructing one or more new transmission lines to increase electric transmission import capabilities, in order to provide adequate electric reliability in accordance with established NERC and other regulatory requirements.[8]

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[6] The terms "gas fueled" and "gas fired" have the same meaning and may be used interchangeably.

[7] As described in the Amended Application, the Utilities retained PricewaterhouseCoopers (PwC) to perform a cost-effectiveness analysis of the Proposed Project and the alternatives identified in the Ruling. *See* Amended Application, Volume III – Cost-Effectiveness Analysis. The Cost-Effectiveness Analysis and underlying methodology were performed by PwC with input and data from the Utilities. I have provided data input to the analysis as well as other data inputs for the portions of the analysis that pertain to my testimony below.

[8] In a "no gas" or very limited gas scenario, SDG&E may not be able to serve all of its customers and may need to drop load.

II. A GAS SINGLE CONTINGENCY STANDARD DOES NOT CURRENTLY EXIST THAT WOULD SUPPORT THE ELECTRIC TRANSMISSION PLANNING AND OPERATION STANDARDS AND THE ELECTRIC GRID'S INCREASING RELIANCE ON NATURAL GAS

From an electric reliability perspective, a single point of failure on the SDG&E gas system could also place SDG&E's electric load at risk due to curtailment of gas supply to EG in San Diego. The Proposed Project is a physical solution that provides a redundant gas supply to San Diego that would address the single point of failure scenario from a gas reliability perspective (*see* the Prepared Direct Testimonies of Gwen Marelli and Mr. Bisi) and an electric reliability perspective (as discussed in my testimony).

The electric grid is designed to handle a single contingency (N-1), meaning an outage condition on a single electric transmission facility and/or generation resource pursuant to established electric reliability standards, such as the FERC-approved NERC reliability standards.[9] However, the electric grid in San Diego relies upon in-basin natural gas-fired EG under many operating scenarios, and that in-basin generation is currently connected to a gas supply system without gas contingency planning for a similar "N-1" single line outage of Line 3010. The CAISO, FERC and the CEC all recognize the need for gas-electric integration because of power plants' reliance on gas as a fuel supply.[10] Indeed, the NERC released a 2013 report recognizing the need for risk mitigation of potential EG outages due to natural gas

[9] *See generally* NERC Report, at 38.

[10] In 2011, the CAISO applied for and obtained a tariff amendment providing that the CAISO may share information regarding outages of natural gas-fired generation resources and other electric grid outages with natural gas transmission and distribution utilities. CAISO Tariff Section 20.4(c)(iv). *See also* February 3, 2012 Request for Comments of Commissioner Moeller on Coordination between the Natural Gas and Electricity Markets, *available at* https://www.ferc.gov/industries/electric/indus-act/electric-coord/moellergaselectricletter.pdf; November 15, 2012: FERC Staff Report on Gas-Electric Coordination Technical Conferences (Docket No. AD12-12-000). *See also* AB 1257 Report, at 31-32 ("Certain natural-gas fired power plants are used to meet local reliability needs, to provide emergency system support, and to provide the range of ancillary services that are needed by [CAISO] to keep the integrated electric system running reliably.").

interruptions and curtailments, even if the probability of a pipeline failure occurring during electric peak periods is very low: "[W]ithin a relatively short time, a major failure [on a gas pipeline] could result in a loss of electric generating capacity that could exceed the electric reserves available to compensate for these losses."[11]

At this time, however, there is no similar gas "N-1" contingency standard for gas system operators that would support the electric transmission planning and operation standards and the electric grid's increasing reliance on natural gas.[12] According to the NERC, "[w]hile it is not possible to fully protect any system against acts of nature, contingency plans can and should be prepared. . . ."[13] As explained in the Sections below, the Proposed Project would allow the Utilities to handle a "contingency event involving the loss of delivered gas supply to gas-fired units within a region and mitigate the potential resulting domino effect."[14]

The existing in-basin gas-fired generation in SDG&E's service territory consists of approximately 3,000 megawatts (MW) of generators that rely on natural gas supplies from the two existing transmission pipelines within San Diego County. If an outage on Line 3010 occurs, as Ms. Marelli and Mr. Bisi testify, these EG plants could be curtailed to continue providing gas to serve core gas customers. That curtailment of gas supply to EG plants could require shedding *electric* load (*i.e.*, firm electric customers) to prevent complete electric system loss, resulting in a widespread blackout.[15] As described below, SDG&E's electric power import capability alone is not sufficient to serve all electric load for many hours during many days of the year.

