

COMMONWEALTH OF KENTUCKY
BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

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

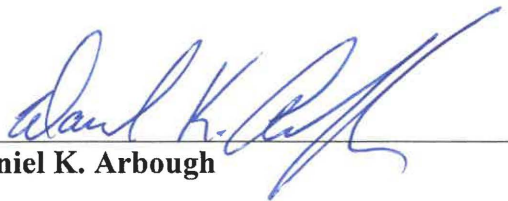
RESPONSE OF
LOUISVILLE GAS AND ELECTRIC COMPANY
AND
KENTUCKY UTILITIES COMPANY
TO SIERRA CLUB'S INITIAL REQUEST FOR INFORMATION
DATED OCTOBER 4, 2019

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

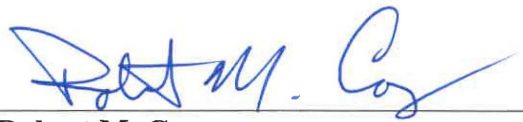
My Commission Expires:
Judy Schooler
Notary Public, ID No. 603967
State at Large, Kentucky

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 24~~th~~ 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, **Christopher M. Garrett**, being duly sworn, deposes and says that he is Controller 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.


Christopher M. Garrett

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

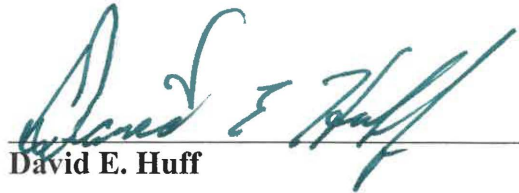

Notary Public

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, **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

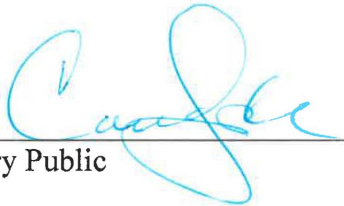
COMMONWEALTH OF KENTUCKY)
))
COUNTY OF JEFFERSON)

The undersigned, **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

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)

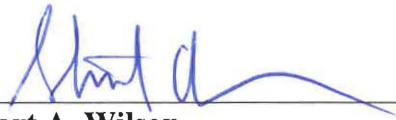
My Commission Expires:



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~~

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 1

Witness: Robert M. Conroy

- Q-1. Please produce an unredacted copy of the Companies' 2018 IRP.
- A-1. The Companies will follow all applicable Commission regulations concerning the filing and distribution of documents in this proceeding. The Companies will separately provide to any intervenor who has entered into a valid confidentiality agreement with the Companies copies of any confidential information the Companies file in this proceeding.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 2

Witness: Robert M. Conroy

- Q-2. Please produce unredacted copies of all the Companies' responses to other parties' data requests (including those of the Commission Staff) produced in this proceeding.
- A-2. See the response to Question No. 1.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 3

Witness: Stuart A. Wilson

Q-3. Reference the 2018 IRP at Vol. I, at 5-18, 5-36–5-37.

- a) With respect to the Companies' increase of the upper-bound of their target capacity reserve margin from 21 percent in the Companies' 2014 IRP to 25 percent in their 2018 IRP, and the Companies' assertion (at 5-37 n.31) that "[t]he increase from 21 percent to 25 percent is driven primarily by an increase in the assumed variability of winter peak demands," explain whether/how that increase in the assumed variability of winter peak demands is the result of polar vortex events (and, if so, identify which specific events).
- b) Whereas the Companies have chosen to "target a reserve margin range of 17 to 25 percent for resource planning" (at 5-37), discuss why, or (if the 2018 IRP already fully does so in the Companies' view) identify all relevant pages of the Companies' 2018 IRP that discuss why, it is economical, necessary, or otherwise reasonable that the Companies' forecasted reserve margin should always remain at the high end of that target range, never falling below 23.4 percent in all forecasted years through 2033.
- c) Identify and provide all forecasts by any other utilities that feature a 25 percent upper bound on their target reserve margin, to the extent the Companies are aware of any.
- d) Identify and provide all forecasts by any other utilities that project their actual capacity margin never falling below 23.4 percent through the year 2033, to the extent the Companies are aware of any.
- e) Explain whether it is the Companies' position that they require OVEC's 152 MW for the purpose of meeting their target reserve margin.

A-3.

- a) See Figure 5-14 on page 5-27, footnote 31 on page 5-37, and Section 5.2 beginning on page 24 of the "2018 Reserve Margin Analysis" in Volume III of the 2018 IRP. The maximum and variability of the distribution of winter peak demands evaluated in the 2018 IRP are higher than in the 2014 IRP primarily because the 2014 IRP did not consider the possibility of winter peak demands exceeding 7,000 (as experienced in 2014 and 2015). The maximum winter peak demand evaluated in the 2018 IRP was

forecasted based on temperatures experienced in January 1994, which were colder than temperatures experienced in the winters of 2014 or 2015.

- b) See the “2018 IRP Reserve Margin Analysis” in Volume III of the 2018 IRP. The results of this analysis show that the Companies’ existing resources with a 23.5 percent reserve margin are economically optimal for meeting system reliability needs in 2021.
- c) The Companies have not performed this research.
- d) The Companies have not performed this research. The Companies’ reserve margin falls below 23.4 percent in many of the scenarios evaluated in the 2018 IRP.
- e) OVEC’s capacity is not required to maintain total capacity within the Companies’ target reserve margin range.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 4

Witness: Gary H. Revlett

Q-4. Reference the 2018 IRP at Vol. I, at 5-20, and the statement: "After the Companies complete projects that are currently in progress to comply with the Coal Combustion Residual Rule ("CCR Rule"), all of the Companies' generating units will be in compliance with known state and federal regulations."

- a) For each coal-fired power plant in the Companies' fleet, please confirm whether the plant is in compliance with all known groundwater protection standards, as of the latest monitoring reading reported.
- b) If any exceedances are identified in response to part (a), explain the reconcilability of such exceedances with the Companies' assertions that all its units are in compliance with all known CCR-related state and federal regulations.

A-4.

a) KU-E.W. Brown Station

The E.W. Brown Generating Station has a single CCR monitoring network that serves both its Auxiliary Pond (a CCR impoundment) and its landfill.

The facility provided notice of the establishment of an Assessment Monitoring Program on June 6, 2018 to its Operating Record for its CCR monitoring network because statistically significant increases (SSIs) over background for various Appendix III parameters had been identified.

KU-Ghent Station

The Ghent Generating Station has three CCR monitoring networks, one each associated with: the landfill; ash treatment basin #1 (ATB #1); and ash treatment basin #2 (ATB #2). A series of three smaller CCR impoundments are located near and adjacent to ATB #1. All of these smaller impoundments are monitored using the same groundwater monitoring network associated with ATB #1.

The facility provided notice of the establishment of an Assessment Monitoring Program on June 1, 2018 to its Operating Record for the ATB #1 complex and ATB #2. Both

of these two monitoring networks had identified statistically significant increases (SSIs) over background for various Appendix III parameters.

LG&E-Cane Run Station

The Cane Run Station has a single CCR unit which was considered an inactive CCR impoundment at the time of the effective date of the CCR Rule (October 2015). When changes to the Rule eliminated the “inactive” category on August 5, 2016, they allowed an additional 547 days for the unit to comply with the requirements of its revised status. The facility has completed the collection of eight rounds of background groundwater samples and has recently initiated its post-background groundwater sampling regime.

The facility posted its initial *Annual Groundwater Monitoring and Corrective Action Report* to the Operating Record on August 2, 2019.

The CCR impoundment at the Cane Run Station was in the process of closing at the time the CCR Rule became effective. The impoundment is now closed and posted Notice of Closure Completion to the Operating Record on August 31, 2017.

LG&E- Mill Creek Station

The Mill Creek Generating Station has three CCR monitoring networks, one each associated with: the landfill; the ash treatment basin; and a series of four, small CCR impoundments collectively referred to as the South Pond Complex. The South Pond Complex includes: the Clearwell; the Dead Storage Pond; the Emergency Pond; and the Construction Runoff Pond.

The facility provided notice of the establishment of an Assessment Monitoring Program on June 1, 2018 to its Operating Record for all three CCR monitoring networks at the site as each had identified statistically significant increases (SSIs) over background for various Appendix III parameters.

LG&E-Trimble County Generating Station

The Trimble County Generating Station has two CCR impoundments which share a common berm. Because of their proximity, a single network of groundwater monitoring wells is used to evaluate the performance of both units.

The facility provided notice of the establishment of an Assessment Monitoring Program on June 1, 2018 to its Operating Record. The notification was provided because of statistically significant increases (SSIs) over background for various Appendix III parameters. However, the groundwater assessment activities and ongoing monitoring performed to date have not identified any exceedances at statistically significant levels for any groundwater protection standards (GPSs) for this monitoring unit at this location.

- b) The CCR Rule anticipates that the groundwater monitoring process may identify exceedances of a single or multiple groundwater protection standards (GPSs). The regulation prescribes steps to be taken in response to the identification of one or more exceedances of a GPS. The Rule dictates that a series of actions, including the establishment of assessment monitoring programs, an assessment of corrective measures, and eventual closure of CCR impoundments must be implemented in these scenarios. In all cases, the company is progressing as the regulation prescribes.

Additionally, the company performs groundwater monitoring and provides the data in accordance with separate, state-issued permits for all the locations identified in this response. The company has previously disclosed and cooperated with state regulators as groundwater monitoring concerns have been identified. The actions have included assessment activities and, for some locations, implementation of various remedies. All these actions predated the effective date of the CCR Rule (October 2015) and are ongoing. The company continues to perform groundwater monitoring and to provide the data to the state in accordance with the relevant permits.

As a result of ongoing compliance with existing state permits and engagement with state regulators and its continued progression in implementing the step-wise procedures identified in the CCR Rule, the company can state definitively that it complies with all known state and federal regulations.

Additional details relating to specific sites and the associated CCR units are provided subsequently.

KU-E.W. Brown Station

Groundwater assessment activities have been undertaken for the monitoring network at the E.W. Brown site. To date, the groundwater assessment activities and ongoing monitoring performed for this network have only identified concentrations of lithium at statistically significant levels (SSLs) in five of the monitoring wells. Molybdenum was identified at an SSL in one of the monitoring wells.

Notification of the initiation of an Assessment of Corrective Measures was posted to the Operating Record on February 26, 2019. A similar notice for both CCR units was provided and posted upon completion of the Assessment of Corrective Measures on June 17, 2019.

A public meeting was held on September 11, 2019 at the Mercer County Public Library to discuss the results of the Assessment of Corrective Measures.

KU-Ghent Station

Groundwater assessment activities have been undertaken for the monitoring networks associated with ATB #1 and ATB #2 at the Ghent site. To date, the groundwater assessment activities and ongoing monitoring performed at the landfill have not

identified any exceedances of any groundwater protection standards (GPSs). Assessment activities at the ATB #1 complex have identified concentrations of lithium and/or molybdenum at statistically significant levels (SSLs) in three of the monitoring wells. Groundwater assessment activities associated with the ATB #2 CCR impoundment have identified only molybdenum in excess of the GPS at a single location.

Notification of the initiation of an Assessment of Corrective Measures was posted to the Operating Record for both ATB #1 complex and ATB #2 on February 26, 2019. A similar notice for both CCR impoundments was provided and posted upon completion of the Assessment of Corrective Measures on July 9, 2019.

A public meeting was held at the offices of the Carroll County Cooperative Extension Service on September 18, 2019 to discuss the results of the Assessment of Corrective Measures.

LG&E-Mill Creek Station

Groundwater assessment activities have been undertaken for all the monitoring networks and CCR units at the Mill Creek Station site. To date, the groundwater assessment activities and ongoing monitoring performed at the South Pond Complex have not identified any exceedances of any groundwater protection standards (GPSs). Assessment activities at the CCR Landfill have identified concentrations of lithium and/or molybdenum at statistically significant levels (SSLs) in three of the monitoring wells. Groundwater assessment activities associated with the ash treatment basin CCR impoundment have identified molybdenum in excess of the GPS at three locations and molybdenum and arsenic in excess of the GPSs at one location.

Notification of the initiation of an Assessment of Corrective Measures was posted to the Operating Record for both the landfill and the ash treatment basin on February 26, 2019. A similar notice for both CCR units was provided and posted upon completion of the Assessment of Corrective Measures on May 27, 2019.

A public meeting was held on September 9, 2019 at the Southwest Jefferson County Public Library to discuss the result of the Assessment of Corrective Measures.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club’s Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 5

Witness: Stuart A. Wilson

Q-5. Reference the 2018 IRP at Vol. I, 5-24, and the statement: “Compared to gas-fired technologies, the pace of renewable and battery technology development is far less certain.”

a) Identify and provide all authorities/analysis on which the Companies’ relied in support of this assertion.

A-5.

a) The Companies did not rely on an external authority for the statement referenced. A comparison of NREL’s ATB forecasts from 2015 to 2018 shows significant year-over-year variation in overnight capital costs for solar and wind resources, and very little variation in overnight capital costs for SCCT and NGCC resources. See the table below, which shows NREL’s forecast of overnight capital costs for 2018, in 2018 dollars assuming 2% inflation from the basis year in each ATB.

	Overnight Capital Costs (2018 \$/kW)				% Change		
	2015 ATB	2016 ATB	2017 ATB	2018 ATB	2015 to 2016	2016 to 2017	2017 to 2018
SCCT	901	927	915	911	3%	-1%	0%
NGCC	1,064	1,084	1,066	1,070	2%	-2%	0%
Solar PV	1,924	1,741	1,203	1,093	-10%	-31%	-9%
Wind	1,759	1,751	1,531	1,515	0%	-13%	-1%

The 2015 ATB, 2016 ATB, and 2017 ATB did not include battery storage. However, a comparison of the 2018 ATB to the 2019 ATB shows a 27% decline in overnight capital cost for battery storage. The high variation in costs of renewable and battery technology and the uncertainty regarding tax credits for these technologies compared to the stability of gas-fired technology costs naturally leads to the conclusion that gas-fired technology development is much more stable and certain than the pace of renewable and battery technology development.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 6

Witness: Stuart A. Wilson

Q-6. Reference the 2018 IRP at Vol. I, 5-29, and the statement: "Figure 5-15 compares the high and low distributed solar generation forecast scenarios to the base forecast. The high scenario was derived from a National Renewable Energy Laboratory ("NREL") forecast of distributed solar generation for the Companies' service territories and assumes a more aggressive consumer adoption rate than the base scenario. The base and low adoption scenarios were developed by the Companies."

- a) Identify and provide the specific NREL analysis referenced there on which the Companies relied for the high scenario; and explain whether it was NREL which characterized that forecast scenario as "high" versus the Companies supplying that characterization.
- b) Explain the basis for, and methodology behind, the Companies' internal development of the base and low-adoption scenarios, and provide all authorities, data and analysis on which the Companies relied in developing them.

A-6.

- a) The NREL analysis can be found at the following link:
<https://www.nrel.gov/docs/fy17osti/68656.pdf>.

NREL's mid-cost scenario was used as the high solar adoption scenario as the NREL mid-cost scenario assumes more aggressive near-term consumer adoption of distributed solar than the Companies' base case forecast.

- b) See attached. The Companies base scenario is based on analysis of the existing distributed generation adoption data within the Companies' service territory, a smoothed history of retail electricity prices, and distributed generation costs. The proportion of customers adopting solar was modeled via logistic regression whereby a prediction of distributed solar adopters was made based on the relationship of solar capital costs and the retail electricity price. The forecast of future solar capital costs was taken from NREL's 2017 ATB (Annual Technology Baseline). Compared to the base scenario, the low scenario assumes less aggressive consumer adoption in the near-term and net metering laws are modified in the longer-term to compensate net metering customers for solar generation pushed back to the electric grid (i.e., solar generation in

excess of the customer's energy consumed from the grid) at the utilities' avoided cost of energy (versus the retail rate).

