COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

ELECTRONIC 2018 JOINT INTEGRATED RESOURCE PLAN OF LOUISVILLE GAS AND ELECTRIC COMPANY AND KENTUCKY UTILITIES COMPANY	**)** **)** **)** **)**	**CASE NO. 2018-00348**

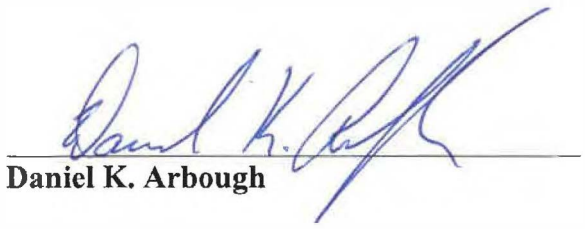
RESPONSE OF LOUISVILLE GAS AND ELECTRIC COMPANY AND KENTUCKY UTILITIES COMPANY TO COMMISSION STAFF'S FIRST REQUEST FOR INFORMATION DATED OCTOBER 3, 2019

FILED: OCTOBER 25, 2019

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Daniel K. Arbough**, being duly sworn, deposes and says that he is Treasurer for Kentucky Utilities Company and Louisville Gas and Electric Company and an employee of LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.



Daniel K. Arbough

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 24th day of October, 2019.

Notary Public

My Commission Expires:

Judy Schooler
Notary Public, ID No. 603967
State at Large, Kentucky
Commission Expires 7/11/2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Robert M. Conroy**, being duly sworn, deposes and says that he is Vice President, State Regulation and Rates, for Kentucky Utilities Company and Louisville Gas and Electric Company and an employee of LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

Robert M. Conroy

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 24th day of October 2019.

Notary Public

My Commission Expires:
Judy Schooler
Notary Public, ID No. 603967
State at Large, Kentucky
Commission Expires 7/11/2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Michael P. Drake**, being duly sworn, deposes and says that he is Director – Generation Services for LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

Michael P. Drake

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 23rd day of October 2019.

Notary Public (SEAL)

My Commission Expires:
Judy Schooler
Notary Public, ID No. 603967
State at Large, Kentucky
Commission Expires 7/11/2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **David E. Huff**, being duly sworn, deposes and says that he is Director of Advanced Meter Initiatives for LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and that the answers contained therein are true and correct to the best of his information, knowledge and belief.

David E. Huff

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 23rd day of October 2019.

Notary Public (SEAL)

My Commission Expires:
Judy Schooler
Notary Public, ID No. 603967
State at Large, Kentucky
Commission Expires 7/11/2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Thomas A. Jessee**, being duly sworn, deposes and says that he is Vice President, Transmission for Louisville Gas and Electric Company and Kentucky Utilities Company and an employee of LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

Thomas A. Jessee

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 24th day of October 2019.

Notary Public

My Commission Expires:

4/1/2020

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Elizabeth J. McFarland**, being duly sworn, deposes and says that she is Vice President, Customer Services for Louisville Gas and Electric Company and Kentucky Utilities Company and an employee of LG&E and KU Services Company, and that she has personal knowledge of the matters set forth in the responses for which she is identified as the witness, and the answers contained therein are true and correct to the best of her information, knowledge and belief.

Elizabeth J. McFarland

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 24th day of October 2019.

Notary Public

My Commission Expires:
Judy Schooler
Notary Public, ID No. 603967
State at Large, Kentucky
Commission Expires 7/11/2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Gary H. Revlett**, being duly sworn, deposes and says that he is Director – Environmental Affairs for LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

Gary H. Revlett

Gary H. Revlett

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 24th day of October 2019.

(SEAL)
Notary Public

My Commission Expires:

CONNIE YORK
NOTARY PUBLIC
Kentucky, State At Large
I.D. # 628548
My Commission Expires 8/7/2023

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **Stuart A. Wilson**, being duly sworn, deposes and says that he is Director, Energy Planning, Analysis & Forecasting for LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

Stuart A. Wilson

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 24th day of October 2019.

Notary Public (SEAL)

My Commission Expires:
Judy Schooler
Notary Public, ID No. 603967
State at Large, Kentucky
Commission Expires 7/11/2022

VERIFICATION

COMMONWEALTH OF KENTUCKY)
)
COUNTY OF JEFFERSON)

The undersigned, **John K. Wolfe**, being duly sworn, deposes and says that he is Vice President, Electric Distribution for Kentucky Utilities Company and Louisville Gas and Electric Company and an employee of LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

John K. Wolfe

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 14th day of October 2019.

Notary Public

My Commission Expires:
Judy Schooler
Notary Public, ID No. 603967
State at Large, Kentucky
Commission Expires 7/11/2022

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's First Request for Information
Dated October 3, 2019

Case No. 2018-00348

Question No. 1

Witness: Stuart A. Wilson

Q-1. Identify and explain any significant changes affecting the load forecast and sensitivity analyses since the filing of LG&E/KU's 2018 Integrated Resource Plan (IRP).

A-1. The Companies' most recent load forecast was developed in June 2019. As shown below, this forecast is not significantly different from the 2018 IRP forecast.

	Electricity Sales (GWh)		
Year	2018 IRP	June 2019 Forecast	Percent Change From 2018 IRP
2019	31,095	31,069	-0.08%
2020	30,640	30,594	-0.15%
2021	30,544	30,476	-0.22%
2022	30,513	30,411	-0.33%
2023	30,502	30,350	-0.50%
2024	30,567	30,342	-0.74%
2025	30,536	30,302	-0.77%
2026	30,544	30,301	-0.79%
2027	30,553	30,302	-0.82%
2028	30,598	30,343	-0.83%
2029	30,570	30,309	-0.86%
2030	30,560	30,305	-0.83%
2031	30,569	30,313	-0.84%
2032	30,605	30,357	-0.81%
2033	30,576	30,331	-0.80%

Net Peak Demand (MW)

Year	2018 IRP	June 2019 Forecast	Percent Change From 2018 IRP
2019	6,360	6,319	-0.64%
2020	6,361	6,310	-0.79%
2021	6,350	6,300	-0.79%
2022	6,338	6,291	-0.74%
2023	6,338	6,288	-0.78%
2024	6,325	6,283	-0.66%
2025	6,330	6,283	-0.74%
2026	6,344	6,286	-0.91%
2027	6,352	6,287	-1.02%
2028	6,351	6,292	-0.94%
2029	6,357	6,288	-1.08%
2030	6,355	6,293	-0.97%
2031	6,353	6,291	-0.97%
2032	6,343	6,289	-0.84%
2033	6,339	6,294	-0.71%

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's First Request for Information
Dated October 3, 2019

Case No. 2018-00348

Question No. 2

Witness: Stuart A. Wilson

Q-2. Provide updates to any affected tables, schedules, exhibits, etc., as a result of any significant change in the assumptions and conclusions since the filing of the 2018 IRP.

A-2. See the response to Question No. 1. There are no significant changes.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's First Request for Information
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Case No. 2018-00348

Question No. 3

Witness: Stuart A. Wilson

Q-3. Refer to the IRP, Volume 1, Section 5.(1), page 5-2.

a. Provide the highest hourly demand experienced by LGE and KU on an individual utility basis and identify when those demand peaks occurred.

b. Provide the highest annual energy requirements for LG&E, KU, and the combined LG&E/KU system.

A-3.

a. The highest hourly demand experienced by LG&E was 2,852 MW on 8/4/2010 at hour ending 3:00 PM EST; the highest hourly demand experienced by KU was 5,112 MW on 2/20/2015 at hour ending 8:00 AM EST.

b. The highest annual energy requirements for LG&E was 13,184,732 MWh in 2010; the highest annual energy requirements for KU was 23,451,802 MWh in 2010; the highest annual energy requirements for the combined LG&E/KU system was 36,636,534 MWh in 2010.

Louisville Gas and Electric Company and Kentucky Utilities Company
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Dated October 3, 2019

Case No. 2018-00348

Question No. 4

Witness: Stuart A. Wilson

Q-4. Refer to the IRP, Volume 1, Section 5.(2), page 5-11, Figure 5-6. Explain whether a reading of 1.10 represents a 10 percent improvement in efficiency over a value of 1.00.

A-4. Yes.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's First Request for Information
Dated October 3, 2019

Case No. 2018-00348

Question No. 5

Witness: Stuart A. Wilson / Elizabeth J. McFarland

Q-5. Refer to the IRP, Volume 1, Section 5.(2), page 5-22, Figure 5-13, regarding the E.W. Brown Solar Profile on March 15-17, 2017.

a. Explain whether batteries are utilized at the Brown Solar Facility to improve the overall performance.

b. Explain whether LG&E/KU have evaluated the addition of batteries as a possible enhancement to improve overall performance of the facility. If so, provide a copy of the evaluation study.

c. Explain whether the solar cells used in the panels degrade over time resulting in a decline of energy production. Provide the useful life of the Brown Solar Facility.

d. Explain whether the resource assessment analysis takes into account the replacement of the energy/capacity as the solar panels and associated equipment degrade over time.

e. Explain whether LG&E/KU have any technology company or other environmentally-conscious customers who would prefer to purchase green energy produced by the solar facility.

f. Explain whether the solar facility plays any part in LG&E/KU's economic development efforts. If so, to what effect.

A-5.

a. No.

b. The Companies have not performed a formal analysis due to the small size of the Brown Solar facility. The load following capabilities of the Companies' existing units are more than sufficient to reliably account for the intermittent nature of Brown Solar energy production. Therefore, the addition of more batteries would unnecessarily increase costs.

c. No significant degradation in generation has been observed from the panels at the Brown Solar facility. However, solar energy production is expected to degrade as solar panels age. The useful life of E.W. Brown Solar facility is expected to be 25 years.

d. No. The analysis does not model the degradation of Brown Solar generation over time. Given the small size of the Brown Solar facility, this assumption does not impact future resource decisions.

e. The Companies have customers who are interested in purchasing green energy produced by renewable energy sources. The Green Tariff and Solar Share Program were developed to meet these customers' interests. E.W. Brown Solar is being used to serve all customers and not available for allocation to individual customers. Furthermore, the renewable attributes (i.e., Renewable Energy Certificates) are being sold to others with the proceeds being returned to all customers.

f. E.W. Brown Solar does play a part in LG&E/KU's economic development efforts. Currently, as the largest solar facility in the Commonwealth of Kentucky, the E.W. Brown facility serves to educate customers on the inclusion of solar energy in the Company's energy portfolio. In addition, the knowledge and experience gained from the facility allows the Company to provide prospects with better economic development proposals that require solar as part of their growth or location decisions.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's First Request for Information
Dated October 3, 2019

Case No. 2018-00348

Question No. 6

Witness: Stuart A. Wilson

Q-6. Refer to the IRP Volume 1, Section 5.(2), page 5-21, Table 5-4. Provide a table illustrating unit retirements over the 55- and 65-year operating life scenarios.

A-6. The following table shows the retirement years for the Companies' units that would occur under the 55- and 65-year operating life scenarios and extends beyond the IRP analysis period. Zorn 1 is planned to retire in 2021. The ages of the Companies' hydro units at the Ohio Falls and Dix Dam stations are beyond 65 years. These units were not assumed to retire in either operating life scenario.

Plant Name	55-year Retirement	65-year Retirement
Brown 3	2026	2036
Brown 5	2056	2066
Brown 6	2054	2064
Brown 7	2054	2064
Brown 8	2050	2060
Brown 9	2050	2060
Brown 10	2050	2060
Brown 11	2051	2061
Brown Solar	2071	2081
Cane Run 7	2070	2080
Ghent 1	2029	2039
Ghent 2	2032	2042
Ghent 3	2036	2046
Ghent 4	2039	2049
Haefling 1	2025	2035
Haefling 2	2025	2035
Mill Creek 1	2027	2037
Mill Creek 2	2029	2039
Mill Creek 3	2033	2043
Mill Creek 4	2037	2047
Paddy's Run 13	2056	2066
Trimble County 1	2045	2055
Trimble County 2	2066	2076
Trimble County 5	2057	2067
Trimble County 6	2057	2067
Trimble County 7	2059	2069
Trimble County 8	2059	2069
Trimble County 9	2059	2069
Trimble County 10	2059	2069
Cane Run 11	2023	2033
Paddy's Run 11	2023	2033
Paddy's Run 12	2023	2033

Louisville Gas and Electric Company and Kentucky Utilities Company
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Dated October 3, 2019

Case No. 2018-00348

Question No. 7

Witness: Stuart A. Wilson / Elizabeth J. McFarland

Q-7. Refer to the IRP, Volume 1, Section 5.(3), page 5-13 and 5-28 through 5- 29, regarding distributed generation.

a. Explain whether LG&E/KU have any customers with Qualifying Facilities (QF).

b. State whether LG&E/KU have had any customers seek assistance in implementing a QF. If so, provide LG&E/KU's policies regarding these situations.

c. Provide a list of customers by industry name that would be good candidates for QFs. Provide the load of each such customer.

d. Also refer to the IRP, Volume 1, Section 5.(4), page 5-38, Table 5-14, which summarizes LG&E/KU's need for new or replacement capacity under certain circumstances. Explain whether QFs could be considered a reasonable resource option to address LG&E/KU's future capacity needs in addition to the resources listed on Table 5-15 on page 5-39 of the IRP.

e. Explain whether LG&E/KU has ever been approached by a large potential customer interested in self supplying a part of its energy and demand needs. If so, explain how LG&E/KU would encourage this arrangement in the context of economic development.

A-7.

a. LG&E/KU have customers with QF who have a standard rate rider of either:
   - Small Capacity Cogeneration and Small Power Production Qualifying Facilities (SQF)
   - Large Capacity Cogeneration and Small Power Production Qualifying Facilities (LQF)

   These customers take service under the LG&E/KU SQF and LQF Tariff riders.

b. LG&E/KU help all customers seeking assistance. The Companies do not track individual customer inquiries regarding QF, nor do the Companies maintain any policies outside of its published tariffs specific to implementing QF.

c. Whether a particular customer would be a good candidate for QF depends on a number of factors which are known only to the customer and largely unknown to the

Companies. Specifically, the customer is in the best position to know its future business plans and corresponding energy usage needs. The customer is also in the best position to decide whether reliance on a renewable energy source is in its best interests and fits with its long-term goals. In short, the Companies do not have the information needed to make an informed assessment about which customers or industries would be good candidates for QF. The Companies do make customers aware of standard rate riders for small and large capacity cogeneration and small power production QF, through its published tariffs and by other means. As set forth in subpart (a) above, the Companies have some customers taking service under the SQF and LQF rate riders.

d. Yes. When a need for capacity is identified, the Companies issue a public Request for Proposals for any and all sources of generating capacity. If a QF project responds, the Companies will evaluate it along with all other responses.

e. In historical context, the Companies have had conversations with customers or prospects who may be considering self-supplying a portion of their energy and demand needs. In those situations, the Companies work with the customer or prospect to determine the best available economic options considering power supply and reliability.

   In the context of economic development, there are a multitude of facets that cause a customer to make a decision. In our interactions with customers, the Companies play an advisory role to educate them about their options; thus, the Companies haven't been in a position of having to encourage or discourage a customer's decision-making process.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's First Request for Information
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Case No. 2018-00348

Question No. 8

Witness: Stuart A. Wilson

Q-8. Refer to the IRP, Volume 1, Section 5.(3), pages 5-14 and 5-30, regarding electric vehicle penetration. Explain how LG&E/KU have approached the potential problem of charging of electric cars during periods of peak demand, thereby increasing demand peaks.

A-8. The Companies are monitoring the number of electric vehicles (EVs) registered in their service territories and frequently review studies pertaining to this issue. In addition, the Companies have offered Residential Time-of-Day Energy Service and Residential Time-of-Day Demand Service tariffs that provide lower rates during off-peak hours (see the response to Question No. 11).

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's First Request for Information
Dated October 3, 2019

Case No. 2018-00348

Question No. 9

Witness: Stuart A. Wilson / Daniel K. Arbough

Q-9. Refer to the IRP, Volume 1, Section 5.(3), pages 5-24 through 5-26, and Tables 5-7 and 5-9. Quantify the revenue lost to KU as a result of the eight municipals leaving the system and the actions KU has taken to-date to make up the loss of sales.

A-9. The non-fuel revenue lost to KU was approximately $47 million as noted on page 8 of the Direct Testimony of Kent W. Blake in Case Nos. 2018-00294 and 2018-00295.

The actions taken by the Companies in 2014 upon receiving the departing municipals' termination notices are summarized in KU's September 20, 2017 response to the June 22, 2017 Order of the Kentucky Public Service Commission in Case No. 2016-00370. Since 2014, KU has added approximately 14,000 new residential and general service customers. In addition, selected large industrial customers have expanded their operations and increased their annual energy consumption by more than 105 GWh. Moving forward, the Companies will continue to support the Commonwealth's economic development efforts and will continue to respond to RFPs for generating capacity and energy whenever the opportunity would not jeopardize the Companies' ability to reliably serve their retail customers.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's First Request for Information
Dated October 3, 2019

Case No. 2018-00348

Question No. 10

Witness: Stuart A. Wilson

Q-10. Refer to the IRP, Volume 1, Section 5.(3), page 5-29.

a. Explain the drivers behind the National Renewable Energy Laboratory's more aggressive customer adoption rate reflected in LG&E/KU's high distributed generation forecast scenario.

b. Explain whether the current statutory limit of 30 kW for net metering was relaxed as a part of the high distributed generation forecast scenario. If not, explain how the base case would change if, everything else being equal, the 30 kW limit was raised to 45 kW.

A-10.

a. The NREL analysis can be found here: https://www.nrel.gov/docs/fy17osti/68656.pdf.

b. The current statutory limit of 30 kW for net metering was not a factor in the high distributed generation forecast scenario. This scenario assumes a larger number of net metering customers, but the typical solar installation is still assumed to average significantly below the statutory limit.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's First Request for Information
Dated October 3, 2019

Case No. 2018-00348

Question No. 11

Witness: Stuart A. Wilson / Robert M. Conroy / Elizabeth J. McFarland

Q-11. Refer to IRP Volume 1, Section 5.(3), pages 5-30 through 5-31, regarding electric vehicles (EV).

a. Explain whether the electric vehicle analysis includes personally-owned EVs as well as EVs owned and operated by municipalities and commercial entities.

b. Explain the reasonable actions LG&E/KU could take to encourage EV charging overnight versus early evenings. Include in the response whether a separate EV tariff would make sense.

c. Explain whether LG&E/KU also included the possible option of either constructing or encouraging the construction of EV charging stations placed in optimal locations as an alternative to at-home charging.

d. If not addressed above, explain whether LG&E/KU's actions to date are following the electric vehicle market as it develops or whether LG&E/KU are actively promoting increased penetration of electric vehicles and the necessary infrastructure that enables the market to grow. If so, describe what actions are being taken.

e. Briefly explain the economics of EV charging stations made available to the public, and the optimal placement of such, versus home-based, individually owned charging stations, and how those economic factors may or may not have a meaningful effect on peak demand.

A-11.

a. The electric vehicle analysis includes all electric vehicles registered in the service territory. The source data upon which the analysis is based is a zip-code level data file from the Electric Power Research Institute (EPRI) that details total electric vehicles in operation.

b. LG&E/KU have historically used educational campaigns for specific efficiency programs and emphasized the benefits of customers reducing load during the peak hours. A similar educational campaign would be a reasonable action to encourage customers to charge their EV in the later hours of the evening versus early evenings.

LG&E and KU historically had Rate LEV (Low Emission Vehicle Service), which was a Commission approved three-year pilot TOU rate offered to residential customers who had low-emission vehicles. The Companies requested the removal of Rate LEV at the end of the three-year pilot and proposed permanent TOU rates for residential customers which allowed any residential customer to participate as TOU rates do not have a low-emission-vehicle eligibility requirement. LG&E and KU's current Residential Time-of-Day Energy Service and Residential Time-of-Day Demand Service tariffs provide lower rates during the off-peak hours which could provide benefits to EV owners.

The Companies continue to evaluate the adoption of the current TOD rates and the need for any specific EV tariff.

c. LG&E/KU considered the fact that customers' range anxiety causes hesitation to purchase an EV without known access to charging stations and a lack of EVs does not encourage others to invest in electric vehicle supply equipment. In providing 20 charging stations under the Companies EVC (Electric Vehicle Charging) tariff, one goal was to promote adoption of EVs by customers and thus encourage others to invest in charging stations. The public charging stations installed to date are intended to supplement at-home charging.

d. The Companies are actively following EV market developments and are promoting EV adoption. To date, the Companies have installed twenty (20) Level 2 public charging stations under the EVC tariffs. In addition, through the Companies Electric Vehicle Supply Equipment (EVSE) standard rate schedules and riders, the Companies provide business customers the option to host a charging station owned and maintained by the Companies. The Companies have and continue to educate customers about EVs through our website, native articles, radio spots, direct customer communication, and other channels.

e. The availability of EV charging stations to the public range from free to some level of fee for the time a vehicle is being charged. Owners of charging stations have different motivations and rationale for providing charging station equipment. Automotive companies provide charging stations to encourage EV purchases and reduce range anxiety as discussed in response to part (c) of this question. Other charging station owners consider the provision of charging to be a benefit to their customers or employees. Others want to encourage environmental benefits and donate the use of a charger. Homeowners generally install charging stations for the convenience of charging while at home. Thus, the economics vary across charging station installations depending upon the charging station owner's motivation and goals.

As stated in the IRP, "If electric vehicles are charged overnight when energy requirements would otherwise be low, the vehicles can likely be charged with the Companies' existing generation assets. However, if electric vehicles are charged early in the evenings (e.g., when customers get home from work), electric vehicle charging could exacerbate summer and winter peak energy requirements and potentially create

the need for additional peaking capacity or load control programs."[1] Consequently, the location, cost, and convenience of public charging may affect peak demand by encouraging EV owners to use these public facilities.

[1] LGE KU IRP Volume 1, page 34 of 117

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's First Request for Information
Dated October 3, 2019

Case No. 2018-00348

Question No. 12

Witness: Elizabeth J. McFarland

Q-12. Explain whether there have been any discussions either within LG&E/KU or with customers regarding setting up microgrids or similar arrangements that could be isolated for security and/or reliability reasons with a master meter for the microgrid, including possible behind-the-meter alternative energy sources (regardless of ownership) such that essential functions could be sustained for a period of time during an outage or an emergency event. If so, explain the status and nature of the discussions.

A-12. LG&E/KU have not been in any recent discussions with customers regarding setting up microgrids or similar arrangements. LG&E/KU readily supports customer discussion and dialogue with respect to potential customer microgrid installations. Additionally, LG&E/KU has created an internal working group to position the Companies to assist and address customer requests for information with respect to distributed energy resources (DER), including microgrids.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's First Request for Information
Dated October 3, 2019

Case No. 2018-00348

Question No. 13

Witness: Stuart A. Wilson

Q-13. Refer to the IRP, Volume 1, Section 5.(4), page 5-35, Table 5-12, and the IRP, Volume 3, 2018 IRP Resource Screening Analysis, page 13. The screening analysis includes both battery storage and SCCT for peaking purposes.

a. Identify and explain the factors that are expected to drive down the cost of batteries over time.

b. Explain the differences in variable O&M costs for SCCT and battery storage.

c. Explain the expected useful life of battery storage units.

d. Provide a comparison of the estimated production cost of a MWh for SCCT and battery storage if the battery storage unit was of similar capacity as the SCCT unit.

e. The Resource Screening Analysis on page 8 lists several attributes of battery storage, including the potential to enhance the variable nature of renewable generation alternatives. Explain whether LG&E/KU have investigated pairing battery storage with its solar PV resources to enhance the variable nature of this resource and, if so, explain the results of the analysis.

A-13.

a. See https://www.nrel.gov/docs/fy19osti/73222.pdf for NREL's documentation of battery storage costs. A Utility Dive article titled "Electricity costs from battery storage down 76% since 2012" attributes the decline in battery storage costs to "technology innovation, economies of scale, price competition, and manufacturer experience." See https://www.utilitydive.com/news/electricity-costs-from-battery-storage-down-76-since-2012-bnef/551337/ .

b. Variable operation and maintenance costs are operation and maintenance costs incurred on a per-unit-energy basis. Total operating and maintenance costs (including fixed and variable) include: insurance, taxes, land lease payments, and other fixed costs; present value and annualized large component replacement costs over the technical life; and scheduled and unscheduled maintenance of power plants, transformers, and other components over the technical lifetime of the plant. The variable O&M costs for SCCT

and battery storage reflect the differences in these per-unit-energy costs between the two technologies and their differing components.

c. The expected useful life of battery storage systems is assumed to be 15 years based on NREL's 2018 ATB. However, the industry has limited experience with utility-scale lithium-ion battery storage applications.

d. Production cost of a SCCT includes fuel cost and variable O&M. Table 1 in the 2018 Resource Screening Analysis shows SCCT fuel cost of $27.90/MWh and variable O&M of $7.31/MWh, resulting in production cost of $35.21/MWh.

   A battery storage system does not produce energy; rather, it stores and discharges energy produced by other generating resources. Therefore, its production cost includes the variable production cost of the energy produced by other resources to charge the battery storage system, the effect of the efficiency of the battery storage system, and variable O&M of the battery storage system. Table 8-8 in Volume I shows average variable production costs for existing units of $23.4/MWh in 2018. Using this value for the variable production cost of the energy produced by other resources to charge the battery storage system, NREL's 2018 ATB assumption of 90% round-trip efficiency for the battery storage system, and variable O&M from Table 1 in the 2018 Resource Screening Analysis of $2.72/MWh, production cost of a battery storage system can be estimated at $28.72/MWh.

e. No scenario in the IRP included resources specifically for the purpose of addressing the intermittent nature of solar. Instead, the IRP assumed the Companies' existing resources could provide the load-following capabilities required to integrate the amounts of solar included in each scenario.

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Case No. 2018-00348

Question No. 14

Witness: David E. Huff / Stuart A. Wilson

Q-14. Refer to the IRP, Volume 1, Section 5.(4), page 5-36, Table 5-13, footnote 22; the IRP, Volume 3, 2018 IRP Resource Screening Analysis, page 10; and Case No. 2017-00441 Order dated October 5, 2018, page 6.[2]

a. Table 5-13 indicates steadily declining Demand Conservation Program (DCP) values. The Case No. 2017-00441 Order at page 6 indicates that LG&E/KU will maintain the DCP for industrial customers, though not add new customers unless an existing customer ceases to participate in the program.

i. Explain why the DCP values in Table 5-13 decline significantly over time.

ii. Explain whether any customers in the commercial sales class participate in the DCP.

b. In the 2018 IRP Resource Screening Analysis, page 10, LG&E/KU indicate that the DCP is a cost effective program and that it is the only Demand-Side Management (DSM) program that can be dispatched. Provide a cost comparison of the cost of the DCP program as compared to other resources during load control events (LCEs) such that even though the program is cost effective, LG&E/KU appear to be phasing out the program.

c. Explain how LG&E/KU forecast LCEs and whether the number of LCEs are projected to decline over time in the same manner as the forecasted decline in DCP participation.

A-14.

a. The DCP line in Table 5-13 comprises both the Residential and Small Nonresidential Demand Conservation and the Large Nonresidential Demand Conservation programs as more fully described in the response to Question No. 15. The Companies are maintaining the Large Nonresidential Demand Conservation Program for both commercial and industrial customers to maintain a static level of participation, but at a reduced incentive. In Case No. 2017-00441 the Companies expanded the eligibility to

[2] Case No. 2017-00441, Electronic Joint Application of Louisville Gas and Electric Company and Kentucky Utilities Company for Review, Modification, and Continuation of Certain Existing Demand Side Management and Energy Efficiency Programs (Ky. PSC Oct. 5, 2018).

include industrial customers who can be added on a replacement basis as current participants exit the program.

i. In Case No. 2017-00441, the Companies proposed to maintain the Residential and Small Nonresidential Demand Conservation and the Large Nonresidential Demand Conservation programs in a maintenance mode, with no new capital being invested and no new load-control devices being deployed. Existing devices will be moved to new customers as current customers exit the program, with the program gradually phased out as the devices eventually fail to operate.

For the Residential and Small Nonresidential Demand Conservation program, the bill credit previously paid for each month from June through September was replaced with an end-of-cooling-season bill credit if a load-control event is called. The additional incentives for increased tonnage for small nonresidential participants was eliminated, and if a load control device becomes available, it will not be installed on a water heater or pool pump. Bill credits from multifamily customers are no longer split between the property owner and tenant, but only paid to the participating tenant.

As stated above, the reduction of incentives to customers (paying only when an event is called, no longer splitting the payment between owners of multifamily properties and tenants, and the removal of increased incentives for increased tonnage for small nonresidential participants) is expected to decrease the number of participants in the program over time. In Case No. 2017-00441, Exhibit GSL-1, the Companies stated that by the end of the proposed DSM-EE Program Plan, 62,000 devices are expected to have been removed from the Residential and Small Nonresidential Demand Conservation Program.[3]

The Companies have assumed attrition in demand reductions provided by the program over time due to switches ceasing to function or being removed from service without the Companies' knowledge, as well as to account for customers leaving the program due to reduced incentive levels."[4]

ii. The Companies do not have industrial customers participating in DCP. Commercial customers do participate in the program.

b. Table 9 on page 17 of the "2018 IRP Reserve Margin Analysis," which is contained in Volume III of the 2018 IRP, shows the average energy costs in 2021 of the Companies' marginal resources, including the DCP. The DCP was included in the 2018 IRP analysis as approved in the Companies' 2017 DSM filing in Case No. 2017-00441. As

[3] https://psc.ky.gov/pscecf/2017-00441/rick.lovekamp%40lge-ku.com/12062017050458/LGE_KU_Testimony_and_Exhibits.pdf, page 48 of 182.
[4] Ibid, Page 47 of 182.

explained in that filing and in the response to part (a), the Companies are not phasing out the DCP, but participation in the program is forecasted to decline over time.

c. The Companies do not forecast the number of load control events (LCEs). Because the bill credit for participating DCP customers is paid only if an LCE is called, an LCE will be called only during an extreme summer weather event with insufficient generation resources. The likelihood of an LCE is low during average summer peak weather conditions and not expected to change materially over time due to the mostly flat load forecast.

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Question No. 15

Witness: David E. Huff / Stuart A. Wilson

Q15. Refer to the IRP, Volume 1, Section 5.(4), page 5-36, Table 5-13, and Volume 1, Section 8, pages 8-19 through 8-21, Table 8-12.

a. Confirm that the DCP program referenced in Table 5-13 corresponds to the Residential and Small Nonresidential Demand Conservation and the Large Nonresidential Demand Conservation programs referenced in Table 8-12. If these are not the same programs, explain the differences.

b. Provide an explanation of how the DCP forecast in Table 5-13 is calculated.

c. The DCP forecast in Table 5-13 shows a steadily declining trend on a calendar year basis. The Demand Conservation forecast amounts in Table 8-12 referenced in part a. illustrate the effect on summer and winter peak. While the forecast amounts in Table 5-13 decline significantly, the amounts in Table 8-12 are not similar and decline in a completely different pattern. Provide an explanation of how the DCP amounts in Table 5-13 correspond to the amounts in Table 8-12.

A-15.

a. Confirmed.

b. The summer peak values in Table 8-12 for these programs reflect the programs' maximum level of demand reductions under extreme summer peak weather conditions. The values in Table 5-13 for DCP are the sum of demand reductions for these programs under normal peak summer weather conditions. In addition to weather, the values in Table 5-13 are also adjusted to account for devices that cease to function or are removed from service without the Companies' knowledge as discussed in response to Question No. 14(a). The values in Table 5-13 are calculated simply by applying a factor to the values in Table 8-12.

c. For the reasons discussed in part b., the values and rates of decline in Table 5-13 and Table 8-12 are consistent through 2025. Beyond 2025, the values in Table 8-12 were held flat because the most recent DSM filing didn't contemplate changes beyond 2025.

However, for resource planning purposes, Table 5-13 and the Companies IRP analyses assumed the rate of attrition from 2019 to 2025 would continue beyond 2025.

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Question No. 16

Witness: Stuart A. Wilson

Q-16. Refer the IRP, Volume 1, Section 5.(4), page 5-36, Table 5-13, and Volume 1, Section 5.(4), page 5-38, Table 5-14.

a. Explain the nature and provide a schedule of the various resources being added in Table 5-14 in the 55-year operating life base, high-load and low-load scenarios for each year 2026-2033.

b. In light of the need for new or replacement capacity under the 55-year operating life base and high-load scenarios explain, if not answered above, why the cost-effective DCP program is not cost competitive with other capacity resources and provide a table illustrating the relative resource costs.