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[11] NERC Report, at 4.
[12] *See* D.02-11-073 and D.06-09-039.
[13] NERC Report, at 29.
[14] *See id.* at 38.
[15] *See id.* at 25:

> While relatively few in number and limited to specific regions, there have been interruptions to the delivery of gas supply to gas-fired units, as well as to consumers within the other demand

III. NATURAL GAS-FIRED GENERATION IS CRITICAL TO SDG&E AND CALIFORNIA

A. Growth in Need for Fast Ramping Natural Gas-Fired EG

Unlike base load units that are operated at a relatively constant level of power output, or renewables that have outputs that cannot be dispatched up or down, fast-ramping natural gas-fired units are needed due to their ability to be dispatched to increase or decrease power output relatively quickly to meet changing electric load demand conditions.

SDG&E's electric system is operated as part of the larger CAISO integrated system. Traditionally, the customer load demand of the CAISO system (including the SDG&E system) would change slowly throughout the day in a cycle that would peak between 3 and 5 PM and reach a minimum around 2 or 3 AM. However, that traditional load curve has been changing, and will continue to change. Senate Bill (SB) 350 requires electric service providers in California to increase their purchase of eligible renewable energy resources from 33 percent to 50 percent under the Renewables Portfolio Standard (RPS) by December 31, 2030. Thus, by law, the amount of renewable generation coming on-line will continue to increase.

Energy generated from renewable sources, such as wind and solar, varies depending on conditions (*e.g.*, wind not blowing, sun not shining). The intermittency of renewable generation can fluctuate hour to hour, which presents challenges for planning and operating the electric grid. For example, with the installation of significant amounts of solar power, we now see a new emerging pattern of natural gas-fired EG dispatch throughout the day. There is a need for natural gas-fired EG on a daily basis in the morning before the solar output has peaked. As solar power

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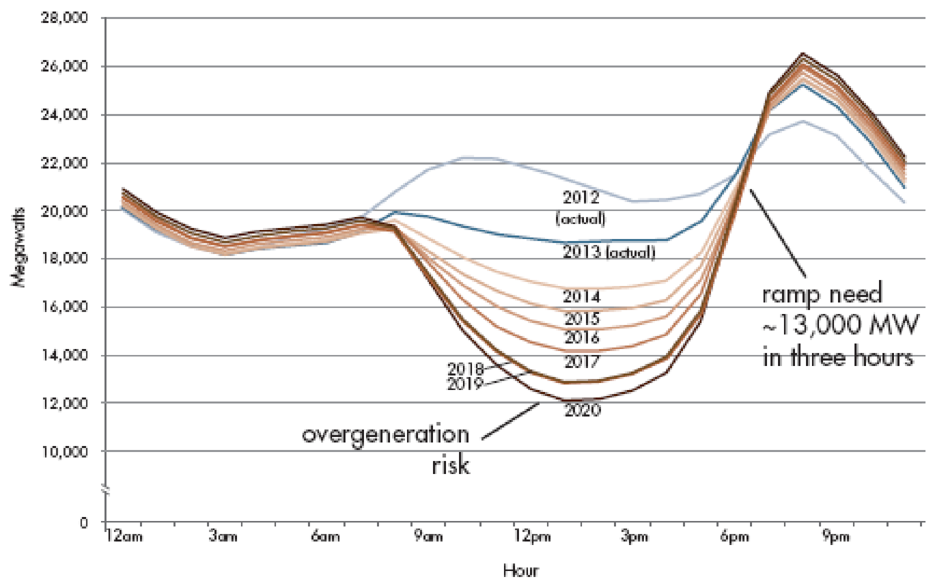
sectors. As illustrated by the review of selected historical service interruption incidents in Chapter 3, none of the incidents directly affected overall system reliability. In some cases, the gas industry was able to either respond quickly or resort to alternatives. However, some historical incidents have contributed to the degradation of system reliability, and similar incidents that could easily threaten regional system reliability are possible.

increases during mid-day and through the early afternoon, the net load[16] that the CAISO must "follow" by dispatching natural gas-fired EG decreases since the solar output is increasing faster than electric demand. After peaking in the afternoon, solar output starts to decline while electric demand continues to rise, resulting in a very fast "ramp" requirement during which natural gas-fired EG must be quickly and dramatically increased.[17]

The CAISO's "duck curve" below illustrates this phenomenon.[18] This curve has come to be known as the duck curve based on the shape of the curve. The magnitude of the duck curve phenomenon is increasing year by year, increasing challenges and reliance on natural gas for fast-ramping EG capability, as solar and other renewables continue being added to the system.

