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PREPARED DIRECT TESTIMONY OF

WEI BIN GUO

ON BEHALF OF SOUTHERN CALIFORNIA GAS COMPANY

AND SAN DIEGO GAS & ELECTRIC COMPANY

(WEATHER DESIGN)

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CHAPTER 2

PREPARED DIRECT TESTIMONY OF WEI BIN GUO

(WEATHER DESIGN)

I. PURPOSE

The purpose of my prepared direct testimony is to present the weather design used in the forecasts of Southern California Gas Company's (SoCalGas) and San Diego Gas & Electric Company's (SDG&E) weather-sensitive gas market segments.

II. SOCALGAS WEATHER DESIGN

This section discusses the temperature assumptions that underlie the forecasts for gas demand for SoCalGas' temperature-sensitive market segments and presents the temperature design values for average year and cold year weather. This section also discusses the temperature design values used to forecast peak day gas demand for the temperature-sensitive market segments.

A. SoCalGas Average Year and Cold Year Weather Design

Temperature variations can cause significant changes in winter gas demand due to space heating, principally in the residential and commercial markets. Recognizing this, the gas demand forecasts are prepared for two temperature designs—average and cold—to quantify changes in demand due to cold weather. SoCalGas creates these temperature designs using the concept of a Heating-Degree-Day (HDD),[1] a measure of the coldness of a month or year. One HDD is

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[1] For SoCalGas, daily values of system-wide average temperatures are calculated from a six-zone temperature monitoring procedure. From this daily system average temperature data, a corresponding daily value of Heating Degrees (HD) is computed from the formula, HD = max{0, 65-T}, where T is the daily system average temperature. For each calendar month, the accumulated number of HD is determined, upon which an annual total is calculated. Accumulated values of HD for a specified number of days (>1) are called Heating-Degree-Days (HDD).

accumulated, daily, for each degree that the daily average temperature is below 65 degrees Fahrenheit (°F).

The Average Year and Cold Year scenarios are calculated and defined in terms of HDD. In this cost allocation proceeding (CAP), SoCalGas has included a climate-change warming trend that gradually reduces HDD's over the forecast period.[2] First, average temperature year values were computed as the simple average of annual HDD's for the calendar years 2002 through 2021: 1,248 HDD's for SoCalGas. Corresponding 1-in-35 cold year HDD's were 1,476 for SoCalGas. For the forecast period, projected annual HDD's were reduced each year by 6 HDD's. Projected average year and cold year HDD's both drop by 6 HDD annually: from 1,242 and 1,470 in year 2022, to 1,206 and 1,434 in year 2028. The annual reductions are based on the latest 20-year trend in 20-year-averaged HDD's. That is, they are based on the observed trend in changes starting with average HDD's for years 1983-2002, then 1984-2003, then 1985-2004, and so on, ending with the average HDD's for years 2002-2021.

The Cold Year HDD value is calculated according to the criterion that it is expected to be exceeded with an average frequency of once out of every 35 years. Based on this criterion, the Cold Year HDD value is calculated as 2.025 standard deviations more than the Average Year HDD. The resulting SoCalGas Cold Year HDD value is 1,476 HDD. In this CAP, the standard deviation has been calculated using an approach that compensates for the annual HDD values for the years 2014-2018 in SoCalGas' service territory being dramatically lower than in any preceding year going back to 1950. Ignoring this warm weather and using a typical standard

[2] SoCalGas and SDG&E first began to use climate warming trend assumptions in the 2020 California Gas Report.

deviation calculation[3] for HDD based on the 20-year period (2002-2021) produces a standard-deviation number that is excessively large,[4] leading to an unrealistically high Cold Year HDD value. Instead, the standard deviation proposed for this CAP is calculated based on an HDD dataset that controls for the warm weather regime that lasted from 2014 to 2018.[5] In this dataset, the annual HDD values for the years 2014-2018 have been adjusted higher to account for a shift in the level of annual HDD[6] and then combined with the unadjusted, actual annual HDD values for the preceding years 2002-2013 and succeeding years 2019-2021. The standard deviation calculation has been performed using this adjusted dataset.[7] Finally, this standard deviation

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3 The typical calculation for the standard deviation is:

$$standard\ deviation = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

4 SoCalGas' typical standard deviation calculation for the 20 years before the warm weather regime (years 1994-2013), results in a standard deviation of 145.5. The same calculation for the most recent 20 years (years 2002-2021), results in a standard deviation of 210.1, an increase of 44%. Using this approach would therefore imply that, on an annual basis, cold weather had become much more volatile since 2013.