YrMn	year	capacity_cost	credit	capacity_cost_ITC	rates	LCOE_normal
1/1/2010	2010	7000.677207	0	7000.677207	0.073399504	0.352179328
2/1/2010	2010	7025.227601	0	7025.227601	0.073399504	0.353424658
3/1/2010	2010	7027.909955	0	7027.909955	0.073399504	0.353590702
4/1/2010	2010	7010.530719	0	7010.530719	0.073399504	0.35267746
5/1/2010	2010	6974.570637	0	6974.570637	0.073399504	0.350850976
6/1/2010	2010	6918.934083	0	6918.934083	0.073399504	0.348111249
7/1/2010	2010	6848.45654	0	6848.45654	0.073399504	0.344541303
8/1/2010	2010	6759.741217	0	6759.741217	0.073399504	0.340058115
9/1/2010	2010	6656.19995	0	6656.19995	0.073399504	0.334910751
10/1/2010	2010	6543.14217	0	6543.14217	0.073399504	0.329182233
11/1/2010	2010	6414.332405	0	6414.332405	0.073399504	0.322706517
12/1/2010	2010	6279.326991	0	6279.326991	0.073399504	0.315898713
1/1/2011	2011	6130.427278	0	6130.427278	0.07346353	0.308426733
2/1/2011	2011	5973.432369	0	5973.432369	0.07346353	0.300539643
3/1/2011	2011	5826.321529	0	5826.321529	0.07346353	0.293150685
4/1/2011	2011	5659.520278	0	5659.520278	0.07346353	0.284765463
5/1/2011	2011	5496.0977	0	5496.0977	0.07346353	0.276546285
6/1/2011	2011	5327.219091	0	5327.219091	0.07346353	0.267995019
7/1/2011	2011	5165.751857	0	5165.751857	0.07346353	0.259858863
8/1/2011	2011	5002.991649	0	5002.991649	0.07346353	0.251722707
9/1/2011	2011	4846.481657	0	4846.481657	0.07346353	0.243835616
10/1/2011	2011	4702.965091	0	4702.965091	0.07346353	0.236612702
11/1/2011	2011	4564.934317	0	4564.934317	0.07346353	0.229638854
12/1/2011	2011	4443.266555	0	4443.266555	0.07346353	0.223578248
1/1/2012	2012	4331.910758	0	4331.910758	0.073445215	0.217932752
2/1/2012	2012	4236.604547	0	4236.604547	0.073445215	0.213117476
3/1/2012	2012	4160.997039	0	4160.997039	0.073445215	0.209298464
4/1/2012	2012	4092.985617	0	4092.985617	0.073445215	0.205894562
5/1/2012	2012	4038.142995	0	4038.142995	0.073445215	0.203154836
6/1/2012	2012	3991.0924	0	3991.0924	0.073445215	0.20083022
7/1/2012	2012	3953.222361	0	3953.222361	0.073445215	0.198920714
8/1/2012	2012	3920.287612	0	3920.287612	0.073445215	0.197260274
9/1/2012	2012	3891.903284	0	3891.903284	0.073445215	0.195765878
10/1/2012	2012	3867.102095	0	3867.102095	0.073445215	0.194520548
11/1/2012	2012	3842.510033	0	3842.510033	0.073445215	0.193275218
12/1/2012	2012	3818.06669	0	3818.06669	0.073445215	0.19211291
1/1/2013	2013	3790.421913	0	3790.421913	0.077836614	0.190701536
2/1/2013	2013	3759.002459	0	3759.002459	0.077836614	0.189124118
3/1/2013	2013	3727.560842	0	3727.560842	0.077836614	0.1875467
4/1/2013	2013	3689.941256	0	3689.941256	0.077836614	0.185637194
5/1/2013	2013	3651.299977	0	3651.299977	0.077836614	0.183727688
6/1/2013	2013	3609.675684	0	3609.675684	0.077836614	0.181569116

7/1/2013	2013	3568.342282	0	3568.342282	0.077836614	0.179493566
8/1/2013	2013	3525.158975	0	3525.158975	0.077836614	0.177334994
9/1/2013	2013	3482.120645	0	3482.120645	0.077836614	0.175176422
10/1/2013	2013	3441.20362	0	3441.20362	0.077836614	0.173100872
11/1/2013	2013	3400.294862	0	3400.294862	0.077836614	0.171108344
12/1/2013	2013	3362.622112	0	3362.622112	0.077836614	0.169198838
1/1/2014	2014	3326.288618	0	3326.288618	0.076594087	0.167372354
2/1/2014	2014	3293.070766	0	3293.070766	0.076594087	0.165711914
3/1/2014	2014	3265.664619	0	3265.664619	0.076594087	0.16430054
4/1/2014	2014	3237.968219	0	3237.968219	0.076594087	0.162889166
5/1/2014	2014	3213.586034	0	3213.586034	0.076594087	0.161643836
6/1/2014	2014	3190.650338	0	3190.650338	0.076594087	0.160481528
7/1/2014	2014	3170.408972	0	3170.408972	0.076594087	0.159485264
8/1/2014	2014	3151.270265	0	3151.270265	0.076594087	0.158572022
9/1/2014	2014	3133.691851	0	3133.691851	0.076594087	0.15765878
10/1/2014	2014	3117.931658	0	3117.931658	0.076594087	0.15682856
11/1/2014	2014	3102.696762	0	3102.696762	0.076594087	0.156081362
12/1/2014	2014	3088.738176	0	3088.738176	0.076594087	0.155417186
1/1/2015	2015	3074.883083	0	3074.883083	0.07913	0.154669988
2/1/2015	2015	3061.398041	0	3061.398041	0.07913	0.154005812
3/1/2015	2015	3049.486711	0	3049.486711	0.07913	0.153424658
4/1/2015	2015	3036.578336	0	3036.578336	0.07913	0.152760482
5/1/2015	2015	3024.347545	0	3024.347545	0.07913	0.152179328
6/1/2015	2015	3011.959578	0	3011.959578	0.07913	0.151515152
7/1/2015	2015	3000.195118	0	3000.195118	0.07913	0.150933998
8/1/2015	2015	2988.250493	0	2988.250493	0.07913	0.150352844
9/1/2015	2015	2976.501638	0	2976.501638	0.07913	0.149771689
10/1/2015	2015	2965.299429	0	2965.299429	0.07913	0.149190535
11/1/2015	2015	2953.877681	0	2953.877681	0.07913	0.148609381
12/1/2015	2015	2942.954738	0	2942.954738	0.07913	0.148028227
1/1/2016	2016	2931.783029	0	2931.783029	0.086454307	0.147530095
2/1/2016	2016	2920.707737	0	2920.707737	0.086454307	0.146948941
3/1/2016	2016	2910.411712	0	2910.411712	0.086454307	0.146450809
4/1/2016	2016	2899.449616	0	2899.449616	0.086454307	0.145869655
5/1/2016	2016	2888.859915	0	2888.859915	0.086454307	0.145371523
6/1/2016	2016	2877.910731	0	2877.910731	0.086454307	0.144790369
7/1/2016	2016	2867.283678	0	2867.283678	0.086454307	0.144292237
8/1/2016	2016	2856.244391	0	2856.244391	0.086454307	0.143711083
9/1/2016	2016	2845.119835	0	2845.119835	0.086454307	0.143129929
10/1/2016	2016	2834.247888	0	2834.247888	0.086454307	0.142548775
11/1/2016	2016	2822.87786	0	2822.87786	0.086454307	0.142050643
12/1/2016	2016	2811.718515	0	2811.718515	0.086454307	0.141469489
1/1/2017	2017	2800	0	2800	0.086783257	0.140888335

2/1/2017	2017	2788.078191	0	2788.078191	0.086783257	0.140307181
3/1/2017	2017	2777.168122	0	2777.168122	0.086783257	0.139726027
4/1/2017	2017	2764.980821	0	2764.980821	0.086783257	0.139144873
5/1/2017	2017	2753.12669	0	2753.12669	0.086783257	0.138480697
6/1/2017	2017	2740.867137	0	2740.867137	0.086783257	0.137899543
7/1/2017	2017	2729.042572	0	2729.042572	0.086783257	0.137318389
8/1/2017	2017	2716.916376	0	2716.916376	0.086783257	0.136654213
9/1/2017	2017	2704.936747	0	2704.936747	0.086783257	0.136073059
10/1/2017	2017	2693.533125	0	2693.533125	0.086783257	0.135491905
11/1/2017	2017	2681.996952	0	2681.996952	0.086783257	0.134910751
12/1/2017	2017	2671.12197	0	2671.12197	0.086783257	0.134412619
1/1/2018	2018	2660.234863	0	2660.234863	0.087035986	0.133831465
2/1/2018	2018	2649.734348	0	2649.734348	0.087035986	0.133333333
3/1/2018	2018	2640.535349	0	2640.535349	0.087035986	0.132835201
4/1/2018	2018	2,630.59	0.3	2630.59368	0.087035986	0.132337069
5/1/2018	2018	2,621.14	0.3	2621.143585	0.087035986	0.131838937
6/1/2018	2018	2,611.48	0.3	2611.477939	0.087035986	0.131423827
7/1/2018	2018	2,602.15	0.3	2602.146511	0.087035986	0.130925695
8/1/2018	2018	2,592.45	0.3	2592.450089	0.087035986	0.130427563
9/1/2018	2018	2,582.62	0.3	2582.620453	0.087035986	0.129929431
10/1/2018	2018	2,572.91	0.3	2572.906434	0.087035986	0.129431299
11/1/2018	2018	2,562.58	0.3	2562.583312	0.087035986	0.128933167
12/1/2018	2018	2,552.24	0.3	2552.243275	0.087035986	0.128435035
1/1/2019	2019	2,541.12	0.3	2541.119869	0.085487861	0.127853881
2/1/2019	2019	2,529.50	0.3	2529.503234	0.085487861	0.127272727
3/1/2019	2019	2,518.65	0.3	2518.649201	0.085487861	0.126691573
4/1/2019	2019	2,506.33	0.3	2506.330486	0.085487861	0.126110419
5/1/2019	2019	2,494.20	0.3	2494.20477	0.085487861	0.125446243
6/1/2019	2019	2,481.57	0.3	2481.567855	0.085487861	0.124865089
7/1/2019	2019	2,469.33	0.3	2469.334756	0.085487861	0.124200913
8/1/2019	2019	2,456.79	0.3	2456.794116	0.085487861	0.123619759
9/1/2019	2019	2,444.46	0.3	2444.461243	0.085487861	0.122955583
10/1/2019	2019	2,432.82	0.3	2432.824849	0.085487861	0.122374429
11/1/2019	2019	2,421.21	0.3	2421.213359	0.085487861	0.121793275
12/1/2019	2019	2,410.48	0.3	2410.475631	0.085487861	0.121295143
1/1/2020	2020	2,400.00	0.26	2400	0.083808376	0.120713989
2/1/2020	2020	2,390.23	0.26	2390.229387	0.083808376	0.120215857
3/1/2020	2020	2,381.69	0.26	2381.685249	0.083808376	0.119800747
4/1/2020	2020	2,373.11	0.26	2373.113975	0.083808376	0.119385637
5/1/2020	2020	2,365.30	0.26	2365.299154	0.083808376	0.118970527
6/1/2020	2020	2,357.64	0.26	2357.642597	0.083808376	0.118638439
7/1/2020	2020	2,350.56	0.26	2350.564378	0.083808376	0.118223329
8/1/2020	2020	2,343.52	0.26	2343.515413	0.083808376	0.117891241

9/1/2020	2020	2,336.66	0.26	2336.657525	0.083808376	0.117559153
10/1/2020	2020	2,330.13	0.26	2330.128077	0.083808376	0.117227065
11/1/2020	2020	2,323.41	0.26	2323.414574	0.083808376	0.116894977
12/1/2020	2020	2,316.88	0.26	2316.876245	0.083808376	0.116562889
1/1/2021	2021	2,310.00	0.22	2310	0.088361422	0.116230801
2/1/2021	2021	2,302.94	0.22	2302.940171	0.088361422	0.115898713
3/1/2021	2021	2,296.41	0.22	2296.409271	0.088361422	0.115566625
4/1/2021	2021	2,289.03	0.22	2289.027717	0.088361422	0.115151515
5/1/2021	2021	2,281.75	0.22	2281.752966	0.088361422	0.114819427
6/1/2021	2021	2,274.12	0.22	2274.121064	0.088361422	0.114404317
7/1/2021	2021	2,266.64	0.22	2266.64452	0.088361422	0.114072229
8/1/2021	2021	2,258.85	0.22	2258.845926	0.088361422	0.113657119
9/1/2021	2021	2,250.99	0.22	2250.994678	0.088361422	0.113242009
10/1/2021	2021	2,243.37	0.22	2243.366914	0.088361422	0.112826899
11/1/2021	2021	2,235.48	0.22	2235.475142	0.088361422	0.112494811
12/1/2021	2021	2,227.85	0.22	2227.84864	0.088361422	0.112079701
1/1/2022	2022	2,220.00	0	2220	0.090419101	0.111664591
2/1/2022	2022	2,212.20	0	2212.200755	0.090419101	0.111332503
3/1/2022	2022	2,205.20	0	2205.197762	0.090419101	0.110917393
4/1/2022	2022	2,197.48	0	2197.484945	0.090419101	0.110585305
5/1/2022	2022	2,190.06	0	2190.056069	0.090419101	0.110170195
6/1/2022	2022	2,182.41	0	2182.410134	0.090419101	0.109755085
7/1/2022	2022	2,175.03	0	2175.034925	0.090419101	0.109422997
8/1/2022	2022	2,167.43	0	2167.433019	0.090419101	0.109007887
9/1/2022	2022	2,159.84	0	2159.84473	0.090419101	0.108675799
10/1/2022	2022	2,152.51	0	2152.508633	0.090419101	0.108260689
11/1/2022	2022	2,144.93	0	2144.929909	0.090419101	0.107928601
12/1/2022	2022	2,137.59	0	2137.592011	0.090419101	0.107513491
1/1/2023	2023	2,130.00	0	2130	0.090710398	0.107181403
2/1/2023	2023	2,122.39	0	2122.393797	0.090710398	0.106766293
3/1/2023	2023	2,115.51	0	2115.512011	0.090710398	0.106434205
4/1/2023	2023	2,107.88	0	2107.88182	0.090710398	0.106019095
5/1/2023	2023	2,100.49	0	2100.488509	0.090710398	0.105687007
6/1/2023	2023	2,092.84	0	2092.841141	0.090710398	0.105271897
7/1/2023	2023	2,085.43	0	2085.434958	0.090710398	0.104939809
8/1/2023	2023	2,077.78	0	2077.778164	0.090710398	0.104524699
9/1/2023	2023	2,070.12	0	2070.119551	0.090710398	0.104109589
10/1/2023	2023	2,062.71	0	2062.708143	0.090710398	0.103777501
11/1/2023	2023	2,055.05	0	2055.051796	0.090710398	0.103362391
12/1/2023	2023	2,047.65	0	2047.646331	0.090710398	0.103030303
1/1/2024	2024	2,040.00	0	2040	0.090710398	0.102615193
2/1/2024	2024	2,032.36	0	2032.361196	0.090710398	0.102283105
3/1/2024	2024	2,025.22	0	2025.221453	0.090710398	0.101867995