TABLE 1
Net Load – March 31



[16] "Net Load" is load (customer power demand) minus renewable generation (solar and wind participating in the CAISO market).
[17] *See* AB 1257 Report, at 32 ("Studies performed by the [CAISO] show that the predicted variation in renewables production mean that large numbers of remaining resources, namely those fired by natural gas, will need to ramp up production quickly, as the renewables generation falls off, and be turned down quickly as the renewables production increases.").
[18] CAISO, *Fast Facts*, "What the duck curve tells us about managing a green grid," *available at* https://www.caiso.com/Documents/FlexibleResourcesHelpRenewables_FastFacts.pdf.

Accordingly, while renewable resources provide an additional source of energy, the need for fast-ramping, natural gas-fired generation to meet peak electric power demand is increasing to "fill the gap" as renewable generation fluctuates during the day or with the weather. Integration of increasing amounts of renewable generation (especially solar and wind) has significantly increased reliance on the availability and flexibility of natural gas-fired units to ensure safe and reliable operation of the electric system, especially during morning and late afternoon load and renewable generation ramps.

In addition to observed, daily ramping patterns of solar generation illustrated by the duck curve, renewable generation has intermittency issues that are not always predictable (*e.g.*, rain or cloud cover reducing solar output). Quick-start, natural gas-fired units known as peaking units alleviate these intermittency issues as well. As more generation from solar and wind comes on-line, the call for dispatch of natural gas-fired generation becomes larger and less predictable than in the past, and peaking units can be quickly dispatched under scenarios that require back-up generation for renewable fluctuations throughout the day. Natural gas-fired units are also needed to provide frequency regulation (matching load and generation) and provide more dependable voltage support than renewables.

To support fast ramping natural-gas fired EG, the gas must be there when called upon, even if it was not scheduled in advance. The CEC and CAISO recognize that the intermittency of renewables may cause natural-gas fired EG to ramp up quickly, and as such, may cause a "greater variation in gas load, as well as large draws on the gas system, sometimes very quickly."[19] As discussed in the testimony of Mr. Bisi, the capacity increase from the Proposed Project provide useful "operational flexibility" under stress conditions or intra-daily system

[19] AB 1257 Report, at 32.

fluctuations, such as when peakers are dispatched to respond to a loss of renewable generation (*i.e.* no sun or wind). The incremental capacity would allow more gas to be readily available in-basin, where the natural-gas fired EG is located, and it would support the fast ramping and associated quick draw from the gas system without impacting service to core and noncore customers.

For all of these reasons, natural gas supply reliability and operational flexibility are key to maintaining electric system reliability and serving firm electric demand in San Diego.

B. Existing and New EG No Longer Have Back-Up Fuel Sources

In the past, the large generating units at the South Bay and Encina Power Plants serving the SDG&E area were required to maintain a dual-fuel capability to avoid electric load curtailment in the event of a loss of natural gas supply. Although these traditional fossil fuel generating units in SDG&E's area were able to switch back-and-forth between natural gas and oil, air quality rules have dictated that only natural gas is now used. As new units come on-line, those are designed to only operate on natural gas, not oil. Thus, oil is no longer available as a back-up fuel source. This issue makes SDG&E's electric customers more dependent on a reliable and assured natural gas supply, and likewise makes electric customers more vulnerable to blackout in the event of a loss of natural gas supply.

C. Alternative Energy Storage Options Would Not be Superior to the Proposed Project

The Utilities considered whether grid-scale battery/energy storage and associated equipment would be sufficient to supply customers with energy equivalent to that of the

Proposed Project from an electric perspective.[20] This evaluation is based on a scenario under which: the gas supply is lost to all local natural gas-fired EG during a peak electric load period; gas supply is unavailable for a four-hour period; and that no customer outages would occur. The Utilities are unaware of a battery storage project of this magnitude being undertaken and, as a result, battery production on this scale would be very difficult, very expensive, very large (requiring approximately 100 acres of land) and would take a very long time to produce.