5 The same approach to control warm weather regime from 2014 to 2017 when estimating standard deviation was proposed by SoCalGas in last TCAP and was adopted by the Commission.

6 A regression with a time trend and a dummy variable for the years 2014-2018 has been used to estimate the shift in the level of annual HDD that occurred from 2014 to 2018. A dummy variable takes the value one for some observations to indicate the presence of an effect or membership in a group and zero for the remaining observations. Estimating the effect of the dummy variable gives an estimate of that effect or the impact of membership in that group. A dummy variable is used here to estimate the average effect on annual HDD of a given year having membership in the group of years 2014-2018. The dataset is SoCalGas system-wide annual HDD for the years 2002-2021. The regression equation is:

$$HDD_t = \alpha + \beta * t + \beta_{2014-2018} * D_{2014-2018} + \varepsilon$$

where $D_{2014-2018}$ is a dummy variable for the years 2014-2018 and $\beta_{2014-2018}$ is the corresponding dummy coefficient. This regression equation estimates average HDD over the period 2002-2021 controlling for time trends in HDD and the warm weather regime of years 2014-2018. It's important to note that p-value for the estimate of $\beta_{2014-2018}$ is 0.003% indicating an extremely low probability that membership in the group of years 2014-2018 had no effect on annual HDD's.

The dummy variable's estimated effect, $\beta_{2014-2018}$, is subtracted from the actual annual HDD data for years 2014-2018 to adjust the data to remove the level shift.

7 The resulting standard deviation is 112.8.

estimate is multiplied by 2.025, as previously described, and added to the Average Year HDD value to arrive at the Cold Year HDD value of 1,476 HDD.

Monthly rounded HDD's for the starting-point Cold Year and Average Year Designs are shown below in Table 1.[8] These figures are reduced by 6 HDD per year through the forecast period, with the monthly reductions made proportionally to the monthly HDD's shown in Table 1.

Table 1

SoCalGas Heating Degree Days Weather Design (for year 2021)

Month	Cold Year 1-in-35 Design	Average Year 1-in-2 Design[9]
January	302.3	255.6
February	259.0	219.0
March	197.3	166.9
April	122.0	103.1
May	56.0	47.3
June	11.5	9.7
July	2.4	2.1
August	2.1	1.8
September	5.3	4.5
October	36.0	30.5
November	146.6	123.9
December	335.5	283.6
	1,476	1,248

8 The monthly starting-point values for Average Year HDD were calculated as the arithmetic average of the respective month's 20 years of observed monthly HDD. The monthly values for the Cold Year HDD were calculated by multiplying a proportion for each calendar month times the Cold Year HDD annual value. The proportion for each calendar month is that month's HDD total relative to the annual HDD total based on the Average Year data.

9 SoCalGas also refers to the Average Year HDD data (monthly or annual) as a "1-in-2" design because the average or expected value has the characteristic that there is a 50% (*i.e.*, 1-in-2) chance of observing a larger value.

B. SoCalGas Peak Day Temperature Designs

SoCalGas plans and designs its system to provide continuous service to its core (retail and wholesale) customers under an extreme peak day event.[10] The extreme peak day design criterion is defined as a 1-in-35-year event;[11] this corresponds to a system average temperature of 40.5°F, or 24.5 HDD, on a peak day. Although the gas demand for most of SoCalGas' noncore retail markets is not HDD-sensitive, the noncore commercial segment does exhibit a small but statistically significant HDD load sensitivity. For such SoCalGas noncore markets, SoCalGas uses a less extreme, but more frequent, 1-in-10-year likelihood peak day temperature[12] of 42.2°F, or 22.8 HDD.

III. SDG&E WEATHER DESIGN

This section discusses the temperature assumptions that underlie the forecasts for gas demand for SDG&E's core market segments and presents the temperature design values for average year and cold year weather. It also discusses the temperature design values that are used to forecast the peak day gas demand for SDG&E's temperature-sensitive market segments.