A-16.

a. See Table 5-15. For each load scenario, the nature of the resources added depends on the level of natural gas and CO_2 prices. Because the Companies are not requesting approval for a particular course of action, the Companies developed new or replacement portfolios to meet the summer and winter capacity needs in 2033 and did not evaluate a detailed implementation plan for each replacement portfolio. As stated in footnote 14 on page 23 of the 2018 IRP Long-Term Resource Planning Analysis, in practice a large generation replacement project would likely take place over multiple years and require significant coordination throughout the Companies.

b. The Companies' DCP is assumed to be cost competitive and is considered as a capacity resource in most of the Companies' long-term planning scenarios. As stated in pages 23-24 of the 2018 IRP Long-Term Resource Planning Analysis, the Companies' DCP is assumed to remain in place in all scenarios except the low load, 65-year operating life scenario. In this scenario, the DCP, Brown 3, and the Companies' small-frame SCCTs are retired by the end of the planning period because the Companies' reserve margin would otherwise be well over 25 percent. The relative resource costs of DCP and other capacity resources are available in Table 10 on page 18 of the 2018 IRP Long-Term Resource Planning Analysis in Volume III.

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Question No. 17

Witness: Stuart A. Wilson

Q-17. Refer to the IRP, Volume 1, Section 5.(4), page 5-37. LG&E/KU states, "All other things equal, if the Companies' load increases by 300 MW to 400 MW, the reliability and production cost benefits from adding new SCCT capacity would more than offset the cost of the capacity."

a. Explain whether the statement includes the loss of the 285-MW load associated with the eight municipals that recently departed from KU's system.

b. If not answered above, explain whether the municipals had not left the system, the load would only have to increase 15 MW to 115 MW for the cost benefits to outweigh the cost of new SCCT capacity.

c. If load were to increase 300 MW to 400 MW and LG&E/KU were to find themselves in need of capacity, would LG&E/KU's consideration of possible options include discussions of possible power purchase arrangements or other market alternatives?

A-17.

a. The load forecast for 2021, which was used to assess the Companies' target reserve margin range, reflects the departure of eight municipal customers.

b. The Companies have not performed this analysis. The Companies took several actions in response to the municipal departure including the cancellation of Green River Unit 5, a 700 MW combined cycle unit (see the response to Question No. 9). In light of these actions, it is difficult to discuss 2021 load changes in the context of the municipal departure.

c. Yes, as discussed in Volume I on page 5-6, the Companies would evaluate available market alternatives prior to committing to a course of action.

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Question No. 18

Witness: Stuart A. Wilson

Q-18. Refer to the IRP, Volume 1, Section 5.(4), page 5-39, Table 5-15.

a. Also refer to Section 5.(2), page 5-21, Table 5-4. Provide a revised Table 5-15 to include the MW retirements corresponding to each of scenarios.

b. Provide the nameplate capacity of the 1 x1 NGCC units.

c. Explain whether the retirements listed under the 65-year operating life plan correspond to these units being retired because they are at the end of their operating life or some other reason.

A-18.

a. See the following table.

Generating Unit Life	Load Scenario	Gas Price	Zero CO_2 Price	High CO_2 Price
55-Year (2,428 MW retired by end of 2033)	Base	Base	5 1x1 NGCCs, 300 MW Solar	5 1x1 NGCCs, 400 MW Solar
		High	5 1x1 NGCCs, 300 MW Solar	5 1x1 NGCCs, 500 MW Solar
		Low	5 1x1 NGCCs, 300 MW Solar	5 1x1 NGCCs, 300 MW Solar
	High	Base	7 1x1 NGCCs, 100 MW Solar	7 1x1 NGCCs, 100 MW Solar
		High	7 1x1 NGCCs, 100 MW Solar	7 1x1 NGCCs, 500 MW Solar
		Low	7 1x1 NGCCs, 100 MW Solar	7 1x1 NGCCs, 200 MW Solar
	Low	Base	4 1x1 NGCCs	4 1x1 NGCCs, 300 MW Solar
		High	4 1x1 NGCCs	4 1x1 NGCCs, 500 MW Solar
		Low	4 1x1 NGCCs	4 1x1 NGCCs
65-Year (49 MW retired by end of 2033)	Base	Base	No additional changes	No additional changes
		High	No additional changes	No additional changes
		Low	No additional changes	No additional changes
	High	Base	1 1x1 NGCC, 100 MW Batteries	2 1x1 NGCC, 400 MW Solar
		High	1 1x1 NGCC, 100 MW Batteries	1 1x1 NGCC, 300 MW Solar, 300 MW Wind
		Low	1 1x1 NGCC, 100 MW Batteries	2 1x1 NGCC, 400 MW Solar
	Low	Base	Retire Small-Frame SCCTs, DCP, Brown 3 or Brown 11N2 SCCTs	Retire Small-Frame SCCTs, DCP, Brown 3 or Brown 11N2 SCCTs
		High	Retire Small-Frame SCCTs, DCP, Brown 3 or Brown 11N2 SCCTs	Retire Small-Frame SCCTs, DCP, Brown 3 or Brown 11N2 SCCTs
		Low	Retire Small-Frame SCCTs, DCP, Brown 3 or Brown 11N2 SCCTs	Retire Small-Frame SCCTs, DCP, Brown 3 or Brown 11N2 SCCTs

b. As shown in Table 10 (p. 18 of the Long-Term Resource Planning Analysis in Volume III of the 2018 IRP), the summer net capacity of the 1x1 NGCC option is 368 MW, and the winter net capacity is 429 MW. The Companies do not have a nameplate capacity for the 1x1 NGCC units.

c. The use of 55-year and 65-year operating lives was based on an analysis of actual and announced coal unit retirements from 1970 to 2030 (see discussion beginning at page 8 of the 2018 IRP Long-Term Resource Planning Analysis in Volume III). The analysis does not prescribe a specific cause of retirement. In practice, a unit may be retired for a variety of reasons, including for regulatory compliance or as a result of a catastrophic failure.

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Question No. 19

Witness: Stuart A. Wilson

Q-19. Refer to the IRP, Volume 1, Section 7.(2).(f), page 7-6, Tables 7-12 and 7-13.

a. Define "Energy Loss" as referenced in the two Tables.

b. Explain the reason(s) KU's annual energy losses are significantly higher than those of LG&E.

A-19.

a. Energy losses include unmetered company uses as well as electricity line losses that occur in transmitting electricity from generating units to the end user.

b. KU's loss percent is higher than LG&E's loss percent because KU customers on average are further from generation sources. KU's Annual Energy Losses (GWh) are higher for this reason and because KU's annual sales are higher than LG&E's.

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Question No. 20

Witness: Stuart A. Wilson / David E. Huff

Q-20. Refer to IRP Volume 1, Section 7.(2).(g), page 7-6, Table 7-14.

a. Provide the incremental energy and demand savings associated with each of the years 2013-2017.

b. Refer to application in Case No. 2017-00441,[5] the Direct Testimony of Gregory Lawson, Exhibit GSL-1, pages 4 and 5 of 182, Figures 1 and 2, respectively.

i. For Figure 1, explain the apparent differences between the listed annual demand savings and the annual savings calculated from the cumulative savings line.

ii. For Figure 2, provide a chart with the associated cumulative totals as was provided in Figure 1.

c. Provide an explanation of the differences between the annual and cumulative energy and demand savings inherent in IRP Table 7-14 and those in Figures 1 and 2.

A-20.

a. Incremental Energy and Demand Savings for KU and LG&E

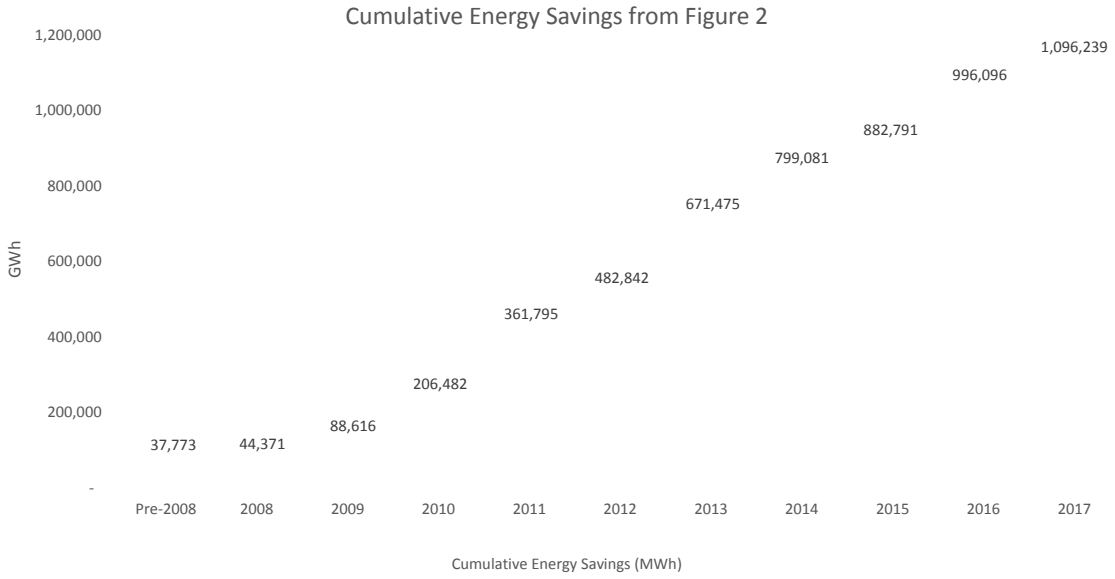
	2013	**2014**	**2015**	**2016**	**2017**
Energy Savings (GWh)	200	172	129	166	165
Demand Savings (MW)	67	53	55	62	62

b.

i. The demand and energy savings of Smart Energy Profile (SEP) and Kentucky School Board Association (KSBA) programs do not accumulate across years as a simple total. SEP and KSBA programs utilize a one-year measure-life of savings. The cumulative amount is calculated as the sum of the previous year plus the incremental savings less the prior year's savings attributed to SEP & KSBA.

[5] Case No. 2017-00441, Electronic Joint Application of Louisville Gas and Electric Company and Kentucky Utilities Company for Review, Modification, and Continuation of Certain Existing Demand Side Management and Energy Efficiency Programs, (Application Filed Dec. 6, 2017).

ii. Cumulative totals to correspond to Figure 2. Please note that 2017 in the figure below has been updated for actuals in 2017. Figure 2 in Exhibit GSL-1 had projected values for 2017.



c. Below is a revised Table 7-14: Impact of Existing DSM Programs (cumulative for KU and LG&E)

Table 7-14: Impact of Existing DSM Programs (Cumulative for KU and LG&E)

	2013	**2014**	**2015**	**2016**	**2017**
Energy Savings (GWh)	671	799	883	996	1,096
Demand Savings (MW)	299	340	382	427	466

The 2013 demand savings value has been updated to reflect actual program savings versus a forecasted value in the original table.

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Question No. 21

Witness: Stuart A. Wilson

Q-21. Refer to the IRP, Volume 1, Section 7.(4).(a), page 7-8, Table 7-19. Provide a revised table including "Losses" for Kentucky only and "Total Requirements" for Kentucky only.

A-21. In the table below, Kentucky Losses is computed as the product of Kentucky Sales and the KU loss factor. In practice, separate loss factors are not computed for the Kentucky and Virginia portions of the KU service territory.

KY Forecasted Losses and Total Energy Requirements (GWh)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Residential	6,021	5,977	5,974	5,937	5,917	5,908	5,948	5,934	5,940	5,945	5,967	5,956	5,955	5,960	5,980	5,969
Commercial	3,789	3,823	3,811	3,801	3,793	3,786	3,781	3,771	3,763	3,756	3,752	3,741	3,732	3,724	3,718	3,707
Industrial	6,490	6,576	6,592	6,578	6,578	6,580	6,581	6,582	6,584	6,586	6,589	6,589	6,590	6,592	6,593	6,594
Total C & I	10,279	10,399	10,403	10,379	10,371	10,366	10,362	10,353	10,347	10,342	10,341	10,330	10,322	10,316	10,311	10,301
Public Authority	1,559	1,449	1,446	1,440	1,437	1,435	1,434	1,432	1,432	1,431	1,431	1,430	1,430	1,430	1,430	1,429
Utility Use and Lighting	42	42	42	41	40	40	39	38	37	37	36	35	35	34	33	33
Sales for Resale	1,844	874	425	427	430	432	435	438	441	443	446	448	450	453	455	457
Total Kentucky	19,745	18,741	18,290	18,224	18,195	18,181	18,218	18,195	18,197	18,198	18,221	18,199	18,192	18,193	18,209	18,189
Virginia	723	709	698	685	678	675	676	670	666	662	660	656	653	650	648	645
Total KU Sales	20,468	19,450	18,988	18,909	18,873	18,856	18,894	18,865	18,863	18,860	18,881	18,855	18,845	18,843	18,857	18,834
Kentucky Losses	1,299	1,234	1,203	1,199	1,198	1,194	1,204	1,204	1,200	1,198	1,196	1,188	1,179	1,178	1,179	1,176
Virginia Losses	48	47	46	45	45	44	45	44	44	44	43	43	42	42	42	42
Total Utility Use and Losses	1,347	1,281	1,249	1,244	1,243	1,238	1,249	1,248	1,244	1,242	1,239	1,231	1,221	1,220	1,221	1,218
Total Kentucky Requirements	21,044	19,975	19,493	19,423	19,393	19,375	19,422	19,399	19,397	19,396	19,417	19,387	19,371	19,371	19,388	19,365
Total Virginia Requirements	771	756	744	730	723	719	721	714	710	706	703	699	695	692	690	687
Total Requirements	21,815	20,731	20,237	20,153	20,116	20,094	20,143	20,113	20,107	20,102	20,120	20,086	20,066	20,063	20,078	20,052

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Question No. 22

Witness: Stuart A. Wilson

Q-22. Refer to the IRP, Volume 1, Section 5.(4), page 5-36, Table 5-13. Refer also to the IRP, Volume 1, Section 7.(4).(a), pages 7-8 through 7-9, Tables 7-19 and 7-20, respectively. Table 5-13 shows a net peak load forecast declining due to the effects of DCP and DSM programs. Tables 7-19 and 7-20 show KU and LG&E forecasted calendar year sales.

a. Provide tables for both KU and LG&E showing the forecasted GWh effects of DCP and DSM programs, average use-per-customer, residential and commercial calendar sales before and after DCP and DSM programs and forecasted residential and commercial customers for 2018-2033.

b. Table 7-19 shows forecasted residential sales for KU slowly declining through most of the forecast period. Table 7-20 shows forecasted residential sales for LG&E declining initially and then slowly climbing. Explain the differences between the KU and LG&E residential customer classes that drive the differing trends.

A-22. Forecasted load reductions for the Companies' DCP and DSM programs decline through the forecast period. Therefore, the slightly declining net peak load forecast is not driven by changes in these programs.

a. The DCP program does not produce energy (GWh) savings. For energy and demand savings (if applicable) from other DSM programs, please refer to tables 8-11 and 8-12 of Vol I of the IRP as well as Case No. 2017-00441 Exhibit GSL-1 Section 2 – Energy Efficiency Programs (Page 27 of 182).

b. Residential sales in both KU and LG&E follow the same broad trend. In the near term, efficiency gains for existing customers outpace the effect of customer growth which leads to declining sales. In the intermediate term, customer growth continues but efficiency gains slow causing energy sales to increase slightly. In the long term, sales flatten as population growth weakens. Deviations from these trends are generally explained by the impact of leap years. Residential efficiency trends are discussed in Volume I of the IRP on pages 6-4 through 6-6.

The table below contains residential use-per-customer and customer forecasts for LG&E and KU. The use-per-customer values do not reflect the impact of distributed solar (less than 200 kWh per customer on average in 2033).

Year	KU		LG&E	
	Customers	Use-per-Customer (kWh)	Customers	Use-per-Customer (kWh)
2018	433,721	13,837	367,626	11,131
2019	435,689	13,675	369,778	11,009
2020	437,725	13,603	372,289	10,949
2021	439,728	13,457	375,031	10,830
2022	441,557	13,355	377,981	10,749
2023	443,524	13,274	380,958	10,685
2024	445,756	13,242	383,974	10,655
2025	448,012	13,144	386,947	10,573
2026	450,228	13,087	389,813	10,524
2027	452,367	13,037	392,539	10,481
2028	454,416	13,026	395,153	10,470
2029	456,382	12,952	397,650	10,414
2030	458,268	12,897	400,041	10,369
2031	460,075	12,849	402,325	10,334
2032	461,802	12,836	404,523	10,322
2033	463,449	12,761	406,655	10,263

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Question No. 23

Witness: Michael P. Drake / John K. Wolfe / Thomas A. Jessee

Q-23. Refer to IRP Volume 1, Section 8.(2).(a), page 8-2 through page 8-5.

a. Provide a tentative timetable/implementation schedule for the projects and improvements discussed in Section 8.(2).(a) over the IRP planning period.

b. Provide a list of the projects discussed in Section 8.(2).(a) that were included in the forecast maintenance schedule and capital spending plan in LG&E/KU's last rate cases, Case Nos. 2018-00294[6] and 2018-00295.[7]

A-23.

a. - b. See the attached Distribution proposed schedules. The Transmission and Generation Outage information requested is confidential and proprietary and is being provided under seal pursuant to the Companies' joint petition for confidential protection.

[6] Electronic Application of Kentucky Utilities Company for an Adjustment of its Electric Rates (Application Filed Sept. 28, 2018).
[7] Electronic Application of Louisville Gas and Electric Company for an Adjustment of its Electric and Gas Rates (Application Filed Sept. 28, 2018).

Projects and Improvements Discussed in Section 8.(2).(a)

Project/Improvement	Tentative Timetable	Included in 2018-00294 or 2018-00295?
Circuit Hardening / Reliability		
KU SCADA Expansion Phase 2	2022-2023	No
KU CIFI	2019-2023	2019-2020 Only
KU CEMI	2019-2023	2019-2020 Only
KU System Hardening	2019-2023	2019-2020 Only
LG&E CIFI	2019-2023	2019-2020 Only
LG&E CEMI	2019-2023	2019-2020 Only
LG&E System Hardening	2019-2023	2019-2020 Only
Distribution Auto LGE 2017	2019-2021	2019-2020 Only
Distribution Auto KU 2017	2019-2021	2019-2020 Only
IT Distrbution Automation LGE	2019	Yes
IT Distribution Automation KU	2019	Yes
Hopewell Circuit Improvements	2019	Yes
Dwina Circuit Relocation	2019	Yes
KU SCADA Expansion Phase 1	2019-2021	2019-2020 Only
LG&E Southern Substation Exit Cable Replacement	2019	Yes
Substation Wildlife Protection Project	2022-2023	No
Substaiton Transformer Protection Upgrades	2021-2023	No
SIO Distr Auto Ph II KU	2022-2023	No
SIO Distr Auto Ph II LGE	2022-2023	No
KU Small Wire Upgrades	2021-2023	No
LG&E Small Wire Upgrades	2021-2023	No
KU Fuse Savings Pilot Program	2019-2021	2019-2020 Only
LG&E Fuse Savings Pilot Program	2019-2021	2019-2020 Only
Columbia Circuit Reconductor	2019	Yes
Whitley City Conversion Project	2019	Yes
Williamsburg Circuit Upgrade	2019	Yes
Thackers Branch Circuit Relocation	2020	No
Strawberry Patch Circuit Relocation	2019	Yes
Dwina Circuit (2) Relocation	2019	Yes
Deer Branch Circuit Relocation	2019	Yes
Middlesboro 1 Circuit Rebuild	2019	Yes
Middlesboro 1 Circuit Reconductor	2019	Yes
Middlesboror 2 Circuit Upgrade	2019	Yes
Middlesboror 2 Circuit Tie Build	2019	Yes
Irvine Circuit Tie Build	2019	Yes
Capital Reliability - 011560	2019-2023	2019-2020 Only
Capital Reliability - 012160	2019-2023	2019-2020 Only
Capital Reliability - 012360	2019-2023	2019-2020 Only
Capital Reliability - 012460	2019-2023	2019-2020 Only
Capital Reliability - 012560	2019-2023	2019-2020 Only
Capital Reliability - 013150	2019-2023	2019-2020 Only
Capital Reliability - 003400	2019-2023	2019-2020 Only
Capital Reliability - 013660	2019-2023	2019-2020 Only
Capital Reliability - 014160	2019-2023	2019-2020 Only
Capital Reliability - 014260	2019-2023	2019-2020 Only
Capital Reliability - 017660	2019-2023	2019-2020 Only

Projects and Improvements Discussed in Section 8.(2).(a)

Project/Improvement	Tentative Timetable	Included in 2018-00294 or 2018-00295?
System Enhancement for Existing Customers		
DSP Somerset Area Substation	2023-2024	No
N1DT Middlesboro Area Sub	2021-2022	No
Lakeshore Substation Circuit Work	2019	Yes
N1DT Pleasure Ridge Circuit Work	2019-2020	Yes
DSP Old Henry Substation Project	2023-2024	No
DSP Shelbyville North Circuit Work	2019	Yes
DSP Paynes Mill Substation Project	2019	Yes
DSP Hoover 2 Substation Project	2020-2021	2020 Only
DSP Versailles Bypass Circuit Work	2019	Yes
DSP Simpsonville Substation Project	2019-2020	Yes
N1DT Plainview Circuit Work	2019	Yes
N1DT Plainview Substation Project	2019	Yes
N1DT Wilson Downing Substation Project	2019-2020	Yes
LGE SMAC Upgrades	2019-2020	Yes
DSP Tucker Station Circuit Work	2020-2021	2020 Only
DSP Tucker Station Subststaion Project	2020-2021	No
DSP Lime Kiln Circuit Work	2019-2020	Yes
DSP Lime Kiln Substation Project	2019-2020	Yes
N1DT Mud Lane/Smyrna Circuit Work	2023-2024	No
N1DT Mud Lane/Smyrna Substation Project	2023-2024	No
Standford Circuit Reconductor	2019	Yes
N1DT Wilson Downing Circuit Work	2020	Yes
Middlesboro 1 Subststion Project	2023-2024	No
Buena Vista Sub Upgrade	2023-2024	No
N1DT Kenwood Circuit Work	2022-2023	No
SCM2019 DAN WILDLIFE PROTECT	2019	Yes
SCM2019 EARL WILDLIFE PROTECT	2019	Yes
SCM2019 LEX WILDLIFE PROT	2019	Yes
SCM2019 LGE WILDLIFE PROTECT	2019	Yes
SCM2019 PINE WILDLIFE PROTECT	2019	Yes
Middlesboro 1 Circuit Work	2022	No
DSP Viley Road Circuit Work	2019	Yes
DSP Paynes Mill Circuit Work	2019	Yes
DSP Simpsonville Circuit Work	2020	Yes
N1DT Middlesboro 2 Circuit Work	2022	No
DSP Ashbottom Substation Project	2020-2021	No
N1DT Middlesboro 2 Substation Project	2021-2022	No
DSP Ashbottom Distribution	2021	No
DSP Fegenbush Substation Project	2023	No
N1DT Pleasure Ridge Substation Project	2019-2020	Yes
N1DT Redhouse Circuit Work	2021	No
KU Enhanced Wildlife Substation Project	2019-2021	Yes
Lex UG Vine to Race	2019	Yes
DSP Paris Substation Breaker Addition	2023	No
DSP Aisin Substation Project	2022-2023	No

Projects and Improvements Discussed in Section 8.(2).(a)

Project/Improvement	Tentative Timetable	Included in 2018-00294 or 2018-00295?
DSP Beech Creek Substation Project	2019	Yes
DSP Beechmont Substation Project	2019	Yes
DSP Canal Circuit Work	2019-2020	Yes
DSP Old Henry Circuit Work	2023	No
DSP Fegenbush Circuit Work	2023	No
DSP White Sulphur Substation Project	2019-2020	Yes
DSP Vine Street Distribution Project	2019	Yes
N1DT Kenwood Substation Project	2022-2023	No
N1DT CENTERFIELD Circuit Work	2021-2022	No
N1DT CENTERFIELD Substation Project	2021-2022	No
N1DT Floyd Circuit Work	2021-2022	No
N1DT Floyd Substation Project	2021-2022	No
N1DT Parkers Mill 2 Substation Project	2021-2022	No
N1DT P&G Substation Project	2021	No
N1DT Trafton Circuit Work	2021	No
DSP Vine Street Substation Project	2019	Yes
Lebannon South Circuit Work	2019	Yes
DSP Beech Creek Circuit Work	2019	Yes
DSP Beechmont Circuit Work	2019	Yes
DSP Madisonville E Circuit Work	2019	Yes
DSP American Ave Circuit Work	2019	Yes
DSP Hoover 2 Circuit Work	2020-2021	No
DSP Lakeshore Circuit Work	2021	No
DSP White Sulphur Substation project	2020	Yes
Aisin Circuit Work	2019	Yes
DSP Paris New Circuit Work	2023	No
Irvine Circuit Work	2019	Yes
Battlefield Mem Hwy Circuit Work	2021	No
Richmond Center Circuit Work	2020	Yes
DSP Fairfield Circuit Work	2019	Yes
DSP LaGrange East Circuit Work	2019	Yes
Sys Enh - 011560	2019-2023	2019-2020 Only
Sys Enh - 012160	2019-2023	2019-2020 Only
Sys Enh - 012360	2019-2023	2019-2020 Only
Sys Enh - 012460	2019-2023	2019-2020 Only
Sys Enh - 012560	2019-2023	2019-2020 Only
Sys Enh - 013150	2019-2023	2019-2020 Only
Sys Enh - 003400	2019-2023	2019-2020 Only
Sys Enh - 013660	2019-2023	2019-2020 Only
Sys Enh - 014160	2019-2023	2019-2020 Only
Sys Enh - 014260	2019-2023	2019-2020 Only
Sys Enh - 017660	2019-2023	2019-2020 Only
Aging Infrastructure		
LG&E PILC Cable Replacement	2021	No
LG&E Network Protector Replacement Project	2019	Yes
LG&E Network Vault Repair Project	2019	Yes

Projects and Improvements Discussed in Section 8.(2).(a)

Project/Improvement	Tentative Timetable	Included in 2018-00294 or 2018-00295?
LG&E PILC Cable Replacement	2019	Yes
SCM2019 DAN REPL SUB BATTERY	2019	Yes
SCM2019 DAN REPL LEGACY BRKR	2019	Yes
SCM2019 EARL REPL SUB BATTERY	2019	Yes
SCM2019 KU LEGACY RELAY REPL	2019	Yes
SCM2019 LEX REPL SUB BATTERY	2019	Yes
SCM2019 LEX LEGACY RTU REPL	2019	Yes
SCM2019 LEX REPL LEGACY BRKR	2019	Yes
SCM2019 LGE CAP&PIN INSLTR UPG	2019	Yes
SCM2019 LGE RPL SUB BATTERY	2019	Yes
SCM2019 LGE LEGACY RELAY REPL	2019	Yes
SCM2019 LGE REPLLGCYAIRMAG BRK	2019	Yes
SCM2019 LGE REPL LGCY OIL BRKR	2019	Yes
SCM2019 LGE REPL LEGACY RTU	2019	Yes
SCM2019 PINE REPL SUB BATTERY	2019	Yes
SCM2019 PINE REPL LEGACY BRKR	2019	Yes
SCM2019 KU REPL LTC/REG CNTRL	2019	Yes
SCM2019 LGE REPL ABB VHK MECH	2019	Yes
LG&E Underground Cable Replacement	2019	Yes
LG&E Manhole Replacement Project	2019	Yes
Ric Remove Roundhill	2019	Yes
KU Underground Cable Replacement	2019-2023	2019-2020 Only
LG&E Substation Exit Cable Replacement	2019-2023	2019-2020 Only
LG&E Manhole Replacement Project	2020	Yes
LG&E Network Vault Repair Project	2020	Yes
LG&E Network Protector Replacement Project	2020	Yes
LG&E PILC Cable Replacement	2020	Yes
LG&E Underground Cable Replacement	2020	Yes
SCM2020 DAN REPL SUB BATTERY	2020	Yes
SCM2020 DAN REPL LEGACY BRKR	2020	Yes
SCM2020 LEX REPL SUB BATTERY	2020	Yes
SCM2020 LEX LEGACY RTU REPL	2020	Yes
SCM2020 LGE RPL SUB BATTERY	2020	No
SCM2020 LGE LEGACY RELAY REPL	2020	Yes
SCM2020 LGE LEGACY AIR MAG BRK	2020	Yes
SCM2020 PINE REPL SUB BATTERY	2020	No
SCM2020 KU REPL LTC/REG CNTRL	2020	Yes
SCM2020 LGE REPL LGCY OIL BRKR	2020	Yes
SCM2020 LGE REPL LEGACY RTU	2020	No
SCM2020 LGE REPL ABB VHK MECH	2020	Yes
SCM2020 PINE REPL LEGACY BRKR	2020	No
SCM2020 LGE CAP&PIN INSUL UPGD	2020	Yes
SCM2020 EARL REPL SUB BATTERY	2020	No
SCM2020 LEX REPL LEGACY BRKR	2020	Yes
SCM2020 KU LEGACY RELAY REPL	2020	Yes
LG&E Substation Oil Breaker Replacement Project	2019-2023	2019-2020 Only
KU Substation Oil Breaker Replacement Project	2019-2023	2019-2020 Only

Projects and Improvements Discussed in Section 8.(2).(a)

Project/Improvement	Tentative Timetable	Included in 2018-00294 or 2018-00295?
LG&E Legacy Relay Replacement Project	2019-2023	2019-2020 Only
KU Legacy Relay Replacement Project	2019-2023	2019-2020 Only
LG&E Underground Cable Replacement	2021	No
LG&E Underground Cable Replacement	2022	No
LG&E Underground Cable Replacement	2023	No
SCM2021 DAN REPL LEGACY BRKR	2021	No
SCM2021 DAN REPL SUB BATTERY	2021	No
SCM2021 EARL REPL SUB BATTERY	2021	No
SCM2021 KU LEGACY ARRST REPL	2021	No
SCM2021 KU LEGACY RELAY REPL	2021	No
SCM2021 KU REPL LTC/REG CNTRL	2021	No
LG&E Manhole Replacement Project	2021	No
LG&E Network Protector Replacement Project	2021	No
LG&E Network Vault Repair Project	2021	No
SCM2021 LEX LEGACY RTU REPL	2021	No
SCM2021 LEX REPL LEGACY BRKR	2021	No
SCM2021 LEX REPL SUB BATTERY	2021	No
SCM2021 LGE CAP&PIN INSUL UPGD	2021	No
SCM2021 LGE LEGACY AIR MAG BRK	2021	No
SCM2021 LGE LEGACY ARRST REPL	2021	No
SCM2021 LGE LEGACY RELAY REPL	2021	No
SCM2021 LGE REPL ABB VHK MECH	2021	No
SCM2021 LGE REPL LEGACY RTU	2021	No
SCM2021 LGE REPL LGCY OIL BRKR	2021	No
SCM2021 LGE RPL SUB BATTERY	2021	No
SCM2021 PINE REPL LEGACY BRKR	2021	No
SCM2021 PINE REPL SUB BATTERY	2021	No
SCM2022 DAN REPL LEGACY BRKR	2022	No
SCM2022 DAN REPL SUB BATTERY	2022	No
SCM2022 EARL REPL SUB BATTERY	2022	No
SCM2022 KU LEGACY ARRST REPL	2022	No
SCM2022 KU LEGACY RELAY REPL	2022	No
SCM2022 KU REPL LTC/REG CNTRL	2022	No
SCM2022 LEO MANHOLE STRUCT REP	2022	No
LG&E Network Protector Replacement Project	2022	No
LG&E Network Vault Repair Project	2022	No
SCM2022 LEX LEGACY RTU REPL	2022	No
SCM2022 LEX REPL LEGACY BRKR	2022	No
SCM2022 LEX REPL SUB BATTERY	2022	No
SCM2022 LGE CAP&PIN INSUL UPGD	2022	No
SCM2022 LGE LEGACY AIR MAG BRK	2022	No
SCM2022 LGE LEGACY ARRST REPL	2022	No
SCM2022 LGE LEGACY RELAY REPL	2022	No
SCM2022 LGE REPL ABB VHK MECH	2022	No
SCM2022 LGE REPL LEGACY RTU	2022	No
SCM2022 LGE REPL LGCY OIL BRKR	2022	No
SCM2022 LGE RPL SUB BATTERY	2022	No

Projects and Improvements Discussed in Section 8.(2).(a)

Project/Improvement	Tentative Timetable	Included in 2018-00294 or 2018-00295?
SCM2022 PINE REPL LEGACY BRKR	2022	No
SCM2022 PINE REPL SUB BATTERY	2022	No
SCM2023 DAN REPL LEGACY BRKR	2023	No
SCM2023 EARL REPL SUB BATTERY	2023	No
SCM2023 KU LEGACY ARRST REPL	2023	No
SCM2023 KU LEGACY RELAY REPL	2023	No
SCM2023 KU REPL LTC/REG CNTRL	2023	No
SCM2023 LEO MANHOLE STRUCT REP	2023	No
LG&E Network Protector Replacement Project	2023	No
LG&E Network Vault Repair Project	2023	No
SCM2023 LEX LEGACY RTU REPL	2023	No
SCM2023 LEX REPL LEGACY BRKR	2023	No
SCM2023 LEX REPL SUB BATTERY	2023	No
SCM2023 LGE CAP&PIN INSUL UPGD	2023	No
SCM2023 LGE LEGACY AIR MAG BRK	2023	No
SCM2023 LGE LEGACY ARRST REPL	2023	No
SCM2023 LGE LEGACY RELAY REPL	2023	No
SCM2023 LGE REPL ABB VHK MECH	2023	No
SCM2023 LGE REPL LEGACY RTU	2023	No
SCM2023 LGE REPL LGCY OIL BRKR	2023	No
SCM2023 LGE RPL SUB BATTERY	2023	No
SCM2023 PINE REPL LEGACY BRKR	2023	No
SCM2023 PINE REPL SUB BATTERY	2023	No
SCM2019 KU LEGACY ARRST REPL	2019	Yes
SCM2020 KU LEGACY ARRST REPL	2020	No
SCM2019 LGE LEGACY ARRST REPL	2019	Yes
SCM2020 LGE LEGACY ARRST REPL	2020	No
KU Underground FCI Project	2019-2023	2019-2020 Only
LG&E Underground FCI Project	2019-2023	2019-2020 Only
KU Direct Burial Cable Replacement	2019-2023	2019-2020 Only
Pole Treatment		
KU Pole Inspection and Treatment Plan	2019-2023	2019-2020 Only
LG&E Pole Inspection and Treatment Plan	2019-2023	2019-2020 Only
Capacitor Installs		
LG&E Distribution Capacitors	2019-2023	2019-2020 Only
KU Distribution Capacitors	2019-2023	2019-2020 Only

The entire Attachment 2 and Attachment 3 are Confidential and are being provided separately under seal.