A system of grid-scale batteries might provide four hours of electric supply under the circumstances that EG was unavailable due to the loss of the natural gas supply; however, grid-scale batteries would not provide any energy replacement for the residential and business needs that are currently supplied by natural gas. For example, during the four-hour period, customers might still receive electricity service from the grid-scale batteries, but would not have any natural gas service to operate their gas water heaters, gas heating units, gas appliances or any other gas supplied equipment.

In order for the four hours of grid-scale battery storage to be ready and available if a system wide natural gas outage occurred, the system of batteries would need to be fully charged at all times. It is likely that grid-scale batteries would be charged and discharged on a regular basis and operated by the CAISO as an ongoing resource it could count on for grid reliability purposes. Therefore, depending on the timing of a natural gas outage, there is no certainty that the system of batteries would be fully charged when needed. Even if the batteries were kept fully charged, at most they would cover a four-hour period, which is not equivalent to the benefit of the Proposed Project.

[20] This evaluation was undertaken to comply with the Joint Assigned Commissioner and Administrative Law Judge's Ruling Requiring an Amended Application and Seeking Protests, Responses, and Replies issued January 22, 2016 (Ruling), at 12-13.

The Utilities also evaluated a smaller-scale, alternative energy battery storage that involves the installation of smaller-scale batteries and associated equipment to supplement the gas supply system at times when additional capacity is needed (e.g. unplanned outages, maintenance, peak demand). Similar to the grid-scale battery storage project, this assumes that smaller-scale battery storage would supply four hours of electric supply, including approximately 11,200 MWh of energy storage capacity.

Similar to the issue with the grid-scale battery storage, smaller-scale battery storage would not provide any energy replacement for the residential and business needs that are currently supplied by natural gas. Customers might still receive electricity service from the batteries, but would not have any natural gas service. Likewise, the same issues exist in that the system of batteries would need to be fully charged at all times, but would be charged and discharged on a regular basis and operated by the CAISO as an ongoing resource it could count on for grid reliability purposes. Therefore, depending on the timing of a natural gas outage, there is no certainty that the system of batteries would be fully charged when needed. As previously discussed, even if the batteries were kept fully charged, at most they would cover a four-hour period, which is not equivalent to the benefit of the Proposed Project.

The Utilities could not identify any other reliable alternative energy options that would not require the installation of a new gas transmission pipeline.

D. Retirement of San Onofre Nuclear Generating Station (SONGS) Requires Additional Base Load Natural Gas-Fired EG

Compounding the renewables intermittency issues, the permanent shutdown of SONGS Units 2 and 3, both base load units,[21] has resulted in eliminating approximately 2,250 MW of

[21] A “base load” unit is one that is expected to run at full load continuously, except for outages for maintenance or other reasons.

generation that was used to serve the base load in the region.[22] SONGS had been SDG&E's primary generation not sourced by gas supplies. The retirement of SONGS has significantly increased reliance on existing natural gas-fired generating units and triggered the need to add natural gas-fired units to replace the SONGS generator capacity to serve the base load of electric demand. This is also a significant driving force for the need to reinforce SDG&E's gas system for reliable service to SDG&E's firm electric customers.

IV. CURRENT AND EXPECTED NATURAL GAS-FIRED ELECTRIC GENERATION IN SDG&E'S SERVICE TERRITORY

A. Existing In-Basin Natural Gas-Fired Generation

Excluding a small water pumped storage facility in the Lake Hodges area of San Diego and 30 MW of "Net Qualifying Capacity" (NQC) associated with wind and solar renewables within the SDG&E in-basin area, existing gas-fired generation in the SDG&E system is a total of approximately 3,000 MW and is comprised of combustion turbines (CTs), steam turbines at Encina Power Plant (located in Carlsbad), the combined cycle plants at Palomar Energy Center (located in Escondido) and the Otay Mesa Energy Center (located in Otay Mesa).

1. Encina (operated by Cabrillo I):

   This gas fired power plant has a maximum capacity of 950 MW (including a small Gas Turbine, GT, included below).

2. Palomar Energy Center (operated by SDG&E):

   This combined cycle power plant has a maximum capacity of 565 MW.

[22] In this context, "base load" refers to the minimum customer load demand, which is a "base" amount of power required around-the-clock.

3. Otay Mesa Energy Center (operated by Calpine):

This combined cycle power plant has a maximum capacity of approximately 600 MW.