4/1/2024	2024	2,017.59	0	2017.594839	0.090710398	0.101535907
5/1/2024	2024	2,010.22	0	2010.218576	0.090710398	0.101120797
6/1/2024	2024	2,002.60	0	2002.599744	0.090710398	0.100788709
7/1/2024	2024	1,995.23	0	1995.22876	0.090710398	0.100373599
8/1/2024	2024	1,987.61	0	1987.613058	0.090710398	0.099958489
9/1/2024	2024	1,980.00	0	1979.997164	0.090710398	0.099626401
10/1/2024	2024	1,972.63	0	1972.625631	0.090710398	0.099211291
11/1/2024	2024	1,965.01	0	1965.005854	0.090710398	0.098879203
12/1/2024	2024	1,957.63	0	1957.628312	0.090710398	0.098464093
1/1/2025	2025	1,950.00	0	1950	0.090710398	0.098132005
2/1/2025	2025	1,942.37	0	1942.365938	0.090710398	0.097716895
3/1/2025	2025	1,935.47	0	1935.466237	0.090710398	0.097384807
4/1/2025	2025	1,927.82	0	1927.823321	0.090710398	0.096969697
5/1/2025	2025	1,920.42	0	1920.42391	0.090710398	0.096637609
6/1/2025	2025	1,912.78	0	1912.775691	0.090710398	0.096222499
7/1/2025	2025	1,905.37	0	1905.373042	0.090710398	0.095890411
8/1/2025	2025	1,897.72	0	1897.723436	0.090710398	0.095475301
9/1/2025	2025	1,890.07	0	1890.074625	0.090710398	0.095060191
10/1/2025	2025	1,882.67	0	1882.674259	0.090710398	0.094728103
11/1/2025	2025	1,875.03	0	1875.029964	0.090710398	0.094312993
12/1/2025	2025	1,867.64	0	1867.635863	0.090710398	0.093980905
1/1/2026	2026	1,860.00	0	1860	0.090710398	0.093565795
2/1/2026	2026	1,852.37	0	1852.36943	0.090710398	0.093150685
3/1/2026	2026	1,845.48	0	1845.480664	0.090710398	0.092818597
4/1/2026	2026	1,837.86	0	1837.855753	0.090710398	0.092486509
5/1/2026	2026	1,830.48	0	1830.476981	0.090710398	0.092071399
6/1/2026	2026	1,822.85	0	1822.850544	0.090710398	0.091739311
7/1/2026	2026	1,815.47	0	1815.466666	0.090710398	0.091324201
8/1/2026	2026	1,807.83	0	1807.831204	0.090710398	0.090992113
9/1/2026	2026	1,800.19	0	1800.18828	0.090710398	0.090577003
10/1/2026	2026	1,792.78	0	1792.782974	0.090710398	0.090161893
11/1/2026	2026	1,785.12	0	1785.119713	0.090710398	0.089829805
12/1/2026	2026	1,777.69	0	1777.691097	0.090710398	0.089414695
1/1/2027	2027	1,770.00	0	1770	0.090710398	0.089082607
2/1/2027	2027	1,762.29	0	1762.293327	0.090710398	0.088667497
3/1/2027	2027	1,755.32	0	1755.323436	0.090710398	0.088335409
4/1/2027	2027	1,747.60	0	1747.602981	0.090710398	0.087920299
5/1/2027	2027	1,740.13	0	1740.133919	0.090710398	0.087505189
6/1/2027	2027	1,732.42	0	1732.424871	0.090710398	0.087173101
7/1/2027	2027	1,724.98	0	1724.97947	0.090710398	0.086757991
8/1/2027	2027	1,717.31	0	1717.307913	0.090710398	0.086425903
9/1/2027	2027	1,709.67	0	1709.665405	0.090710398	0.086010793
10/1/2027	2027	1,702.30	0	1702.303434	0.090710398	0.085678705

11/1/2027	2027	1,694.74	0	1694.737758	0.090710398	0.085263595
12/1/2027	2027	1,687.46	0	1687.462761	0.090710398	0.084931507
1/1/2028	2028	1,680.00	0	1680	0.090710398	0.084516397
2/1/2028	2028	1,672.59	0	1672.594411	0.090710398	0.084184309
3/1/2028	2028	1,665.70	0	1665.701726	0.090710398	0.083769199
4/1/2028	2028	1,658.35	0	1658.348485	0.090710398	0.083437111
5/1/2028	2028	1,651.22	0	1651.224879	0.090710398	0.083105023
6/1/2028	2028	1,643.83	0	1643.832626	0.090710398	0.082689913
7/1/2028	2028	1,636.63	0	1636.626267	0.090710398	0.082357825
8/1/2028	2028	1,629.10	0	1629.102005	0.090710398	0.081942715
9/1/2028	2028	1,621.48	0	1621.475017	0.090710398	0.081610627
10/1/2028	2028	1,613.97	0	1613.973631	0.090710398	0.081195517
11/1/2028	2028	1,606.07	0	1606.074378	0.090710398	0.080780407
12/1/2028	2028	1,598.26	0	1598.264513	0.090710398	0.080448319
1/1/2029	2029	1,590.00	0	1590	0.090710398	0.080033209
2/1/2029	2029	1,581.53	0	1581.53287	0.090710398	0.079535077
3/1/2029	2029	1,573.77	0	1573.768036	0.090710398	0.079202989
4/1/2029	2029	1,565.12	0	1565.122513	0.090710398	0.078704857
5/1/2029	2029	1,556.79	0	1556.787158	0.090710398	0.078289747
6/1/2029	2029	1,548.29	0	1548.29179	0.090710398	0.077874637
7/1/2029	2029	1,540.27	0	1540.266348	0.090710398	0.077459527
8/1/2029	2029	1,532.26	0	1532.261309	0.090710398	0.077127439
9/1/2029	2029	1,524.64	0	1524.635819	0.090710398	0.076712329
10/1/2029	2029	1,517.70	0	1517.700443	0.090710398	0.076380241
11/1/2029	2029	1,511.08	0	1511.078329	0.090710398	0.076048153
12/1/2029	2029	1,505.28	0	1505.278563	0.090710398	0.075716065
1/1/2030	2030	1,500.00	0	1500	0.090710398	0.075466999
2/1/2030	2030	1,495.51	0	1495.505349	0.090710398	0.075217933
3/1/2030	2030	1,492.07	0	1492.07173	0.090710398	0.075051889
4/1/2030	2030	1,488.88	0	1488.882706	0.090710398	0.074885845
5/1/2030	2030	1,486.33	0	1486.329562	0.090710398	0.074802823
6/1/2030	2030	1,484.16	0	1484.156838	0.090710398	0.074636779
7/1/2030	2030	1,482.42	0	1482.423107	0.090710398	0.074553757
8/1/2030	2030	1,480.93	0	1480.927537	0.090710398	0.074470735
9/1/2030	2030	1,479.65	0	1479.646125	0.090710398	0.074470735
10/1/2030	2030	1,478.53	0	1478.527456	0.090710398	0.074387713
11/1/2030	2030	1,477.41	0	1477.411701	0.090710398	0.074304691
12/1/2030	2030	1,476.29	0	1476.289243	0.090710398	0.074304691
1/1/2031	2031	1,475.00	0	1475	0.090710398	0.074221669
2/1/2031	2031	1,473.51	0	1473.511148	0.090710398	0.074138647
3/1/2031	2031	1,472.00	0	1471.998491	0.090710398	0.074055625
4/1/2031	2031	1,470.16	0	1470.159596	0.090710398	0.073972603
5/1/2031	2031	1,468.24	0	1468.237241	0.090710398	0.073889581

6/1/2031	2031	1,466.13	0	1466.126209	0.090710398	0.073723537
7/1/2031	2031	1,463.98	0	1463.984657	0.090710398	0.073640515
8/1/2031	2031	1,461.69	0	1461.692756	0.090710398	0.073557493
9/1/2031	2031	1,459.34	0	1459.343914	0.090710398	0.073391449
10/1/2031	2031	1,457.04	0	1457.038828	0.090710398	0.073308427
11/1/2031	2031	1,454.65	0	1454.646766	0.090710398	0.073142383
12/1/2031	2031	1,452.34	0	1452.344015	0.090710398	0.073059361
1/1/2032	2032	1,450.00	0	1450	0.090710398	0.072976339
2/1/2032	2032	1,447.71	0	1447.710376	0.090710398	0.072810295
3/1/2032	2032	1,445.62	0	1445.616525	0.090710398	0.072727273
4/1/2032	2032	1,443.42	0	1443.423532	0.090710398	0.072644251
5/1/2032	2032	1,441.34	0	1441.339869	0.090710398	0.072478207
6/1/2032	2032	1,439.22	0	1439.220348	0.090710398	0.072395185
7/1/2032	2032	1,437.20	0	1437.195701	0.090710398	0.072312163
8/1/2032	2032	1,435.12	0	1435.124674	0.090710398	0.072229141
9/1/2032	2032	1,433.07	0	1433.068721	0.090710398	0.072063097
10/1/2032	2032	1,431.09	0	1431.087366	0.090710398	0.071980075
11/1/2032	2032	1,429.04	0	1429.042239	0.090710398	0.071897053
12/1/2032	2032	1,427.06	0	1427.059276	0.090710398	0.071814031
1/1/2033	2033	1,425.00	0	1425	0.090710398	0.071731009
2/1/2033	2033	1,422.93	0	1422.92534	0.090710398	0.071564965
3/1/2033	2033	1,421.04	0	1421.038557	0.090710398	0.071481943
4/1/2033	2033	1,418.94	0	1418.937013	0.090710398	0.071398921
5/1/2033	2033	1,416.89	0	1416.892304	0.090710398	0.071315899
6/1/2033	2033	1,414.77	0	1414.769885	0.090710398	0.071149855
7/1/2033	2033	1,412.71	0	1412.708378	0.090710398	0.071066833
8/1/2033	2033	1,410.57	0	1410.572118	0.090710398	0.070983811
9/1/2033	2033	1,408.43	0	1408.431519	0.090710398	0.070817767
10/1/2033	2033	1,406.36	0	1406.357552	0.090710398	0.070734745
11/1/2033	2033	1,404.21	0	1404.213721	0.090710398	0.070651723
12/1/2033	2033	1,402.14	0	1402.140029	0.090710398	0.070568701

LCOE_ITC	GridToLCOE	total_customers	monthly_new_customers	total_capacity
0.352179328	0.208415139	25	1	103.329
0.353424658	0.207680766	26	1	108.129
0.353590702	0.207583241	31	5	131.309
0.35267746	0.208120768	33	2	134.024
0.350850976	0.209204217	38	5	141.524
0.348111249	0.210850709	44	6	160.504
0.344541303	0.213035427	46	2	163.444
0.340058115	0.215843999	48	2	167.994
0.334910751	0.219161384	51	3	178.034
0.329182233	0.222975289	54	3	181.934
0.322706517	0.22744971	58	4	191.224
0.315898713	0.232351385	64	6	224.72
0.308426733	0.238187946	68	4	230.67
0.300539643	0.244438735	76	8	255.552
0.293150685	0.250599892	79	3	274.207
0.284765463	0.257979073	85	6	282.972
0.276546285	0.265646418	90	5	289.422
0.267995019	0.274122745	94	4	293.682
0.259858863	0.282705502	99	5	302.512
0.251722707	0.29184308	101	2	308.527
0.243835616	0.301283017	107	6	320.793
0.236612702	0.310480077	116	9	342.353
0.229638854	0.319908973	121	5	364.303
0.223578248	0.328580847	124	3	371.203
0.217932752	0.337008613	127	3	376.163
0.213117476	0.344623143	133	6	385.053
0.209298464	0.350911388	136	3	392.133
0.205894562	0.356712746	138	2	399.493
0.203154836	0.361523338	141	3	428.743
0.20083022	0.365707982	142	1	441.703
0.198920714	0.369218535	144	2	479.383
0.197260274	0.372326435	146	2	488.663
0.195765878	0.375168621	148	2	494.688
0.194520548	0.377570469	151	3	501.858
0.193275218	0.380003268	151	0	501.858
0.19211291	0.382302338	153	2	509.658
0.190701536	0.408159345	154	1	519.858
0.189124118	0.411563659	159	5	538.853
0.1875467	0.415025239	160	1	544.085
0.185637194	0.419294282	162	2	548.165
0.183727688	0.423652063	164	2	561.065
0.181569116	0.428688621	164	0	561.065

0.179493566	0.433645705	170	6	595.31
0.177334994	0.438924164	173	3	602.77
0.175176422	0.444332708	176	3	644.095
0.173100872	0.449660439	181	5	695.385
0.171108344	0.454896659	187	6	752.26
0.169198838	0.460030429	192	5	779.05
0.167372354	0.457626874	195	3	834.335
0.165711914	0.462212314	197	2	860.105
0.16430054	0.466182809	198	1	861.605
0.162889166	0.470222109	200	2	869.105
0.161643836	0.473844776	204	4	893.305
0.160481528	0.477276657	208	4	919.145
0.159485264	0.480258084	212	4	941.845
0.158572022	0.483023968	218	6	1033.365
0.15765878	0.485821895	222	4	1082.085
0.15682856	0.488393742	225	3	1122.335
0.156081362	0.490731797	225	0	1122.335
0.155417186	0.492828941	229	4	1145.345
0.154669988	0.511605395	240	11	1218.055
0.154005812	0.513811779	246	6	1260.069
0.153424658	0.515758036	248	2	1296.009
0.152760482	0.518000462	251	3	1336.569
0.152179328	0.519978642	255	4	1386.469
0.151515152	0.522258	265	10	1446.439
0.150933998	0.524268894	271	6	1484.019
0.150352844	0.526295334	280	9	1549.339
0.149771689	0.5283375	291	11	1625.069
0.149190535	0.530395576	298	7	1686.479
0.148609381	0.532469749	307	9	1765.239
0.148028227	0.534560208	313	6	1820.064
0.147530095	0.586011327	323	10	1940.344
0.146948941	0.588328886	327	4	1970.864
0.146450809	0.590330004	329	2	1986.674
0.145869655	0.592681917	333	4	2046.014
0.145371523	0.594712808	340	7	2094.334
0.144790369	0.597099844	348	8	2151.742
0.144292237	0.599161178	356	8	2200.272
0.143711083	0.601584129	361	5	2238.802
0.143129929	0.604026756	371	10	2292.682
0.142548775	0.6064893	375	4	2318.702
0.142050643	0.608616089	382	7	2383.291
0.141469489	0.611116272	396	14	2502.371
0.140888335	0.615971908	404	8	2575.641

0.140307181	0.618523271	406	2	2588.541
0.139726027	0.621095858	409	3	2670.081
0.139144873	0.623689933	414	5	2704.741
0.138480697	0.626681252	424	10	2812.381
0.137899543	0.629322293	431	7	2881.161
0.137318389	0.631985688	436	5	2911.171
0.136654213	0.635057308	438	2	2944.831
0.136073059	0.637769572	443	5	3008.181
0.135491905	0.640505103	449	6	3102.391
0.134910751	0.643264202	457	8	3144.491
0.134412619	0.645648134	467	10	3214.301
0.133831465	0.650340233	483	16	3366.561
0.133333333	0.652769898	499	16	3506.741
0.132835201	0.655217785	500	1	3528.641
0.132337069	0.657684101 NA	NA	NA	NA
0.131838937	0.660169053 NA	NA	NA	NA
0.131423827	0.662254236 NA	NA	NA	NA
0.130925695	0.66477391 NA	NA	NA	NA
0.130427563	0.66731283 NA	NA	NA	NA
0.129929431	0.669871218 NA	NA	NA	NA
0.129431299	0.672449298 NA	NA	NA	NA
0.128933167	0.6750473 NA	NA	NA	NA
0.128435035	0.677665453 NA	NA	NA	NA
0.127853881	0.668637198 NA	NA	NA	NA
0.127272727	0.671690335 NA	NA	NA	NA
0.126691573	0.674771484 NA	NA	NA	NA
0.126110419	0.67788103 NA	NA	NA	NA
0.125446243	0.681470076 NA	NA	NA	NA
0.124865089	0.684641811 NA	NA	NA	NA
0.124200913	0.688302998 NA	NA	NA	NA
0.123619759	0.691538807 NA	NA	NA	NA
0.122955583	0.695274331 NA	NA	NA	NA
0.122374429	0.698576177 NA	NA	NA	NA
0.121793275	0.701909533 NA	NA	NA	NA
0.121295143	0.704792118 NA	NA	NA	NA
0.120713989	0.694272276 NA	NA	NA	NA
0.120215857	0.697149095 NA	NA	NA	NA
0.119800747	0.699564719 NA	NA	NA	NA
0.119385637	0.701997142 NA	NA	NA	NA
0.118970527	0.704446539 NA	NA	NA	NA
0.118638439	0.706418397 NA	NA	NA	NA
0.118223329	0.708898799 NA	NA	NA	NA
0.117891241	0.710895697 NA	NA	NA	NA