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Question No. 24

Witness: Michael P. Drake

Q-24. Refer to IRP Volume 1, Section 8.(2).(a), page 8-3.

a. Explain and describe the changes in coal supply that LG&E/KU have undertaken to reduce gaseous emissions that have negatively impacted boiler slagging and precipitator performance. Include in the discussion the characteristics of the coal prior to the changes and the characteristics of the coal now being purchased.

b. Provide a similar discussion for coal burner modifications that have been undertaken to reduce gaseous emissions that have negatively impacted boiler slagging and precipitator performance.

A-24.

a. "Changes in coal supply … have negatively impacted boiler slagging and precipitator performance." Coal supply changes were not made specifically to reduce gaseous emissions. The first sentence in the reference paragraph is intended to state that normal changes in coal supply have impacted slagging and precipitator performance. Coal supply qualities vary normally based on mine location, seam being mined, processing of the coal, and other factors. The impact of coal quality on slagging is a complex issue requiring the analysis of many variables, including coal quality, equipment condition and operating conditions. As coal quality changes, LG&E and KU must make adjustments to operations and maintenance in order to more efficiently and effectively burn the coal. This includes new or modified low NO_x burners and precipitator upgrade/rebuild projects.

b. "…coal burner modifications to reduce gaseous emissions have negatively impacted slagging and precipitator performance." This references low NO_x burner installations across the fleet that, when combined with changing coal over time (as noted above), have resulted in increased slagging of the units, associated reduced performance of the precipitators, and wear and tear on the burners themselves. Both the low NO_x burner and precipitator projects noted in the IRP reference modifications and/or upgrades to existing equipment to better manage the increased variability in fuel while maintaining emissions.

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Question No. 25

Witness: Stuart A. Wilson

Q-25. Refer to the IRP, Volume 1, Section 8.(3).(b), page 8-6, regarding existing and planned generating resources. Explain how the 2 percent escalation factor was determined.

A-25. The 2 percent escalation factor reflects a general level of inflation. It is roughly equivalent to the difference in interest rates between standard treasuries and inflation-protected treasuries and aligns with the Federal Reserve's stated inflation target of 2 percent. For further information, see the article at the following link: https://www.stlouisfed.org/open-vault/2019/january/fed-inflation-target-2-percent.[8]

[8] "The Fed's Inflation Target, Why 2 Percent?," Kristie Engemann, Public Affairs Staff, January 16, 2019, Federal Reserve Bank of St. Louis.

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Question No. 26

Witness: David E. Huff

Q-26. Refer to the IRP Volume 1, Section 8.(3).(e).1, page 8-14, regarding Advanced Metering Systems (AMS) Customer Service Offering. In Case 2017-00441, the Commission approved an increase to the offering of 10,000 meters for residential and 10,000 meters for small commercial customers.

a. Explain in detail whether LG&E/KU are expecting a potential applicants in numbers greater than the approved amounts.

b. Discuss the participant satisfaction level with the AMS program.

A-26. The Commission's order in Case 2017-00441 states, "LG&E/KU's opt-in AMS programs should be modified to increase the customer cap from 5,000 LG&E and 5,000 KU residential and small commercial customers to 10,000 LG&E and 10,000 KU residential and small commercial customers." The program does not have proration limits on the number of residential or commercial customers which may participate within the 10,000 customer limit.

a. Yes. LG&E/KU as of October 4th, 2019 have approximately 3,300 customers on a waiting list to participate in AMS. Additionally, the Companies are experiencing interest from PS customers who have offered to pay for the meters and services to help them better manage their consumption and evaluate self-generation opportunities.

The Companies ceased actively promoting the program in June 2019 to preserve customer experience; however, the backlog of customers requesting participation continues to slowly grow organically.

Note: The Companies stopped actively promoting and educating customers about AMS because the program is currently fully subscribed. When customers inquire about AMS they are informed that the program is fully subscribed, that they may join a wait list but currently the Companies do not have a projected timeframe for providing them a meter and participation. The Companies do not feel it is appropriate to promote the service without a plan and timeframe for providing that service to customers.

b. In the most recent surveying, conducted from August 21st to September 5th, 2019, a random sample of approximately 5,500 LG&E and KU participants rated their overall

satisfaction of the AMS program at 8.3 out of 10. KU customers rated significantly higher than LG&E with a score of 8.5 at KU compared to 8.1 at LG&E. Satisfaction scores are similar for KU customers regardless of program tenure. Newly enrolled participants at LG&E (less than a year) are the least satisfied with the program giving an overall satisfaction score of 7.9. Below are some verbatim reasons customers gave for their satisfaction with the program.

"I am better informed about usage, can access more information, and it appears that my electric bills are much less." – KU customer, installed 2018

"Able to get details on usage as well as trended data." – LG&E customer, installed 2019

"This program allowed me to identify the cause of excessive energy use in my home. This allowed me to remedy the situation and save hundreds of dollars." – KU customer, installed 2017

"Seeing peak hours of energy usage is a helpful reminder for conservation at home." – KU customer, installed 2018

"I like how it shows my usage at the current moment and allows me to estimate what my bill could be." – KU customer, installed 2019

"The graph makes it easy to track daily info." – LG&E customer, installed 2016

Customers provided ways to improve their satisfaction with the program.

"Make the graphs easier to comprehend." – LG&E customer, installed 2019

"Create an app. The online (or mobile online) version is out-of-site and out-of-mind for me, so I have honestly forgotten that I am part of this program." – LG&E customer, installed 2019

"I have no idea how to read this meter program. I would love to have some training on how to read the data." – LG&E customer, installed 2018

"There's a LOT of available data and a lot of different ways to look at it. It might be useful to have a short tutorial that gives some samples of how the data can be used effectively." – LG&E customer, installed 2019

Customers with usage greater than 20,000 kWh per year find the program most valuable with 92% stating they use MyMeter and 78% taking steps to save energy. Those customers who accessed MyMeter are more satisfied with the program and are likely to promote the program to others.

The Companies have approximately 300 participants in the program who have received bill assistance and may be considered low income. The Companies sought to better

understand the value of the program to this customer segment, however, survey participation is too low to base decisions, although the results provide some insights. Generally, of those responding, this group has higher satisfaction with MyMeter and are more likely to promote the program to others. This group utilizes a smartphone to access MyMeter information almost three times more than those participants not receiving bill assistance. This customer segment utilizes the Unbilled usage or dollars, energy markers, rate comparison, and to schedule MyMeter notifications more than other customers. These customers also provided verbatim reasons for their satisfaction levels with both the program and the MyMeter tool which included the below.

> "Just because of the use of it. It's got something on it for everything. I can see how much by dollars a day, by kilowatts. I think it is the best thing they have ever done."

> "I just love being able to look at the consumption I am using and I am on a limited income and it's great to not be surprised when I open that bill."

The Companies provide a monthly newsletter to participants, video instruction on how to access and use the data presented in MyMeter and are working on an enhanced mobile app for customers. The Companies actively survey customers to gain insights, such as those discussed above, and utilize these insights to improve the education, communication, customer experience, and overall program.

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Question No. 27

Witness: Stuart A. Wilson

Q-27. Refer to the IRP, Volume 1, Section 8.(4).(c), page 8-26, Table 8-17.

a. For the Hydro category, explain the increase in generation capacity from 2018 to 2019 and explain why there is an occasional variation for the remaining years versus a constant generation output assumption.

b. For the Solar category, explain why there is a slight variation in generation output in 2021 and 2026 versus a constant output assumption for the remaining years.

A-27.

a. Year 2018 reflects 6 months of actual generation and 6 months of forecasted generation. Leap years reflect 1 more day of hydro generation than non-leap years.

b. Compared to other years, solar generation in 2021 and 2026 appears notably higher only because the values are rounded to the nearest GWh. The actual difference is only 0.1 GWh. The table below contains the same data as Table 8-17, rounded to the nearest tenth of a GWh. Minor differences in solar generation from one year to the next are explained by minor differences in modeled solar irradiance.

Year	Solar Energy (GWh)
2018	18.3
2019	18.4
2020	18.4
2021	18.5
2022	18.5
2023	18.5
2024	18.5
2025	18.5
2026	18.5
2027	18.4
2028	18.5
2029	18.5
2030	18.5
2031	18.5
2032	18.5
2033	18.4

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Question No. 28

Witness: Gary H. Revlett

Q-28. Refer to the IRP, Volume 1, Section 8.(5).(f), page 8-29, regarding significant capital investments that will be needed in the future to comply with various environmental compliance requirements. Explain whether any of these capital expenditures has been identified. If so, provide the identity of the project and the projected capital expenditures. Consider this an ongoing request throughout this proceeding.

A-28. The Companies service territories are currently in National Ambient Air Quality Standards (NAAQS) attainment for SO_2, NO_x, and PM, as such, no additional projects or projected capital expenditures are contemplated in our business plan. If any of these standards are revised, the Companies will assess compliance strategies and communicate as appropriate. Jefferson County and portions of Oldham and Bullitt counties are non-attainment for the 2015 ozone NAAQS. Efforts to meet the 2015 standard will likely include reductions in volatile organic carbon (VOC) emissions and/or NOx emissions. The Companies NO_x emissions would most likely be controlled through the installation of a Selective Catalytic Reduction (SCR) system. An order-of-magnitude estimate for an SCR is $135 million per generating unit (in 2024 dollars).

The Companies coal-fired generating units are subject to EPA's new Affordable Clean Energy (ACE) rule. This rule requires the Companies to evaluate the applicability of heat rate improvement projects identified in the ACE rule across the fleet of coal-fired generating units. Screening level analysis has been undertaken which includes a range of potential costs for individual projects. These costs range from $200,000 to $60,500,000 per individual heat rate improvement project, per unit. Additional engineering design and analysis will be required for candidate projects that are identified based on the State of Kentucky's implementation plan. Until the implementation plan is drafted, and additional engineering design analysis is completed, it is not possible to accurately estimate the cost of compliance for the fleet. The Companies are currently in discussion with the State regarding the implementation.

The Companies may incur additional capital expenditures associated with EPA's Section 316(b) requirements. See response to Question No. 32

Additional capital expenditures will be associated the revised Effluent Guidelines, see response to AG 1-21c.

Also additional capital expenditures will be associated with the Storage of CCR Material, see response to AG 1-21b.

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Question No. 29

Witness: Gary H. Revlett

Q-29. Refer to the IRP, Volume 1, Section 8.(5).(f), beginning on page 8-29, regarding environmental regulation compliance and planning. Provide updates as necessary to update the status of compliance with the various environmental regulations referenced in this section of the IRP. Consider this an ongoing request throughout this proceeding.

A-29. Acid Rain Deposition Control Program: no regulatory updates; Companies continue compliance.

CAIR/CSAPR: September 13, 2019, the D.C. Circuit remanded the CSAPR Update Rule to EPA without vacatur. Within this ruling the Court determined the Clean Air Act (CAA) requires upwind states to eliminate their downwind contribution by the next attainment deadline. CSAPR Update Rule imposed no deadline on upwind states to control/eliminate their downwind contribution. Eventually as part of the remand, the EPA will need to address the deadline. Companies continue to comply with the CSAPR Update Rule; the future regulatory changes related to this specific case do not pose an additional impact to our operations.

HAP/MATS: no regulatory updates; Companies continue compliance.

NAAQS:
SO_2: no regulatory updates; Companies continue compliance.

NO_x: The Good Neighbor state implementation plan (SIP) submitted by Kentucky Division for Air Quality in October of 2018 was approved by the EPA in July of 2019. This SIP was based on compliance with the CSAPR Update Rule. As such, this rule does not pose an additional impact to our operation. Companies continue compliance.

Ozone: The infrastructure state implementation plan (SIP) submitted by Kentucky Division for Air Quality in October of 2018 was approved by the EPA in July of 2019. This SIP was based on compliance with the CSAPR Update Rule. As such, the CSAPR Update Rule does not pose an additional impact to our operation. Jefferson County and portions of Oldham and Bullitt counties are marginal non-attainment for EPA's 2015 ozone NAAQS. Louisville Metro Air Pollution Control District (LMAPCD) is currently assessing methods of achieving attainment status for the 2015 ozone standard. LMAPCD is performing a photochemical grid model analysis to assess the impact of volatile organic compound

(VOC) and nitrogen oxides (NOx) impact on ozone levels. Based on the outcome of that model, decisions will be made on how ozone level might be reduced. Those decisions may require reductions in emissions from sources within the Louisville-Jefferson County KY-IN metropolitan statistical area, which may include reductions from the Companies generating assets within Jefferson County.

PM/PM2.5: no regulatory updates; Companies continue compliance.

GHG: see the response to Question No. 31 and AG 1-8.

ELG: no regulatory updates; Companies are waiting on the issuance of EPA's proposed ELG revisions.

CCR: see the response to Question No. 33.

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Question No. 30

Witness: Gary H. Revlett

Q-30. Refer to the IRP, Volume 1, Section 8.(5) .(f), page 8-30, regarding the National Ambient Air Quality Standards. Provide a copy of the January 7, 2017 Consent Decree referenced in this section of the IRP.

A-30. See attached consent decree to the EPA (defendant) in a case against the Center for Biological Diversity (plaintiff) is provided as requested.

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IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF CALIFORNIA
SAN FRANCISCO DIVISION

CENTER FOR BIOLOGICAL DIVERSITY and CENTER FOR ENVIRONMENTAL HEALTH, Plaintiffs, v. SCOTT PRUITT, in his official capacity as the Administrator of the United States Environmental Protection Agency,[1] Defendant.	Case No. 3:16-cv-03796-VC ~~**[PROPOSED]**~~ **CONSENT DECREE**

WHEREAS, on July 7, 2016, Plaintiffs Center for Biological Diversity and Center for Environmental Health filed the above-captioned matter against Gina McCarthy, in her

[1] Pursuant to Fed. R. Civ. P. 25(d), Defendant Gina McCarthy's successor, Scott Pruitt, Administrator of the U.S. Environmental Protection Agency, is automatically substituted as the Defendant in this case.

official capacity as Administrator of the United States Environmental Protection Agency (collectively "EPA" or the "Agency") (the "Complaint") (Dkt. No. 1);

WHEREAS, Plaintiffs allege that EPA has failed to undertake certain non-discretionary duties under the Clean Air Act ("CAA"), 42 U.S.C. §§ 7401-7671q, and that such alleged failure is actionable under section 304(a)(2) of the CAA, § 7604(a)(2), and seeking declaratory and injunctive relief as well as attorney fees and other costs of litigation pursuant to 42 U.S.C. § 7604(a), Compl. at 11-13;

WHEREAS, Plaintiffs allege that EPA has violated a nondiscretionary duty under the Clean Air Act, 42 U.S.C. § 7409(d)(1), to complete a five-year review of the primary national ambient air quality standards ("NAAQS") for oxides of nitrogen ("NO_X"), Compl. ¶¶35-39;

WHEREAS, Plaintiffs allege that EPA has violated a nondiscretionary duty under the Clean Air Act, 42 U.S.C. § 7409(d)(1), to complete a five-year review of the air quality criteria and primary NAAQS for sulfur oxides ("SO_X"), Compl. ¶¶41-44;

WHEREAS, the relief requested in the Complaint includes, among other things, an order from this Court to establish dates certain by which EPA must fulfill its obligations;

WHEREAS, Plaintiffs and EPA have agreed to a settlement of this action without admission of any issue of fact or law, except as expressly provided herein;

WHEREAS, the Clean Air Act, 42 U.S.C. § 7409(d)(2), provides for the establishment of an independent scientific review committee to advise the Administrator on the review, and revision as appropriate, of the air quality criteria and NAAQS;

WHEREAS, consistent with the CAA, 42 U.S.C. § 7607(d)(3), EPA carefully considers the advice of this committee, known as the Clean Air Scientific Advisory Committee, including its advice whether the air quality criteria and other scientific documents (such as Risk and Exposure Assessments and Policy Assessments) provide an adequate basis for EPA to use in reaching proposed decisions in its review of the NAAQS;

WHEREAS, EPA's agreement to enter into this Consent Decree is premised on its current expectation that the Clean Air Scientific Advisory Committee will not request, and EPA will not determine that it is necessary to prepare, more than one draft of either the Policy Assessment or the Health Risk and Exposure Assessment, if any, as part of the reviews of the primary NAAQS for either NO_X or SO_X, or more than two drafts of the Integrated Science Assessment addressing human health effects of SO_X;

WHEREAS, if the Clean Air Scientific Advisory Committee requests, or if EPA determines that it is necessary to prepare, more than one draft of any Policy Assessment or Health Risk and Exposure Assessment as part of the review of the primary NAAQS for either NO_X or SO_X, or more than two drafts of the Integrated Science Assessment addressing human health effects of SO_X, EPA anticipates that additional time would be needed to complete its review of the corresponding NAAQS;

WHEREAS, Plaintiffs and EPA, by entering into this Consent Decree, do not waive or limit any claim, remedy, or defense, on any grounds, related to any final EPA action;

WHEREAS, Plaintiffs and EPA consider this Consent Decree to be an adequate and equitable resolution of all the claims in this matter and therefore wish to effectuate a settlement;

WHEREAS, it is in the interest of the public, Plaintiffs, EPA, and judicial economy to resolve this matter without protracted litigation;

WHEREAS, Plaintiffs and EPA agree that this Court has jurisdiction over this matter pursuant to the citizen suit provision in CAA section 304(a)(2), 42 U.S.C. § 7604(a)(2), and that venue is proper in the Northern District of California pursuant to 28 U.S.C. § 1391(e) and N.D. Cal. Civ. Local Rule 3-2(c)-(d);

WHEREAS, the Court, by entering this Consent Decree, finds that the Consent Decree is fair, reasonable, in the public interest, and consistent with the CAA;

NOW THEREFORE, before the taking of testimony, without trial or determination of any issues of fact or law, and upon the consent of Plaintiffs and EPA, it is hereby ordered, adjudged and decreed that:

1. The appropriate EPA official shall:

a. sign a notice of proposed rulemaking setting forth its proposed decision pursuant to 42 U.S.C. § 7409(d)(1) concerning its review of the primary NAAQS for NO_X and including such revisions to these NAAQS and/or such new primary NAAQS for NO_X as may be appropriate in accordance with 42 U.S.C. §§ 7408 and 7409(b) no later than July 14, 2017;

b. sign a notice of final rulemaking setting forth its final decision pursuant to 42 U.S.C. § 7409(d)(1) concerning its review of the primary NAAQS for NO_X and including such revisions to these NAAQS and/or such new primary NAAQS for NO_X as may be appropriate in accordance with 42 U.S.C. §§ 7408 and 7409(b) no later than April 6, 2018;

c. issue a final Integrated Science Assessment, a document containing the air quality criteria, addressing human health effects of SO_X pursuant to 42 U.S.C. §§ 7408 and 7409(d)(1) no later than December 14, 2017;

d. sign a notice of proposed rulemaking setting forth its proposed decision pursuant to 42 U.S.C. § 7409(d)(1) concerning its review of the primary NAAQS for SO_X and including such revisions to these NAAQS and/or such new primary NAAQS for SO_X as may be appropriate in accordance with 42 U.S.C. §§ 7408 and 7409(b) no later than May 25, 2018; and

e. sign a notice of final rulemaking setting forth its final decision pursuant to 42 U.S.C. § 7409(d)(1) concerning its review of the primary NAAQS for SO_X and including such revisions to these NAAQS and/or such new primary NAAQS for SO_X as may be appropriate in accordance with 42 U.S.C. §§ 7408 and 7409(b) no later than January 28, 2019.

2. EPA shall, within 15 business days of the issuance of the final Integrated Science Assessment pursuant to Paragraph 1.c or signature of each action set forth in Paragraphs 1.a, 1.b, 1.d, and 1.e, send notice of the action to the Office of the Federal Register for review and publication.

3. After EPA has completed the actions set forth in Paragraph 1 of this Consent Decree and the issue of costs of litigation, including attorney fees, has been resolved, EPA may move to have this Decree terminated. Plaintiffs shall have fourteen (14) days in which to respond to such a motion, unless the parties stipulate to a longer time for Plaintiffs to respond.

4. The deadlines established by this Consent Decree may be extended (a) by written stipulation of Plaintiffs and EPA with notice to the Court, or (b) by the Court upon motion of EPA for good cause shown pursuant to the Federal Rules of Civil Procedure and upon consideration of any response by Plaintiffs and any reply by EPA. Any other provision of this Consent Decree also may be modified by the Court following motion of an undersigned party for good cause shown pursuant to the Federal Rules of Civil Procedure and upon consideration of any response by a non-moving party and any reply.

5. If a lapse in EPA appropriations occurs within one hundred twenty (120) days prior to a deadline in Paragraph 1 or 2 in this Decree, that deadline shall be extended automatically one day for each day of the lapse in appropriations. Nothing in this Paragraph shall preclude EPA from seeking an additional extension of time through modification of this Consent Decree pursuant to Paragraph 4.

6. Plaintiffs and EPA agree that this Consent Decree shall constitute a complete and final settlement of all claims in the Complaint.

7. In the event of a dispute between Plaintiffs and EPA concerning the interpretation or implementation of any aspect of this Consent Decree, the disputing party shall provide the other party with a written notice via electronic mail or other means, outlining the nature of the dispute and requesting informal negotiations. The parties shall

meet and confer in order to attempt to resolve the dispute. If the parties are unable to resolve the dispute within ten (10) business days after receipt of the notice, either party may petition the Court to resolve the dispute.

8. No motion or other proceeding seeking to enforce this Consent Decree or for contempt of Court shall be filed unless the procedure set forth in Paragraph 7 has been followed.

9. The deadline for filing a motion for costs of litigation (including reasonable attorney fees) for activities performed prior to entry of the Consent Decree is hereby extended until ninety (90) days after this Consent Decree is entered by the Court. During this period, the Parties shall seek to resolve informally any claim for costs of litigation (including reasonable attorney fees), and if they cannot, Plaintiffs will file a motion for costs of litigation (including reasonable attorney fees) or a stipulation or motion to extend the deadline to file such a motion. EPA reserves the right to oppose any such request.

10. This Court shall retain jurisdiction over this matter to enforce the terms of this Consent Decree and to consider any requests for costs of litigation (including attorney fees).

11. Nothing in the terms of this Consent Decree shall be construed (a) to confer upon this Court jurisdiction to review any final rule or determination issued by EPA pursuant to this Consent Decree, (b) to confer upon this Court jurisdiction to review any issues that are within the exclusive jurisdiction of the United States Courts of Appeals under CAA section 307(b)(1), 42 U.S.C. § 7607(b)(1), or (c) to waive any claims, remedies, or defenses that the parties may have under CAA section 307(b)(1), 42 U.S.C. § 7607(b)(1).

12. Nothing in this Consent Decree shall be construed to limit or modify any discretion accorded EPA by the Clean Air Act or by general principles of administrative law in taking the actions which are the subject of this Consent Decree, including the discretion to alter, amend, or revise any final actions promulgated pursuant to this

Consent Decree. EPA's obligation to perform each action specified in this Consent Decree does not constitute a limitation or modification of EPA's discretion within the meaning of this paragraph.

13. Except as expressly provided herein, nothing in this Consent Decree shall be construed as an admission of any issue of fact or law nor to waive or limit any claim, remedy, or defense, on any grounds, related to any final action EPA takes with respect to the actions addressed in this Consent Decree.

14. Plaintiff reserves the right to seek additional costs of litigation (including reasonable attorney fees) incurred subsequent to entry of this Consent Decree. EPA reserves the right to oppose any such request for additional costs of litigation (including attorney fees).

15. It is hereby expressly understood and agreed that this Consent Decree was jointly drafted by Plaintiffs and EPA. Accordingly, the parties hereby agree that any and all rules of construction to the effect that ambiguity is construed against the drafting party shall be inapplicable in any dispute concerning the terms, meaning, or interpretation of this Consent Decree.

16. The parties agree and acknowledge that before this Consent Decree is entered by the Court, EPA must provide notice of this Consent Decree in the Federal Register and an opportunity for public comment pursuant to CAA section 113(g), 42 U.S.C. § 7413(g). After this Consent Decree has undergone notice and an opportunity for comment, the Administrator and/or the Attorney General, as appropriate, shall promptly consider any such written comments in determining whether to withdraw or withhold their consent to the Consent Decree, in accordance with CAA section 113(g). If the Administrator and/or the Attorney General do not elect to withdraw or withhold consent, EPA shall promptly file a motion that requests that the Court enter this Consent Decree.

17. Any notices required or provided for by this Consent Decree shall be in writing, via electronic mail or other means, and sent to the following (or to any new address of counsel as filed and listed in the docket of the above-captioned matter, at a future date):

For Plaintiffs Center for Biological Diversity and Center for Environmental Health:

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18. EPA and Plaintiffs recognize and acknowledge that the obligations imposed upon EPA under this Consent Decree can only be undertaken using appropriated funds legally available for such purpose. No provision of this Consent Decree shall be interpreted as or constitute a commitment or requirement that the United States obligate or pay funds in contravention of the Anti-Deficiency Act, 31 U.S.C. § 1341, or any other applicable provision of law.

19. If for any reason the Court should decline to approve this Consent Decree in the form presented, this agreement is voidable at the sole discretion of either party and the terms of the proposed Consent Decree may not be used as evidence in any litigation between the parties.

20. The undersigned representatives of Plaintiffs and Defendant EPA certify that they are fully authorized by the party they represent to consent to the Court's entry of the terms and conditions of this Consent Decree.

SO ORDERED on this 28th day of April, 2017.

Vince Chhabria
United States District Judge

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Attorneys for Defendant EPA

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's First Request for Information
Dated October 3, 2019

Case No. 2018-00348

Question No. 31

Witness: Gary H. Revlett

Q-31. Refer to the IRP, Volume 1, Section 8.(5).(f), page 8-34, regarding greenhouse gas regulations. Identify and explain any events that have transpired since the Affordable Clean Energy Rule was proposed on August 21, 2018.

A-31. The Affordable Clean Energy ("ACE") Rule was published on July 8, 2019. The New Source Review revisions which were included with the proposed ACE rule (as mentioned in the 2018 IRP, Volume 1, Section 8.(5).(f), page 8-34) were not finalized with final ACE rule.

On that same date, July 8, 2019, the American Lung Association and the American Public Health Association both filed petitions for judicial review of the ACE rule in the U.S. Court of Appeals for the District of Columbia Circuit. Since that date, various other groups have filed petitions for administrative reconsideration of the ACE rule and/or filed petitions to intervene in the cases.

Litigation notwithstanding, the Companies will evaluate the heat rate improvement ("HRI") projects identified in the final ACE rule for their technical and economic feasibility as they might apply to each of the Companies ACE-affected electric generating units. With that information, the Companies will be able to aid the Commonwealth of Kentucky in meeting Kentucky's ACE timelines (as mentioned in the 2018 IRP, Volume 1, Section 8.(5).(f), page 8-34) for developing and submitting a state implementation plan ("SIP") for the ACE rule by July 8, 2022.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's First Request for Information
Dated October 3, 2019

Case No. 2018-00348

Question No. 32

Witness: Gary H. Revlett

Q-32. Refer to the IRP, Volume 1, Section 8.(5).(f), page 8-35, regarding the Clean Water Act - 316(b).

a. Provide the options that LG&E/KU is evaluating to bring Mill Creek Unit 1 into compliance with the impingement standard and indicate when this evaluation is anticipated to be completed.

b. Provide the status of the aquatic studies that is needed for the Mill Creek Station with respect to compliance with the entrainment standard and indicate when the final report will be submitted to the Kentucky Division of Water (KDOW). Also, provide the time frame in which LG&E/KU anticipates entering into negotiation discussions with KDOW regarding the appropriate technologies needed to comply with the entrainment standard.

A-32.

a. Compliance with the impingement standard requires a selection from one of seven predetermined compliance alternatives as Best Technology Available (BTA). If an entrainment study is also required (as is the case for Mill Creek Unit 1), then the impingement selection is delayed until after the entrainment compliance alternatives are evaluated. It is most likely that Mill Creek Unit 1 will select from Option 1(closed -cycle cooling), Option 5 (modified traveling screens) or Option 6 (system of existing/additional technologies).

b. The impingement and entrainment data required by 316(b) must be submitted to KDOW as part of the next KPDES permit renewal application for Mill Creek Station. The current permit expires on June 30, 2023 and the renewal application must be submitted 180 days prior to the expiration date. Part of the 316(b) data requirement for Mill Creek will include a two-year entrainment study of the facility's cooling water intake system. LG&E has contracted that study to be performed by an outside firm during 2020-2021. A final report will be generated in 2022 and based on the results of the study, both an entrainment and impingement strategy will be developed. LG&E anticipates discussions with KDOW staff to occur in late 2022 after their review of the report and the accompanying data.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's First Request for Information
Dated October 3, 2019

Case No. 2018-00348

Question No. 33

Witness: Gary H. Revlett

Q-33. Refer to the IRP, Volume 1, Section 8.(5).(f), pages 8-35 through 8-36. Provide a discussion of any revisions to the coal combustion residual rule since the filing of the IRP.

A-33. The CCR Rule has been revised on many occasions since its issuance and effective date, with the most recent three revisions having occurred subsequent to the filing of the IRP. These most recent and likely most relevant occasions are described in the following sections.

On March 15, 2018, EPA issued a revision to the CCR Rule commonly referenced as the "Remand Rule, Phase 1" (Federal Register, Volume 83, Number 51). EPA addressed a number of concerns, the most prominent of which included: the addition of boron as an Appendix IV constituent; vegetative height and cover related to slope stability for CCR impoundments; non-groundwater releases of CCRs; and alternative closures for non-CCR waste streams. The revisions associated with this Rule update did not have a material effect on the Companies' plans for any CCR impoundment closure.

On July 30, 2018, the "Remand Rule, Phase 1, Part 1" was issued by EPA (Federal Register, Volume 83, Number 146). Among the changes proposed and initiated by this update were the establishment of regional screening levels as Groundwater Protection Standards (GPS) for various Appendix IV constituents (cobalt, lithium, and molybdenum). Additionally, EPA introduced allowances within the Rule for risk-based considerations when selecting and implementing remedies for groundwater contamination, although it did not provide guidance on how risk-based standards might be implemented.

Finally, simultaneous with the proposed actions identified in this revision, EPA implemented a suspension of the deadline to initiate closure of unlined impoundments, if the impoundments were forced to close because of the exceedance of a GPS or if the impoundment violated the separation (Location) standard of 5 feet between the base of the impoundment and the uppermost aquifer. This is significant as it has adjusted most closure schedules associated with the largest CCR impoundments within LG&E and KU's fleet.