4. Combustion Turbines (CTs):

The total maximum capacity of these generators, including Gas Turbines, Qualifying Facilities and other Peakers is approximately 900 MW.

B. Imperial Valley Natural Gas-Fired Generation:

Existing gas-fired generation in the Imperial Valley area is comprised of combined cycle plants located south of the USA-Mexico border. These plants play an important role in regulating the voltages in this very important hub of 500 kV lines and renewables. The lack of this generation would limit SDG&E import capability and cause issues in neighboring systems such as the Imperial Irrigation District (IID) and Comisión Federal de Electricidad (CFE).

1. Termoeléctrica de Mexicali

This combined cycle power plant has a maximum capacity of 600 MW.

2. Central La Rosita II

This combined cycle power plant has a maximum capacity of 450 MW.

C. Predicted Retirements and Additions

Planned (Future) Generation:

Additionally, approximately 800 MW of future natural gas fired generation has been approved for construction in SDG&E's service territory.

1. Pio Pico Generation:

Gas Turbine generators with an installed capacity of approximately 300 MW are planned for an in-service date in early 2016.

2. Encina Generation (Carlsbad Energy Center):

Gas Turbine generators with an installed capacity of approximately 500 MW are planned to be in service in 2017. These will replace the existing units totaling 950 MW described earlier in my testimony. Although the installed capacity at Encina will be reduced from 950 MW to approximately 500 MW, the increased efficiency of the new units will likely mean that they will be run more often than the existing units.

V. WITHOUT SAN DIEGO NATURAL GAS-FIRED ELECTRIC GENERATION, SDG&E DOES NOT HAVE SUFFICIENT LOAD SERVING CAPABILITY TO PROVIDE RELIABLE ELECTRIC SERVICE

The San Diego and southern Orange County areas are served by SDG&E. The peak electrical demand is projected to reach up to 5,372 MW[23] in 2016 climbing at an annual growth rate that varies, but typically is around 1 percent per year through 2025. The electric load serving ability for this area relies heavily on local natural gas generation, especially during high electric load[24] levels, with the area containing approximately 3,000 MW of natural gas-fired generation and a very small amount, 70 MW, of non-gas-fired generation.

SDG&E's customer load is served by a combination of internal generation and power import. SDG&E's maximum power import capability is 3,500 MW. However, this maximum level is established under operating conditions with in-basin natural gas-fired generation available. As discussed in the testimony of Mr. Bisi and Mr. Kikuts, any number of circumstances could result in an outage on the gas transmission system. A gas curtailment or gas supply interruption would result in significantly reducing SDG&E's power import capability. Even if there were an abundance of generation available in the CAISO system, SDG&E's limited

[23] California Energy Commission, California Energy Demand 2015-2025 Final Forecast, Mid-Case Final Baseline Demand Forecast Forms, at: http://www.energy.ca.gov/2014_energypolicy/documents/demand_forecast_sf/Mid_Case/ and specifically Tab "SDGE Form 1.5-Mid" at: http://www.energy.ca.gov/2014_energypolicy/documents/demand_forecast_sf/Mid_Case/SDGE_Mid.xlsx

[24] The terms "load" and "demand" may be used interchangeably.

power import capability would prevent those resources from serving SDG&E's customer load demand.

A solution to eliminating the reliance on natural gas supply and capacity, although with potentially high cost and environmental impact, would require building additional transmission infrastructure that would allow for greater import capacity from the north (California) or east (Arizona).

A simple comparison of SDG&E's maximum electric power import capability (up to 3,500 MW) to SDG&E's peak load (5,372 MW for 2016) shows that <u>even under maximum import conditions</u>, up to 1,872 MW of local generation (which is more than 50 percent of the local generation) is needed and must have a reliable gas supply to serve SDG&E's customer peak electric demand. That number will climb upward every year due to the projection of year-by-year increasing electric customer demand (projected through 2025).[25]

Absent internal natural gas-fired electric generation due to a gas interruption, SDG&E's power import capability would be reduced to approximately 2,500 MW or lower, as shown in the Table below.