0.117559153	0.712903877	NA	NA	NA
0.117227065	0.714923435	NA	NA	NA
0.116894977	0.716954467	NA	NA	NA
0.116562889	0.718997073	NA	NA	NA
0.116230801	0.760223803	NA	NA	NA
0.115898713	0.762402095	NA	NA	NA
0.115566625	0.764592906	NA	NA	NA
0.115151515	0.767349189	NA	NA	NA
0.114819427	0.769568564	NA	NA	NA
0.114404317	0.772360903	NA	NA	NA
0.114072229	0.774609407	NA	NA	NA
0.113657119	0.777438513	NA	NA	NA
0.113242009	0.780288361	NA	NA	NA
0.112826899	0.783159179	NA	NA	NA
0.112494811	0.785471088	NA	NA	NA
0.112079701	0.78838024	NA	NA	NA
0.111664591	0.809738346	NA	NA	NA
0.111332503	0.812153673	NA	NA	NA
0.110917393	0.81519317	NA	NA	NA
0.110585305	0.817641198	NA	NA	NA
0.110170195	0.820721986	NA	NA	NA
0.109755085	0.823826078	NA	NA	NA
0.109422997	0.826326309	NA	NA	NA
0.109007887	0.82947302	NA	NA	NA
0.108675799	0.832007697	NA	NA	NA
0.108260689	0.835197911	NA	NA	NA
0.107928601	0.83776775	NA	NA	NA
0.107513491	0.841002375	NA	NA	NA
0.107181403	0.846325902	NA	NA	NA
0.106766293	0.849616438	NA	NA	NA
0.106434205	0.852267348	NA	NA	NA
0.106019095	0.855604338	NA	NA	NA
0.105687007	0.858292804	NA	NA	NA
0.105271897	0.861677239	NA	NA	NA
0.104939809	0.864404066	NA	NA	NA
0.104524699	0.867836966	NA	NA	NA
0.104109589	0.871297241	NA	NA	NA
0.103777501	0.874085392	NA	NA	NA
0.103362391	0.877595775	NA	NA	NA
0.103030303	0.880424448	NA	NA	NA
0.102615193	0.883986035	NA	NA	NA
0.102283105	0.88685612	NA	NA	NA
0.101867995	0.89047004	NA	NA	NA

0.101535907	0.893382453	NA	NA	NA
0.101120797	0.897049868	NA	NA	NA
0.100788709	0.900005552	NA	NA	NA
0.100373599	0.903727659	NA	NA	NA
0.099958489	0.907480681	NA	NA	NA
0.099626401	0.910505616	NA	NA	NA
0.099211291	0.914315263	NA	NA	NA
0.098879203	0.917386011	NA	NA	NA
0.098464093	0.921253575	NA	NA	NA
0.098132005	0.924371184	NA	NA	NA
0.097716895	0.928297995	NA	NA	NA
0.097384807	0.931463546	NA	NA	NA
0.096969697	0.935450976	NA	NA	NA
0.096637609	0.938665584	NA	NA	NA
0.096222499	0.942715047	NA	NA	NA
0.095890411	0.945979861	NA	NA	NA
0.095475301	0.950092817	NA	NA	NA
0.095060191	0.954241694	NA	NA	NA
0.094728103	0.957586976	NA	NA	NA
0.094312993	0.961801707	NA	NA	NA
0.093980905	0.9652003	NA	NA	NA
0.093565795	0.969482466	NA	NA	NA
0.093150685	0.973802798	NA	NA	NA
0.092818597	0.977286887	NA	NA	NA
0.092486509	0.980795996	NA	NA	NA
0.092071399	0.98521798	NA	NA	NA
0.091739311	0.98878438	NA	NA	NA
0.091324201	0.993278854	NA	NA	NA
0.090992113	0.996903959	NA	NA	NA
0.090577003	1.001472722	NA	NA	NA
0.090161893	1.006083554	NA	NA	NA
0.089829805	1.009802902	NA	NA	NA
0.089414695	1.014490937	NA	NA	NA
0.089082607	1.018272823	NA	NA	NA
0.088667497	1.023040018	NA	NA	NA
0.088335409	1.026886033	NA	NA	NA
0.087920299	1.031734409	NA	NA	NA
0.087505189	1.036628785	NA	NA	NA
0.087173101	1.040577847	NA	NA	NA
0.086757991	1.045556689	NA	NA	NA
0.086425903	1.049574198	NA	NA	NA
0.086010793	1.05463971	NA	NA	NA
0.085678705	1.058727461	NA	NA	NA

0.085263595	1.063881928	NA	NA	NA
0.084931507	1.068041779	NA	NA	NA
0.084516397	1.073287563	NA	NA	NA
0.084184309	1.077521439	NA	NA	NA
0.083769199	1.082860991	NA	NA	NA
0.083437111	1.087170885	NA	NA	NA
0.083105023	1.091515224	NA	NA	NA
0.082689913	1.096994718	NA	NA	NA
0.082357825	1.101418084	NA	NA	NA
0.081942715	1.10699771	NA	NA	NA
0.081610627	1.111502278	NA	NA	NA
0.081195517	1.117184805	NA	NA	NA
0.080780407	1.122925734	NA	NA	NA
0.080448319	1.127561135	NA	NA	NA
0.080033209	1.133409481	NA	NA	NA
0.079535077	1.140508079	NA	NA	NA
0.079202989	1.145290083	NA	NA	NA
0.078704857	1.152538755	NA	NA	NA
0.078289747	1.158649777	NA	NA	NA
0.077874637	1.164825948	NA	NA	NA
0.077459527	1.171068317	NA	NA	NA
0.077127439	1.176110592	NA	NA	NA
0.076712329	1.182474826	NA	NA	NA
0.076380241	1.187616021	NA	NA	NA
0.076048153	1.192802117	NA	NA	NA
0.075716065	1.198033706	NA	NA	NA
0.075466999	1.201987612	NA	NA	NA
0.075217933	1.205967704	NA	NA	NA
0.075051889	1.208635774	NA	NA	NA
0.074885845	1.211315676	NA	NA	NA
0.074802823	1.212660088	NA	NA	NA
0.074636779	1.215357886	NA	NA	NA
0.074553757	1.216711291	NA	NA	NA
0.074470735	1.218067714	NA	NA	NA
0.074470735	1.218067714	NA	NA	NA
0.074387713	1.219427165	NA	NA	NA
0.074304691	1.220789653	NA	NA	NA
0.074304691	1.220789653	NA	NA	NA
0.074221669	1.22215519	NA	NA	NA
0.074138647	1.223523785	NA	NA	NA
0.074055625	1.224895448	NA	NA	NA
0.073972603	1.22627019	NA	NA	NA
0.073889581	1.227648022	NA	NA	NA

0.073723537	1.230412995	NA	NA	NA
0.073640515	1.231800157	NA	NA	NA
0.073557493	1.233190451	NA	NA	NA
0.073391449	1.235980475	NA	NA	NA
0.073308427	1.237380226	NA	NA	NA
0.073142383	1.240189262	NA	NA	NA
0.073059361	1.241598568	NA	NA	NA
0.072976339	1.243011108	NA	NA	NA
0.072810295	1.245845769	NA	NA	NA
0.072727273	1.247267968	NA	NA	NA
0.072644251	1.248693417	NA	NA	NA
0.072478207	1.251554112	NA	NA	NA
0.072395185	1.25298938	NA	NA	NA
0.072312163	1.254427944	NA	NA	NA
0.072229141	1.255869816	NA	NA	NA
0.072063097	1.258763525	NA	NA	NA
0.071980075	1.260215386	NA	NA	NA
0.071897053	1.2616706	NA	NA	NA
0.071814031	1.263129179	NA	NA	NA
0.071731009	1.264591134	NA	NA	NA
0.071564965	1.26752522	NA	NA	NA
0.071481943	1.268997375	NA	NA	NA
0.071398921	1.270472953	NA	NA	NA
0.071315899	1.271951967	NA	NA	NA
0.071149855	1.27492035	NA	NA	NA
0.071066833	1.276409743	NA	NA	NA
0.070983811	1.277902619	NA	NA	NA
0.070817767	1.280898874	NA	NA	NA
0.070734745	1.282402277	NA	NA	NA
0.070651723	1.283909212	NA	NA	NA
0.070568701	1.285419694	NA	NA	NA

monthly_new_capacity	Universe	NM_ratio	binomial_probs	NM_customers
3.68	435828.7258	5.7362E-05	0.000150276	65.49438152
4.8	435954.2975	5.96393E-05	0.000149873	65.33756682
23.18	436067.7481	7.10899E-05	0.000149819	65.33128216
2.715	436193.3886	7.56545E-05	0.000150114	65.47864084
7.5	436315.0106	8.7093E-05	0.00015071	65.75712145
18.98	436440.7224	0.000100816	0.000151623	66.17439838
2.94	436562.4134	0.000105369	0.000152846	66.72672403
4.55	436688.1964	0.000109918	0.000154438	67.44125381
10.04	436814.0157	0.000116754	0.000156348	68.29509136
3.9	436935.8108	0.000123588	0.000158584	69.29124595
9.29	437061.7014	0.000132704	0.000161264	70.48226786
33.496	437183.5655	0.000146392	0.00016427	71.81605365
5.95	437309.5275	0.000155496	0.000167948	73.4451825
24.882	437435.5258	0.00017374	0.000172009	75.24302036
18.655	437549.3619	0.000180551	0.000176141	77.07018323
8.765	437675.4293	0.000194208	0.000181261	79.3334962
6.45	437797.4646	0.000205575	0.000186788	81.77532641
4.26	437923.6034	0.000214649	0.000193153	84.58633629
8.83	438045.7079	0.000226004	0.000199883	87.55781938
6.015	438171.9183	0.000230503	0.000207377	90.86666474
12.266	438298.1651	0.000244126	0.000215492	94.44988453
21.56	438420.374	0.000264586	0.000223782	98.11075985
21.95	438546.6923	0.000275911	0.000232694	102.0471555
6.9	438668.9705	0.000282673	0.000241277	105.840636
4.96	438795.3605	0.000289429	0.00024999	109.6945177
8.89	438921.7869	0.000303015	0.000258192	113.3262168
7.08	439040.0897	0.000309767	0.000265211	116.4383441
7.36	439166.5866	0.000314232	0.000271891	119.4052511
29.25	439289.0376	0.000320973	0.000277582	121.9388247
12.96	439415.6063	0.000323156	0.000282649	124.2004341
37.68	439538.1267	0.000327617	0.000286985	126.1407776
9.28	439664.7671	0.000332071	0.000290889	127.8937635
6.025	439791.444	0.000336523	0.000294515	129.52522
7.17	439914.0693	0.000343249	0.000297621	130.9276296
0	440040.818	0.00034315	0.000300806	132.3670452
7.8	440163.5128	0.000347598	0.000303854	133.7452643
10.2	440290.3334	0.000349769	0.000340747	150.0277029
18.995	440417.1905	0.000361021	0.000345985	152.3775289
5.232	440531.8025	0.000363197	0.000351406	154.8055609
4.08	440658.7292	0.000367631	0.000358229	157.856576
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0	440908.595	0.000371959	0.000373789	164.8068935

34.245	441031.5318	0.00038546	0.000382314	168.612479
7.46	441158.6024	0.000392149	0.000391638	172.7745964
41.325	441285.7097	0.000398835	0.000401465	177.1605809
51.29	441408.7516	0.000410051	0.000411421	181.6050216
56.875	441535.931	0.000423522	0.000421484	186.1001447
26.79	441659.0427	0.000434724	0.000431623	190.6300468
55.285	441786.2942	0.00044139	0.000426841	188.5726964
25.77	441913.5823	0.000445789	0.000436016	192.6813261
1.5	442028.5837	0.000447935	0.000444142	196.323337
7.5	442155.9417	0.000452329	0.000452586	200.1134543
24.2	442279.2262	0.000461247	0.000460314	203.5873837
25.84	442406.6564	0.000470156	0.000467774	206.9463288
22.7	442530.0109	0.000479064	0.000474366	209.9212275
91.52	442657.5133	0.00049248	0.000480576	212.730491
48.72	442785.0524	0.000501372	0.000486951	215.6147205
40.25	442908.5124	0.000508006	0.000492896	218.307802
0	443036.1239	0.000507859	0.000498371	220.796559
23.01	443159.6539	0.000516744	0.000503341	223.0605412
72.71	443287.3377	0.00054141	0.000550412	243.9908588
42.014	443415.0583	0.000554785	0.000556261	246.6546554
35.94	443530.4505	0.00055915	0.000561479	249.0328471
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61.41	444413.3689	0.000670547	0.000602519	267.7675059
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38.53	445674.7723	0.000810008	0.00085605	381.5200589
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Mid Cost PV Scenario - Installed Distributed PV Capacity (MWdc)

	Big Rivers	EKPC	LGE/KU	Kentucky	
2014	0.09	1.16	2.31	12.04	
2016	0.31	1.95	3.57	15.6	
2018	1.13	9.13	5.98	27.31	
2020	2.2	14.54	12.17	46.92	
2022	3.65	15.76	17.41	62.01	
2024	6.17	18.41	27.66	90.12	
2026	10.31	24.34	45.33	139.24	
2028	17.06	35.32	74.38	220.77	
2030	27.47	53.36	120.02	347.85	
2032	43.3	81.01	189.05	539.49	

	Original	Smoothed	Customers
2014	2.31	2.31	
2015	2.31	2.94	
2016	3.57	3.57	505.8604715
2017	3.57	4.775	676.6060928
2018	5.98	5.98	847.3517142
2019	5.98	9.075	1285.90582
2020	12.17	12.17	1724.459927
2021	12.17	14.79	2095.707668
2022	17.41	17.41	2466.955409
2023	17.41	22.535	3193.155665
2024	27.66	27.66	3919.355922
2025	27.66	36.495	5171.254316
2026	45.33	45.33	6423.152709
2027	45.33	59.855	8481.31051
2028	74.38	74.38	10539.46831
2029	74.38	97.2	13773.0078
2030	120.02	120.02	17006.54728
2031	120.02	154.535	21897.24033
2032	189.05	189.05	26787.93337
2033	189.05	237.075	33592.96114