On August 14, 2019, EPA proposed "Remand Rule, Phase 2" (Federal Register, Volume 84, Number 157). The proposed actions within this Rule update generally applied to formatting of the Annual Groundwater Monitoring and Corrective Action Report, establishment of minimal standards relating to the publicly-accessible web site established

and maintained by CCR unit owners, and standards for the management of CCR piles. Additionally, EPA postulated on a GPS relating to boron if it were to incorporate boron into the listing of the Appendix IV parameters and on various standards it might consider when evaluating standards for beneficial use. EPA's intent is not clear as it has not proposed any specific approach to beneficial use, nor has it eliminated or affirmed the strict volume limitation of 12,400 tons which was initially specified in the Rule. It appears that EPA is considering various types of changes and is soliciting comments on various "options" it has identified but also appears to be welcoming of other suggested "options" that can be justified.

It is doubtful that the revisions associated with the August 14, 2019 Rule update will have any significant impact to the Companies' scheduled plans for any CCR impoundment closure.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Commission Staff's First Request for Information
Dated October 3, 2019

Case No. 2018-00348

Question No. 34

Witness: Stuart A. Wilson

Q-34. Refer to the IRP, Volume 3, E.W. Brown Solar Profile, 2017.

a. Refer to page 2 and the discussion of power limiting, or clipping, as a result of the high array-to-inverter ratio. Explain power limiting or clipping in lay terms and how it causes the solar facility to experience a higher capacity factor.

b. If a similar profile was developed for 2018, provide a copy of that report.

A-34.

a. To improve the AC performance of the Brown solar facility, the Companies used an array-to-inverter ratio of 1.4. The array-to-inverter ratio is the ratio of panels' DC capacity (14 megawatts at Brown) and the site AC capacity (10 megawatts at Brown). This array-to-inverter ratio enables hardware and software at the site to better maintain and stabilize maximum electricity generation, 10 megawatts AC, during hours of peak sunlight, as well as increase overall electricity generation. When sunlight is insufficient to produce 10 megawatts of AC power, which is more than 98% of the time, the software engages all 14 megawatts DC of panels together in an attempt to produce as much of the 10 megawatts as possible. When sunlight is sufficient to produce more than 10 megawatts AC, which is less than 2% of the time, the software clips excess power and only sends 10 megawatts to the grid.

   Capacity factor is computed as the ratio of the average hourly AC output and the maximum hourly AC output. A higher array-to-inverter ratio increases the capacity factor simply by lowering the maximum hourly AC output. If the clip were disabled, the maximum hourly output would be 11.69 megawatts AC, resulting in a lower capacity factor.

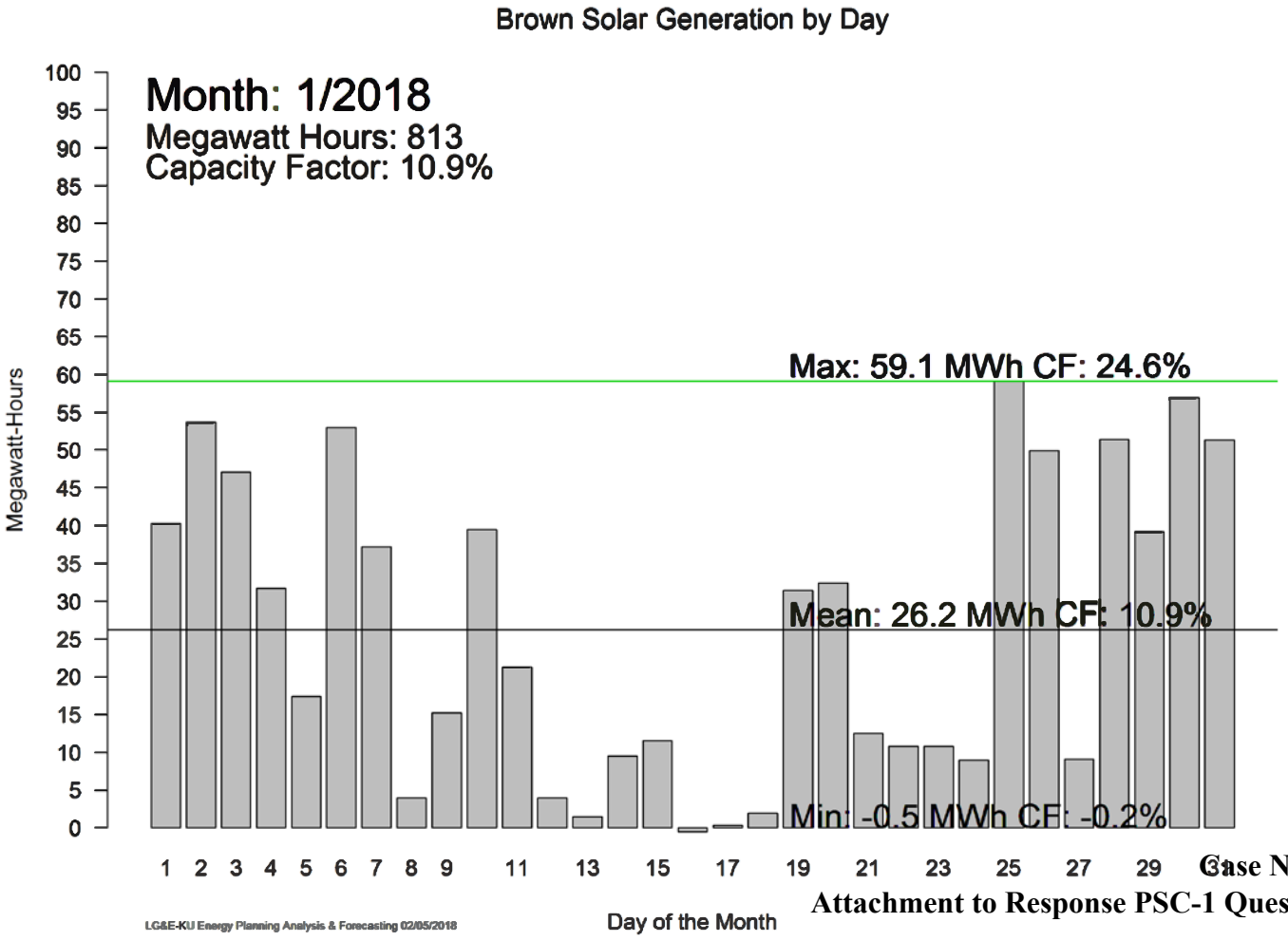
b. A similar 2018 report was not developed. However, the Companies monitor E.W. Brown Solar's operations in real-time and summarize and review its performance monthly. See attached.

2018 Brown Solar Metrics

PPL companies

January 2018

Brown Solar achieved a 10.9% capacity factor in January, averaging 26 MWh per day



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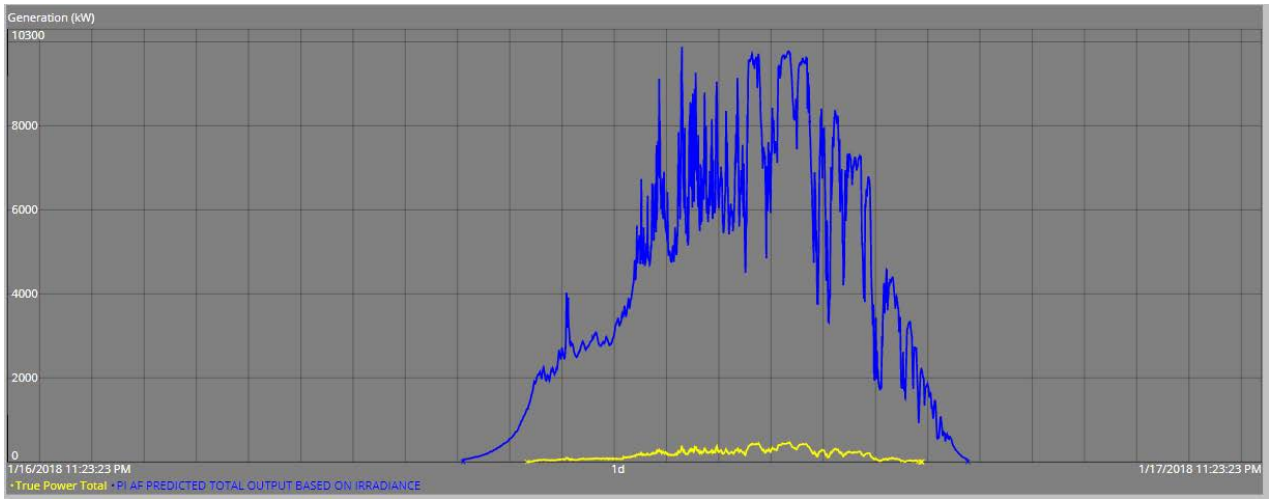
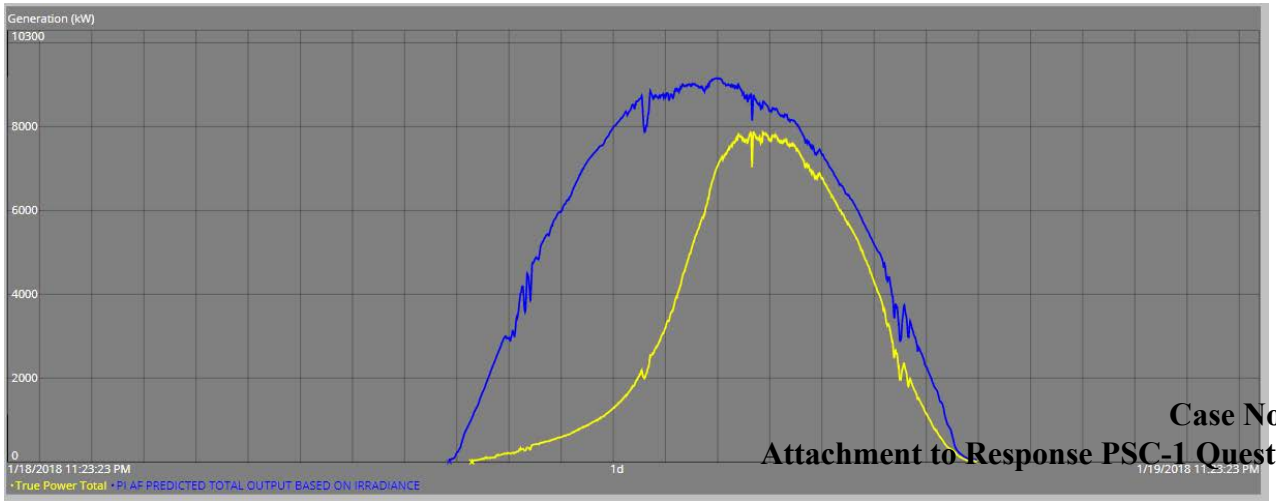
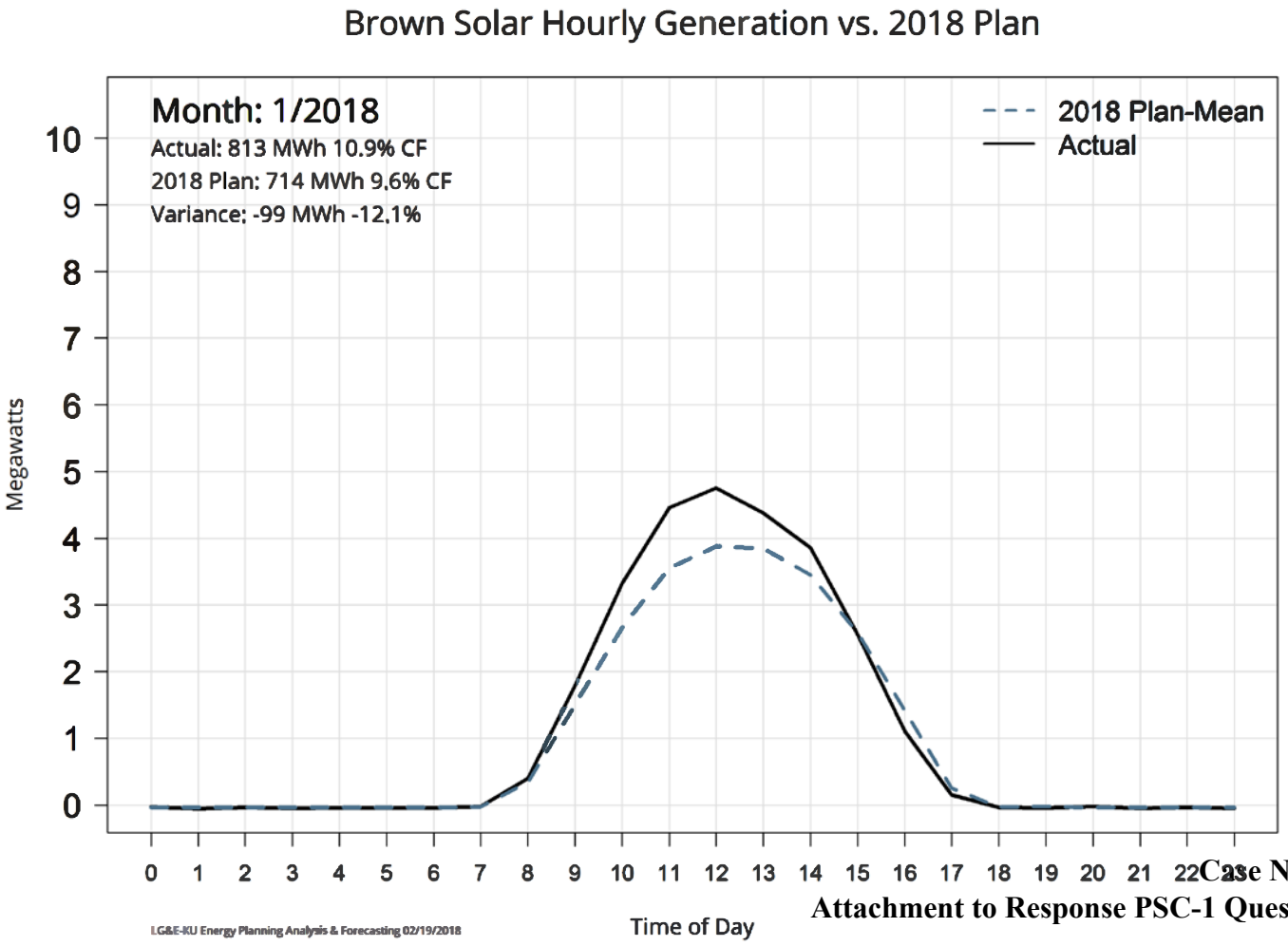
Brown Solar was affected by 3 snow days



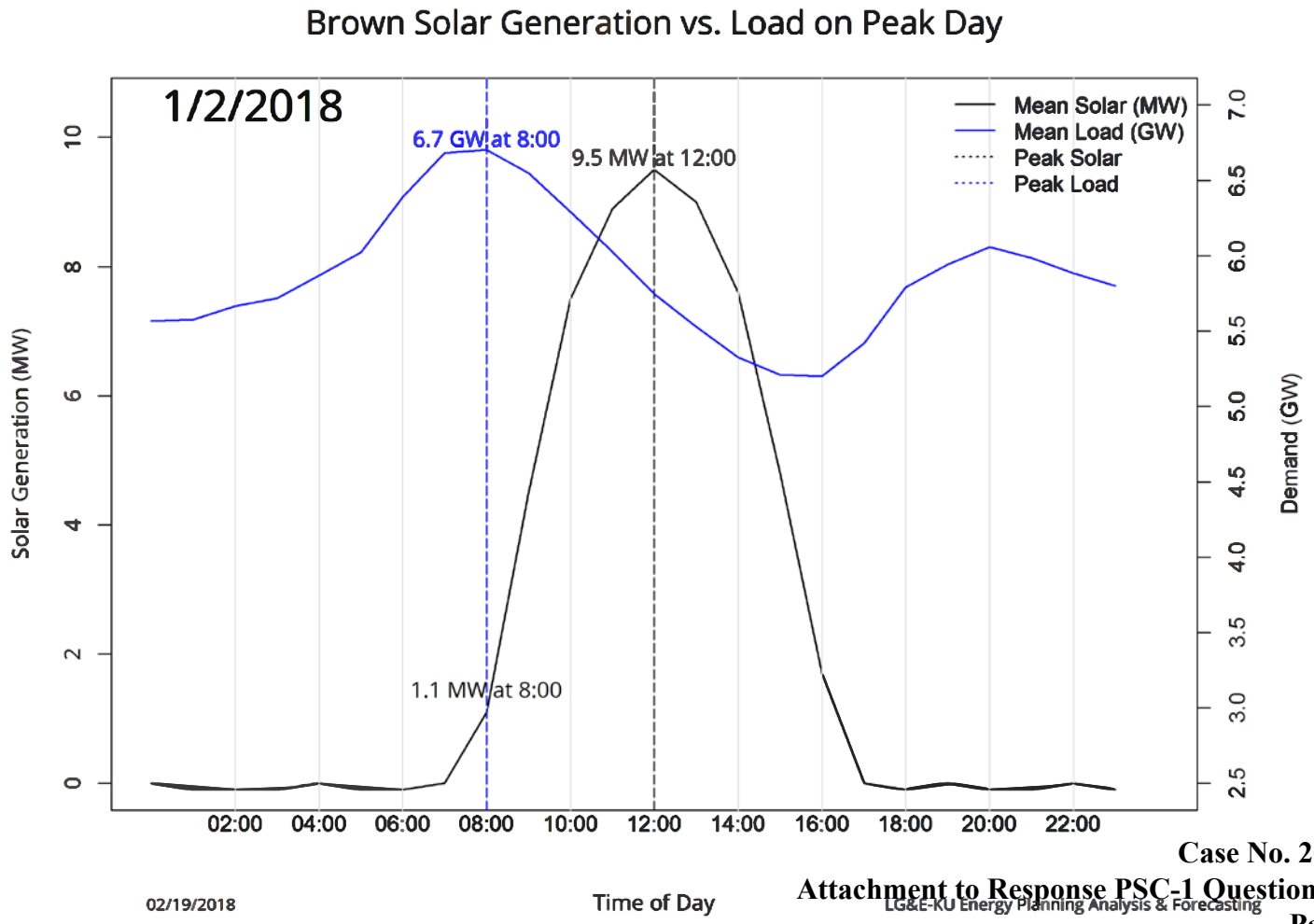
Snow Melting with rising temperatures - January 18th



Solar generation was 12.1% less in January than the 2018 Plan

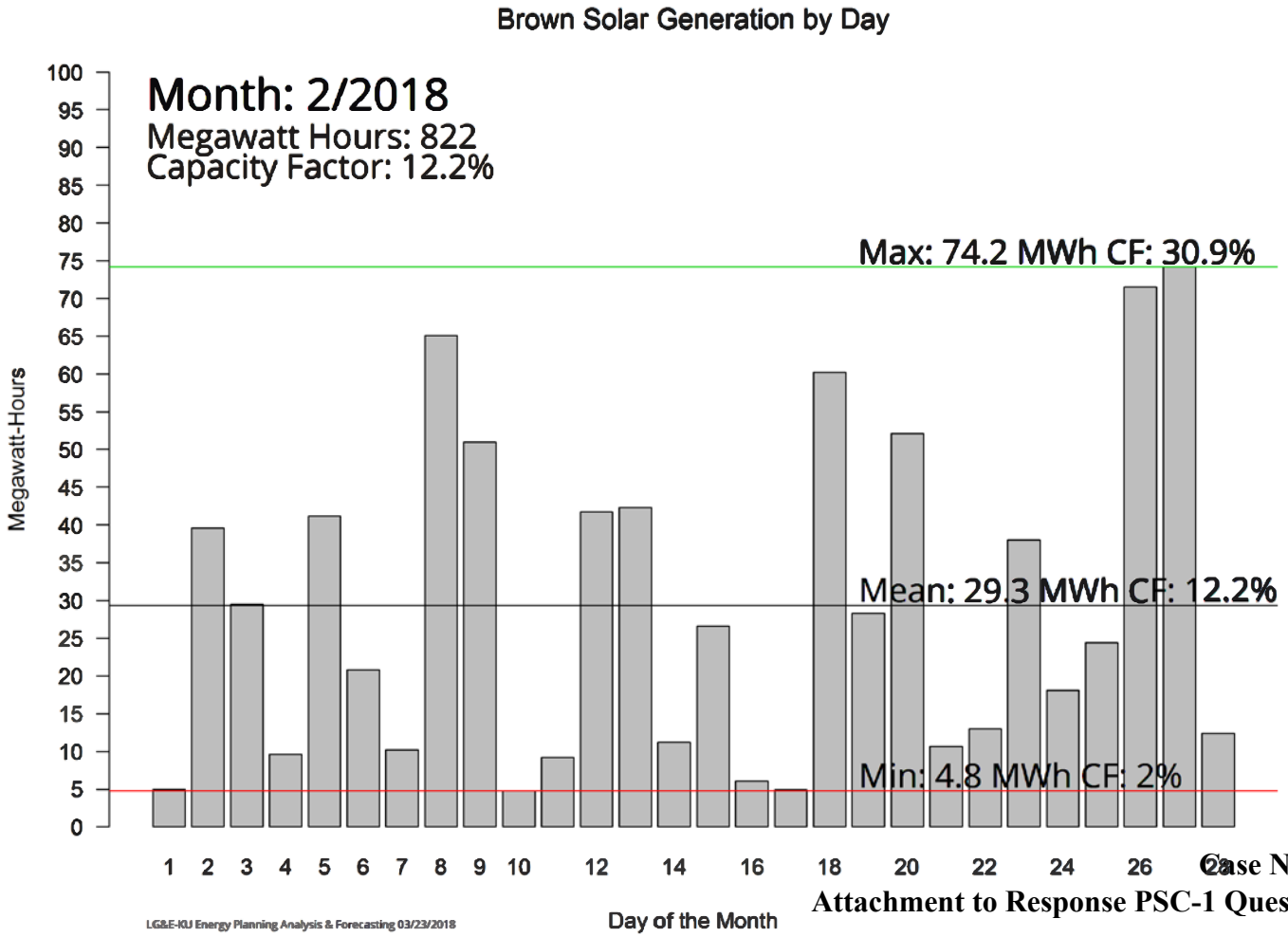


Solar generation was at 11% of capacity at January's peak of 6.7 GW on 1/2/18 at 08:00



February 2018

Brown Solar achieved a 12% capacity factor in February, averaging 29 MWh daily



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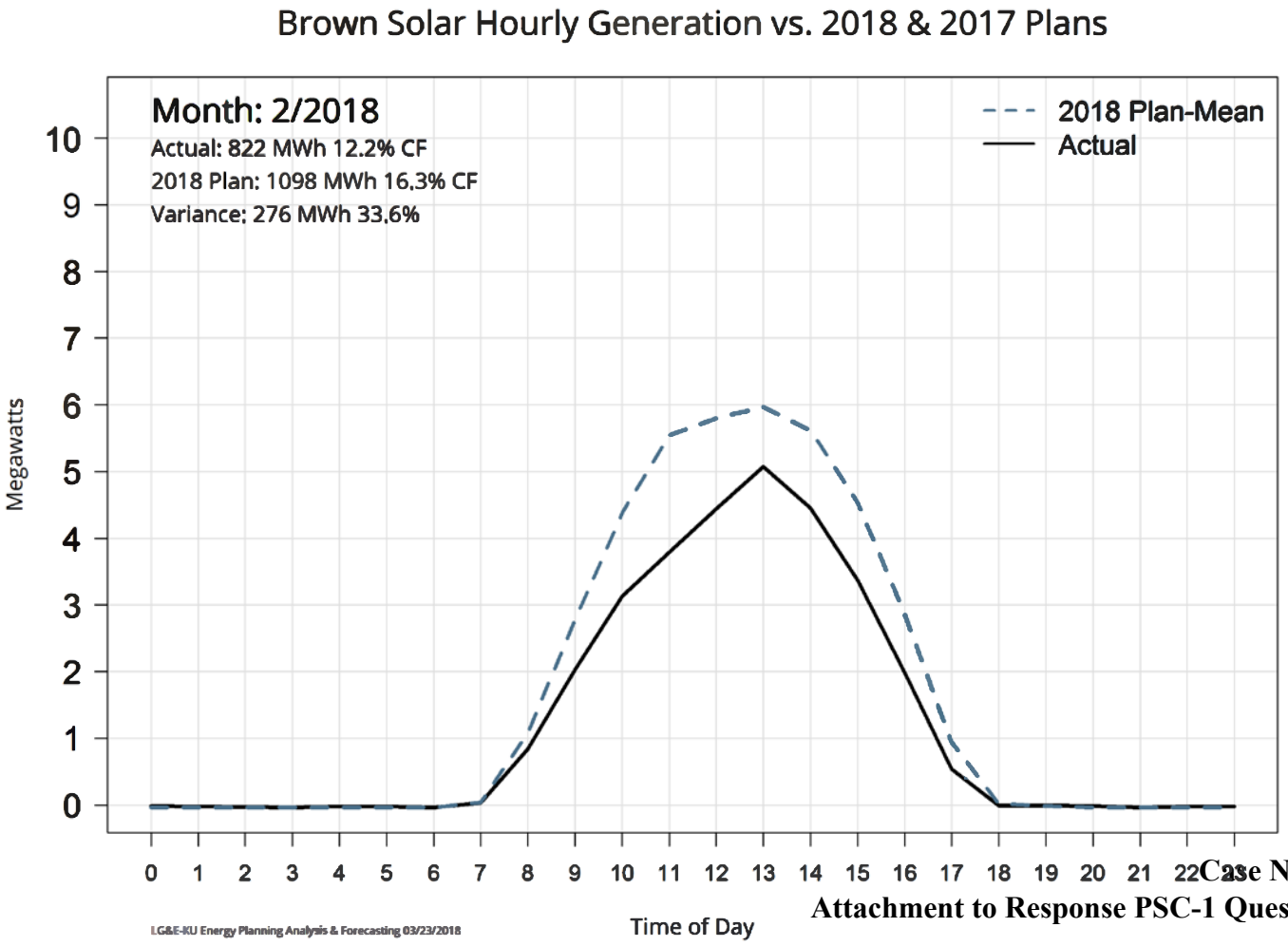
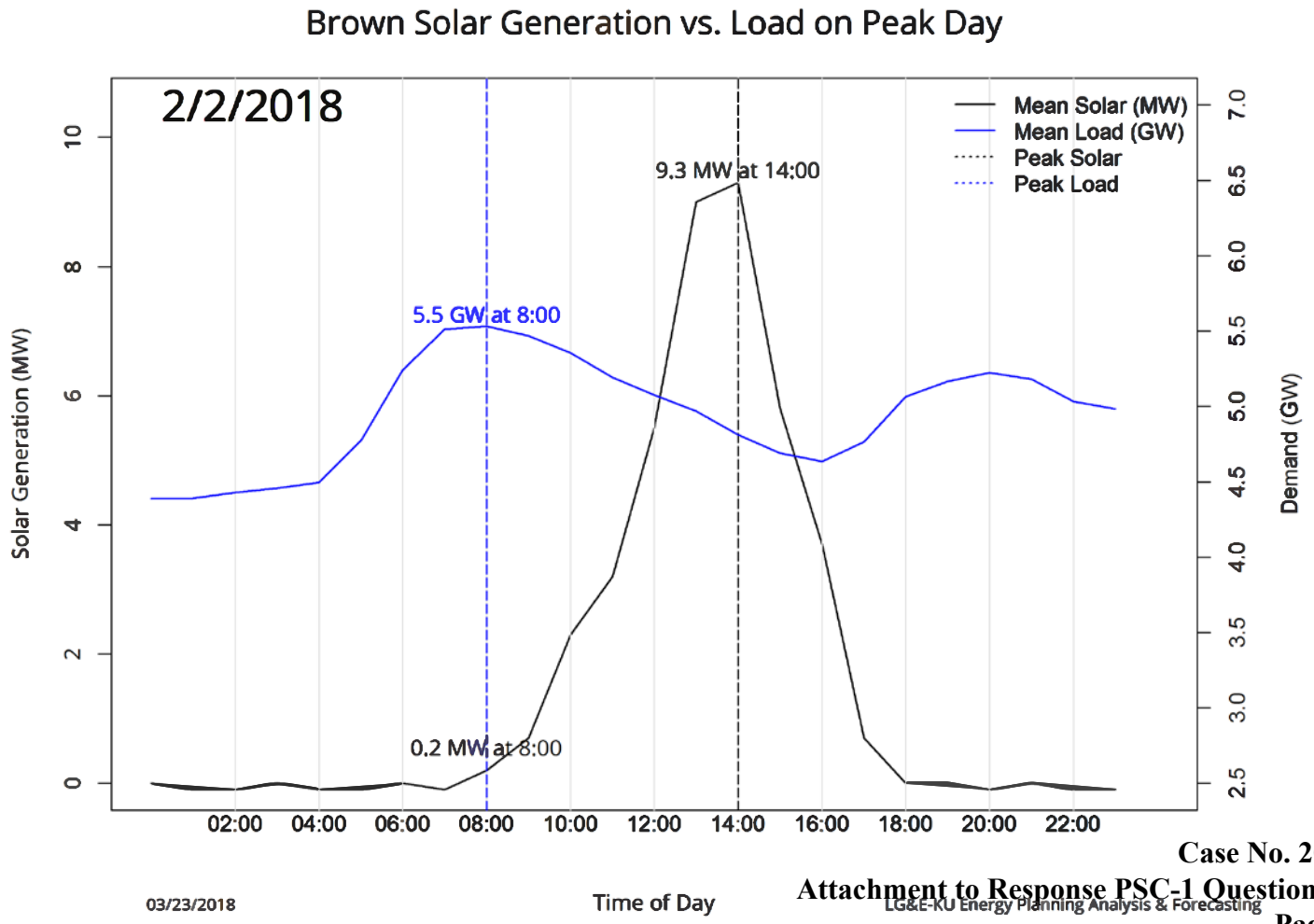
Solar generation was 34% less in February than the 2018 Plan