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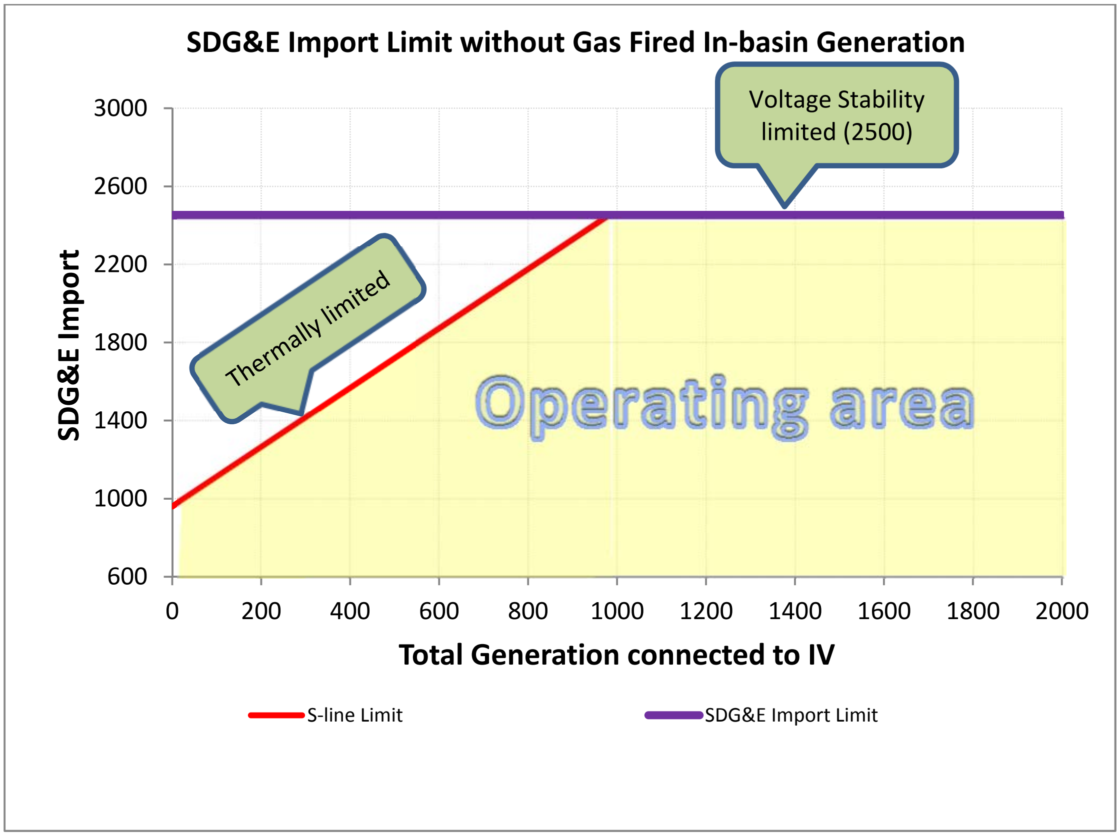
[25] At the time my testimony was prepared, I relied on the CEC's California Energy Demand 2015 – 2025 Final Forecast, adopted January 15, 2015, which was the then-current forecast. I am aware a new forecast was recently issued by the CEC on January 27, 2016.