YrMn	Year	NM_customers	NREL	NREL_Smooth	blend_factor
1/1/2010	2010	65.49438152	#N/A	0	0
2/1/2010	2010	65.33756682	#N/A	0	0
3/1/2010	2010	65.33128216	#N/A	0	0
4/1/2010	2010	65.47864084	#N/A	0	0
5/1/2010	2010	65.75712145	#N/A	0	0
6/1/2010	2010	66.17439838	#N/A	0	0
7/1/2010	2010	66.72672403	#N/A	0	0
8/1/2010	2010	67.44125381	#N/A	0	0
9/1/2010	2010	68.29509136	#N/A	0	0
10/1/2010	2010	69.29124595	#N/A	0	0
11/1/2010	2010	70.48226786	#N/A	0	0
12/1/2010	2010	71.81605365	#N/A	0	0
1/1/2011	2011	73.4451825	#N/A	0	0
2/1/2011	2011	75.24302036	#N/A	0	0
3/1/2011	2011	77.07018323	#N/A	0	0
4/1/2011	2011	79.3334962	#N/A	0	0
5/1/2011	2011	81.77532641	#N/A	0	0
6/1/2011	2011	84.58633629	#N/A	0	0
7/1/2011	2011	87.55781938	#N/A	0	0
8/1/2011	2011	90.86666474	#N/A	0	0
9/1/2011	2011	94.44988453	#N/A	0	0
10/1/2011	2011	98.11075985	#N/A	0	0
11/1/2011	2011	102.0471555	#N/A	0	0
12/1/2011	2011	105.840636	#N/A	0	0
1/1/2012	2012	109.6945177	#N/A	0	0
2/1/2012	2012	113.3262168	#N/A	0	0
3/1/2012	2012	116.4383441	#N/A	0	0
4/1/2012	2012	119.4052511	#N/A	0	0
5/1/2012	2012	121.9388247	#N/A	0	0
6/1/2012	2012	124.2004341	#N/A	0	0
7/1/2012	2012	126.1407776	#N/A	0	0
8/1/2012	2012	127.8937635	#N/A	0	0
9/1/2012	2012	129.52522	#N/A	0	0
10/1/2012	2012	130.9276296	#N/A	0	0
11/1/2012	2012	132.3670452	#N/A	0	0
12/1/2012	2012	133.7452643	#N/A	0	0
1/1/2013	2013	150.0277029	#N/A	0	0
2/1/2013	2013	152.3775289	#N/A	0	0
3/1/2013	2013	154.8055609	#N/A	0	0
4/1/2013	2013	157.856576	#N/A	0	0
5/1/2013	2013	161.0403249	#N/A	0	0
6/1/2013	2013	164.8068935	#N/A	0	0

7/1/2013	2013	168.612479	#N/A		0	0
8/1/2013	2013	172.7745964	#N/A		0	0
9/1/2013	2013	177.1605809	#N/A		0	0
10/1/2013	2013	181.6050216	#N/A		0	0
11/1/2013	2013	186.1001447	#N/A		0	0
12/1/2013	2013	190.6300468	#N/A		0	0
1/1/2014	2014	188.5726964		0	0	0
2/1/2014	2014	192.6813261		0	0	0
3/1/2014	2014	196.323337		0	0	0
4/1/2014	2014	200.1134543		0	0	0
5/1/2014	2014	203.5873837		0	0	0
6/1/2014	2014	206.9463288		0	0	0
7/1/2014	2014	209.9212275		0	0	0
8/1/2014	2014	212.730491		0	0	0
9/1/2014	2014	215.6147205		0	0	0
10/1/2014	2014	218.307802		0	0	0
11/1/2014	2014	220.796559		0	0	0
12/1/2014	2014	223.0605412		0	0	0
1/1/2015	2015	243.9908588		0	0	0
2/1/2015	2015	246.6546554		0	0	0
3/1/2015	2015	249.0328471		0	0	0
4/1/2015	2015	251.801716		0	0	0
5/1/2015	2015	254.2790588		0	0	0
6/1/2015	2015	257.1587362		0	0	0
7/1/2015	2015	259.7357929		0	0	0
8/1/2015	2015	262.3637179		0	0	0
9/1/2015	2015	265.0413592		0	0	0
10/1/2015	2015	267.7675059		0	0	0
11/1/2015	2015	270.548427		0	0	0
12/1/2015	2015	273.3804798		0	0	0
1/1/2016	2016	352.2141869	505.8604715	42.15503929		0
2/1/2016	2016	356.4124851	505.8604715	84.31007858		0
3/1/2016	2016	360.0891853	505.8604715	126.4651179		0
4/1/2016	2016	364.4531749	505.8604715	168.6201572		0
5/1/2016	2016	368.2792132	505.8604715	210.7751965		0
6/1/2016	2016	372.8177397	505.8604715	252.9302357		0
7/1/2016	2016	376.7976072	505.8604715	295.085275		0
8/1/2016	2016	381.5200589	505.8604715	337.2403143		0
9/1/2016	2016	386.3455712	505.8604715	379.3953536		0
10/1/2016	2016	391.2735112	505.8604715	421.5503929		0
11/1/2016	2016	395.6035904	505.8604715	463.7054322		0
12/1/2016	2016	400.7369221	505.8604715	505.8604715		0
1/1/2017	2017	410.811409	676.6060928	520.0892733		0

2/1/2017	2017	416.2725997	676.6060928	534.3180751	0
3/1/2017	2017	421.8467235	676.6060928	548.5468768	0
4/1/2017	2017	427.560931	676.6060928	562.7756786	0
5/1/2017	2017	434.2319171	676.6060928	577.0044804	0
6/1/2017	2017	440.2345587	676.6060928	591.2332822	0
7/1/2017	2017	446.3743836	676.6060928	605.4620839	0
8/1/2017	2017	453.5560685	676.6060928	619.6908857	0
9/1/2017	2017	460.0176654	676.6060928	633.9196875	0
10/1/2017	2017	466.6307183	676.6060928	648.1484893	0
11/1/2017	2017	473.4088161	676.6060928	662.377291	0
12/1/2017	2017	479.3657642	676.6060928	676.6060928	0
1/1/2018	2018	491.2013438	847.3517142	690.8348946	0
2/1/2018	2018	497.5236302	847.3517142	705.0636964	0
3/1/2018	2018	503.9675192	847.3517142	719.2924982	0
4/1/2018	2018	510.5647692	847.3517142	733.5212999	0
5/1/2018	2018	517.3006783	847.3517142	747.7501017	0
6/1/2018	2018	523.0555581	847.3517142	761.9789035	0
7/1/2018	2018	530.0654318	847.3517142	776.2077053	0
8/1/2018	2018	537.2356743	847.3517142	790.436507	0
9/1/2018	2018	544.5659649	847.3517142	804.6653088	0
10/1/2018	2018	552.0558755	847.3517142	818.8941106	0
11/1/2018	2018	559.720467	847.3517142	833.1229124	0
12/1/2018	2018	567.5544521	847.3517142	847.3517142	0
1/1/2019	2019	541.7058172	1285.90582	883.8978897	0
2/1/2019	2019	550.5134318	1285.90582	920.4440652	0
3/1/2019	2019	559.5420458	1285.90582	956.9902407	0
4/1/2019	2019	568.8309697	1285.90582	993.5364162	0
5/1/2019	2019	579.7288107	1285.90582	1030.082592	0
6/1/2019	2019	589.5720557	1285.90582	1066.628767	0
7/1/2019	2019	601.1268796	1285.90582	1103.174943	0
8/1/2019	2019	611.5683786	1285.90582	1139.721118	0
9/1/2019	2019	623.8385197	1285.90582	1176.267294	0
10/1/2019	2019	634.9207102	1285.90582	1212.813469	0
11/1/2019	2019	646.3284989	1285.90582	1249.359645	0
12/1/2019	2019	656.3911988	1285.90582	1285.90582	0
1/1/2020	2020	621.2731133	1724.459927	1322.451996	0
2/1/2020	2020	630.9017366	1724.459927	1358.998171	0
3/1/2020	2020	639.1286295	1724.459927	1395.544347	0
4/1/2020	2020	647.5404106	1724.459927	1432.090522	0
5/1/2020	2020	656.1240126	1724.459927	1468.636698	0
6/1/2020	2020	663.1653132	1724.459927	1505.182874	0
7/1/2020	2020	672.0819476	1724.459927	1541.729049	0
8/1/2020	2020	679.3973903	1724.459927	1578.275225	0

9/1/2020	2020	686.8393874	1724.459927	1614.8214	0
10/1/2020	2020	694.4043359	1724.459927	1651.367576	0
11/1/2020	2020	702.1079986	1724.459927	1687.913751	0
12/1/2020	2020	709.9404038	1724.459927	1724.459927	0
1/1/2021	2021	885.0610304	2095.707668	1755.397238	0
2/1/2021	2021	895.7648274	2095.707668	1786.33455	0
3/1/2021	2021	906.6428852	2095.707668	1817.271862	0
4/1/2021	2021	920.4932849	2095.707668	1848.209174	0
5/1/2021	2021	931.8535237	2095.707668	1879.146485	0
6/1/2021	2021	946.3001761	2095.707668	1910.083797	0
7/1/2021	2021	958.151755	2095.707668	1941.021109	0
8/1/2021	2021	973.2279196	2095.707668	1971.958421	0
9/1/2021	2021	988.6685925	2095.707668	2002.895732	0
10/1/2021	2021	1004.475786	2095.707668	2033.833044	0
11/1/2021	2021	1017.466023	2095.707668	2064.770356	0
12/1/2021	2021	1033.98025	2095.707668	2095.707668	0
1/1/2022	2022	1162.272197	2466.955409	2126.644979	0
2/1/2022	2022	1178.115011	2466.955409	2157.582291	0
3/1/2022	2022	1198.255909	2466.955409	2188.519603	0
4/1/2022	2022	1214.838786	2466.955409	2219.456915	0
5/1/2022	2022	1235.951353	2466.955409	2250.394226	0
6/1/2022	2022	1257.627055	2466.955409	2281.331538	0
7/1/2022	2022	1275.438929	2466.955409	2312.26885	0
8/1/2022	2022	1298.15596	2466.955409	2343.206162	0
9/1/2022	2022	1316.840316	2466.955409	2374.143473	0
10/1/2022	2022	1340.650632	2466.955409	2405.080785	0
11/1/2022	2022	1360.248958	2466.955409	2436.018097	0
12/1/2022	2022	1385.233366	2466.955409	2466.955409	0
1/1/2023	2023	1427.173135	3193.155665	2527.472097	0
2/1/2023	2023	1453.927729	3193.155665	2587.988785	0
3/1/2023	2023	1475.909188	3193.155665	2648.505473	0
4/1/2023	2023	1504.021313	3193.155665	2709.022161	0
5/1/2023	2023	1527.153215	3193.155665	2769.538849	0
6/1/2023	2023	1556.711449	3193.155665	2830.055537	0
7/1/2023	2023	1581.040053	3193.155665	2890.572225	0
8/1/2023	2023	1612.139358	3193.155665	2951.088913	0
9/1/2023	2023	1644.137723	3193.155665	3011.605601	0
10/1/2023	2023	1670.486547	3193.155665	3072.122289	0
11/1/2023	2023	1704.188825	3193.155665	3132.638977	0
12/1/2023	2023	1731.948998	3193.155665	3193.155665	0
1/1/2024	2024	1767.470726	3919.355922	3253.672353	0
2/1/2024	2024	1796.755209	3919.355922	3314.189041	0
3/1/2024	2024	1834.187595	3919.355922	3374.705729	0

4/1/2024	2024	1865.084194	3919.355922	3435.222418	0
5/1/2024	2024	1904.612277	3919.355922	3495.739106	0
6/1/2024	2024	1937.234092	3919.355922	3556.255794	0
7/1/2024	2024	1978.987685	3919.355922	3616.772482	0
8/1/2024	2024	2022.062723	3919.355922	3677.28917	0
9/1/2024	2024	2057.614132	3919.355922	3737.805858	0
10/1/2024	2024	2103.149176	3919.355922	3798.322546	0
11/1/2024	2024	2140.75933	3919.355922	3858.839234	0
12/1/2024	2024	2188.953377	3919.355922	3919.355922	0
1/1/2025	2025	2228.773219	5171.254316	4023.680788	0.01
2/1/2025	2025	2279.843816	5171.254316	4128.005654	0.006666667
3/1/2025	2025	2321.97319	5171.254316	4232.33052	0.01
4/1/2025	2025	2376.112745	5171.254316	4336.655387	0.013333333
5/1/2025	2025	2420.836203	5171.254316	4440.980253	0.016666667
6/1/2025	2025	2478.278541	5171.254316	4545.305119	0.02
7/1/2025	2025	2525.748519	5171.254316	4649.629985	0.023333333
8/1/2025	2025	2586.747613	5171.254316	4753.954851	0.026666667
9/1/2025	2025	2649.839213	5171.254316	4858.279717	0.03
10/1/2025	2025	2702.009815	5171.254316	4962.604583	0.033333333
11/1/2025	2025	2769.100359	5171.254316	5066.92945	0.036666667
12/1/2025	2025	2824.600404	5171.254316	5171.254316	0.04
1/1/2026	2026	2896.008438	6423.152709	5275.579182	0.043333333
2/1/2026	2026	2969.961728	6423.152709	5379.904048	0.046666667
3/1/2026	2026	3031.122854	6423.152709	5484.228914	0.05
4/1/2026	2026	3094.135785	6423.152709	5588.55378	0.053333333
5/1/2026	2026	3175.228352	6423.152709	5692.878646	0.056666667
6/1/2026	2026	3242.45222	6423.152709	5797.203513	0.06
7/1/2026	2026	3329.011365	6423.152709	5901.528379	0.063333333
8/1/2026	2026	3400.798449	6423.152709	6005.853245	0.066666667
9/1/2026	2026	3493.317453	6423.152709	6110.178111	0.07
10/1/2026	2026	3589.310289	6423.152709	6214.502977	0.073333333
11/1/2026	2026	3668.9775	6423.152709	6318.827843	0.076666667
12/1/2026	2026	3771.707912	6423.152709	6423.152709	0.08
1/1/2027	2027	3857.006993	8481.31051	6594.66586	0.083333333
2/1/2027	2027	3967.101201	8481.31051	6766.17901	0.086666667
3/1/2027	2027	4058.415898	8481.31051	6937.69216	0.09
4/1/2027	2027	4176.487145	8481.31051	7109.20531	0.093333333
5/1/2027	2027	4299.253835	8481.31051	7280.71846	0.096666667
6/1/2027	2027	4401.318184	8481.31051	7452.23161	0.1
7/1/2027	2027	4533.212008	8481.31051	7623.74476	0.103333333
8/1/2027	2027	4642.921142	8481.31051	7795.25791	0.106666667
9/1/2027	2027	4784.827927	8481.31051	7966.77106	0.11
10/1/2027	2027	4902.847095	8481.31051	8138.28421	0.113333333

11/1/2027	2027	5055.657645	8481.31051	8309.79736	0.116666667
12/1/2027	2027	5182.816106	8481.31051	8481.31051	0.12
1/1/2028	2028	5347.56607	10539.46831	8652.82366	0.123333333
2/1/2028	2028	5484.789165	10539.46831	8824.33681	0.126666667
3/1/2028	2028	5662.52619	10539.46831	8995.84996	0.13
4/1/2028	2028	5810.737212	10539.46831	9167.36311	0.133333333
5/1/2028	2028	5964.123187	10539.46831	9338.87626	0.136666667
6/1/2028	2028	6163.17802	10539.46831	9510.389411	0.14
7/1/2028	2028	6329.15471	10539.46831	9681.902561	0.143333333
8/1/2028	2028	6544.697512	10539.46831	9853.415711	0.146666667
9/1/2028	2028	6724.596576	10539.46831	10024.92886	0.15
10/1/2028	2028	6958.240015	10539.46831	10196.44201	0.153333333
11/1/2028	2028	7202.825871	10539.46831	10367.95516	0.156666667
12/1/2028	2028	7407.097764	10539.46831	10539.46831	0.16
1/1/2029	2029	7672.856176	13773.0078	10808.92993	0.163333333
2/1/2029	2029	8008.138873	13773.0078	11078.39156	0.166666667
3/1/2029	2029	8242.991887	13773.0078	11347.85318	0.17
4/1/2029	2029	8611.614974	13773.0078	11617.31481	0.173333333
5/1/2029	2029	8935.805175	13773.0078	11886.77643	0.176666667
6/1/2029	2029	9276.21076	13773.0078	12156.23805	0.18
7/1/2029	2029	9633.627855	13773.0078	12425.69968	0.183333333
8/1/2029	2029	9933.206454	13773.0078	12695.1613	0.186666667
9/1/2029	2029	10324.16167	13773.0078	12964.62292	0.19
10/1/2029	2029	10651.90733	13773.0078	13234.08455	0.193333333
11/1/2029	2029	10993.33092	13773.0078	13503.54617	0.196666667
12/1/2029	2029	11348.90174	13773.0078	13773.0078	0.2
1/1/2030	2030	11626.27158	17006.54728	14042.46942	0.203333333
2/1/2030	2030	11912.4106	17006.54728	14311.93104	0.206666667
3/1/2030	2030	12109.02855	17006.54728	14581.39267	0.21
4/1/2030	2030	12310.16086	17006.54728	14850.85429	0.213333333
5/1/2030	2030	12414.00065	17006.54728	15120.31591	0.216666667
6/1/2030	2030	12621.63174	17006.54728	15389.77754	0.22
7/1/2030	2030	12728.8243	17006.54728	15659.23916	0.223333333
8/1/2030	2030	12837.29162	17006.54728	15928.70078	0.226666667
9/1/2030	2030	12840.99032	17006.54728	16198.16241	0.23
10/1/2030	2030	12950.54097	17006.54728	16467.62403	0.233333333
11/1/2030	2030	13061.39824	17006.54728	16737.08566	0.236666667
12/1/2030	2030	13065.0401	17006.54728	17006.54728	0.24
1/1/2031	2031	13177.13096	21897.24033	17414.10503	0.243333333
2/1/2031	2031	13290.43978	21897.24033	17821.66279	0.246666667
3/1/2031	2031	13404.60834	21897.24033	18229.22054	0.25
4/1/2031	2031	13520.39655	21897.24033	18636.7783	0.253333333
5/1/2031	2031	13637.32311	21897.24033	19044.33605	0.256666667