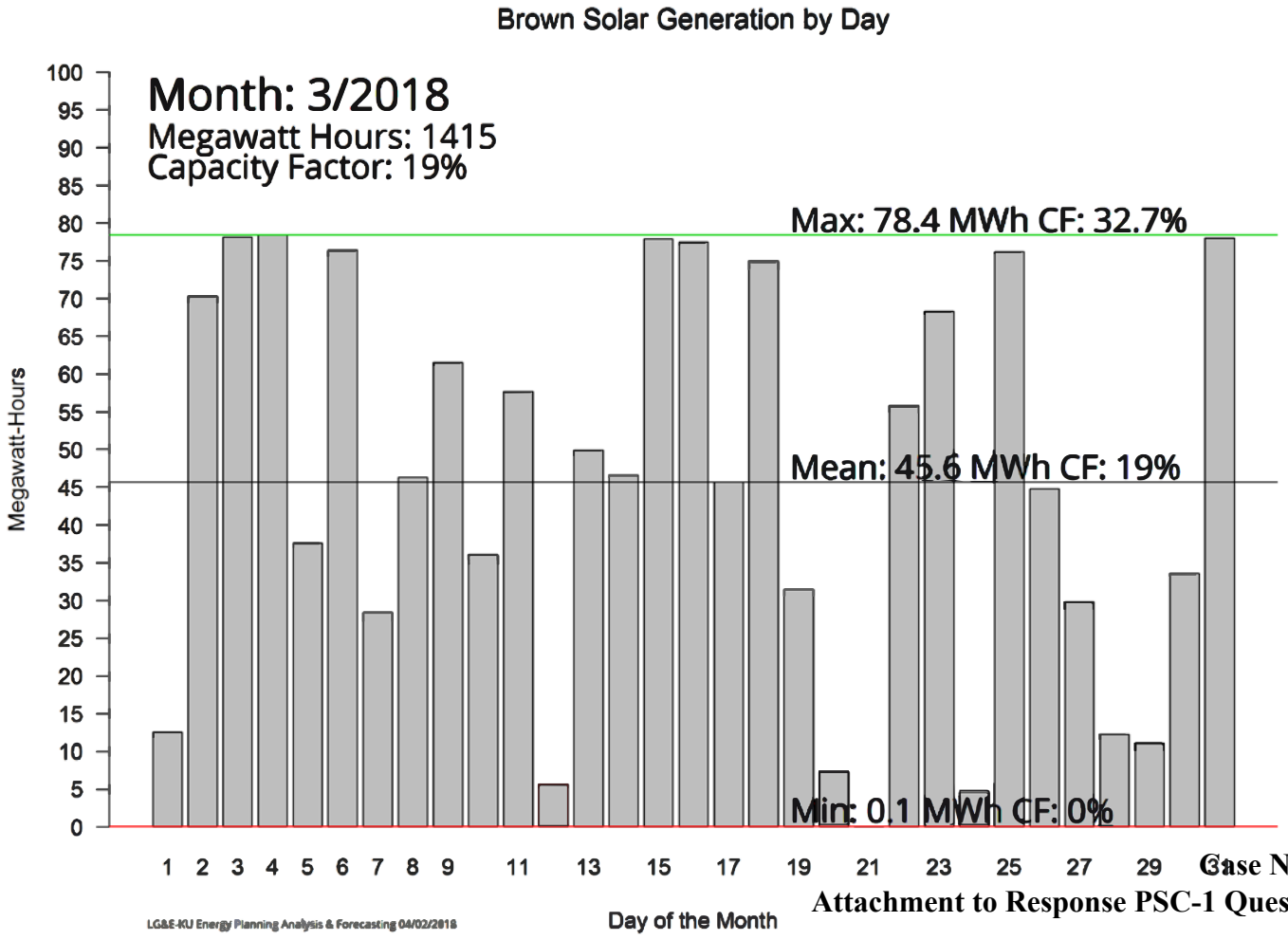


Solar output was at 2% in February hourly peak of 5.5 GW on 2/2 at 08:00



March 2018

Brown Solar achieved a 19% capacity factor in March, averaging 46 MWh daily



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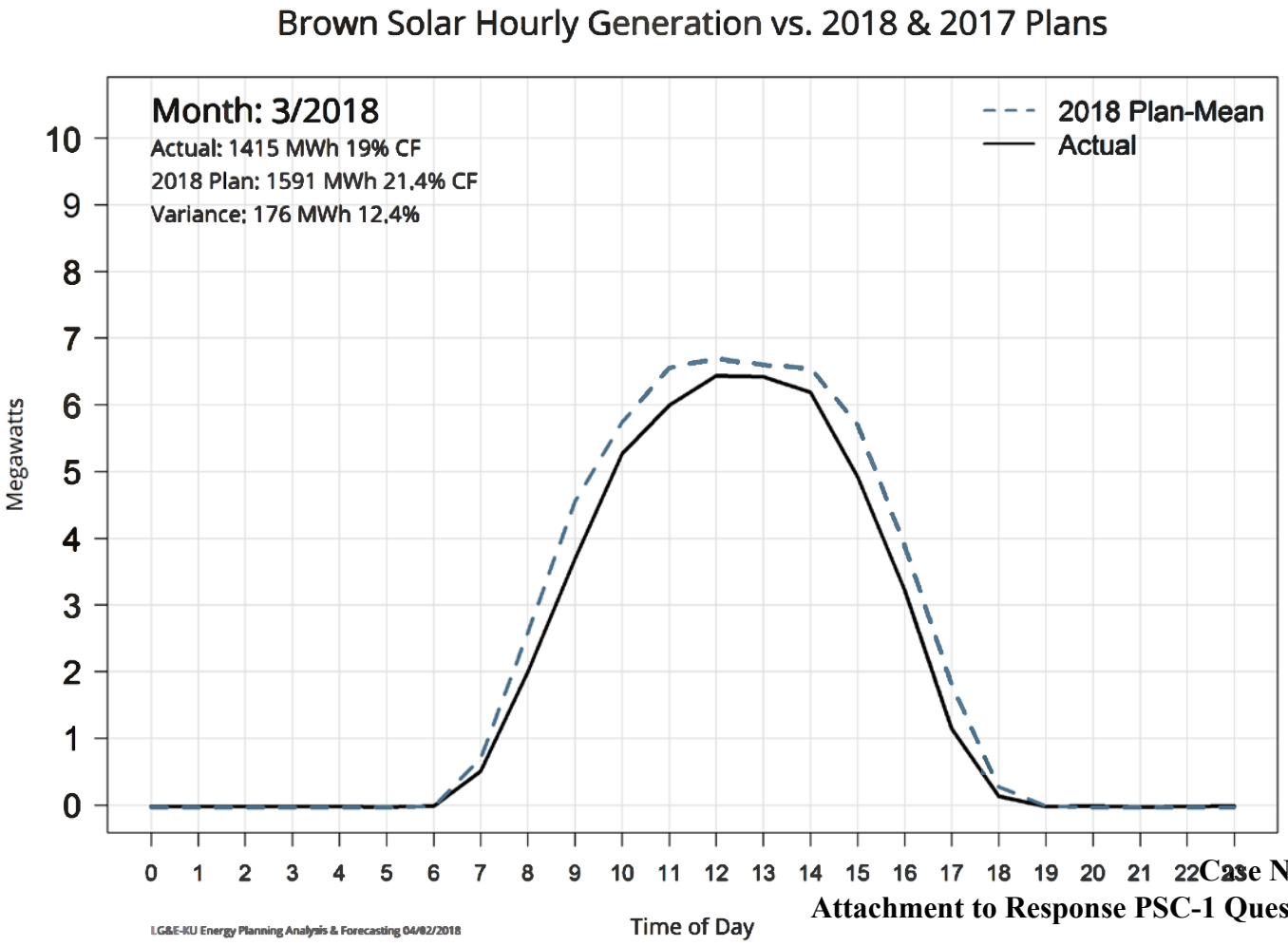
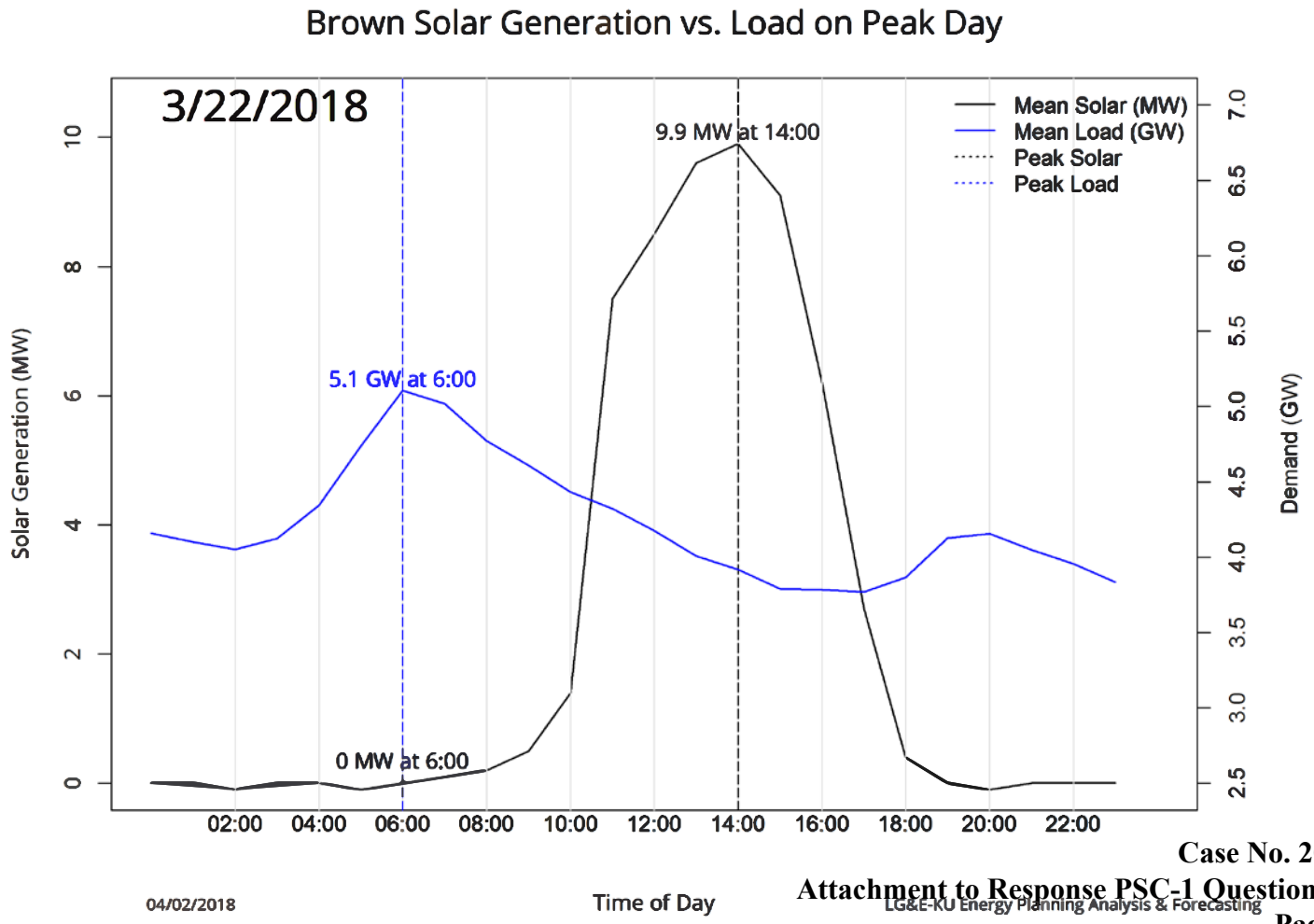
Solar generation was 12.4% less in March than the 2018 Plan, due to snow

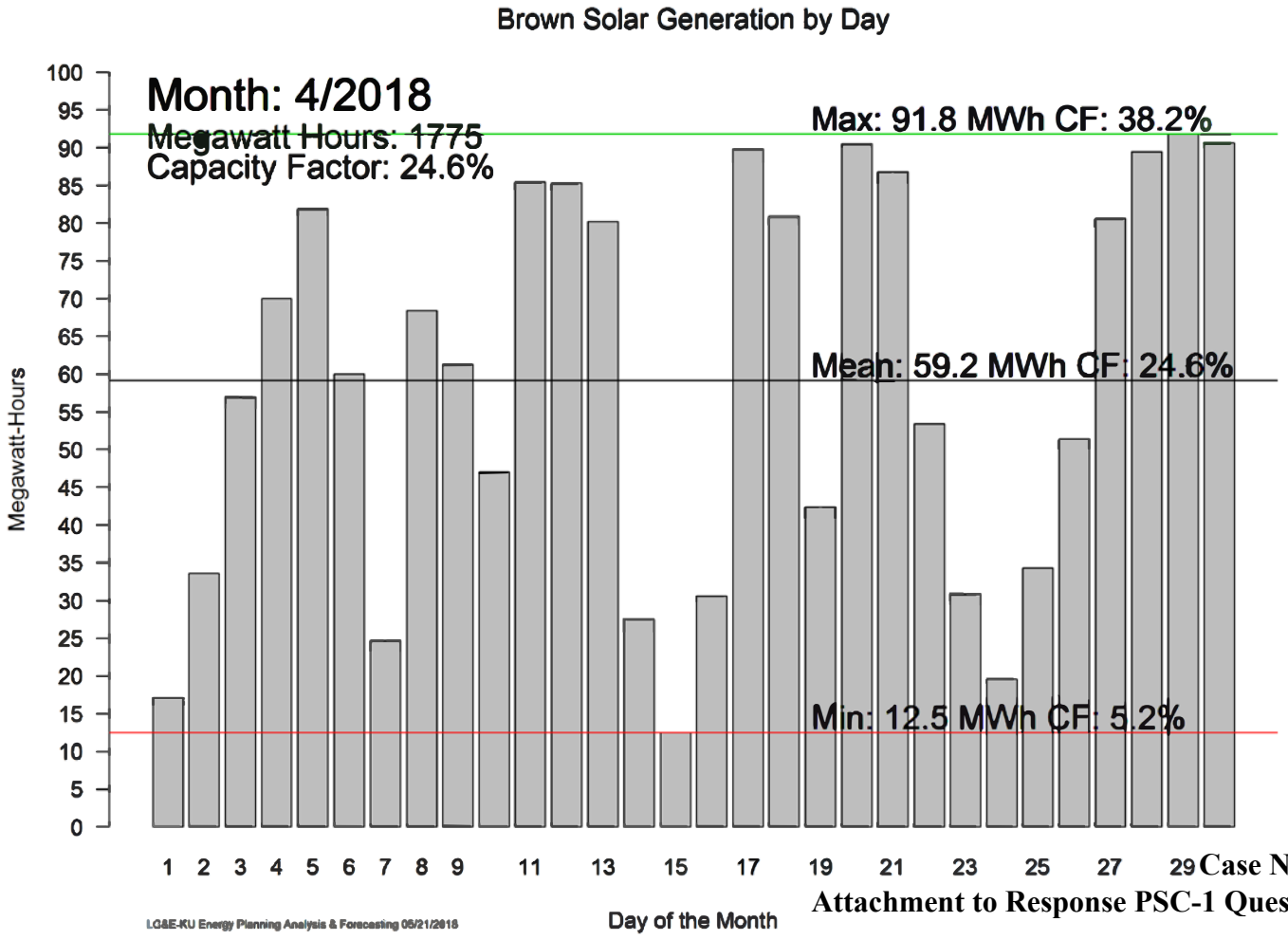


Solar output was at 0% in March hourly peak of 5.1 GW on 3/22 at 06:00



April 2018

Brown Solar achieved a 25% capacity factor in April



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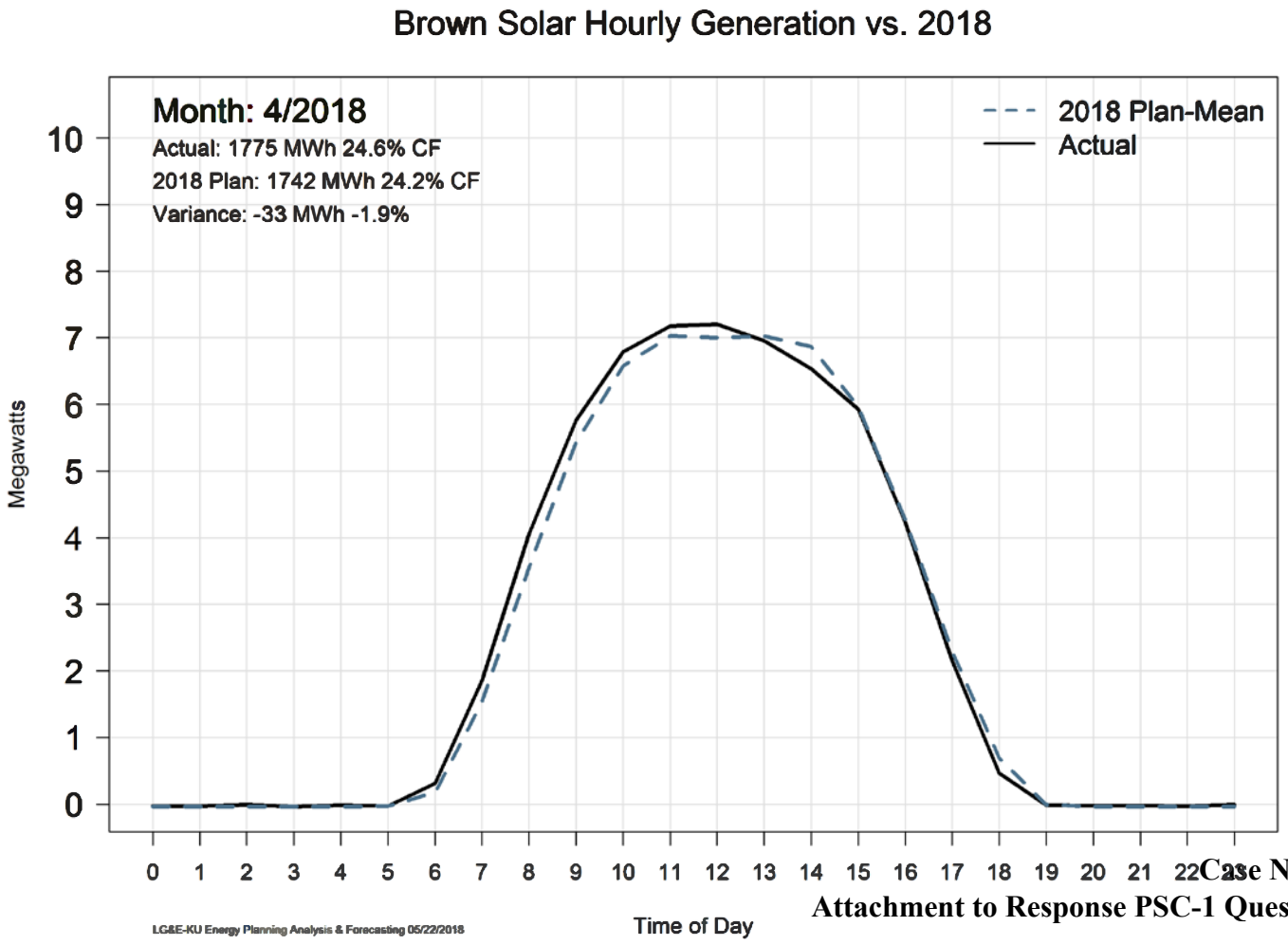
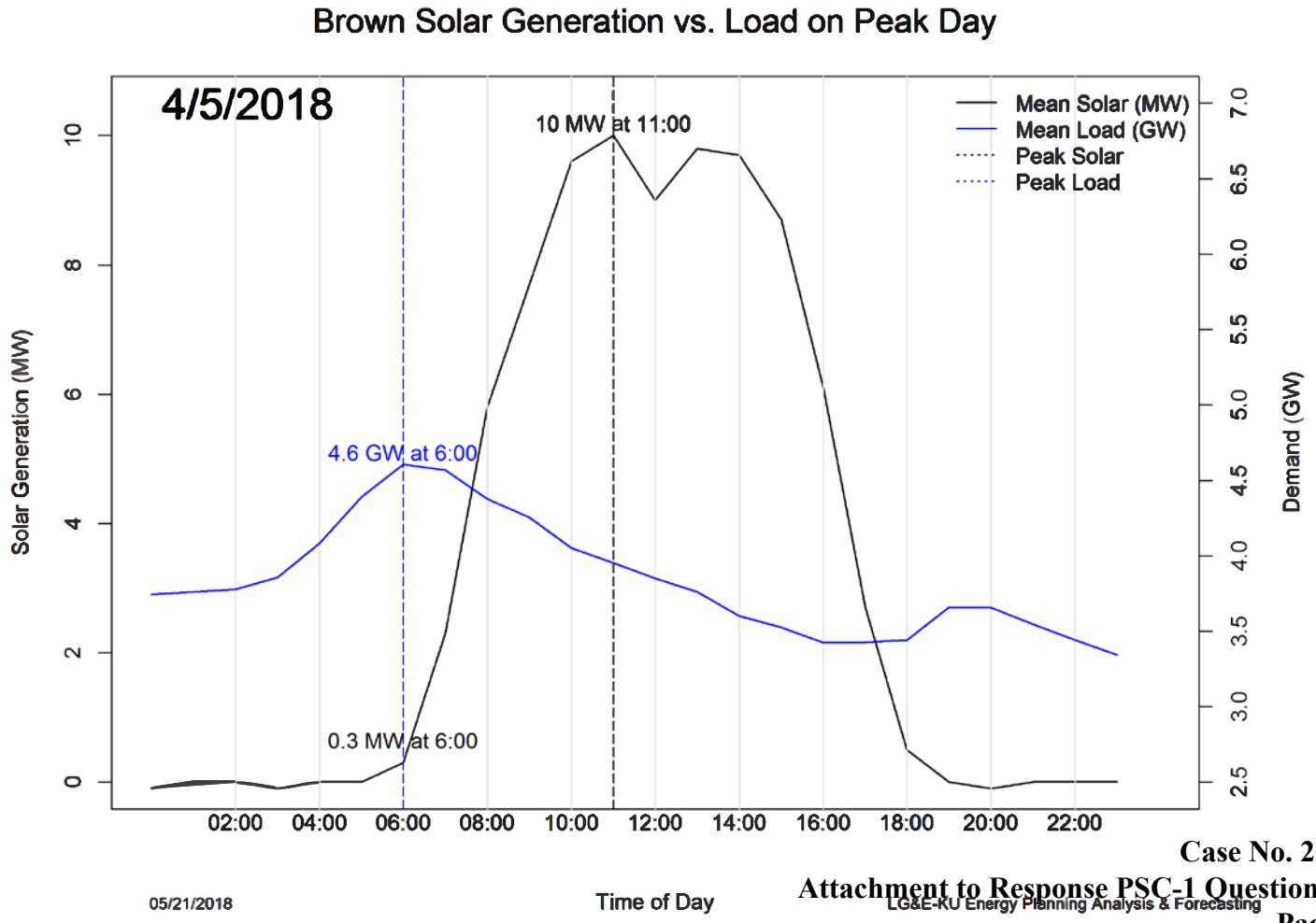
Wilson

Solar generation was 1.9% more than plan

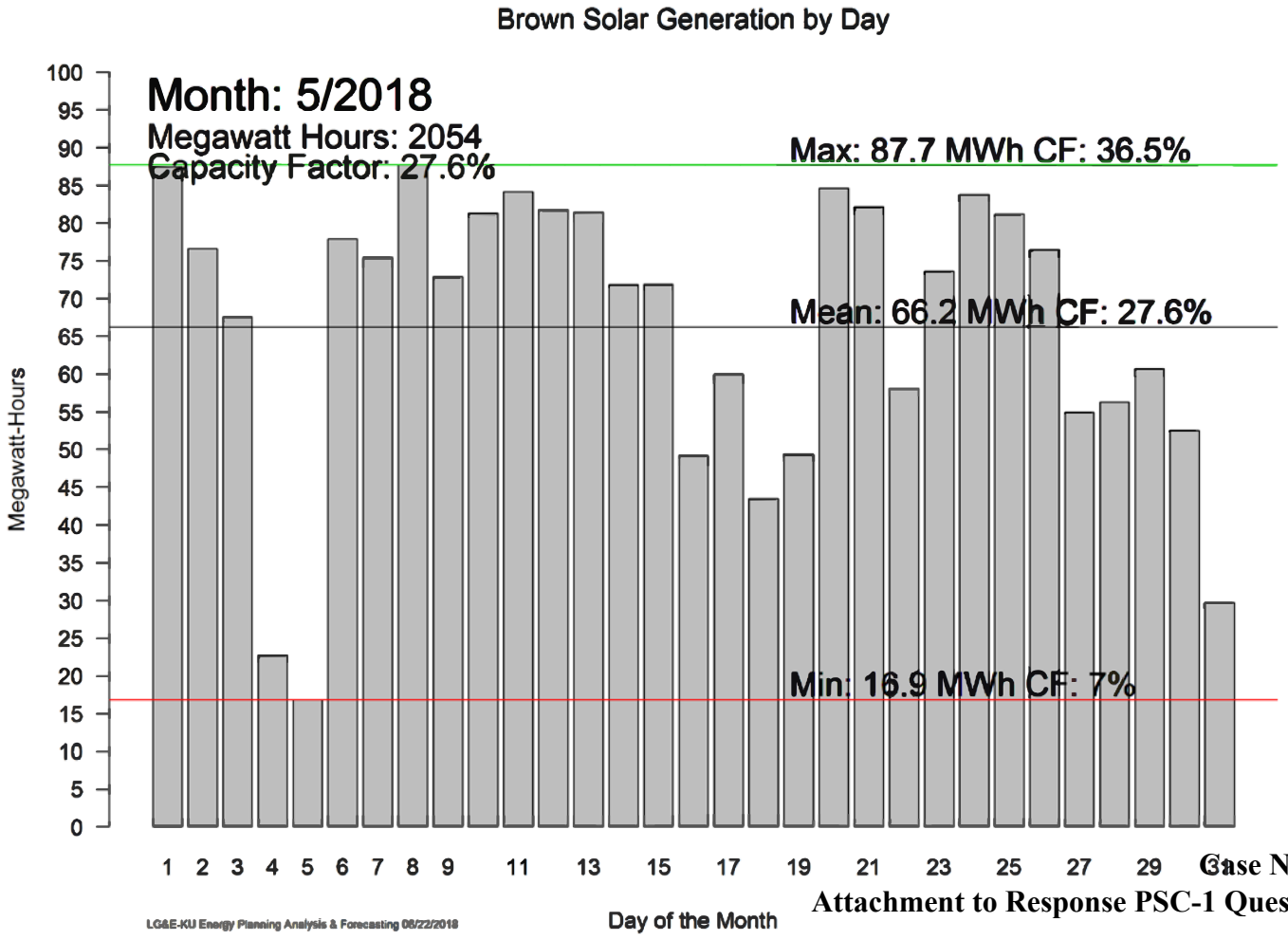


Solar output was at 0.3% in April hourly peak of 4.6 GW on 4/5 at 06:00



May 2018

Brown Solar achieved a 27.6% capacity factor



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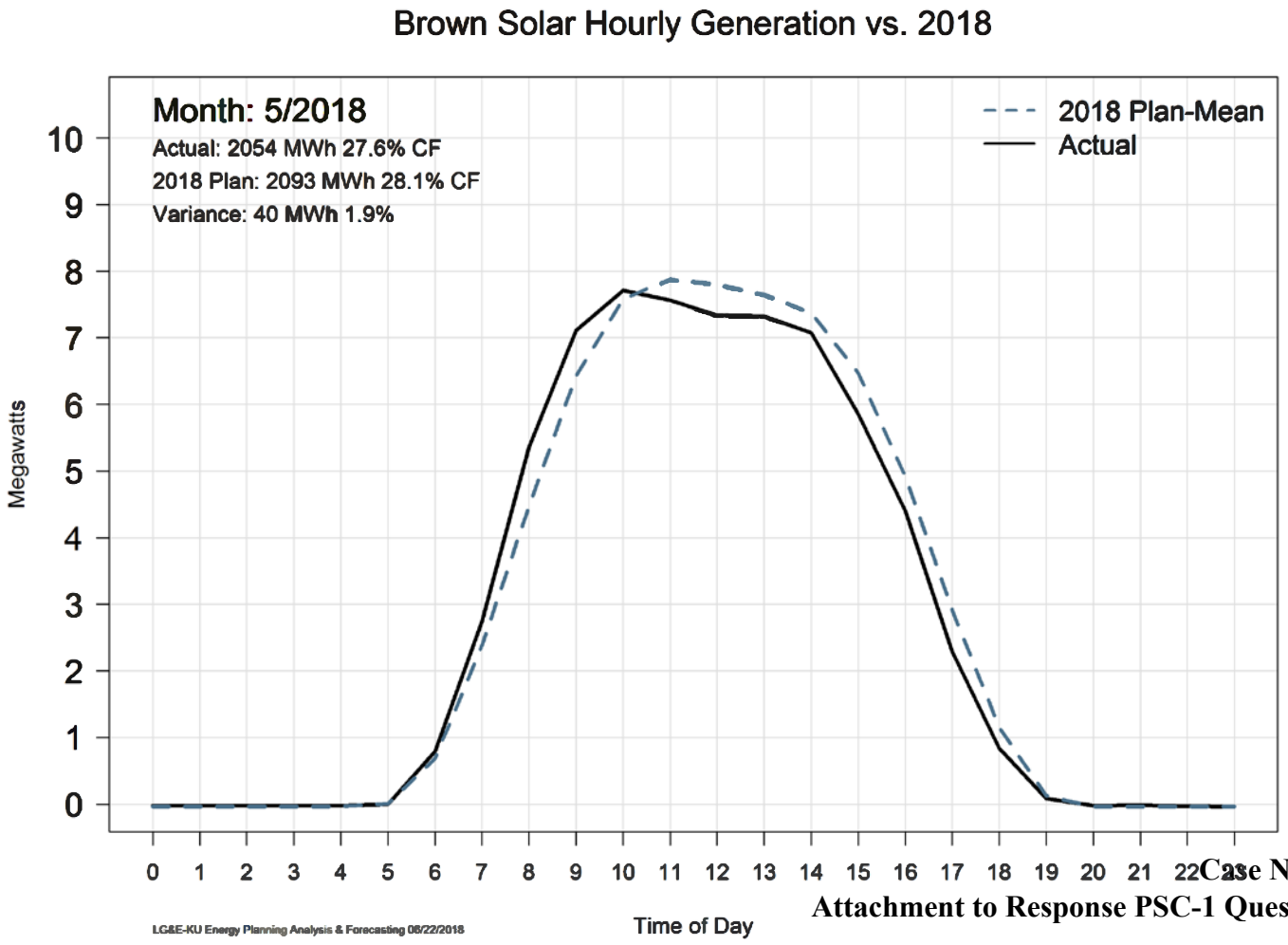
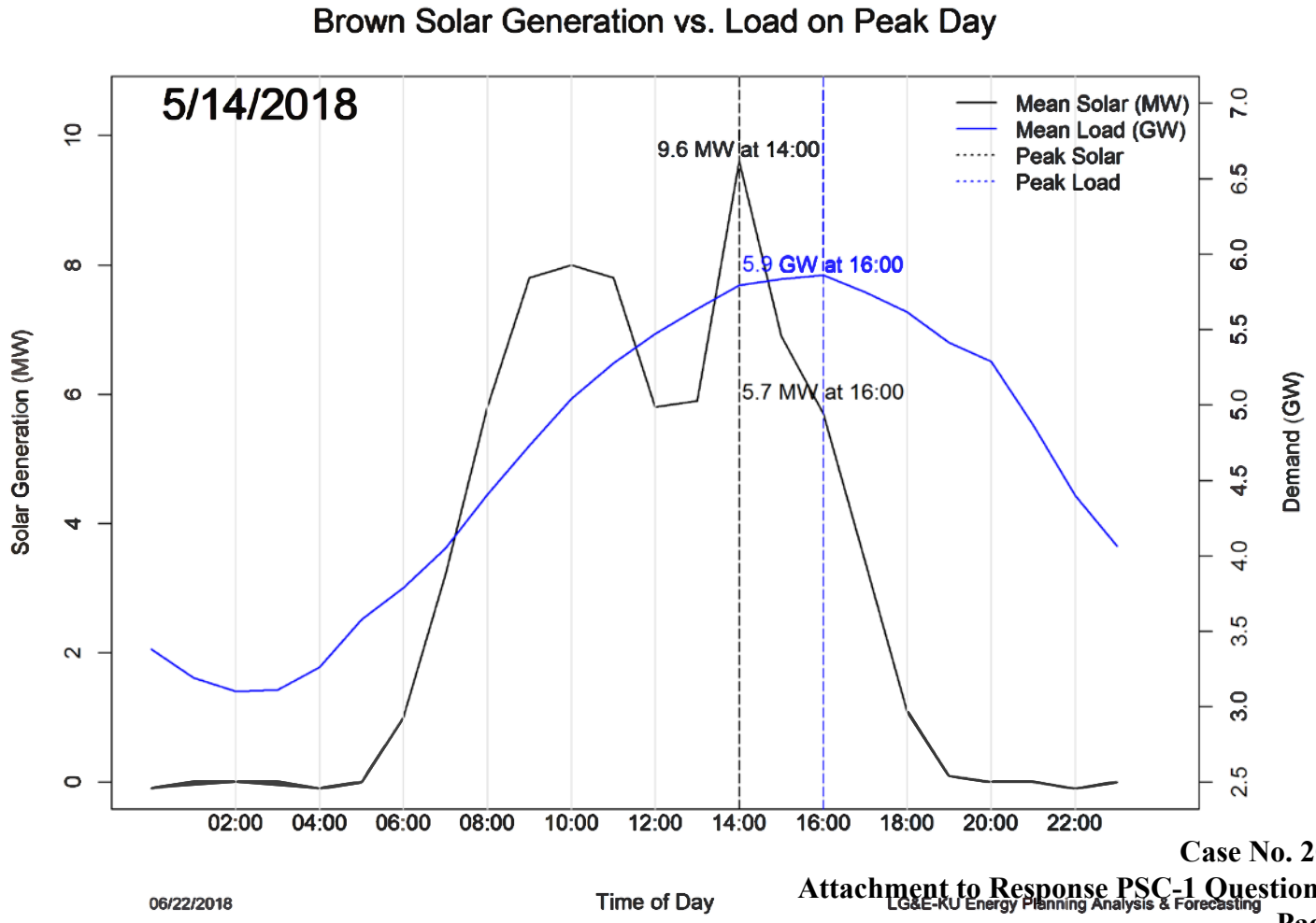
Solar generation was 1.9% more than plan