TABLE 2

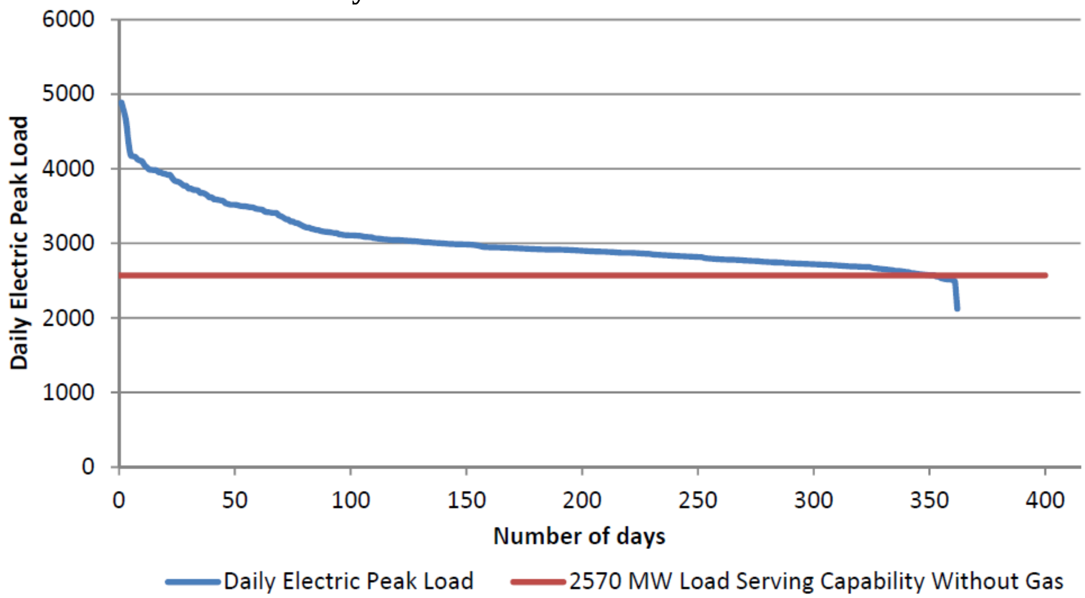


If the gas supply were interrupted, about 70 MW of in-basin non-gas generation[26] would remain. Under this scenario, SDG&E could serve up to about 2,570 MW of customer load. At peak load, up to about 2,802 MW of customer load (over half of the customer load) would be unserved or need to be dropped.[27] This is an unacceptable outcome. This is not only an annual peak load condition problem, but would be a daily problem. This issue will only be exacerbated as customer demand continues to grow. SDG&E's daily peak demand typically ranges from 2,500 MW to 3,500 MW. The ability to serve only about 2,570 MW of customer load under gas outage conditions means that load would need to be dropped almost all days of a gas

[26] The 70 MW of non-gas electric generation refers to 40 MW of Lake Hodges pumped storage hydro generation along with 30 MW of "Net Qualifying Capacity" (NQC) associated with Kumeyaay wind generation and a small amount of solar generation at Borrego.
[27] The figure of 2,802 reflects the annual peak load of 5,372 MW minus the 2,570 MW load-serving capability without gas.

interruption. This points out a critical need for the Proposed Project to avoid such a scenario occurring. Table 3 below illustrates the severity of this issue.

TABLE 3
2014 Daily Electric Peak Load Duration Curve



The need for a reliable gas supply to electric natural gas-fired generation is further illustrated by the events during SDG&E's peak-load period of 2015, when the high humidity of the monsoonal conditions was causing high electric demand while at the same time the associated cloudiness severely limited solar output.

Although SDG&E does have Demand Response (DR) programs, the amount of DR is very limited and would not have any significant impact in resolving the problems of potential blackouts. The number of DR programs available depends upon the season. Some DR programs are available year round and others are available only May through October. SDG&E's DR forecast filed April 1, 2015 shows that SDG&E has 14 MW available in April and 80 MW available in September. These amounts are far too small to mitigate the potential for blackouts in the event of a gas curtailment.

As discussed above, there is a need to ensure coordination between the gas and electric industries. With an increasing amount of renewables coming on-line, and even more so with the passage of SB 350, there is a greater need for energy system flexibility. Natural gas-fired EG provides the increased dispatchability and operational flexibility to integrate increasing amounts of renewable energy onto the electric system. Indeed, the CEC recognizes that as California moves from utilizing carbon-intensive resources, how natural gas is used will change.[28] Such changes will affect the quantity of natural gas used for EG and how and when natural gas-fired resources need to operate, requiring a higher degree of coordination between gas and electric industries.[29]

The interdependency of the gas and electric systems in the San Diego region is evident in the following examples, which can be expected to grow as the use of solar and wind increases.

- January 15, 2013 Gas Curtailment Watch
- December 9, 2013 Gas Curtailment Watch
- February 6, 2014 Gas Emergency Localized Curtailment Notice:
  - This curtailment impacted local generation, with only one plant (Otay Mesa) operational for the majority of the day.
  - CAISO issued Restricted Maintenance Order – Cancelled all scheduled work
  - CAISO issued Flex Alert for customers statewide to conserve
  - These impacts lingered for 2 days due to extreme weather conditions to the east.

The gas curtailment on February 6, 2014 and corresponding electrical curtailment occurred under winter and not peak summer conditions for electric service. If such a curtailment were to take place under a heavier electric demand period, there is no assurance that all

[28] AB 1257 Report, at 30.
[29] *Id*.

customers' loads would be served, and electric outages could occur. This issue will only continue to intensify in future years as electric demand continues to rise and gas demand on a daily and hourly basis continues to fluctuate. In addition, the potential for an extended gas outage as described by Mr. Bisi and Mr. Kikuts is of particular concern due to the high consequences for both gas and electric reliability in the San Diego region.