6/1/2031	2031	13871.29096	21897.24033	19451.8938	0.26
7/1/2031	2031	13992.07139	21897.24033	19859.45156	0.2633333333
8/1/2031	2031	14114.31144	21897.24033	20267.00931	0.2666666667
9/1/2031	2031	14358.71532	21897.24033	20674.56706	0.27
10/1/2031	2031	14484.88013	21897.24033	21082.12482	0.2733333333
11/1/2031	2031	14737.44914	21897.24033	21489.68257	0.2766666667
12/1/2031	2031	14867.82675	21897.24033	21897.24033	0.28
1/1/2032	2032	14999.79615	26787.93337	22304.79808	0.2833333333
2/1/2032	2032	15263.77743	26787.93337	22712.35583	0.2866666667
3/1/2032	2032	15399.90019	26787.93337	23119.91359	0.29
4/1/2032	2032	15537.83818	26787.93337	23527.47134	0.2933333333
5/1/2032	2032	15813.68575	26787.93337	23935.02909	0.2966666667
6/1/2032	2032	15956.29701	26787.93337	24342.58685	0.3
7/1/2032	2032	16100.37141	26787.93337	24750.1446	0.3033333333
8/1/2032	2032	16246.22799	26787.93337	25157.70236	0.3066666667
9/1/2032	2032	16538.16402	26787.93337	25565.26011	0.31
10/1/2032	2032	16688.85379	26787.93337	25972.81786	0.3133333333
11/1/2032	2032	16841.41839	26787.93337	26380.37562	0.3166666667
12/1/2032	2032	16995.56891	26787.93337	26787.93337	0.32
1/1/2033	2033	17151.64285	33592.96114	27355.01902	0.3233333333
2/1/2033	2033	17464.15358	33592.96114	27922.10467	0.3266666667
3/1/2033	2033	17625.1321	33592.96114	28489.19031	0.33
4/1/2033	2033	17788.45946	33592.96114	29056.27596	0.3333333333
5/1/2033	2033	17953.50672	33592.96114	29623.36161	0.3366666667
6/1/2033	2033	18284.42484	33592.96114	30190.44726	0.34
7/1/2033	2033	18455.22914	33592.96114	30757.5329	0.3433333333
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9/1/2033	2033	18974.72519	33592.96114	31891.7042	0.35
10/1/2033	2033	19153.58685	33592.96114	32458.78985	0.3533333333
11/1/2033	2033	19334.72201	33592.96114	33025.8755	0.3566666667
12/1/2033	2033	19517.80119	33592.96114	33592.96114	0.36

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2/1/2018	2018	494.3751316	505.4301456	497.5236302	497.5236302
3/1/2018	2018	497.62273	519.6589473	503.9675192	503.9675192
4/1/2018	2018	500.9605102	533.8877491	510.5647692	510.5647692
5/1/2018	2018	504.3815077	548.1165509	517.3006783	517.3006783
6/1/2018	2018	507.3195762	562.3453527	523.0555581	523.0555581
7/1/2018	2018	510.9054364	576.5741544	530.0654318	530.0654318
8/1/2018	2018	514.5867837	590.8029562	537.2356743	537.2356743
9/1/2018	2018	518.3639359	605.031758	544.5659649	544.5659649
10/1/2018	2018	522.237155	619.2605598	552.0558755	552.0558755
11/1/2018	2018	526.2146157	633.4893616	559.720467	559.720467
12/1/2018	2018	530.2941352	647.7181633	567.5544521	567.5544521
1/1/2019	2019	517.1101386	684.2643388	541.7058172	541.7058172
2/1/2019	2019	521.687757	720.8105144	550.5134318	550.5134318
3/1/2019	2019	526.3968053	757.3566899	559.5420458	559.5420458
4/1/2019	2019	531.2582307	793.9028654	568.8309697	568.8309697
5/1/2019	2019	536.9700442	830.4490409	579.7288107	579.7288107
6/1/2019	2019	542.1573725	866.9952164	589.5720557	589.5720557
7/1/2019	2019	548.2526968	903.541392	601.1268796	601.1268796
8/1/2019	2019	553.7922019	940.0875675	611.5683786	611.5683786
9/1/2019	2019	560.3053124	976.633743	623.8385197	623.8385197
10/1/2019	2019	566.2228531	1013.179919	634.9207102	634.9207102
11/1/2019	2019	572.3328459	1049.726094	646.3284989	646.3284989
12/1/2019	2019	577.7608278	1086.27227	656.3911988	656.3911988
1/1/2020	2020	559.4890228	1122.818445	621.2731133	621.2731133
2/1/2020	2020	564.6837504	1159.364621	630.9017366	630.9017366
3/1/2020	2020	569.1590234	1195.910796	639.1286295	639.1286295
4/1/2020	2020	573.7483711	1232.456972	647.5404106	647.5404106
5/1/2020	2020	578.4454356	1269.003147	656.1240126	656.1240126
6/1/2020	2020	582.3422476	1305.549323	663.1653132	663.1653132
7/1/2020	2020	587.2489444	1342.095498	672.0819476	672.0819476
8/1/2020	2020	591.3216405	1378.641674	679.3973903	679.3973903
9/1/2020	2020	595.476421	1415.187849	686.8393874	686.8393874
10/1/2020	2020	599.7117416	1451.734025	694.4043359	694.4043359
11/1/2020	2020	604.0364041	1488.2802	702.1079986	702.1079986
12/1/2020	2020	608.44548	1524.826376	709.9404038	709.9404038
1/1/2021	2021	702.7039955	1555.763688	885.0610304	885.0610304
2/1/2021	2021	708.856498	1586.700999	895.7648274	895.7648274
3/1/2021	2021	715.1243346	1617.638311	906.6428852	906.6428852
4/1/2021	2021	723.018992	1648.575623	920.4932849	920.4932849
5/1/2021	2021	729.5941731	1679.512935	931.8535237	931.8535237
6/1/2021	2021	737.8649109	1710.450246	946.3001761	946.3001761

7/1/2021	2021	744.7554171	1741.387558	958.151755	958.151755
8/1/2021	2021	753.423801	1772.32487	973.2279196	973.2279196
9/1/2021	2021	762.3209943	1803.262182	988.6685925	988.6685925
10/1/2021	2021	771.4491895	1834.199493	1004.475786	1004.475786
11/1/2021	2021	779.0681233	1865.136805	1017.466023	1017.466023
12/1/2021	2021	788.6441846	1896.074117	1033.98025	1033.98025
1/1/2022	2022	859.619242	1927.011429	1162.272197	1162.272197
2/1/2022	2022	869.0038609	1957.94874	1178.115011	1178.115011
3/1/2022	2022	880.7884091	1988.886052	1198.255909	1198.255909
4/1/2022	2022	890.6492117	2019.823364	1214.838786	1214.838786
5/1/2022	2022	903.0480991	2050.760676	1235.951353	1235.951353
6/1/2022	2022	915.8011879	2081.697987	1257.627055	1257.627055
7/1/2022	2022	926.4532038	2112.635299	1275.438929	1275.438929
8/1/2022	2022	939.8681103	2143.572611	1298.15596	1298.15596
9/1/2022	2022	951.0822511	2174.509923	1316.840316	1316.840316
10/1/2022	2022	965.1940464	2205.447234	1340.650632	1340.650632
11/1/2022	2022	976.9989599	2236.384546	1360.248958	1360.248958
12/1/2022	2022	991.8592762	2267.321858	1385.233366	1385.233366
1/1/2023	2023	1016.281518	2327.838546	1427.173135	1427.173135
2/1/2023	2023	1032.253572	2388.355234	1453.927729	1453.927729
3/1/2023	2023	1045.59186	2448.871922	1475.909188	1475.909188
4/1/2023	2023	1062.431806	2509.38861	1504.021313	1504.021313
5/1/2023	2023	1076.514151	2569.905298	1527.153215	1527.153215
6/1/2023	2023	1094.280063	2630.421986	1556.711449	1556.711449
7/1/2023	2023	1109.139892	2690.938674	1581.040053	1581.040053
8/1/2023	2023	1127.894136	2751.455362	1612.139358	1612.139358
9/1/2023	2023	1147.222144	2811.97205	1644.137723	1644.137723
10/1/2023	2023	1163.39391	2872.488738	1670.486547	1670.486547
11/1/2023	2023	1183.817196	2933.005426	1704.188825	1704.188825
12/1/2023	2023	1200.909002	2993.522114	1731.948998	1731.948998
1/1/2024	2024	1222.5037	3054.038803	1767.470726	1767.470726
2/1/2024	2024	1240.589262	3114.555491	1796.755209	1796.755209
3/1/2024	2024	1263.418438	3175.072179	1834.187595	1834.187595
4/1/2024	2024	1282.557865	3235.588867	1865.084194	1865.084194
5/1/2024	2024	1306.739452	3296.105555	1904.612277	1904.612277
6/1/2024	2024	1327.008272	3356.622243	1937.234092	1937.234092
7/1/2024	2024	1352.629635	3417.138931	1978.987685	1978.987685
8/1/2024	2024	1379.100943	3477.655619	2022.062723	2022.062723
9/1/2024	2024	1401.287174	3538.172307	2057.614132	2057.614132
10/1/2024	2024	1429.354982	3598.688995	2103.149176	2103.149176
11/1/2024	2024	1452.89365	3659.205683	2140.75933	2140.75933
12/1/2024	2024	1482.688531	3719.722371	2188.953377	2188.953377
1/1/2025	2025	1507.680891	3824.047237	2246.722295	2228.773219

2/1/2025	2025	1539.345832	3928.372103	2292.164895	2279.843816
3/1/2025	2025	1565.864417	4032.69697	2341.076763	2321.97319
4/1/2025	2025	1599.529248	4137.021836	2402.253314	2376.112745
5/1/2025	2025	1627.756276	4241.346702	2454.50527	2420.836203
6/1/2025	2025	1663.57689	4345.671568	2519.619072	2478.278541
7/1/2025	2025	1693.618724	4449.996434	2575.305753	2525.748519
8/1/2025	2025	1731.764735	4554.3213	2644.539806	2586.747613
9/1/2025	2025	1771.2736	4658.646166	2716.092428	2649.839213
10/1/2025	2025	1804.421575	4762.971033	2777.362974	2702.009815
11/1/2025	2025	1846.551258	4867.295899	2853.354092	2769.100359
12/1/2025	2025	1881.907183	4971.620765	2918.46656	2824.600404
1/1/2026	2026	1926.871179	5075.945631	2999.12317	2896.008438
2/1/2026	2026	1973.500053	5180.270497	3082.425702	2969.961728
3/1/2026	2026	2012.614328	5284.595363	3153.778157	3031.122854
4/1/2026	2026	2052.962008	5388.92023	3227.171411	3094.135785
5/1/2026	2026	2104.301576	5493.245096	3317.895202	3175.228352
6/1/2026	2026	2147.454371	5597.569962	3395.737297	3242.45222
7/1/2026	2026	2202.400786	5701.894828	3491.937442	3329.011365
8/1/2026	2026	2248.597995	5806.219694	3574.468769	3400.798449
9/1/2026	2026	2307.48159	5910.54456	3676.497699	3493.317453
10/1/2026	2026	2368.655365	6014.869426	3781.82442	3589.310289
11/1/2026	2026	2420.11147	6119.194293	3872.132693	3668.9775
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1/1/2027	2027	2540.976984	6395.032309	4085.145232	3857.006993
2/1/2027	2027	2611.500257	6566.545459	4209.687944	3967.101201
3/1/2027	2027	2670.769436	6738.058609	4317.550762	4058.415898
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5/1/2027	2027	2825.537521	7081.084909	4587.462082	4299.253835
6/1/2027	2027	2892.013084	7252.598059	4706.409527	4401.318184
7/1/2027	2027	2977.037902	7424.111209	4852.567059	4533.212008
8/1/2027	2027	3048.660739	7595.624359	4979.170397	4642.921142
9/1/2027	2027	3140.368946	7767.137509	5134.841672	4784.827927
10/1/2027	2027	3217.598418	7938.650659	5269.529968	4902.847095
11/1/2027	2027	3316.599794	8110.163809	5435.307279	5055.657645
12/1/2027	2027	3400.002497	8281.676959	5578.635435	5182.816106
1/1/2028	2028	3507.003839	8453.190109	5755.214506	5347.56607
2/1/2028	2028	3597.212969	8624.703259	5907.798533	5484.789165
3/1/2028	2028	3712.936723	8796.21641	6095.85828	5662.52619
4/1/2028	2028	3810.591725	8967.72956	6258.287331	5810.737212
5/1/2028	2028	3911.777496	9139.24271	6425.33944	5964.123187
6/1/2028	2028	4041.858743	9310.75586	6631.787614	6163.17802
7/1/2028	2028	4151.598104	9482.26901	6809.715235	6329.15471
8/1/2028	2028	4292.796937	9653.78216	7029.976181	6544.697512