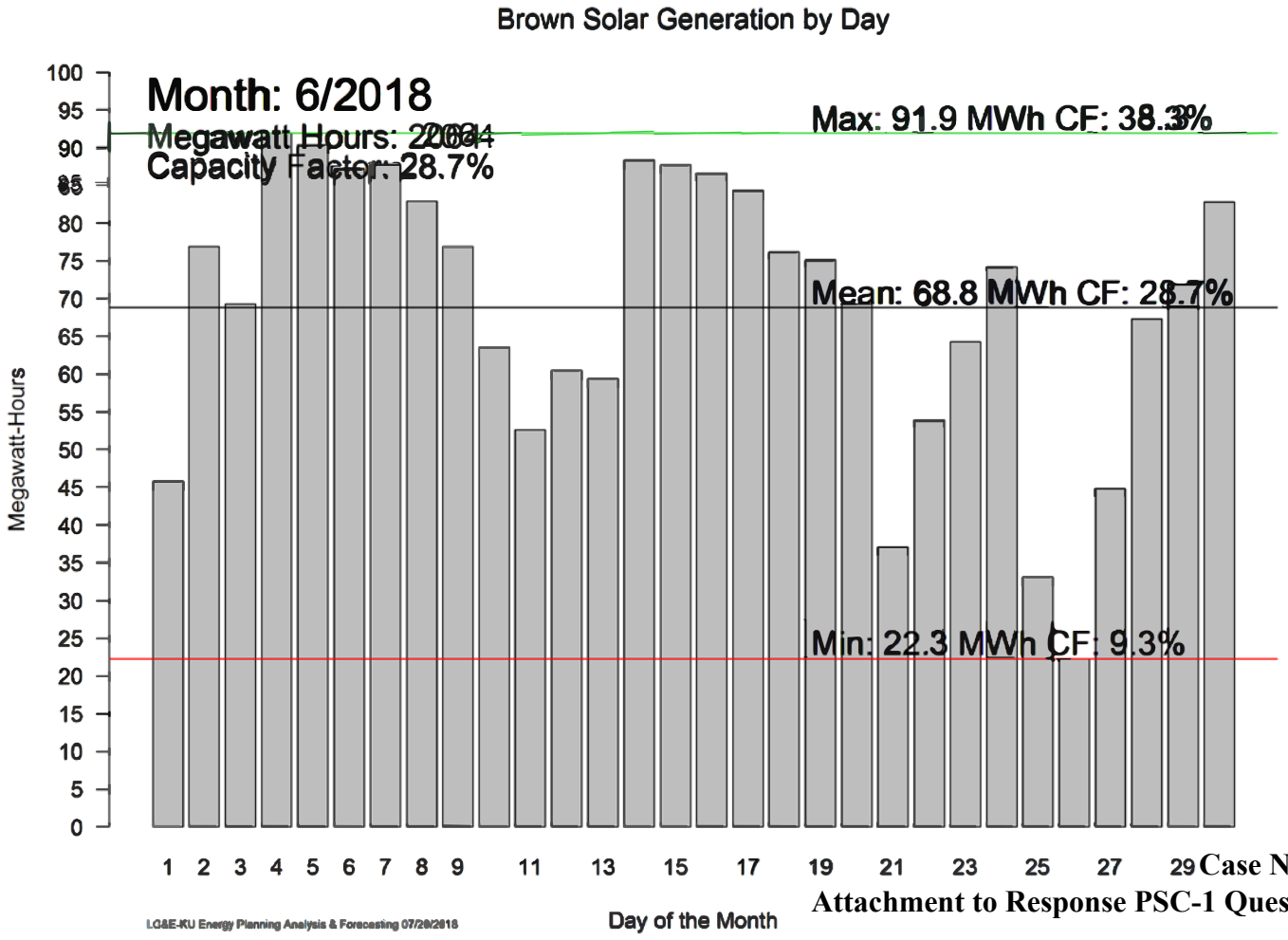


Solar output was at 59% in May hourly peak of 5.9 GW on 5/14 at 16:00



June 2018

Brown Solar achieved a 28.7% capacity factor



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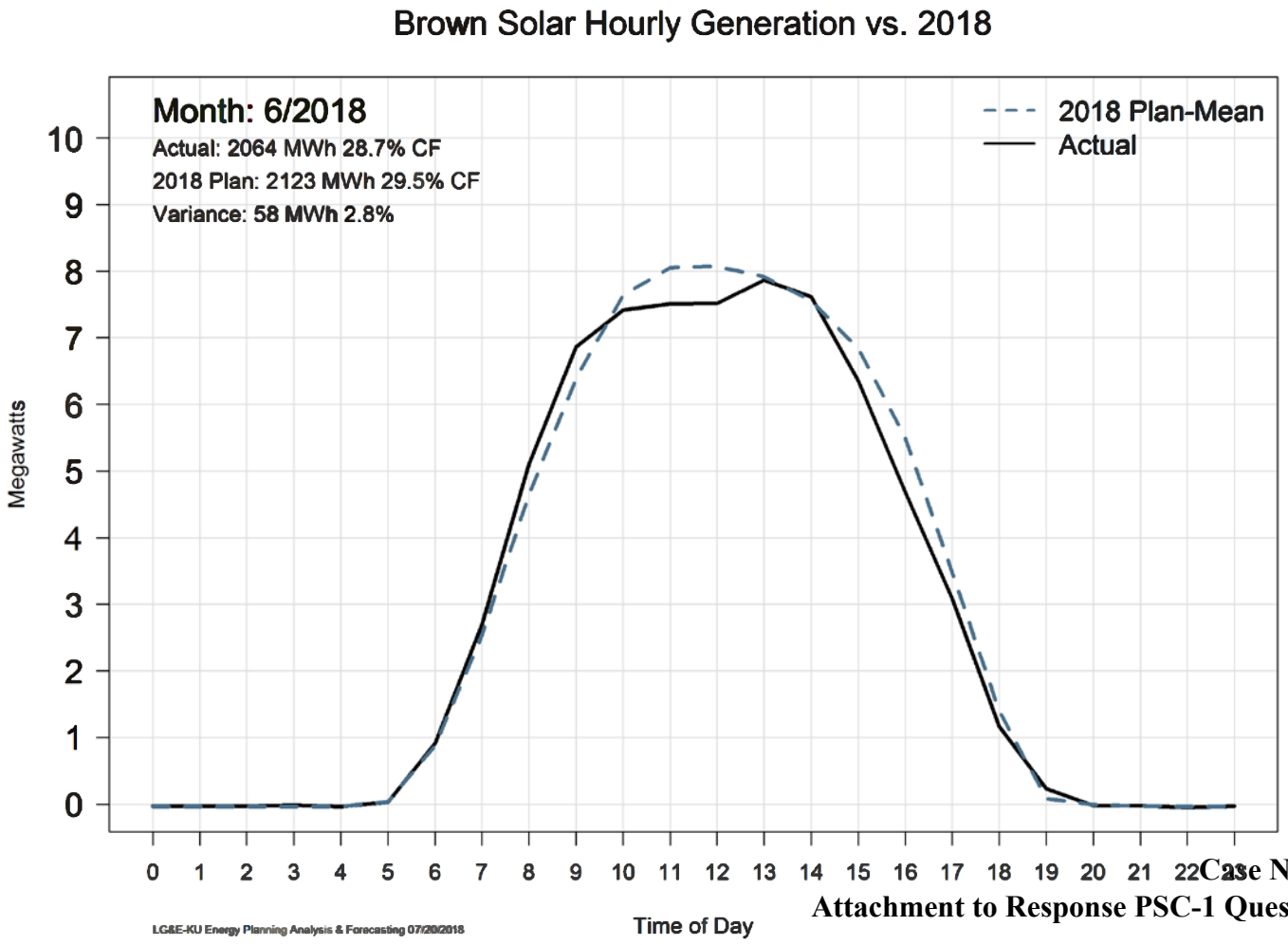
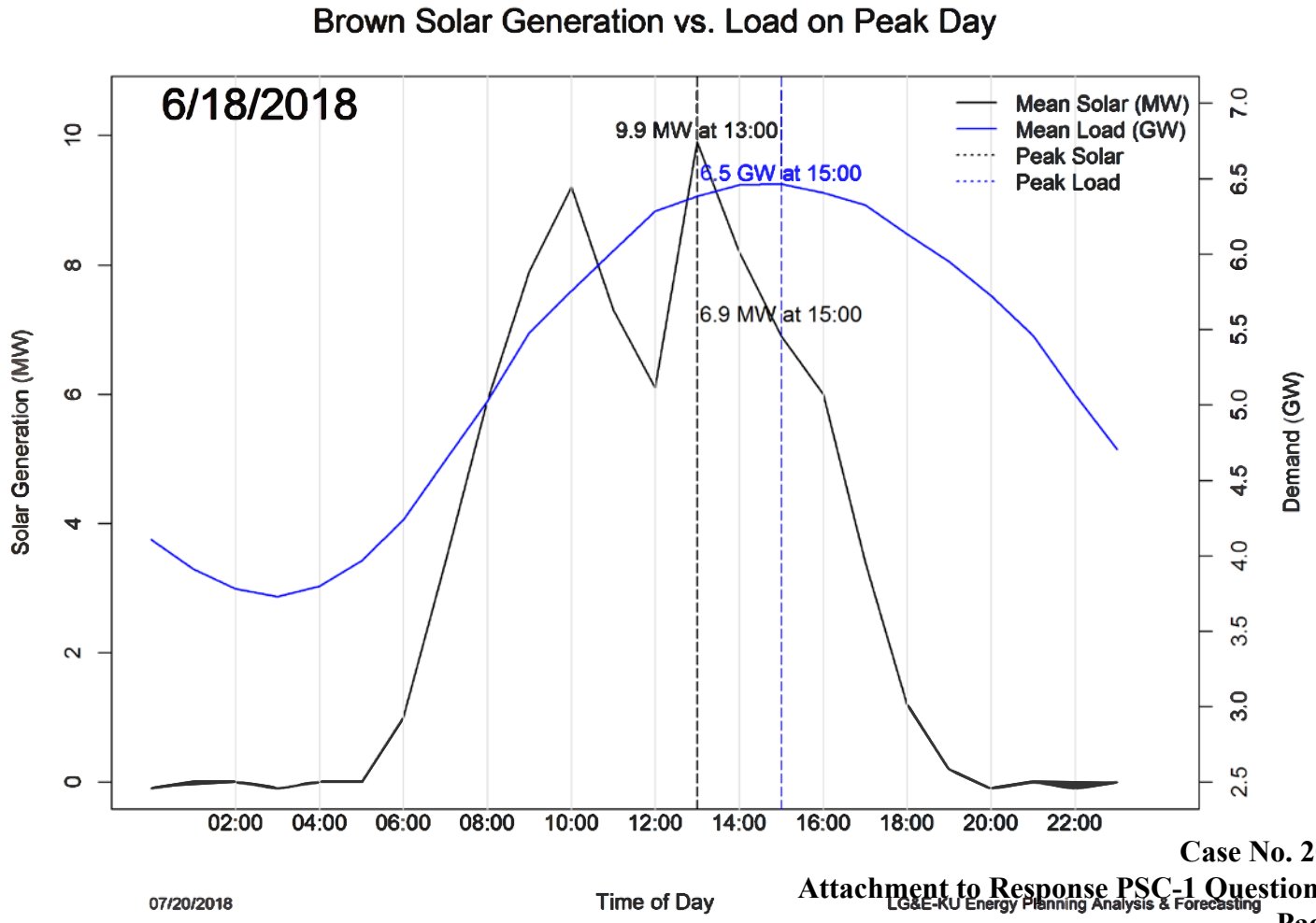
Solar generation was 2.8% less than plan

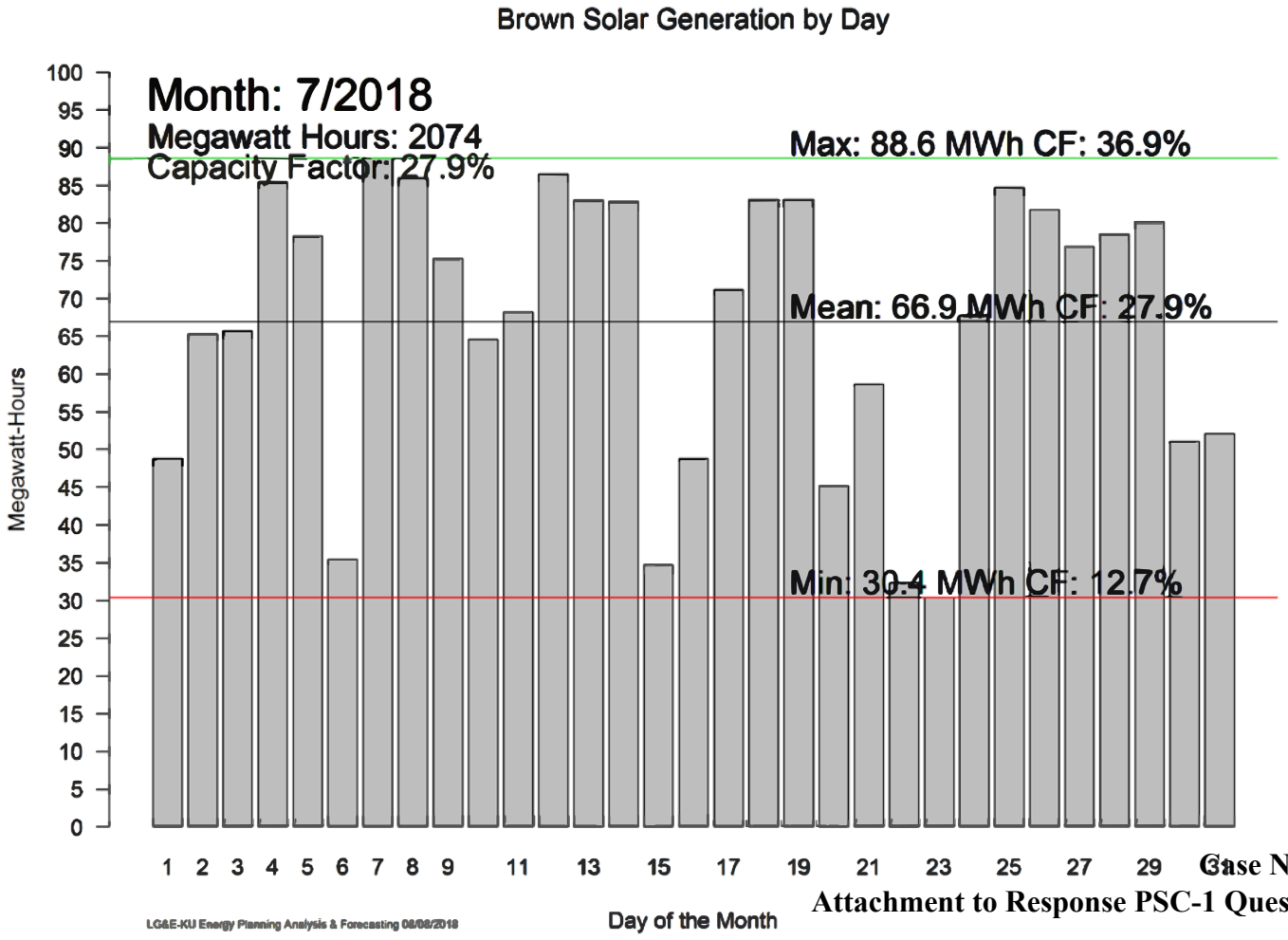


Solar output was at 69% in June hourly peak of 6.5 GW on 6/18 at 15:00



July 2018

Brown Solar achieved a 28% capacity factor



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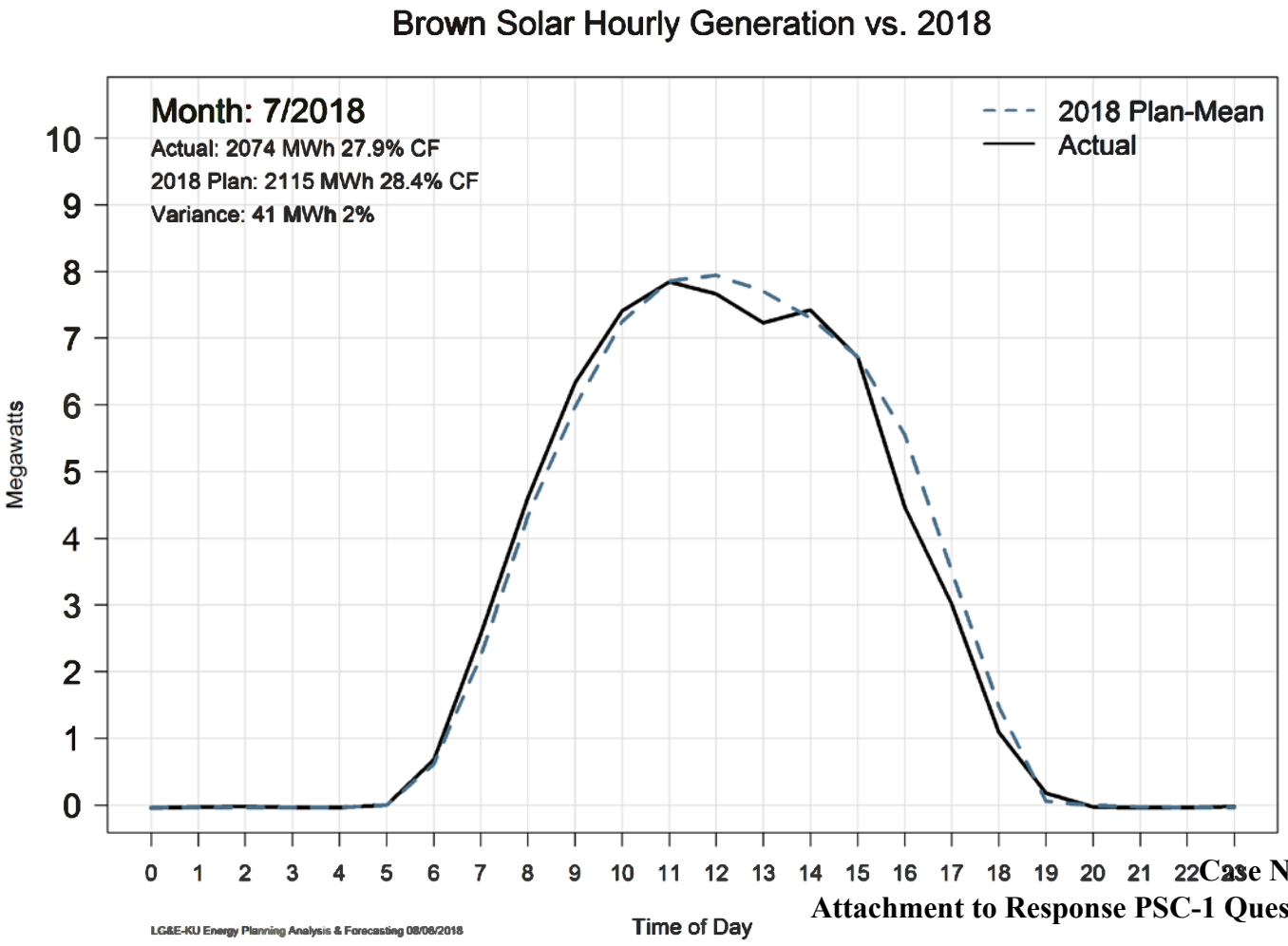
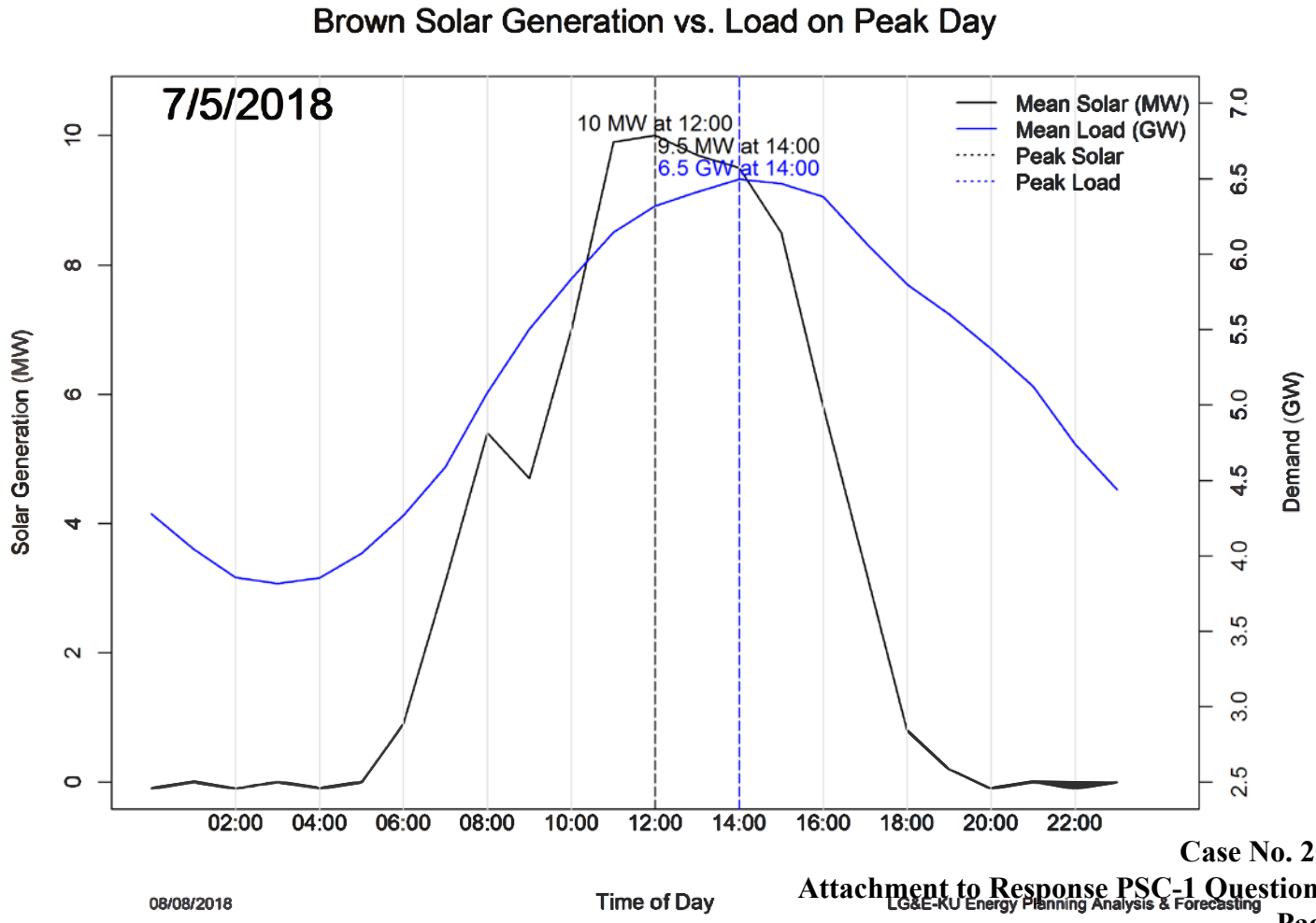
Solar generation was 2% less than plan

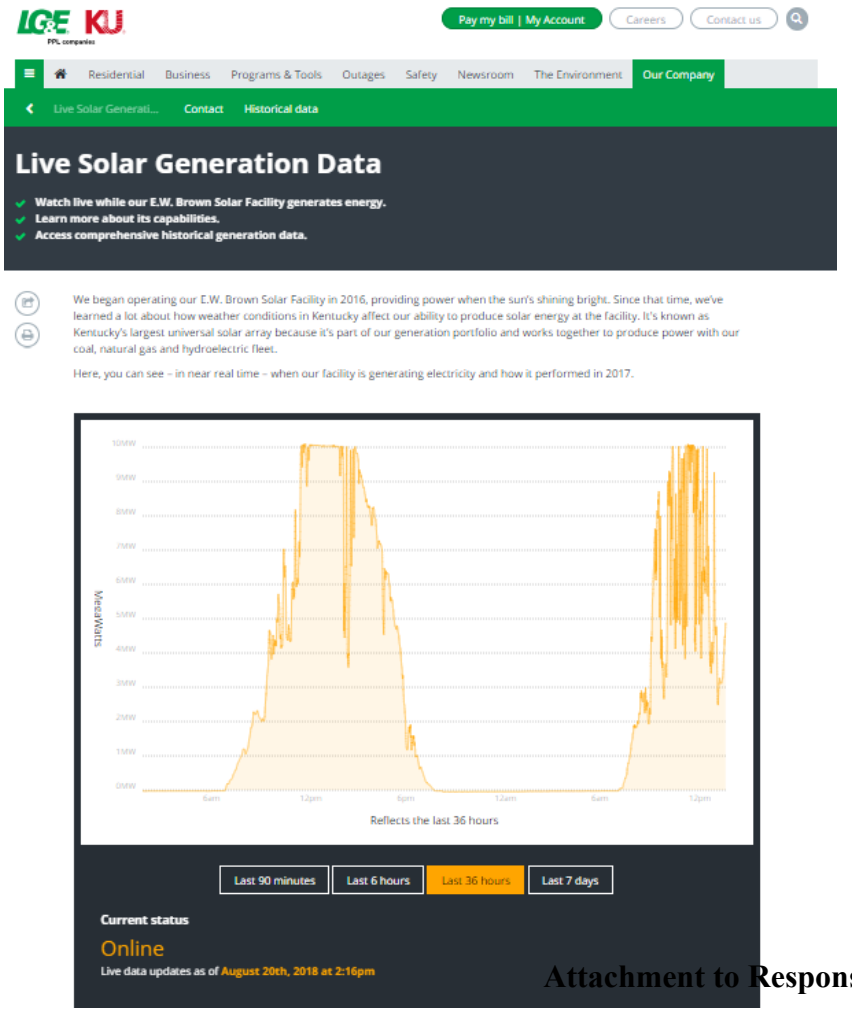


Solar output was at 65% in July hourly peak of 6.5 GW on 7/5 at 14:00



Live public solar dashboard soft launch

https://corpwebdev.lge-ku.com/live-solar-generation



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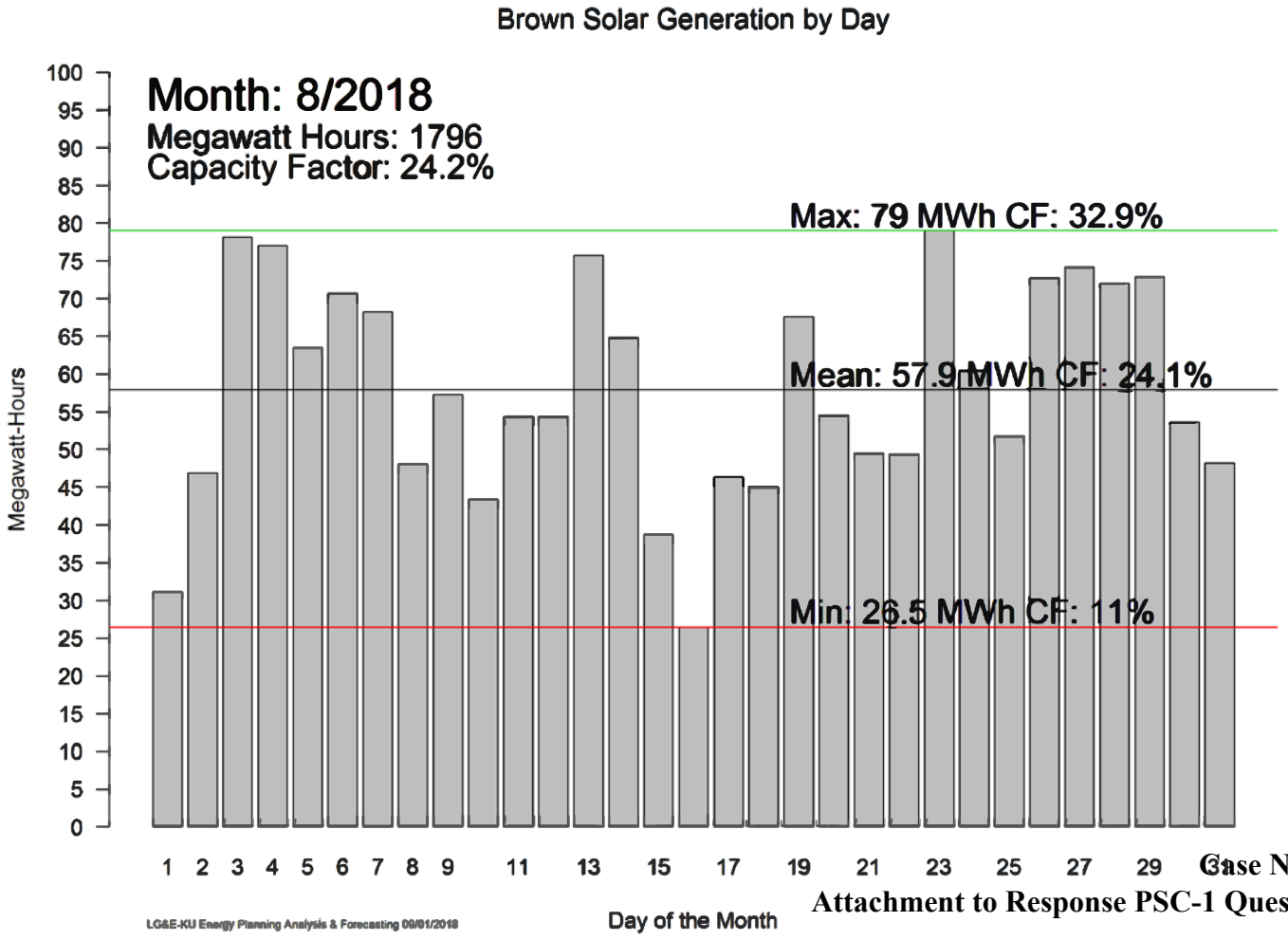
August 2018

Brown Solar achieved a 24% capacity factor



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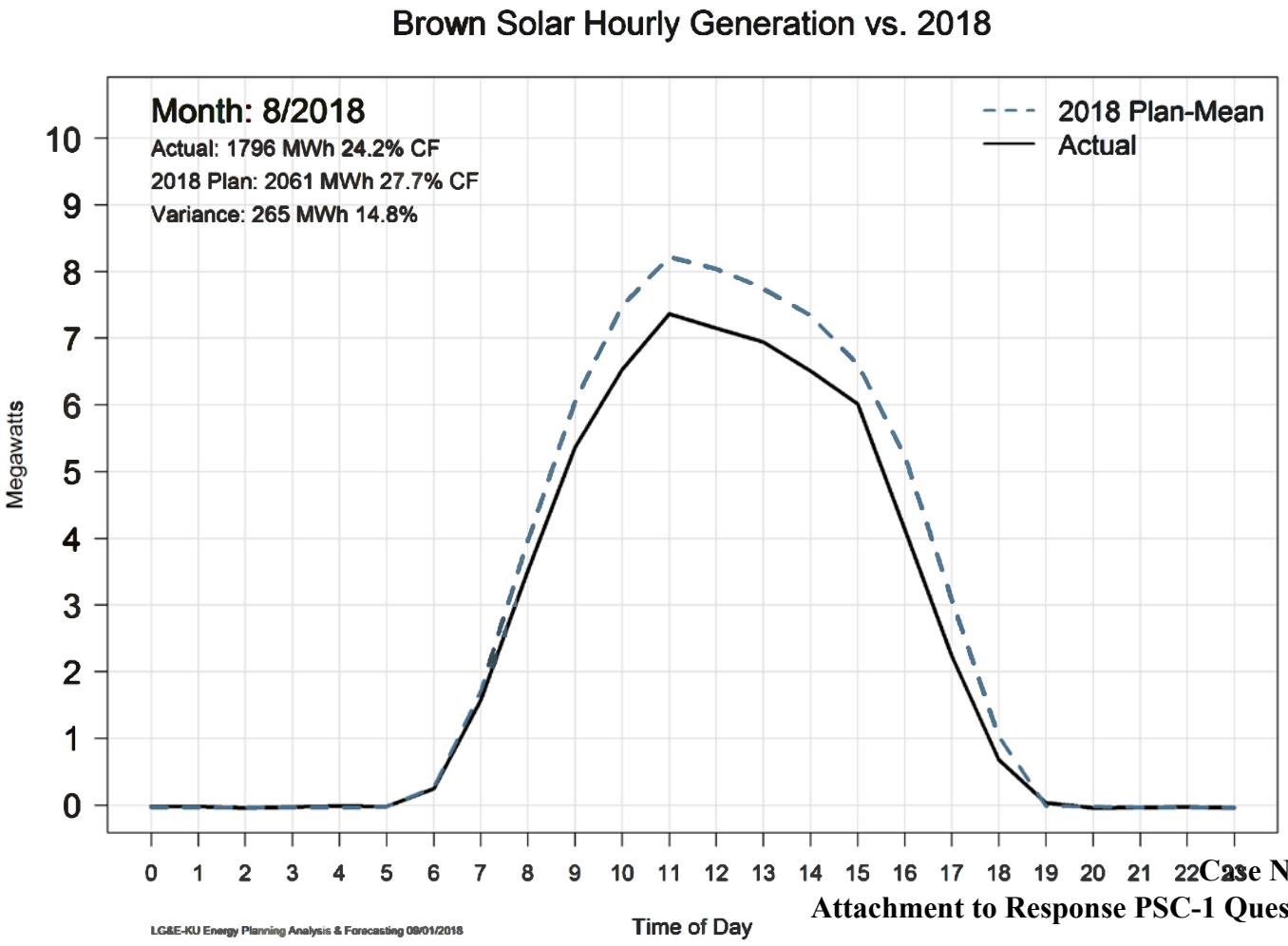
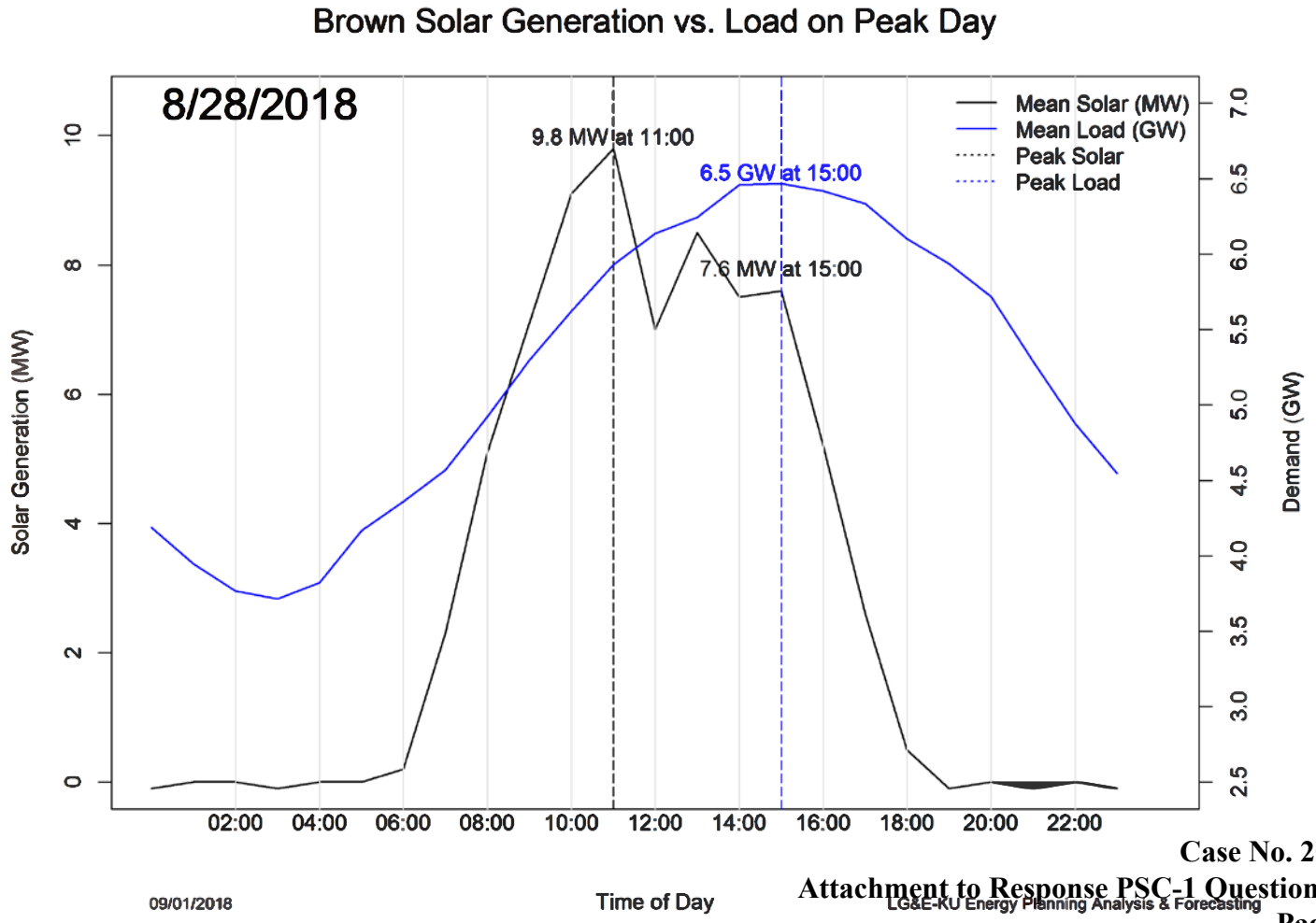
Solar generation was 15% less than plan