A. SDG&E's Average Year and Cold Year Weather Design

As with SoCalGas, the core demand forecasts for SDG&E are prepared for two temperature designs —average and cold—to quantify changes in space heating demand due to weather. HDD's for SDG&E are defined similarly as for SoCalGas but use a daily system-

[10] The temperature SoCalGas uses to define a peak day is determined from an analysis of the annual minima of SoCalGas' daily system-average temperatures. These temperatures are used to estimate a probability model for the annual minimum daily temperature. The extreme peak day temperature value is determined from a calculation using this estimated model such that the chance we would observe a lower value than this extreme peak day temperature is 1/35 or about 2.86%.

[11] System planning criterion ordered by CPUC Decision D.02-11-073.

[12] System planning criterion ordered by CPUC Decision D.02-11-073.

average temperature calculated from a weighted-average of three weather station locations in SDG&E's service territory.

The Average and Cold Year scenarios for SDG&E are calculated using the same methodologies used for SoCalGas. SDG&E has also included a climate-change warming trend that gradually reduces HDD's by 6 HDD per year over the forecast period. First, the average temperature year value was computed as the simple average of annual HDD's for the calendar years 2002 through 2021: 1,158 HDD's for SDG&E. Like SoCalGas, SDG&E's service territory experienced an unusual warm weather regime from 2014 to 2018. To address this anomaly, the SDG&E Cold Year scenario was calculated using the same approach as for SoCalGas.[13] The resulting 1-in-35 Cold Year HDD's are 1,368 for SDG&E: 210 HDD's higher than for the Average Year. With the assumed warming trend, projected average year and cold year HDD's were then both set to drop by 6 HDD annually: from 1,152 and 1,362 in year 2022, to 1,116 and 1,326 in year 2028.

Monthly starting-point HDD values[14] are shown in Table 6. These figures are reduced by 6 HDD per year through the forecast period, with the monthly reductions made proportionally to the monthly HDD's shown in Table 6.

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[13] The same approach to control warm weather regime from 2014 to 2017 when estimating standard deviation was proposed by SDG&E in last TCAP and was adopted by the Commission.

[14] The monthly starting-point values for Average Year HDD were calculated as the arithmetic average of the respective month's 20 years of observed monthly HDD. The monthly values for the Cold Year HDD were calculated by multiplying a proportion for each calendar month times the Cold Year HDD annual value. The proportion for each calendar month is that month's HDD total relative to the annual HDD total based on the Average Year data.

Table 6

SDG&E Heating Degree Days Weather Design (for year 2021)

Month	Cold Year 1-in-35 Design	Average Year 1-in-2 Design
January	280.9	237.8
February	246.1	208.4
March	196.9	166.7
April	122.8	104.0
May	57.4	48.6
June	10.6	9.0
July	0.6	0.6
August	0.1	0.1
September	0.9	0.8
October	26.5	22.5
November	122.5	103.7
December	302.5	256.1
	1,368	1,158

B. SDG&E's Peak Day Temperature Designs

SDG&E plans and designs its system to provide continuous service to its core customers under an extreme peak day event.[15] The extreme peak day design criterion is defined as a 1-in-35 annual event; this corresponds to a system average temperature of 43.3°F, or 21.7 HDD, on a peak day.

This concludes my prepared direct testimony.

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[15] The temperature SDG&E uses to define a peak day is determined from an analysis of the annual minima of SDG&E's daily system-average temperatures in order to estimate a probability model for the annual minimum daily temperature. The extreme peak day temperature value is determined from a calculation using this estimated model such that the chance we would observe a lower value than this extreme peak day temperature is 1/35 or about 2.86%.

IV. QUALIFICATIONS

My name is Wei Bin (William) Guo. My business address is 555 West Fifth Street, Los Angeles, California 90013-1011. I am employed by SoCalGas as a Forecasting Advisor in the Regulatory Affairs Department. I am responsible for weather design, noncore non-dispatchable EG demand forecast, as well as preparation and consolidation of natural gas demand forecasts for SoCalGas and SDG&E. I have held my current position since March 2016. I previously worked as a Principal Regulatory Economic Advisor in the Regulatory Affairs Department of SoCalGas from March 2015 to March 2016.

I earned an undergraduate degree in Applied Mathematics from Dalian University of Technology, and a Master of Science in Applied Statistics from California State University of Long Beach.

I have previously submitted testimony before the Commission.