9/1/2028	2028	4412.006945	9825.29531	7219.646419	6724.596576
10/1/2028	2028	4565.435707	9996.80846	7454.764321	6958.240015
11/1/2028	2028	4726.236421	10168.32161	7698.696126	7202.825871
12/1/2028	2028	4862.047881	10339.83476	7908.277051	7407.097764
1/1/2029	2029	5037.188853	10609.29638	8185.081557	7672.856176
2/1/2029	2029	5256.939737	10878.75801	8519.847654	8008.138873
3/1/2029	2029	5413.588339	11148.21963	8770.818307	8242.991887
4/1/2029	2029	5655.784413	11417.68125	9132.602945	8611.614974
5/1/2029	2029	5870.413984	11687.14288	9457.14343	8935.805175
6/1/2029	2029	6096.037351	11956.6045	9794.615673	9276.21076
7/1/2029	2029	6333.211884	12226.06613	10145.50769	9633.627855
8/1/2029	2029	6534.084615	12495.52775	10448.77136	9933.206454
9/1/2029	2029	6794.128915	12764.98937	10825.84931	10324.16167
10/1/2029	2029	7014.374587	13034.451	11151.12826	10651.90733
11/1/2029	2029	7244.070663	13303.91262	11487.00659	10993.33092
12/1/2029	2029	7483.560399	13573.37424	11833.72295	11348.90174
1/1/2030	2030	7673.321648	13842.83587	12117.56514	11626.27158
2/1/2030	2030	7869.302521	14112.29749	12408.31149	11912.4106
3/1/2030	2030	8007.935544	14381.75912	12628.22501	12109.02855
4/1/2030	2030	8149.887114	14651.22074	12852.17546	12310.16086
5/1/2030	2030	8229.098091	14920.68236	13000.36895	12414.00065
6/1/2030	2030	8375.981104	15190.14399	13230.62382	12621.63174
7/1/2030	2030	8457.893889	15459.60561	13383.28362	12728.8243
8/1/2030	2030	8540.852201	15729.06723	13538.01103	12837.29162
9/1/2030	2030	8555.613542	15998.52886	13613.1399	12840.99032
10/1/2030	2030	8639.609462	16267.99048	13771.19369	12950.54097
11/1/2030	2030	8724.680314	16537.45211	13931.31093	13061.39824
12/1/2030	2030	8739.639569	16806.91373	14011.00182	13065.0401
1/1/2031	2031	8825.857102	17214.47148	14208.12799	13177.13096
2/1/2031	2031	8913.100234	17622.02924	14408.14145	13290.43978
3/1/2031	2031	9001.136555	18029.58699	14610.76139	13404.60834
4/1/2031	2031	9090.470182	18437.14474	14816.54659	13520.39655
5/1/2031	2031	9180.787829	18844.7025	15025.1231	13637.32311
6/1/2031	2031	9348.820668	19252.26025	15322.2477	13871.29096
7/1/2031	2031	9442.278183	19659.81801	15537.14817	13992.07139
8/1/2031	2031	9536.94645	20067.37576	15755.03087	14114.31144
9/1/2031	2031	9713.098136	20474.93351	16063.99529	14358.71532
10/1/2031	2031	9810.991417	20882.49127	16288.12701	14484.88013
11/1/2031	2031	9993.448621	21290.04902	16605.56705	14737.44914
12/1/2031	2031	10094.78711	21697.60677	16836.06255	14867.82675
1/1/2032	2032	10197.45127	22105.16453	17069.5467	14999.79615
2/1/2032	2032	10388.82732	22512.72228	17399.03657	15263.77743
3/1/2032	2032	10494.93827	22920.28004	17638.70408	15399.90019

4/1/2032	2032	10602.5413	23327.83779	17881.46391	15537.83818
5/1/2032	2032	10803.23335	23735.39554	18223.01761	15813.68575
6/1/2032	2032	10914.67582	24142.9533	18472.18396	15956.29701
7/1/2032	2032	11027.39114	24550.51105	18724.13595	16100.37141
8/1/2032	2032	11141.59936	24958.06881	18979.08013	16246.22799
9/1/2032	2032	11354.99508	25365.62656	19336.56381	16538.16402
10/1/2032	2032	11473.2097	25773.18431	19597.8292	16688.85379
11/1/2032	2032	11592.99872	26180.74207	19862.08818	16841.41839
12/1/2032	2032	11714.17129	26588.29982	20129.12554	16995.56891
1/1/2033	2033	11836.96201	27155.38547	20450.73448	17151.64285
2/1/2033	2033	12066.75477	27722.47112	20880.4176	17464.15358
3/1/2033	2033	12193.67605	28289.55676	21210.27131	17625.1321
4/1/2033	2033	12322.5259	28856.64241	21544.39829	17788.45946
5/1/2033	2033	12452.88053	29423.72806	21882.35787	17953.50672
6/1/2033	2033	12697.35266	29990.81371	22332.47246	18284.42484
7/1/2033	2033	12832.48844	30557.89935	22679.0201	18455.22914
8/1/2033	2033	12969.45111	31124.985	23029.62005	18628.19228
9/1/2033	2033	13226.34928	31692.07065	23495.66785	18974.72519
10/1/2033	2033	13368.24734	32259.1563	23854.75858	19153.58685
11/1/2033	2033	13512.07413	32826.24194	24217.90009	19334.72201
12/1/2033	2033	13657.60844	33393.32759	24584.85877	19517.80119

NREL_Smooth	NM_customers_blend	bloom adjustments high scenario
690.8348946	491.2013438	-199.6335508
705.0636964	497.5236302	-199.6335508
719.2924982	503.9675192	-199.6335508
733.5212999	510.5647692	-199.6335508
747.7501017	517.3006783	-199.6335508
761.9789035	523.0555581	-199.6335508
776.2077053	530.0654318	-199.6335508
790.436507	537.2356743	-199.6335508
804.6653088	544.5659649	-199.6335508
818.8941106	552.0558755	-199.6335508
833.1229124	559.720467	-199.6335508
847.3517142	567.5544521	-199.6335508
883.8978897	541.7058172	-199.6335508
920.4440652	550.5134318	-199.6335508
956.9902407	559.5420458	-199.6335508
993.5364162	568.8309697	-199.6335508
1030.082592	579.7288107	-199.6335508
1066.628767	589.5720557	-199.6335508
1103.174943	601.1268796	-199.6335508
1139.721118	611.5683786	-199.6335508
1176.267294	623.8385197	-199.6335508
1212.813469	634.9207102	-199.6335508
1249.359645	646.3284989	-199.6335508
1285.90582	656.3911988	-199.6335508
1322.451996	621.2731133	-199.6335508
1358.998171	630.9017366	-199.6335508
1395.544347	639.1286295	-199.6335508
1432.090522	647.5404106	-199.6335508
1468.636698	656.1240126	-199.6335508
1505.182874	663.1653132	-199.6335508
1541.729049	672.0819476	-199.6335508
1578.275225	679.3973903	-199.6335508
1614.8214	686.8393874	-199.6335508
1651.367576	694.4043359	-199.6335508
1687.913751	702.1079986	-199.6335508
1724.459927	709.9404038	-199.6335508
1755.397238	885.0610304	-199.6335508
1786.33455	895.7648274	-199.6335508
1817.271862	906.6428852	-199.6335508
1848.209174	920.4932849	-199.6335508
1879.146485	931.8535237	-199.6335508
1910.083797	946.3001761	-199.6335508

1941.021109	958.151755	-199.6335508
1971.958421	973.2279196	-199.6335508
2002.895732	988.6685925	-199.6335508
2033.833044	1004.475786	-199.6335508
2064.770356	1017.466023	-199.6335508
2095.707668	1033.98025	-199.6335508
2126.644979	1162.272197	-199.6335508
2157.582291	1178.115011	-199.6335508
2188.519603	1198.255909	-199.6335508
2219.456915	1214.838786	-199.6335508
2250.394226	1235.951353	-199.6335508
2281.331538	1257.627055	-199.6335508
2312.26885	1275.438929	-199.6335508
2343.206162	1298.15596	-199.6335508
2374.143473	1316.840316	-199.6335508
2405.080785	1340.650632	-199.6335508
2436.018097	1360.248958	-199.6335508
2466.955409	1385.233366	-199.6335508
2527.472097	1427.173135	-199.6335508
2587.988785	1453.927729	-199.6335508
2648.505473	1475.909188	-199.6335508
2709.022161	1504.021313	-199.6335508
2769.538849	1527.153215	-199.6335508
2830.055537	1556.711449	-199.6335508
2890.572225	1581.040053	-199.6335508
2951.088913	1612.139358	-199.6335508
3011.605601	1644.137723	-199.6335508
3072.122289	1670.486547	-199.6335508
3132.638977	1704.188825	-199.6335508
3193.155665	1731.948998	-199.6335508
3253.672353	1767.470726	-199.6335508
3314.189041	1796.755209	-199.6335508
3374.705729	1834.187595	-199.6335508
3435.222418	1865.084194	-199.6335508
3495.739106	1904.612277	-199.6335508
3556.255794	1937.234092	-199.6335508
3616.772482	1978.987685	-199.6335508
3677.28917	2022.062723	-199.6335508
3737.805858	2057.614132	-199.6335508
3798.322546	2103.149176	-199.6335508
3858.839234	2140.75933	-199.6335508
3919.355922	2188.953377	-199.6335508
4023.680788	2246.722295	-199.6335508

4128.005654	2292.164895	-199.6335508
4232.33052	2341.076763	-199.6335508
4336.655387	2402.253314	-199.6335508
4440.980253	2454.50527	-199.6335508
4545.305119	2519.619072	-199.6335508
4649.629985	2575.305753	-199.6335508
4753.954851	2644.539806	-199.6335508
4858.279717	2716.092428	-199.6335508
4962.604583	2777.362974	-199.6335508
5066.92945	2853.354092	-199.6335508
5171.254316	2918.46656	-199.6335508
5275.579182	2999.12317	-199.6335508
5379.904048	3082.425702	-199.6335508
5484.228914	3153.778157	-199.6335508
5588.55378	3227.171411	-199.6335508
5692.878646	3317.895202	-199.6335508
5797.203513	3395.737297	-199.6335508
5901.528379	3491.937442	-199.6335508
6005.853245	3574.468769	-199.6335508
6110.178111	3676.497699	-199.6335508
6214.502977	3781.82442	-199.6335508
6318.827843	3872.132693	-199.6335508
6423.152709	3983.823495	-199.6335508
6594.66586	4085.145232	-199.6335508
6766.17901	4209.687944	-199.6335508
6937.69216	4317.550762	-199.6335508
7109.20531	4450.207507	-199.6335508
7280.71846	4587.462082	-199.6335508
7452.23161	4706.409527	-199.6335508
7623.74476	4852.567059	-199.6335508
7795.25791	4979.170397	-199.6335508
7966.77106	5134.841672	-199.6335508
8138.28421	5269.529968	-199.6335508
8309.79736	5435.307279	-199.6335508
8481.31051	5578.635435	-199.6335508
8652.82366	5755.214506	-199.6335508
8824.33681	5907.798533	-199.6335508
8995.84996	6095.85828	-199.6335508
9167.36311	6258.287331	-199.6335508
9338.87626	6425.33944	-199.6335508
9510.389411	6631.787614	-199.6335508
9681.902561	6809.715235	-199.6335508
9853.415711	7029.976181	-199.6335508

10024.92886	7219.646419	-199.6335508
10196.44201	7454.764321	-199.6335508
10367.95516	7698.696126	-199.6335508
10539.46831	7908.277051	-199.6335508
10808.92993	8185.081557	-199.6335508
11078.39156	8519.847654	-199.6335508
11347.85318	8770.818307	-199.6335508
11617.31481	9132.602945	-199.6335508
11886.77643	9457.14343	-199.6335508
12156.23805	9794.615673	-199.6335508
12425.69968	10145.50769	-199.6335508
12695.1613	10448.77136	-199.6335508
12964.62292	10825.84931	-199.6335508
13234.08455	11151.12826	-199.6335508
13503.54617	11487.00659	-199.6335508
13773.0078	11833.72295	-199.6335508
14042.46942	12117.56514	-199.6335508
14311.93104	12408.31149	-199.6335508
14581.39267	12628.22501	-199.6335508
14850.85429	12852.17546	-199.6335508
15120.31591	13000.36895	-199.6335508
15389.77754	13230.62382	-199.6335508
15659.23916	13383.28362	-199.6335508
15928.70078	13538.01103	-199.6335508
16198.16241	13613.1399	-199.6335508
16467.62403	13771.19369	-199.6335508
16737.08566	13931.31093	-199.6335508
17006.54728	14011.00182	-199.6335508
17414.10503	14208.12799	-199.6335508
17821.66279	14408.14145	-199.6335508
18229.22054	14610.76139	-199.6335508
18636.7783	14816.54659	-199.6335508
19044.33605	15025.1231	-199.6335508
19451.8938	15322.2477	-199.6335508
19859.45156	15537.14817	-199.6335508
20267.00931	15755.03087	-199.6335508
20674.56706	16063.99529	-199.6335508
21082.12482	16288.12701	-199.6335508
21489.68257	16605.56705	-199.6335508
21897.24033	16836.06255	-199.6335508
22304.79808	17069.5467	-199.6335508
22712.35583	17399.03657	-199.6335508
23119.91359	17638.70408	-199.6335508

23527.47134	17881.46391	-199.6335508
23935.02909	18223.01761	-199.6335508
24342.58685	18472.18396	-199.6335508
24750.1446	18724.13595	-199.6335508
25157.70236	18979.08013	-199.6335508
25565.26011	19336.56381	-199.6335508
25972.81786	19597.8292	-199.6335508
26380.37562	19862.08818	-199.6335508
26787.93337	20129.12554	-199.6335508
27355.01902	20450.73448	-199.6335508
27922.10467	20880.4176	-199.6335508
28489.19031	21210.27131	-199.6335508
29056.27596	21544.39829	-199.6335508
29623.36161	21882.35787	-199.6335508
30190.44726	22332.47246	-199.6335508
30757.5329	22679.0201	-199.6335508
31324.61855	23029.62005	-199.6335508
31891.7042	23495.66785	-199.6335508
32458.78985	23854.75858	-199.6335508
33025.8755	24217.90009	-199.6335508
33592.96114	24584.85877	-199.6335508

in-house adjustments low scenario	prop of jan18	portion of increase
0	1	0.501
-3.148498636	1.012871069	0.502
-6.344789175	1.0259897	0.503
-9.604259014	1.039420547	0.504
-12.9191706	1.053133679	0.505
-15.73598187	1.064849607	0.506
-19.1599954	1.079120484	0.507
-22.64889062	1.093717843	0.508
-26.20202895	1.108641032	0.509
-29.81872056	1.12388918	0.51
-33.50585125	1.139492947	0.511
-37.26031686	1.155441571	0.512
-24.59567854	1.102818272	0.513
-28.82567478	1.120749035	0.514
-33.14524046	1.139129713	0.515
-37.57273894	1.158040337	0.516
-42.75876653	1.180226435	0.517
-47.41468313	1.200265559	0.518
-52.87418271	1.223789159	0.519
-57.77617672	1.245046225	0.52
-63.53320727	1.270026085	0.521
-68.69785717	1.292587486	0.522
-73.99565299	1.315811748	0.523
-78.630371	1.336297645	0.524
-61.78409051	1.264803367	0.525
-66.2179862	1.284405559	0.526
-69.96960617	1.301154074	0.527
-73.79203955	1.318278988	0.528
-77.67857701	1.3357537	0.529
-80.82306565	1.350088557	0.53
-84.83300317	1.368241264	0.531
-88.07574976	1.383134226	0.532
-91.36296637	1.39828483	0.533
-94.69259435	1.413685742	0.534
-98.07159449	1.429369051	0.535
-101.4949239	1.445314458	0.536
-182.3570349	1.801829416	0.537
-186.9083294	1.823620474	0.538
-191.5185506	1.845766297	0.539
-197.4742929	1.873963287	0.54
-202.2593506	1.897090746	0.541
-208.4352652	1.926501603	0.542

-213.3963379	1.950629344	0.543
-219.8041186	1.981321778	0.544
-226.3475982	2.012756286	0.545
-233.026597	2.044936968	0.546
-238.3978997	2.071382817	0.547
-245.3360658	2.105002894	0.548
-302.6529546	2.366182852	0.549
-309.1111504	2.398436051	0.55
-317.4674997	2.439439395	0.551
-324.189574	2.473199231	0.552
-332.9032543	2.516180725	0.553
-341.8258673	2.560308662	0.554
-348.9857256	2.596570521	0.555
-358.2878495	2.642818421	0.556
-365.7580645	2.680856501	0.557
-375.4565852	2.729330139	0.558
-383.2499977	2.769228901	0.559
-393.3740898	2.820092786	0.56
-410.8916162	2.905474818	0.561
-421.6741567	2.959942491	0.562
-430.317328	3.004692896	0.563
-441.5895065	3.061924263	0.564
-450.6390639	3.109016769	0.565
-462.4313855	3.169192162	0.566
-471.9001613	3.218720945	0.567
-484.2452223	3.282033689	0.568
-496.9155796	3.347176762	0.569
-507.0926375	3.400818358	0.57
-520.3716296	3.4694303	0.571
-531.0399959	3.525945154	0.572
-544.9670261	3.598261178	0.573
-556.1659464	3.657879262	0.574
-570.7691566	3.734085051	0.575
-582.5263283	3.796985121	0.576
-597.8728248	3.877457383	0.577
-610.2258199	3.943869692	0.578
-626.3580497	4.028872702	0.579
-642.9617791	4.116565942	0.58
-656.3269582	4.188942392	0.581
-673.7941938	4.281643775	0.582
-687.8656804	4.35821147	0.583
-706.2648459	4.456326118	0.584
-721.0923282	4.537392349	0.585