Irradiance was 11.2% lower than 1998-2017 normals
Brief outage on 8/14 and derate on 8/31

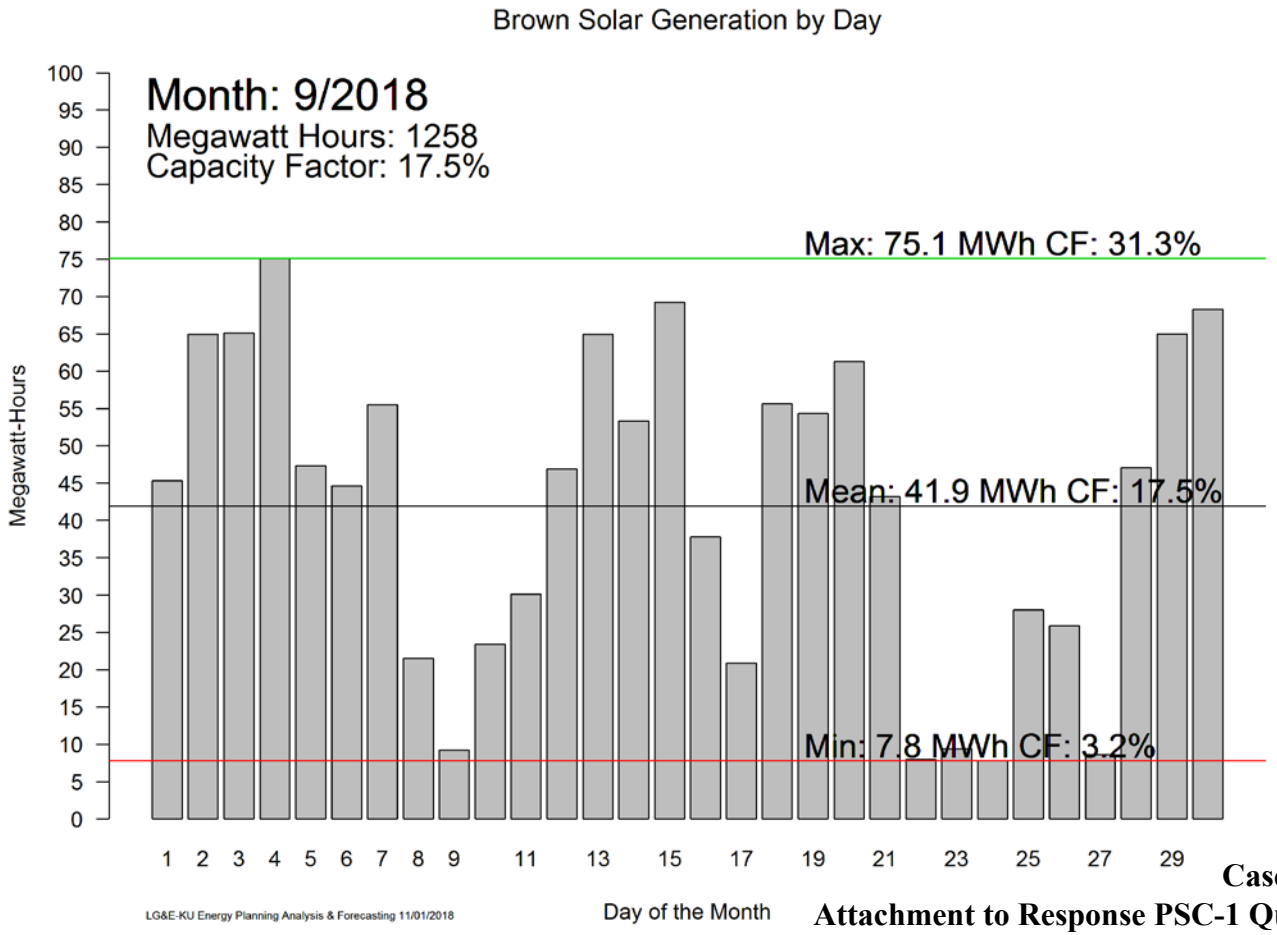


Solar output was 76% in August hourly peak of 6.5 GW on 8/28 at 15:00

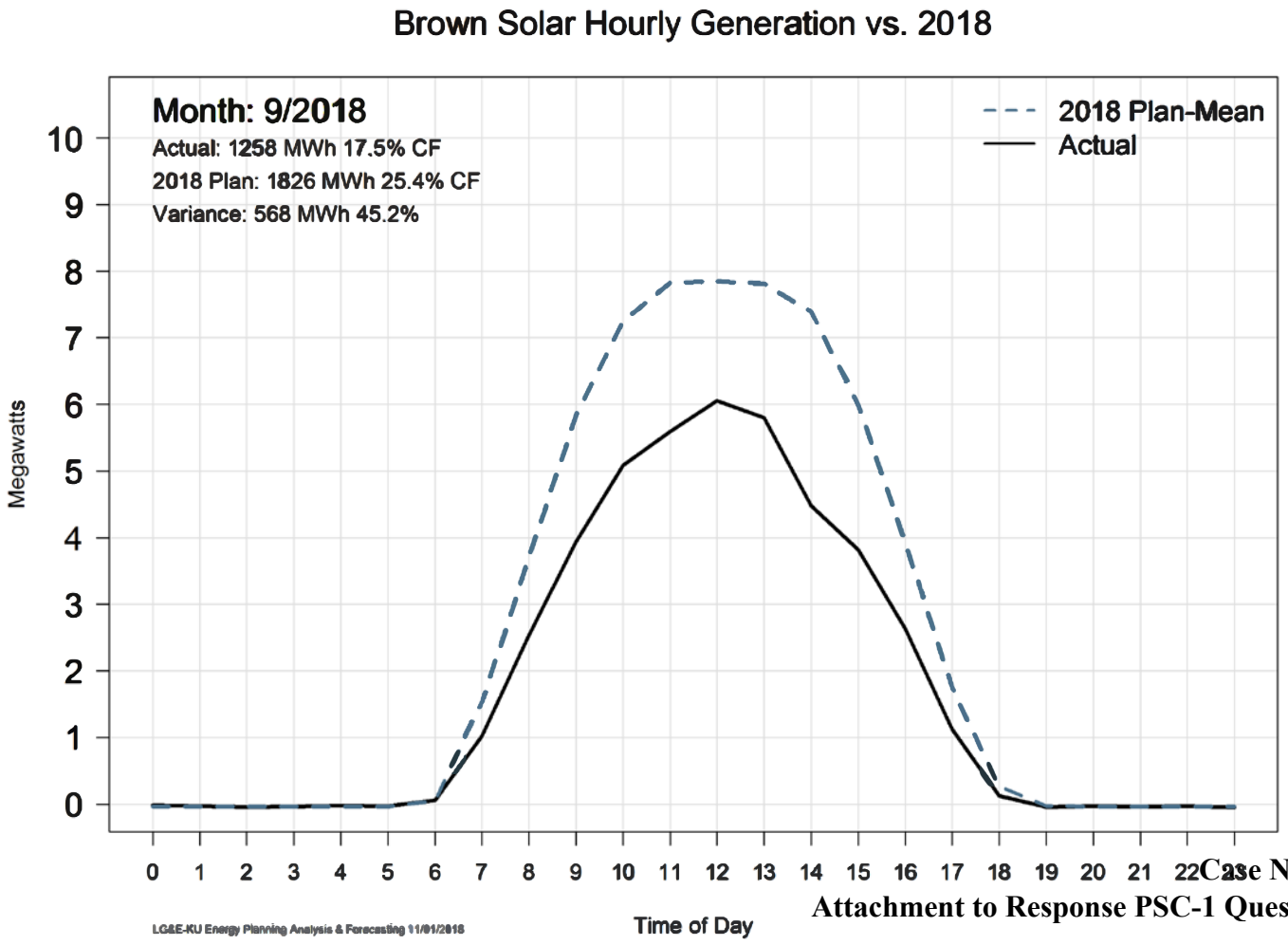


September 2018

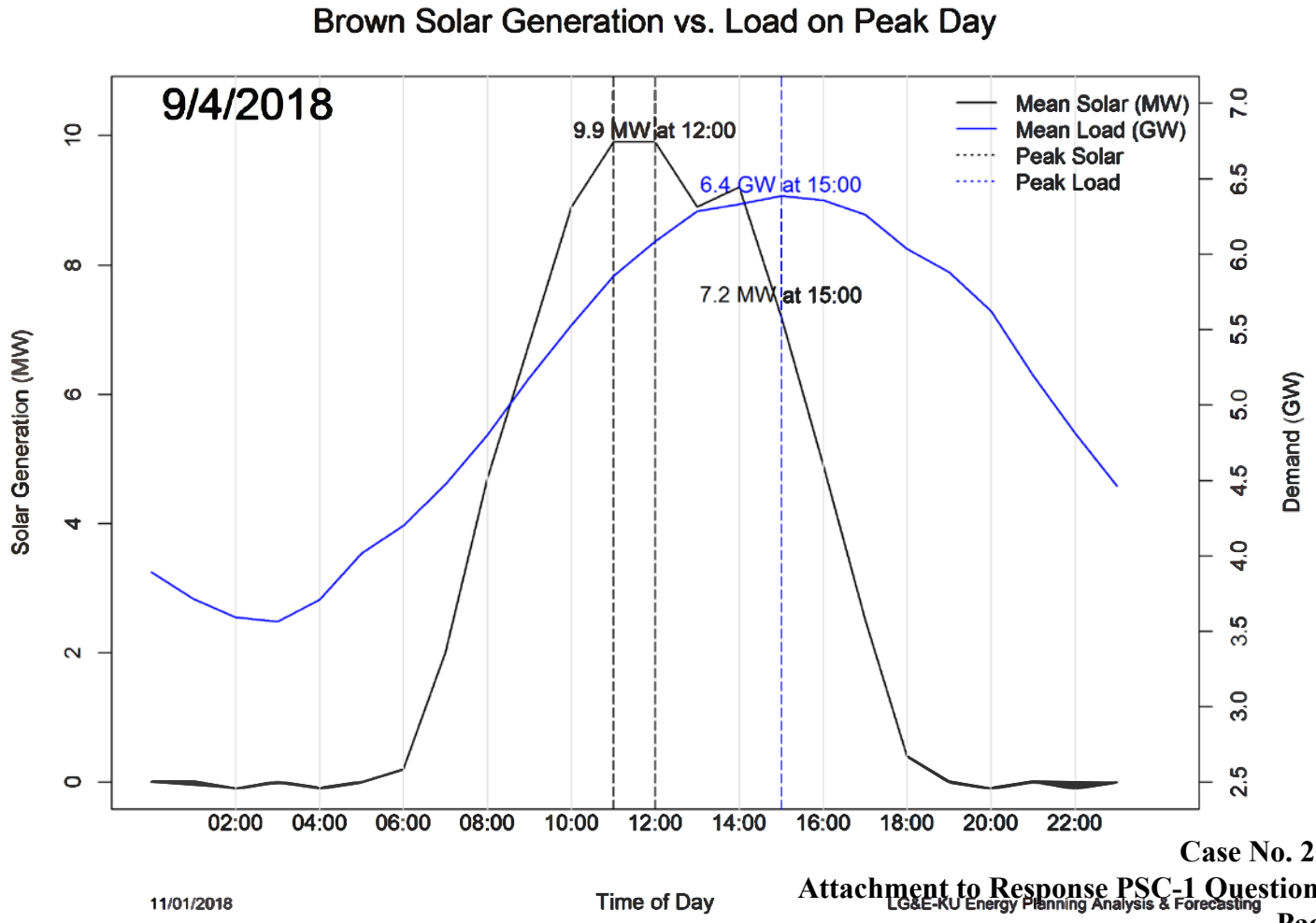
Brown Solar achieved an 18% capacity factor in September



Solar generation was 45% less than plan

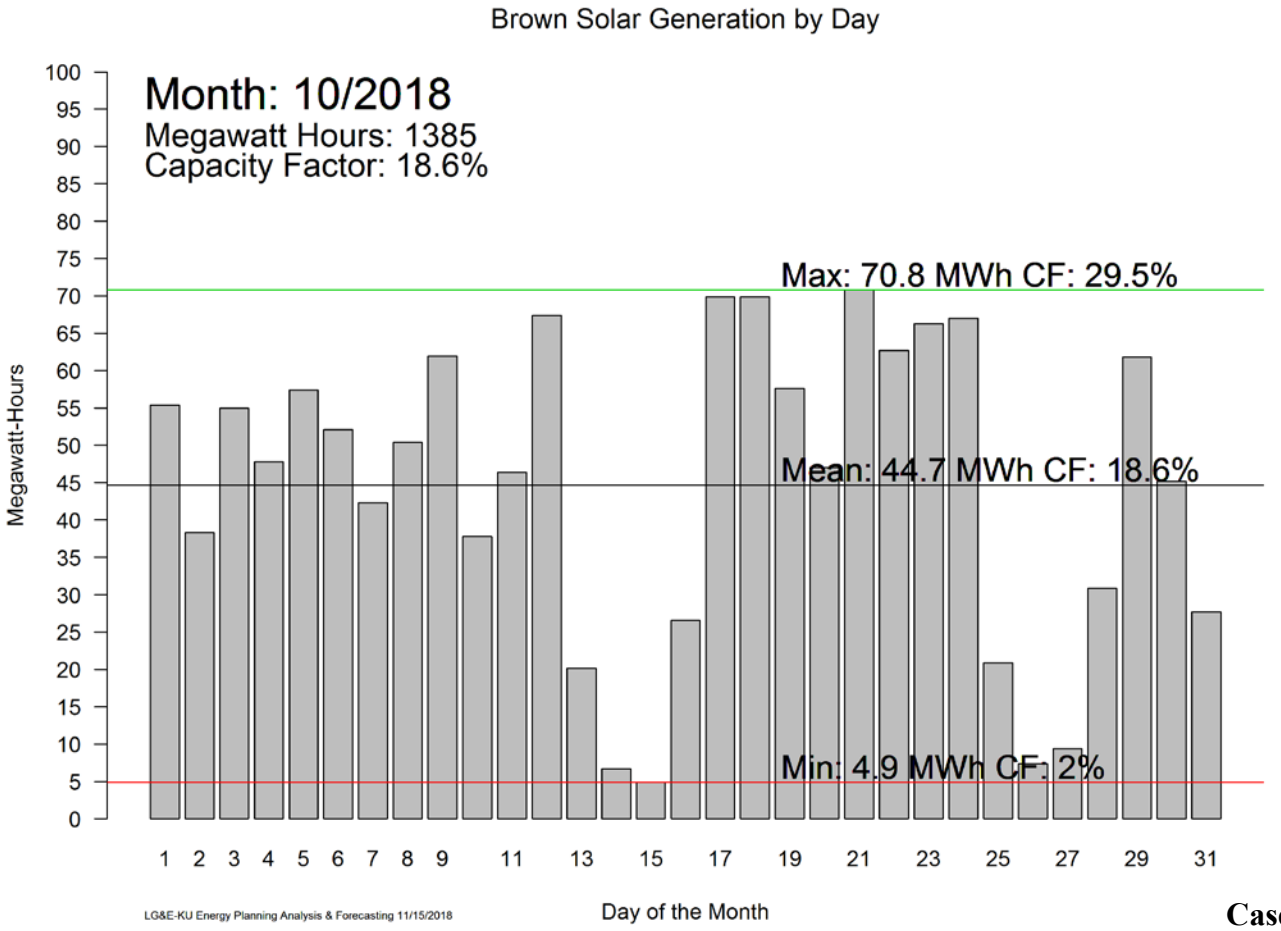


Solar output was 72% in September hourly peak of 6.4 GW on 9/4 at 15:00

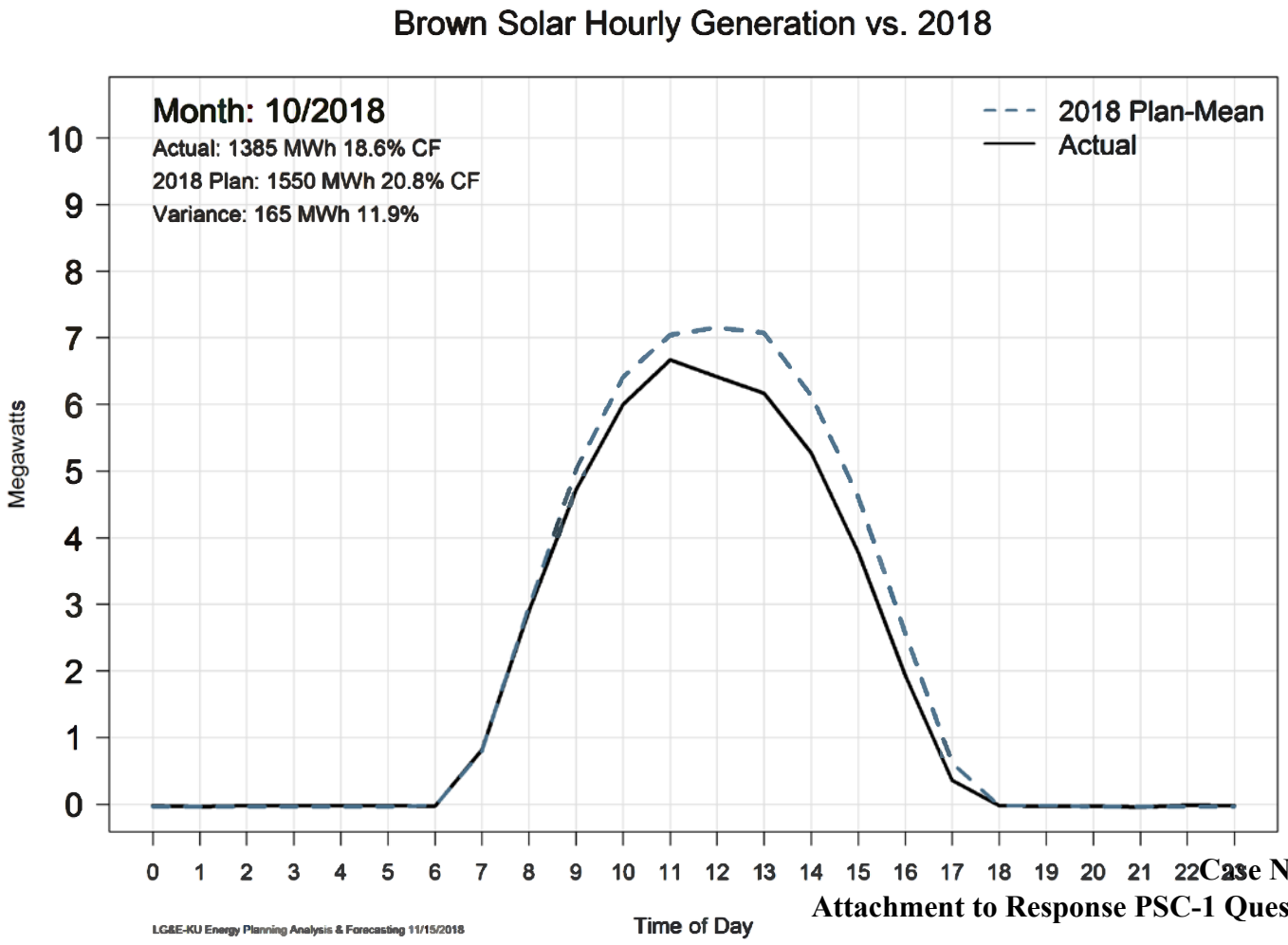


October 2018

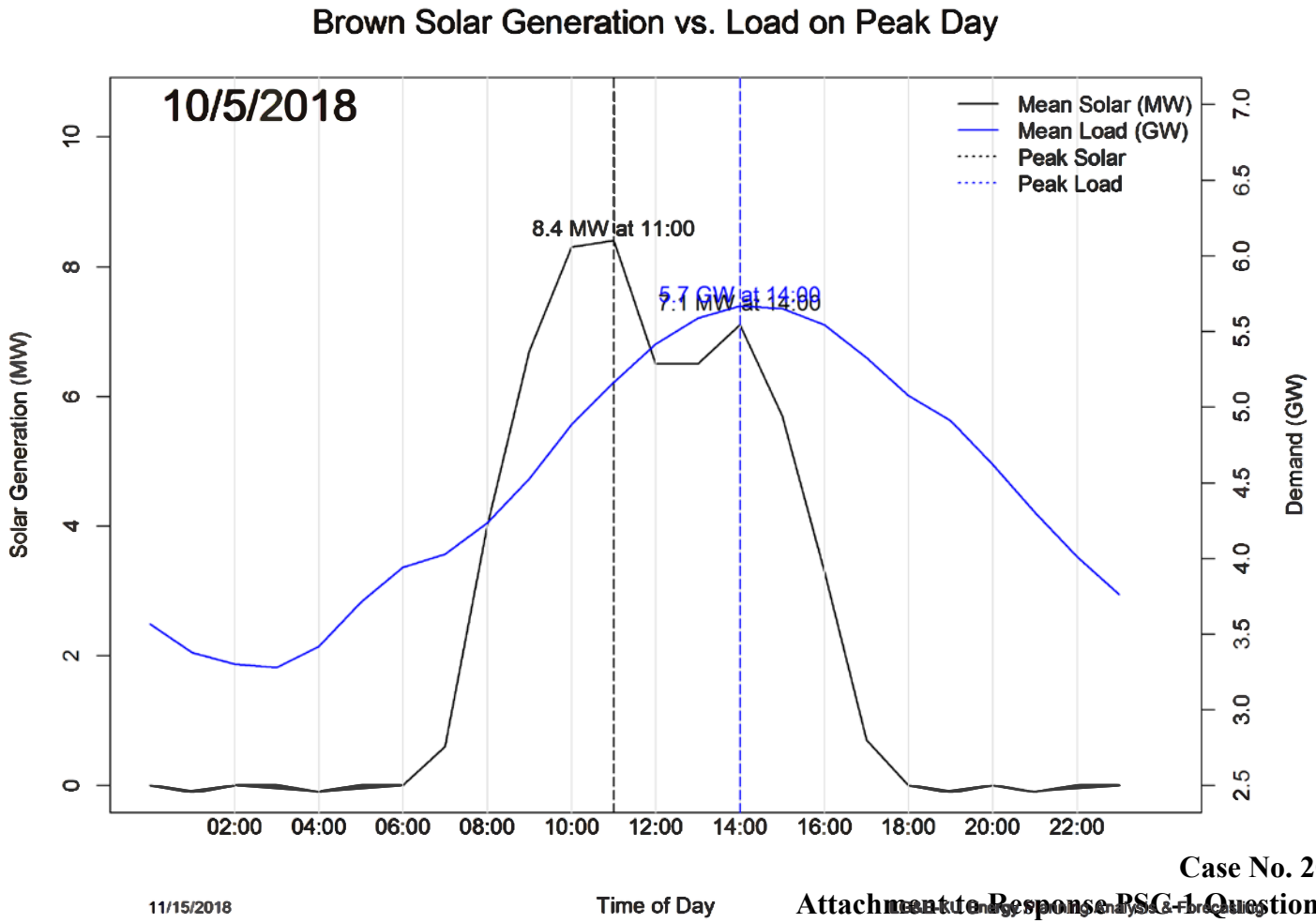
Brown Solar achieved a 19% capacity factor in October



Solar generation was 12% less than plan



Solar output was 71% in October hourly peak of 5.7 GW on 10/5 at 14:00



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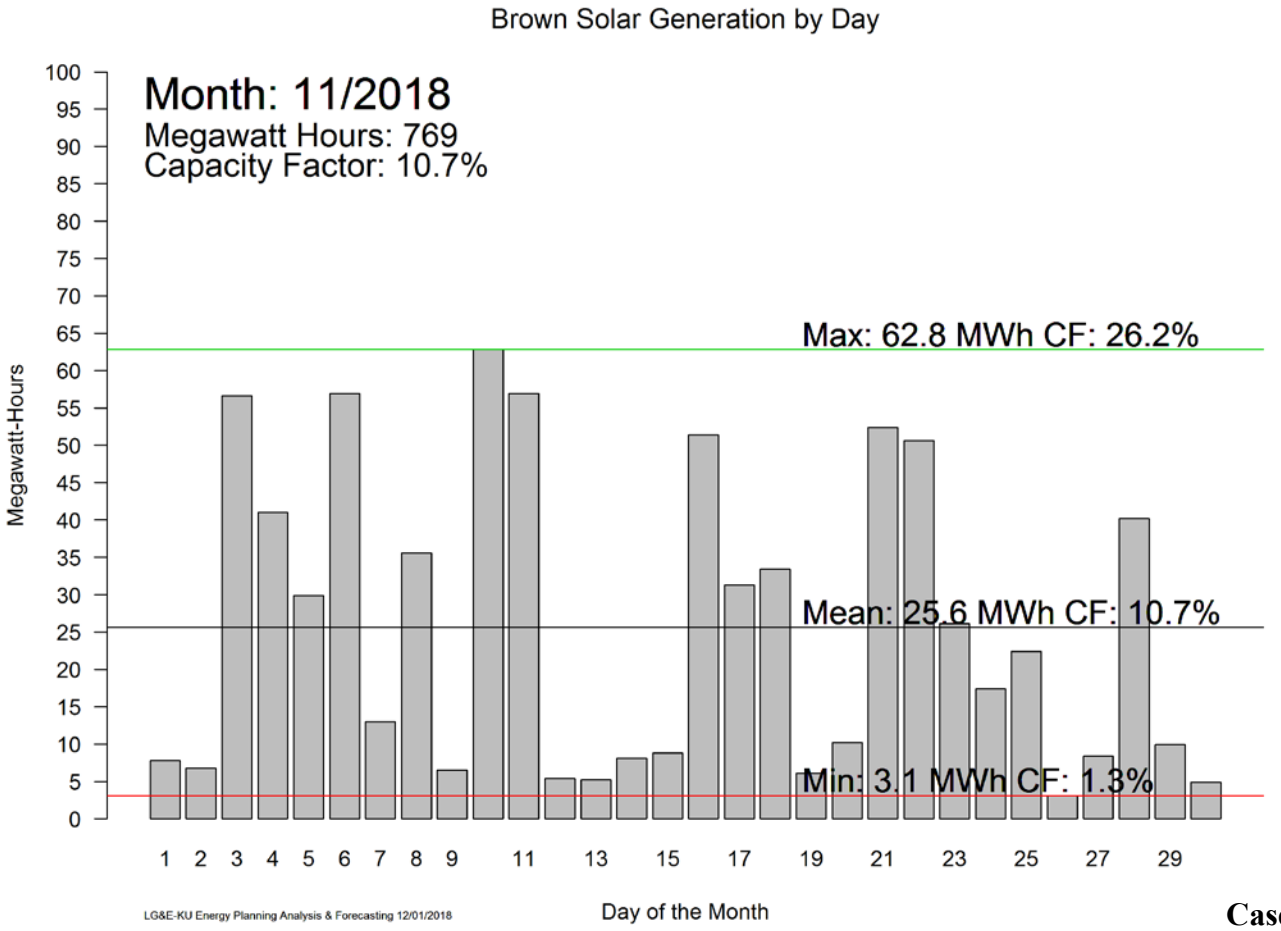
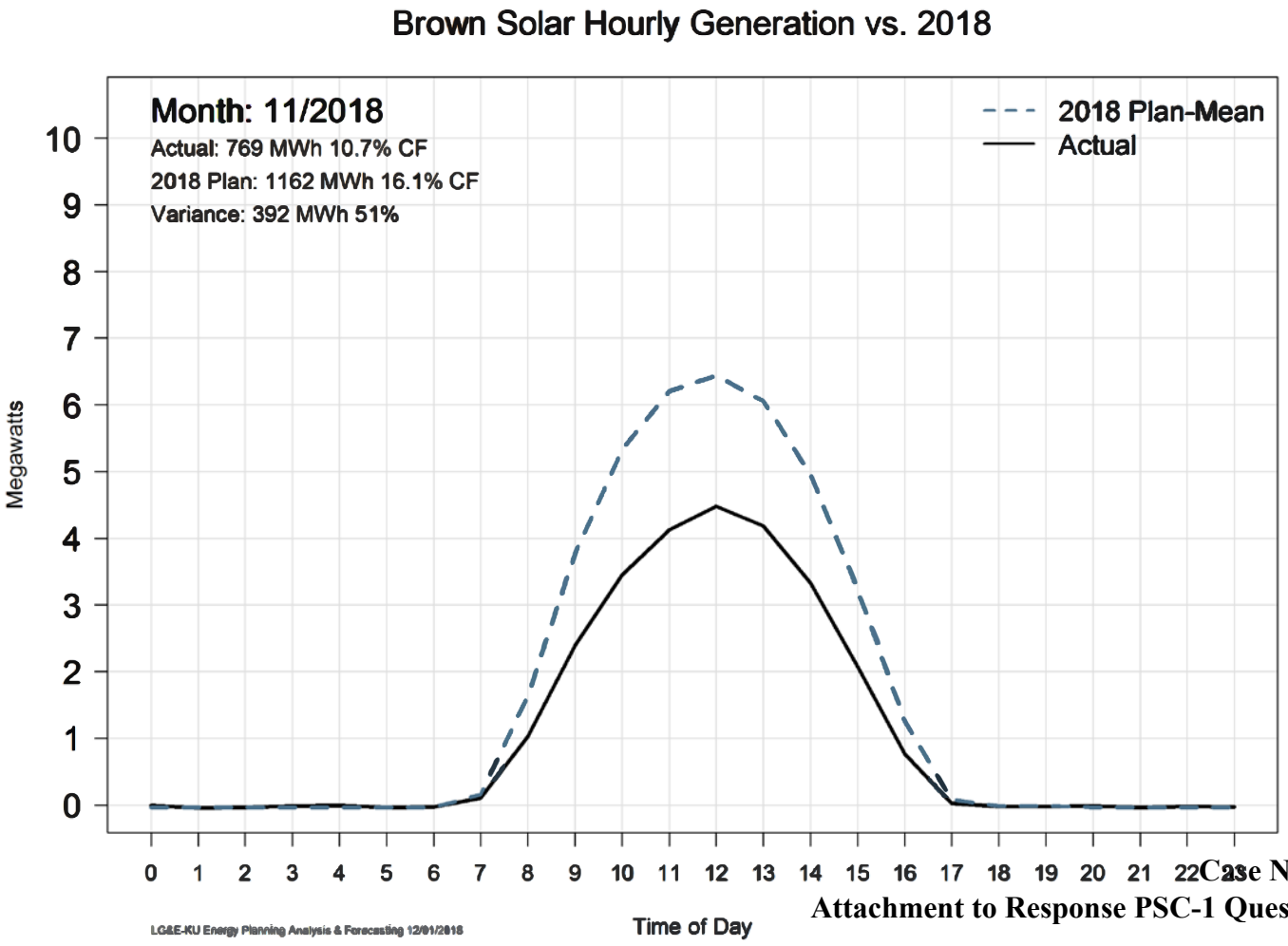
November 2018