It is for the reasons outlined above that it is vitally important from an electric standpoint that the SDG&E natural gas system be reinforced as proposed.

VI. ELECTRIC GENERATION IN SAN DIEGO ALSO PROVIDES ENERGY TO CAISO SYSTEM

When the SONGS generating units were operational, power would normally flow from San Onofre into SDG&E's system through SDG&E's five-line 230 kV interconnection at San Onofre. Since the shutdown of SONGS, power now routinely flows from SDG&E's system into the Southern California Edison (SCE) system through that interconnection. This flow from SDG&E's system supports the CAISO system.

The CAISO oversees the dispatch of generators through its market mechanisms. To the extent that generators in the San Diego area would have otherwise been winning bidders, but cannot run due to a gas curtailment, then clearly higher-bidding units would be dispatched in their place, resulting in higher costs to electric customers throughout California.

Although there are specific power import constraints into SDG&E's system as described earlier in this testimony, the CAISO's market dispatch of generation covers the entire CAISO area, including SDG&E. A loss of gas supply resulting in a loss of EG in the San Diego area would not only affect electric system reliability locally, but would affect the CAISO operations. At best, there may be higher prices to customers if the generators in the San Diego would have otherwise been winning bidders. At worst, should there be an overall shortfall of generation within the CAISO as a whole, then loss of EG in the San Diego area would exacerbate such a shortfall and could result in loss of customer load in San Diego and elsewhere in the CAISO system.

As described in the testimony of Mr. Bisi, the addition of a 36-inch pipeline will provide complete redundancy for the existing 30-inch Line 3010 or Moreno Compressor Station, reduce reliance on Moreno Compressor Station, and increase the capacity on the SDG&E gas system to support operational flexibility during the swings in natural gas-fired generation needed to respond to the intermittency issues associated with solar and wind generation. With the new pipeline, a single pipeline contingency would still leave enough gas capacity to avoid the risk of electric generation curtailment for the foreseeable future.

VII. QUALIFICATIONS

I graduated with a Bachelor of Science degree in Electrical Engineering from the University of Texas in El Paso in 1979. I worked as a plant electrical engineer for Lone Star Industries from 1979 to 1980 and was responsible for electrical projects in System Protection and Control. I obtained a Master of Science degree in Electrical Engineering with emphasis in Power Systems from the University of Texas at El Paso in 1983.

I joined the Transmission Planning Section of SDG&E in 1982. I had lead responsibility for development of SDG&E's electric transmission capital budget projects to expand the transmission system within the SDG&E service territory, evaluation of transmission interconnection capabilities to accommodate off system resources, and the conducting of system analysis. From 1999 to 2004, I served as SDG&E's Manager of Grid Operations Services, where I was responsible for technical evaluation to identify day-to-day and seasonal transfer capability limits and mitigating measures for the safe and reliable operation of SDG&E's transmission system. I managed development and coordination of operating procedures to minimize congestion. I also managed SDG&E's existing transmission contract administration responsibilities and was responsible for overseeing all Reliability Must Run contract, settlements, technical studies and FERC filings. From 2004 to 2012, I served as the Director of SDG&E's Electric Transmission and Distribution Engineering Department, responsible for design and engineering of distribution, substation, and transmission projects, including the engineering, equipment, and structural design involved in the development of Transmission and Substation Engineering projects.

From 2012 to the present, I have been serving as the Director of SDG&E's Electric Grid Operations Department. In that capacity, I am responsible for the reliable operation of SDG&E's

electric transmission grid, which supplies electricity to the distribution system that ultimately provides electricity to SDG&E's customers.

From 1986 to 1998, on a part-time basis, I taught at the senior level at San Diego State University in the Electrical and Computer Engineering department in system network modeling and power flow analysis, system stability, and system protection. Since 2000, I have been teaching a Professional Engineering preparation class at SDG&E in the Electrical Engineering discipline.

I have served as the Chairman of the Western Electricity Coordinating Committee (WECC) Pacific and Southwest Transfer work group, and I have represented SDG&E on the WECC Planning and Operations Committees.

I am a registered Professional Engineer in the State of California.

I have previously testified before the California Public Utilities Commission.

This concludes my prepared direct testimony.