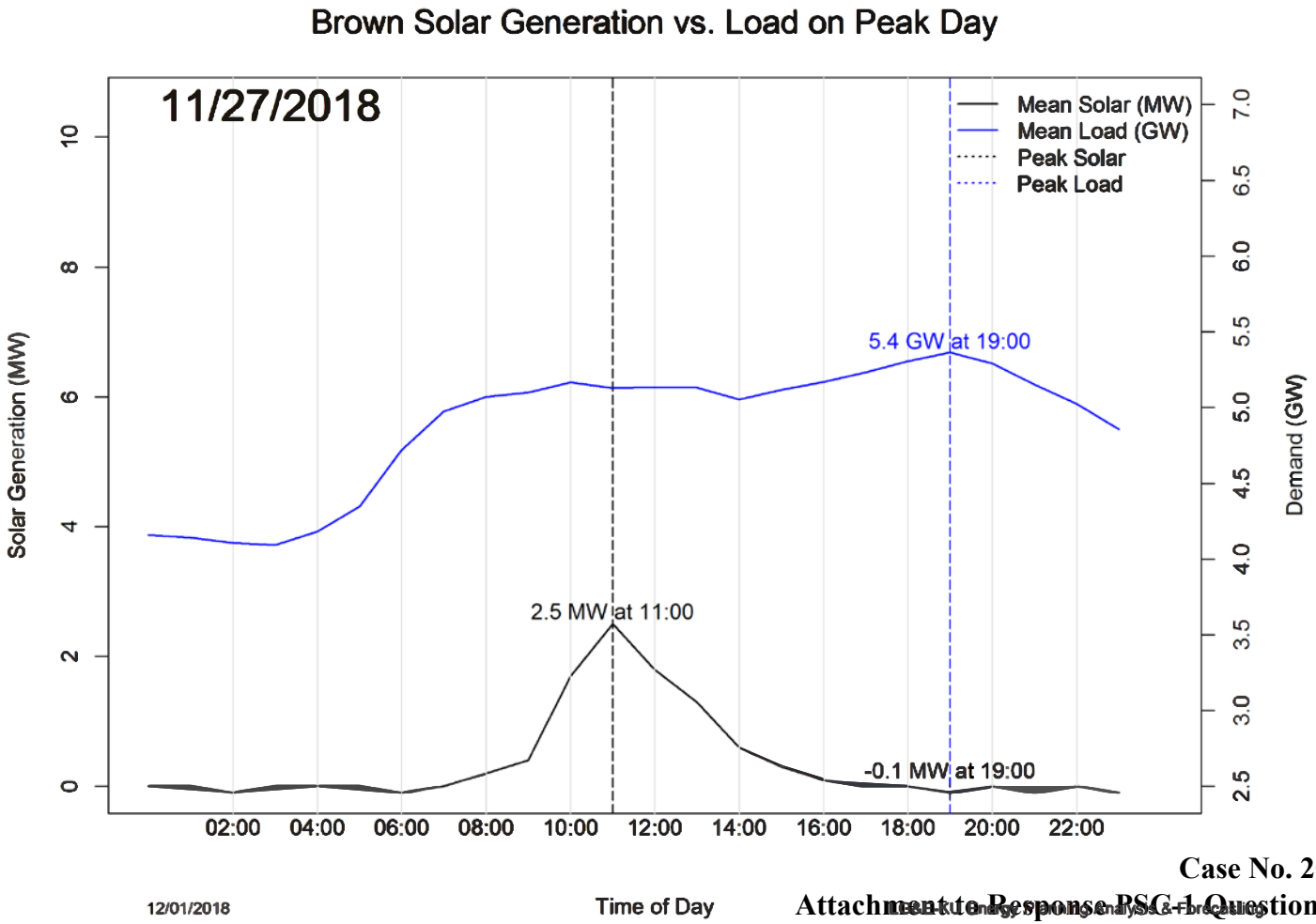
Brown Solar achieved an 11% capacity factor in November



Solar generation was 51% less than plan

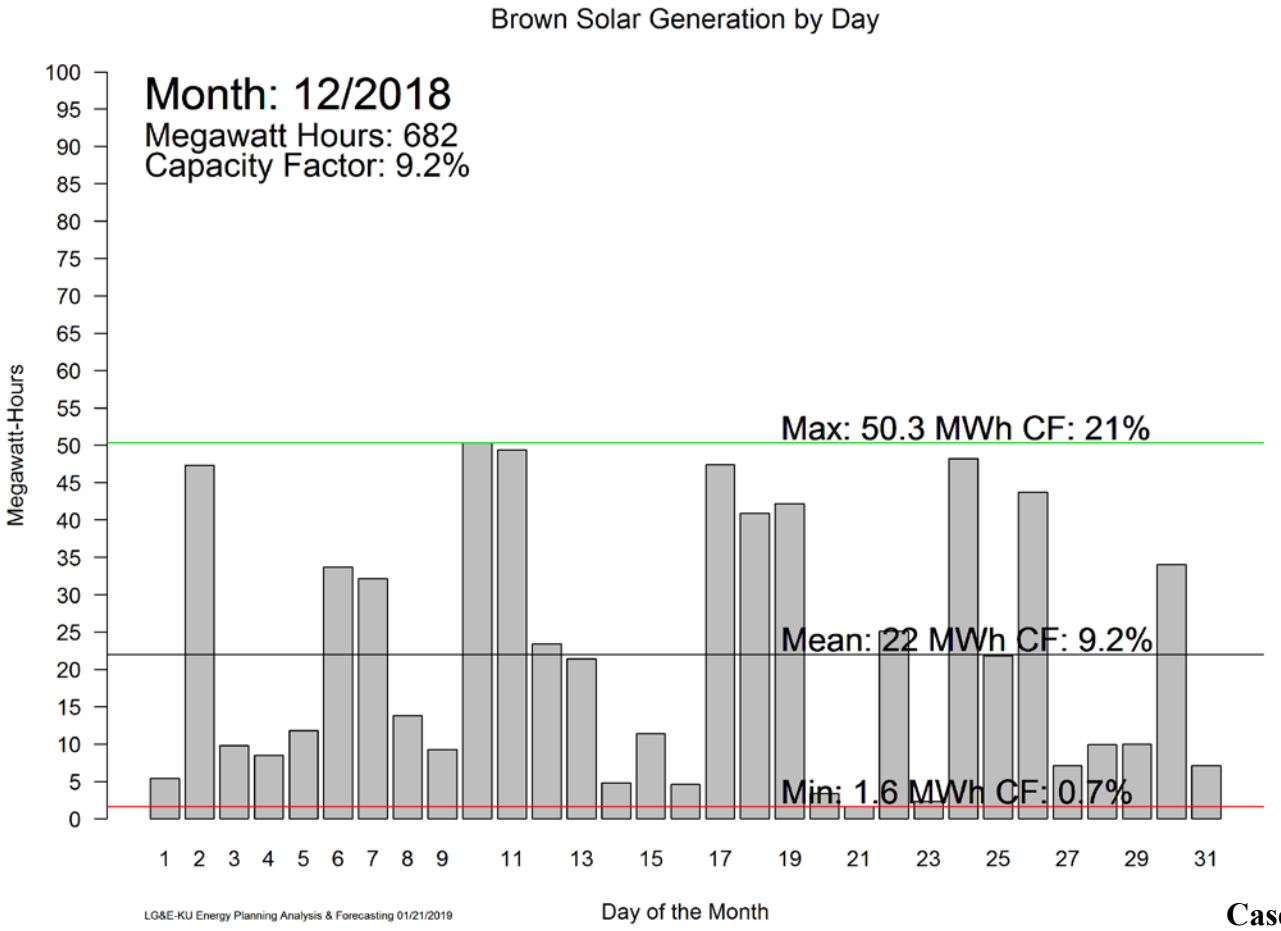


Solar output was 0% in November hourly peak of 5.4 GW on 11/27 at 19:00



December 2018

Brown Solar achieved a 9% capacity factor in December



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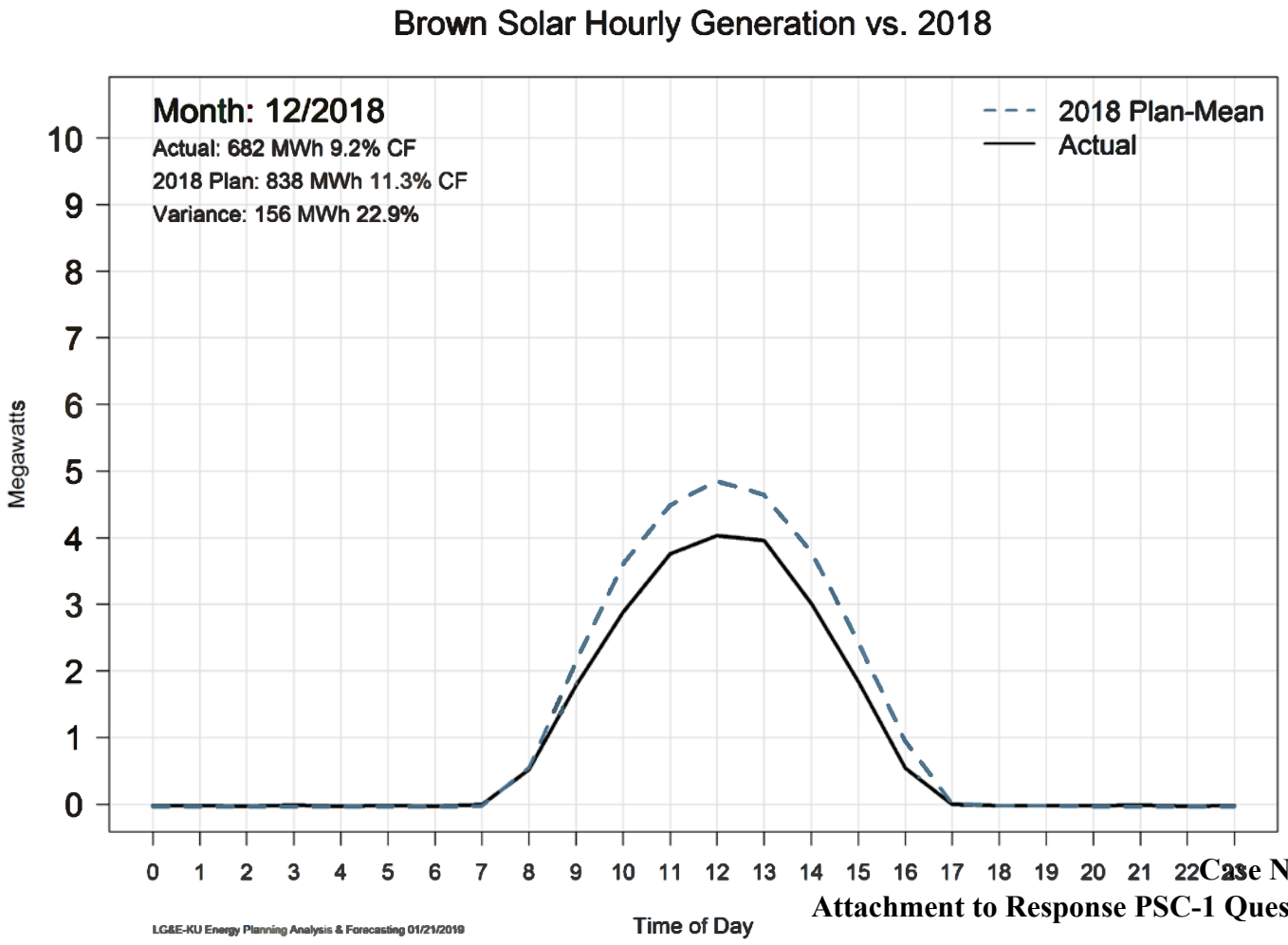
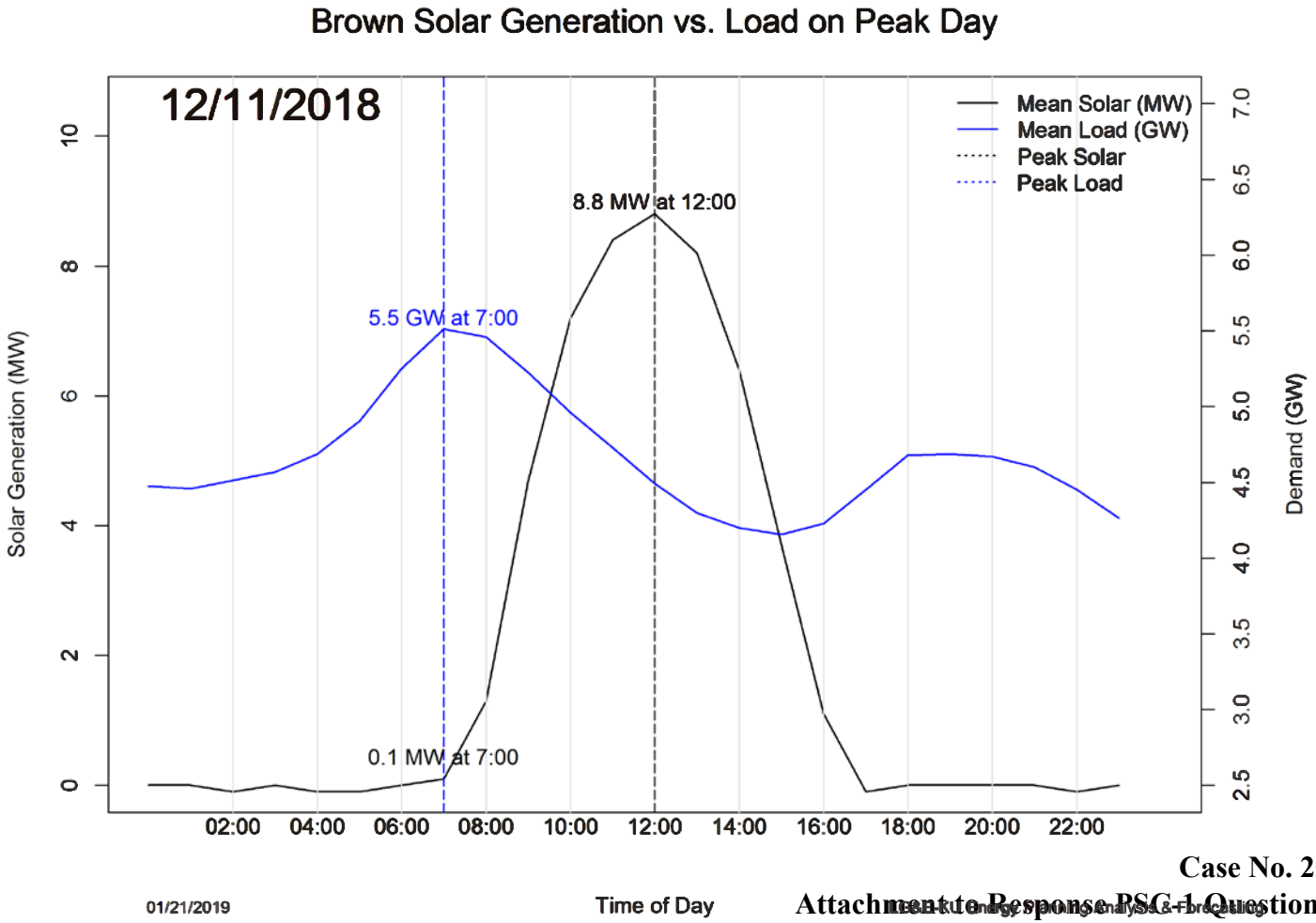
Solar generation was 23% less than plan



Solar output was 0% in December hourly peak of 5.5 GW on 12/11 at 7:00



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Question No. 35

Witness: Stuart A. Wilson

Q-35. Refer to the IRP, Volume 3, 2018 IRP Resource Screening Analysis (Resource Screening Analysis), page 4, Table 1. Refer also to the Resource Screening Analysis, page 5, Figure 1. Provide an updated Table 1 and Figure 1 using cost data from the National Renewable Energy Laboratory's 2019 Annual Technology Baseline.

A-35. Table 1 and Figure 1 below have been updated using cost data from NREL's 2019 ATB.

Table 1: Resource Screening Analysis Results

	Demand-Side Resources	**Generation Resources (2018 Dollars)**				
		Peaking		**Baseload/ Intermediate**	**Renewables**	
	Demand Conservation Program[9]	**SCCT**	**Battery Storage**	**NGCC**	**Non-KY Wind**	**PV Solar**
Summer Capacity (MW)[10]	127	201	1-500	368	50-500	1-500
Winter Capacity (MW)[10]	0	220	1-500	429	50-500	1-500
Contribution to Summer Peak	100%	100%	100%	100%	15%	80%
Contribution to Winter Peak	0%	100%	100%	100%	33%	0%
Net Capacity Factor	N/A	5-90%	5-40%	10-90%	40-50%	18-22%
Heat Rate (MMBtu/MWh)[11]	N/A	9.8	N/A	6.4	N/A	N/A
Capital Cost ($/kW)[11]	N/A	916	1,514	918	1,579	1,122
Fixed O&M ($/kW-yr)[11]	18	12	38	11	44	14
Firm Gas Cost ($/kW-yr)[12]	N/A	22	N/A	19	N/A	N/A
Variable O&M[11]	$5/customer	$7.28/MWh	N/A	$2.83/MWh	N/A	N/A
Fuel Cost ($/MWh)	N/A	27.83	N/A	18.36	N/A	N/A
Transmission Cost ($/MWh)	N/A	N/A	N/A	N/A	12	N/A

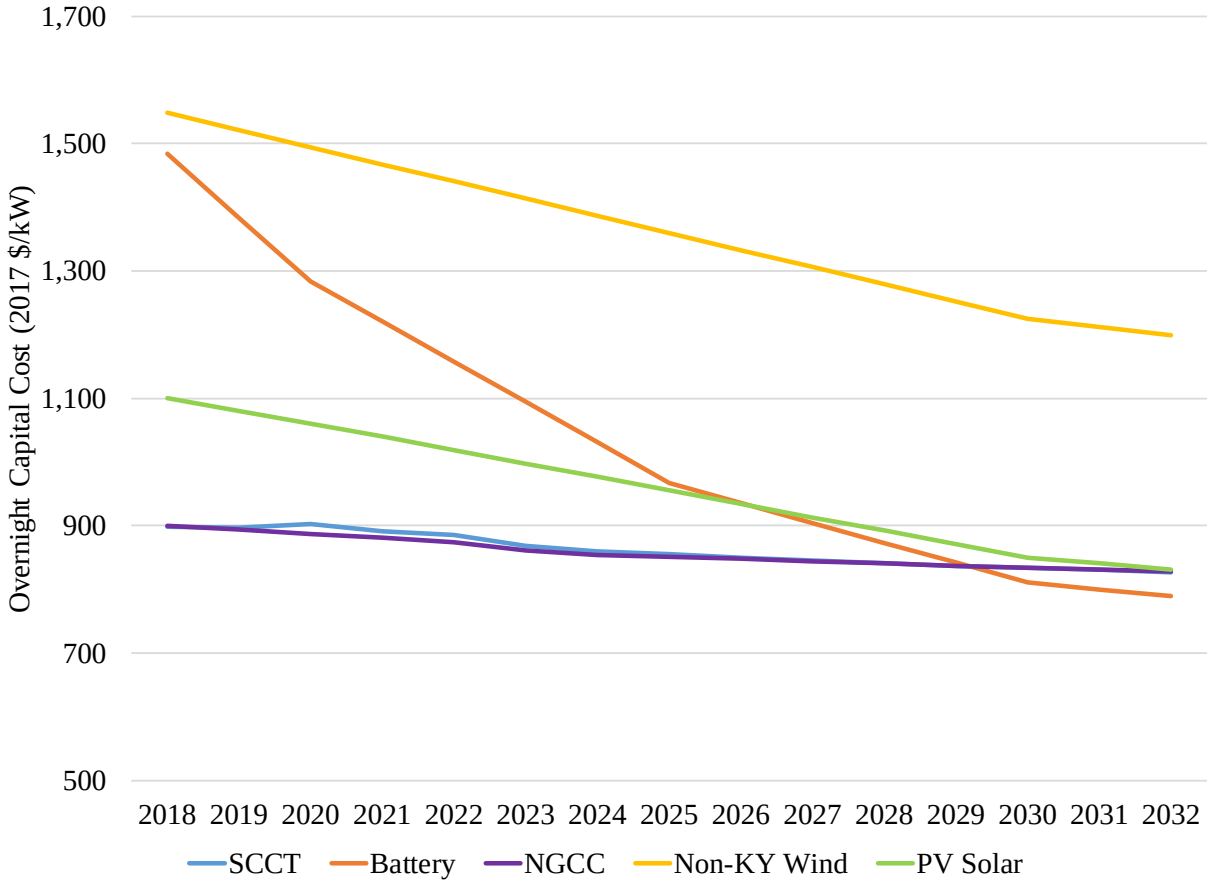
[9] Inputs for the DCP reflect program modifications approved in the Companies' most recent DSM filing. The summer capacity of this program is forecast to decrease from 127 MW in 2018 to 87 MW in 2021 due to customer attrition, but any actual decline is uncertain. Fixed O&M is the annual cost that could be saved if the DCP was discontinued.

[10] NREL's 2019 ATB did not specify capacity values. The capacities shown are representative of typical installations.

[11] Source: NREL's 2019 ATB (https://atb.nrel.gov/). The Companies inflated NREL's cost forecasts, which were provided in real 2017 dollars, to nominal dollars at 2% annually.

[12] Firm gas transportation costs are based on the cost of firm gas transportation for Cane Run 7 and the Trimble County SCCTs.

Figure 1: Generation Technology Cost Forecast (2017 Dollars)[13]



[13] Source: 2019 ATB from NREL (https://atb.nrel.gov/).

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Question No. 36

Witness: Stuart A. Wilson

Q-36. Refer to the IRP, Volume 3, Resource Screening Analysis, page 7, Table 2. The table includes SCCTs as peaking units. The 2018 IRP Reserve Margin Analysis at page 6 discusses both large frame and small frame SCCTs.

a. Explain whether or not large frame SCCTs are included in Table 2 of the Resource Screening Analysis and, if not, why not.

b. If not answered above, explain whether there is a significant cost difference (both fixed and variable) between large frame and small frame SCCTs and, if so, the nature of the cost differences.

A-36.

a. Yes, large-frame SCCTs are represented by the technology option "SCCT" in Table 2 of the 2018 IRP Resource Screening Analysis.

b. Yes. See Table 9 at page 17 of the 2018 IRP Reserve Margin Analysis. Peaking units Brown 5-11, Paddy's Run 13, and Trimble County 5 & 6 are all large-frame SCCTs. Compared to small-frame SCCTs, large-frame SCCTs generally have higher stay-open (i.e., fixed) costs but much lower average energy (i.e., variable) costs.

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Question No. 37

Witness: Stuart A. Wilson

Q-37. Refer to the IRP, Volume 3, 2018 IRP Reserve Margin Analysis, Subsection 2, page 6. Explain the characteristics of small- and large-frame SCCTs that permit large-frame SCCTs to be committed with little notice, whereas small-frame SCCTs require more notice.

A-37. The Companies' large-frame SCCTs start much more reliably than their older small-frame SCCTs.

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Question No. 38

Witness: Stuart A. Wilson

Q-38. Refer to the IRP, Volume 3, 2018 IRP Reserve Margin Analysis, Section 2, page 4.

a. Explain the drivers behind LG&E/KU experiencing increasing penetration of electric heating. Discuss whether LG&E/KU is experiencing higher growth rates in electric heat or whether the customers in the electric service territories are switching non-electric heating sources to electric or to something else.

b. Explain whether LG&E/KU have programs that actively encourage customers to switch to electric heat. If so, describe the programs.

c. Explain whether the increasing penetration of electric heating is also taking place within LG&E's natural gas operations service territory, both for customers within and outside the electric service territory.

A-38.

a. The increasing penetration of electric heating in the LG&E service territory is driven in part by improving heat pump efficiencies as well as significant customer growth in urban areas over the past decade. Many of these new premises are multi-family units and/or are being developed in areas on the outskirts of Jefferson County and Fayette Counties or in bordering counties that may not have the same level of access to natural gas as a heating fuel.

b. There are currently no programs designed to encourage customers to switch to electric heat.

c. Yes, the penetration of electric heating is also increasing within LG&E's natural gas operations service territory. The Companies do not have electricity consumption data for premises outside the electric service territory.

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Question No. 39

Witness: Stuart A. Wilson

Q-39. Refer to the IRP, Volume 3, 2018 IRP Reserve Margin Analysis, Section 3, page 9.

a. Provide a lay person's explanation for the equivalent load duration curve model from the link provided in footnote 8.

b. Provide a similar explanation for the Strategic Energy Risk Valuation Model.

A-39.

a. A loss of load event (and unserved energy) occurs when load is greater than available generation resources. In the equivalent load duration curve model ("ELDCM"), available generation resources are represented by installed capacity, which is a constant. On the other hand, load is represented by equivalent load duration curve, which is created by incorporating generation resources' forced outage rates into a load duration curve. Note that outages result in equivalent load. Because the load duration curve is based on hourly load, ELDCM estimates reliability metrics for every hour, not just the peak hour.

b. Again, a loss of load event (and unserved energy) occurs when load is greater than available generation resources. In the Strategic Energy Risk Valuation Model ("SERVM"), load is represented by hourly load, which is used to create the load duration curve in the ELDCM. On the other hand, installed capacity is used in conjunction with forced outage rates to simulate available generation resources. Given the differences between ELDCM and SERVM, the results are consistent but not identical.

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Question No. 40

Witness: Stuart A. Wilson

Q-40. Refer to the IRP, Volume 3, 2018 IRP Reserve Margin Analysis, Section 4.2, page 10. The long term reserve planning margin of MISO (17.1 percent) is at the low end of LG&E/KU's reserve margin range (17 percent - 25 percent) and that for PJM (15.8 percent), and TVA (15 percent) are well below LG&E/KU's range. Explain LG&E/KU's specific characteristics that necessitate the reserve margin being so much higher than neighboring territories.

A-40. The Companies have not performed the analyses required to comment on this comparison. If one were to perform this analysis, it would be important to make sure that the Companies' capacity conforms with RTO market rules to ensure comparability of reserve margins. For example, as discussed in the response to Question No. 37, it is unclear whether the Companies' small-frame SCCTs would qualify as capacity given their poor starting characteristics. Similarly, the Companies' DCP and CSR resources may need to be modified to conform to the RTO's market rules.

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Question No. 41

Witness: Stuart A. Wilson

Q-41. Refer to the IRP, Volume 3, the 2018 IRP Long-Term Resource Planning Analysis, page 24, Table 15. Provide the present value of the revenue requirement for each of the scenarios listed.

A-41. The tables below contain the PVRR of system production costs for all units and the capital and fixed O&M for new resources from 2029 to 2033 in 2029 dollars as modeled in the 2018 IRP. The PVRR values exclude capital and fixed O&M for existing resources because these costs are the same for all resource plans evaluated in a given scenario and are not needed to identify the least-cost resource plan.

Generating Unit Life	Load Scenario	Gas Price	Zero CO_2 Price	PVRR ($M, 2029$)	High CO_2 Price	PVRR ($M, 2029$)
55-Year	Base	Base	5 1x1 NGCCs, 300 MW Solar	5,535	5 1x1 NGCCs, 400 MW Solar	7,556
		High	5 1x1 NGCCs, 300 MW Solar	6,390	5 1x1 NGCCs, 500 MW Solar	8,671
		Low	5 1x1 NGCCs, 300 MW Solar	5,090	5 1x1 NGCCs, 300 MW Solar	7,054
	High	Base	7 1x1 NGCCs, 100 MW Solar	6,277	7 1x1 NGCCs, 100 MW Solar	8,326
		High	7 1x1 NGCCs, 100 MW Solar	7,278	7 1x1 NGCCs, 500 MW Solar	9,655
		Low	7 1x1 NGCCs, 100 MW Solar	5,756	7 1x1 NGCCs, 200 MW Solar	7,731
	Low	Base	4 1x1 NGCCs	4,772	4 1x1 NGCCs, 300 MW Solar	6,662
		High	4 1x1 NGCCs	5,470	4 1x1 NGCCs, 500 MW Solar	7,605
		Low	4 1x1 NGCCs	4,393	4 1x1 NGCCs	6,233

Generating Unit Life	Load Scenario	Gas Price	Zero CO_2 Price	PVRR ($M, 2029$)	High CO_2 Price	PVRR ($M, 2029$)
65-Year	Base	Base	No additional changes	4,331	No additional changes	7,431
		High	No additional changes	4,541	No additional changes	7,807
		Low	No additional changes	4,179	No additional changes	7,219
	High	Base	1 1x1 NGCC, 100 MW Batteries	5,000	2 1x1 NGCC, 400 MW Solar	8,070
		High	1 1x1 NGCC, 100 MW Batteries	5,292	1 1x1 NGCC, 300 MW Solar, 300 MW Wind	8,641
		Low	1 1x1 NGCC, 100 MW Batteries	4,789	2 1x1 NGCC, 400 MW Solar	7,767
	Low	Base	Retire Small-Frame SCCTs, DCP, Brown 3 or Brown 11N2 SCCTs	3,800	Retire Small-Frame SCCTs, DCP, Brown 3 or Brown 11N2 SCCTs	6,511
		High	Retire Small-Frame SCCTs, DCP, Brown 3 or Brown 11N2 SCCTs	3,973	Retire Small-Frame SCCTs, DCP, Brown 3 or Brown 11N2 SCCTs	6,861
		Low	Retire Small-Frame SCCTs, DCP, Brown 3 or Brown 11N2 SCCTs	3,660	Retire Small-Frame SCCTs, DCP, Brown 3 or Brown 11N2 SCCTs	6,329

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Question No. 42

Witness: Stuart A. Wilson

Q-42. Refer to the IRP, Volume 3, the 2018 IRP Long-Term Resource Planning Analysis, page 20, Table 11: Key Financial Inputs.

a. Provide a schedule showing how the revenue requirement discount rate was determined.

b. Explain how the deductibility of interest expense for income tax purposes was factored into the computation of the revenue requirement discount rate.

A-42.

a. Discount Rate = Debt % * Cost of Debt * (1 – Tax Rate) + Equity % * Return on Equity
7.06% = 47.16% * 4.40% * (1 – 24.95%) + 52.84% * 10.42%

b. See the response to part (a). Multiplying the debt portion of the discount rate by 1 minus the tax rate accounts for the deductibility of interest expense for income tax purposes.

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Question No. 43

Witness: Thomas A. Jessee

Q-43. Discuss the status of LG&E/KU's economic analysis regarding joining a Regional Transmission Organization.

A-43. The Companies' most recent RTO Membership Analysis was completed in September 2018 and was filed with the Companies' base rate cases that same month.[14] The Companies are in the process of updating this report and will file that update with their annual report in April 2020 consistent with the Commission's Orders entered in Case Nos. 2018-00294 and 2018-00295.[15]

[14] Electronic Application of Kentucky Utilities for and Adjustment of its Electric Rates, Case No. 2018-00294, Electronic Application of Louisville Gas & Electric Company for an Adjustment of its Electric and Gas Rates, Case No. 2018-00295, Direct Testimony of Lonnie E. Bellar, Exhibit LEB-2.
[15] Case No. 2018-00294, Order at 29-31 (Ky. PSC Apr. 30, 2019); Case No. 2018-00295, Order at 33-34 (Ky. PSC Apr. 30, 2019).