-740.4979834	4.641363149	0.586
-756.1087725	4.727131184	0.587
-776.5834975	4.837349848	0.588
-793.079927	4.928398982	0.589
-814.7016507	5.045341533	0.59
-832.1297946	5.141982103	0.591
-854.9828779	5.266165588	0.592
-878.5656126	5.394609046	0.593
-897.5882392	5.500819265	0.594
-922.5491011	5.637403875	0.595
-942.6932202	5.750392257	0.596
-969.1372589	5.895766521	0.597
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Year	Month	YM	Base	High	Low
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2018	3	2018_3	3.480679718	3.58905344	3.436859078
2018	4	2018_4	3.553784657	3.716124194	3.486934239
2018	5	2018_5	3.599837719	3.814281939	3.509934652
2018	6	2018_6	3.638948147	3.912291051	3.529471398
2018	7	2018_7	3.686899089	4.010393052	3.553630694
2018	8	2018_8	3.735961772	4.108471133	3.578460337
2018	9	2018_9	3.78613347	4.206526183	3.603962007
2018	10	2018_10	3.8374107	4.304559019	3.630136976
2018	11	2018_11	3.889899286	4.402572285	3.657043076
2018	12	2018_12	3.943561411	4.500566148	3.684664054
2019	1	2019_1	3.759493376	4.748863992	3.58879687
2019	2	2019_2	3.82008114	5.001793766	3.620056199
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2019	9	2019_9	4.325792897	6.772129606	3.8852438
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2027	9	2027_9	35.61673559	53.87509502	21.78250033
2027	10	2027_10	36.55239446	55.06690201	22.31905451
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2027	12	2027_12	38.70282632	57.45568226	23.58815299
2028	1	2028_1	39.93283137	58.65286425	24.33351403
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2029	1	2029_1	56.84571288	73.68198006	34.98347442
2029	2	2029_2	59.18451146	75.57106701	36.51818938
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2029	4	2029_4	63.45873517	79.33681289	39.29974043
2029	5	2029_5	65.72260697	81.22003263	40.42744072
2029	6	2029_6	68.07679637	83.10354966	41.60037719
2029	7	2029_7	70.52470974	84.98734526	42.8202549
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2029	10	2029_10	77.53043742	90.62461339	46.31683982
2029	11	2029_11	79.86844689	92.50128225	47.48475195
2029	12	2029_12	82.28196701	94.3780699	48.69042281
2030	1	2030_1	84.25075843	96.24618535	49.67663241
2030	2	2030_2	86.26745219	98.11423176	50.68674625
2030	3	2030_3	87.78341653	99.97287423	51.44941498
2030	4	2030_4	89.3272375	101.8312486	52.22592319
2030	5	2030_5	90.33577552	103.6794738	52.73772989
2030	6	2030_6	91.92302259	105.5372723	53.53574588
2030	7	2030_7	92.96199654	107.3843941	54.06262574
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2030	9	2030_9	94.50607086	111.0660813	54.85228547
2030	10	2030_10	95.58203297	112.9116065	55.39732585
2030	11	2030_11	96.67210811	114.7566346	55.94932997
2030	12	2030_12	97.19413656	116.5893409	56.22043507
2031	1	2031_1	98.54472081	119.3961152	56.90115135
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2031	4	2031_4	102.713314	127.8125254	59.00125067
2031	5	2031_5	104.1424016	130.6167386	59.7209109
2031	6	2031_6	106.1958013	133.4340264	60.74940948
2031	7	2031_7	107.6680645	136.2370063	61.49058848
2031	8	2031_8	109.1607594	139.039396	62.24191261
2031	9	2031_9	111.2956202	141.8557702	63.31100276
2031	10	2031_10	112.8309012	144.6569214	64.08356698
2031	11	2031_11	115.0240441	147.4726837	65.18173984
2031	12	2031_12	116.602679	150.272611	65.97593105
2032	1	2032_1	118.2017463	153.0719647	66.78027722
2032	2	2032_2	120.4776853	155.8868308	67.91973859
2032	3	2032_3	122.118772	158.684926	68.74506193

2032	4	2032_4	123.7809968	161.4824731	69.58089461
2032	5	2032_5	126.1397436	164.2964284	70.7616695
2032	6	2032_6	127.8455018	167.092748	71.61923834
2032	7	2032_7	129.5702065	169.8884688	72.48623607
2032	8	2032_8	131.3153078	172.6836319	73.36338244
2032	9	2032_9	133.7833305	175.4964344	74.5986664
2032	10	2032_10	135.5712828	178.2903414	75.49722266
2032	11	2032_11	137.379615	181.0836924	76.40592326
2032	12	2032_12	139.2067999	183.8764494	77.3240132
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2033	2	2033_2	144.3916839	191.7056623	79.91882126
2033	3	2033_3	146.659253	195.6092499	81.05549628
2033	4	2033_4	148.9560328	199.5122312	82.206759
2033	5	2033_5	151.2789011	203.4145166	83.37106323
2033	6	2033_6	154.392309	207.3371403	84.92743206
2033	7	2033_7	156.7735154	211.2379319	86.12097498
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2033	9	2033_9	162.4048779	219.0593984	88.93935521
2033	10	2033_10	164.8712582	222.9579339	90.17555028
2033	11	2033_11	167.3651959	226.8557717	91.42551729
2033	12	2033_12	169.885031	230.7528608	92.68843354

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 7

Witness: Stuart A. Wilson

Q-7. Reference the 2018 IRP at Vol. I, 5-40, and the statement "CO2 prices also weaken the overall value of battery storage, as the energy arbitrage value from off-peak coal-fired generation is eroded...."

a) Identify and provide all authorities/analysis on which the Companies' relied in support of the assertion that CO2 pricing would weaken the overall value of battery storage.

A-7.

a) The Companies' analysis demonstrated that CO₂ pricing would weaken the overall value of battery storage because it would increase the cost of charging the battery.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 8

Witness: Stuart A. Wilson / Gary H. Revlett

- Q-8. Reference the 2018 IRP at Vol. I, at 5-22, and the statement “With no regulations specifying a market for CO₂ emissions allowances or a CO₂ emissions tax, the Companies assumed CO₂ prices would begin in 2026 in the High CO₂ price scenario. The High CO₂ scenario is not linked in any way to the proposed ACE Rule”; and at 5-24 n.17, the statement “The High CO₂ emissions price is based on a forecast developed by Synapse Energy Economics in March 2016. Synapse’s Spring 2016 Low CO₂ price forecast began in 2022 and was presented in real 2015 dollars. For this analysis, it was escalated to nominal dollars at 1.8% annually and the onset was delayed to 2026.”
- a) Confirm that the Companies’ High CO₂ price scenario is based on Synapse’s 2016 Low CO₂ scenario (or if denied, please explain); and discuss why the Company chose Synapse’s Low scenario, as opposed to their Mid or High forecasts, for the Companies’ High own scenario.
 - b) Explain the Companies’ choice to begin the carbon price in 2026 rather than 2022, the latter being the start year of the Synapse model on which the Companies base their High scenario.
 - c) Explain the Companies’ decision to model only a Zero case and a High case for future CO₂ pricing (and not also a Low case, for instance); and explain which, if either, the Companies consider to be their “base,” or most likely, case.
 - d) Explain whether the Companies have performed or obtained any analysis considering the prospective impact of the so-called ACE rule (assuming it were upheld and implemented) on the effect of that rule on the respective economics of their coal and gas units, their current PPAs (including with OVEC), DSM, or renewable energy and storage build-out. Further, if they have, identify and provide such analysis; or if they have not, explain whether or not they believe it is reasonable to do so, as well as an estimate of when they may perform such analysis.
- A-8.
- a) Confirmed. Because no CO₂ prices currently exist for any promulgated legislation, choosing a CO₂ price forecast is necessarily an arbitrary exercise. Synapse’s high and

- mid forecasts reflected “the indicated stringency of the Clean Power Plan” which has been replaced by the Affordable Clean Energy Rule, for which there are no CO₂ prices. Therefore, of Synapse’s three options, the low case appeared to be the most reasonable alternative to use as a basis for developing a theoretical CO₂ price scenario for the 2018 IRP. Synapse’s plot of “Utility non-zero and non-confidential reference case forecasts from 2012-2015” supports this conclusion by demonstrating that most of other utilities’ CO₂ price scenarios fall near or below Synapse’s low case.
- b) Because no CO₂ prices actually exist for any promulgated legislation, the Companies delayed the start date of prices in this theoretical CO₂ price scenario to allow time for a potential new regulation to be developed and implemented.
 - c) The Companies’ modeling of CO₂ prices was not an attempt to accurately forecast the CO₂ prices that might occur from any new regulation that might be developed. Instead the Zero and High CO₂ prices were intended to demonstrate a range of possible futures that could drive different scenarios of future replacement generation capacity. An additional “Low” CO₂ price case was unnecessary for this analysis. By showing the results of both CO₂ price scenarios, the Companies did not treat either CO₂ price case as more likely than the other.
 - d) The Companies have initiated an evaluation of the Affordable Clean Energy (“ACE”) rule’s impact on continued operation of the Companies coal-fired electric generating units. The ACE rule does not require the review of impacts on gas-fired units, PPAs, DSM, or potential renewable energy and possible storage build-out. The Companies will complete the required ACE rule evaluation of affected units to meet deadlines set by the State of Kentucky that will aid in facilitating the State’s submittal of required state implementation plans to EPA.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 9

Witness: Stuart A. Wilson

Q-9. Reference the 2018 IRP at Vol. I, at 5-37-5-39.

- a) Whereas the heading and context of discussion is the Companies' "Long-Term Resource Plan," and the title of Table 5-15 is "Long-Term Resource Plans," explain why the Companies choose to consider only the near-term with respect to battery storage and renewables, in stating (at 5-38): "Table 5-15 lists the least-cost resource plans from this analysis. ... In developing these resource plans, the Companies evaluated whether – in the near-term – existing resources should be replaced with a combination of battery storage and renewables and determined that this is not least-cost."

A-9.

- a) The Companies' long-term analysis did consider both battery storage and renewables, as the results in Table 5-15 include varying levels of wind, solar, and batteries as part of the resource mix. In addition to the long-term analysis, the Companies performed a near-term replacement analysis that evaluated replacing Brown 3 with a combination of battery storage and renewables and determined that such a combination was not least-cost.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 10

Witness: Stuart A. Wilson

Q-10. Reference the 2018 IRP at Vol. I, at 5-40, and the statement: "The economics of meeting load exclusively with renewable assets (wind and solar), coupled with SCCTs and batteries for peaking needs, is not cost effective. In the absence of significantly lower than forecasted costs of renewables and battery storage or significantly higher natural gas or CO₂ prices, NGCC capacity is forecasted to be the primary source of replacement capacity as coal resources are retired."

- a) Identify and provide all authorities on which the Companies' relied in support of that assertion.
- b) Identify/estimate specific numerical figures for the terms "significantly lower" and "significantly higher" as used by the Companies in that assertion.

A-10.

- a) The statement referenced is supported by the Companies' analysis.
- b) The Companies have not performed a break-even analysis on the costs of renewables and battery storage, or the prices of natural gas and CO₂ emissions at which renewables and battery storage become cost competitive as the primary source of replacement capacity. However, Tables 16 through 21 beginning on page 26 of the 2018 IRP Long-Term Resource Planning Analysis in Volume III contain annual revenue requirement differences between the optimal resource plan in each scenario and less favorable resource plans. In the Base Load, High CO₂ Price scenario, for example, replacing one NGCC unit in the optimal resource plan with one SCCT and 500 MW of wind increases annual revenue requirements by \$18.4 million (see Table 17).

**Louisville Gas and Electric Company and Kentucky Utilities Company
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Case No. 2018-00348

Question No. 11

Witness: Stuart A. Wilson

- Q-11. Identify and provide the most recently published evaluation of the economics of solar generation and of battery storage, respectively, relied on by the 2018 IRP.
- A-11. As stated on page 4 of the 2018 IRP Resource Screening Analysis, the Companies' source for most of the cost and operating inputs for generation resources was NREL's 2018 ATB, which is available at <https://atb.nrel.gov/electricity/2018/index.html>. NREL's 2019 ATB is now available at <http://atb.nrel.gov/>.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
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Case No. 2018-00348

Question No. 12

Witness: Stuart A. Wilson

Q-12. Reference the 2018 IRP at Vol. I, at 6-3, and the statement: "Moving forward, near-term gas prices are not expected to change materially and the pace of coal retirements is expected to slow.³⁵ 35 PJM coal capacity retirements in the most recent five years (2014-2018) total just over 20 GW, while announced PJM coal capacity retiring in the next five years (2019-2023) only total just over 3 GW."

- a) Identify the timeframe as well as the geographic area to which the Companies' prediction that the "pace of coal retirements is expected to slow" pertains.
- b) Identify and produce all authorities and analysis relied on by the Companies to support that prediction.

A-12.

- a) As indicated in footnote 35, the timeframe over which the pace of coal retirements is expected to slow is 2019 through 2023 and the geographic region is the PJM territory.
- b) The source of this prediction is the April 2018 issue of "Announced US coal-fired power plant retirements" from IHS Markit. A footnote in this report names "SNL Energy, ABB Velocity Suite, Company announcements, and other public documents" as data sources.

**Louisville Gas and Electric Company and Kentucky Utilities Company
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Case No. 2018-00348

Question No. 13

Witness: Stuart A. Wilson

- Q-13. Reference the 2018 IRP at Vol. I, 6-17, addressing the Companies' forward-going DSM-EE programs, and the statement: "For example, because the Companies are experiencing very low load growth and have no capacity constraints, the 2019-2025 DSM-EE Program Plan uses zero avoided capacity costs, which has a significant impact on program and portfolio cost-effectiveness."
- a) Whereas the Companies' suggest that low load growth and no capacity constraints lead to the choice of a zero avoided capacity cost, explain whether this implies that, if the Companies choice to target/maintain a lower capacity reserve margin, DSM-EE programs might instead be cost-effective in such circumstances (including by identifying what percentage that reserve margin would have to be)?
 - b) Identify and provide all analysis performed or obtained by the Companies (whether by pointing to relevant parts of the 2018 IRP or otherwise) relied on by the Companies that compares the cost-effectiveness of investing in DSM-EE programs, versus maintaining baseload resources to provide capacity, in order to achieve energy margin goals.
- A-13.
- a) The Companies have not performed this analysis.
 - b) The Companies' only DSM-EE program that provides capacity is the DLC program, which was evaluated the in the "2018 IRP Reserve Margin Analysis," contained in Volume III of the 2018 IRP.

**Louisville Gas and Electric Company and Kentucky Utilities Company
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Case No. 2018-00348

Question No. 14

Witness: Gary H. Revlett

Q-14. Reference the 2018 IRP at Vol. I, 6-19, and the statement addressing the Companies' forward-going DSM-EE programs, and the statement: "Unlined CCR storage impoundments (which account for most of the Companies' ponds) must monitor groundwater surrounding CCR impoundments and begin closure of the ponds within 6 months if a statistically significant increase in contaminants is found. Those studies are nearing an end and will likely lead to the eventual closure of all current CCR storage impoundments."

- a) Provide an update on the referenced studies, including by explain whether the studies are completed and what they concluded with regard to the increase in contaminants.
- b) Provide an update, with respect to each of the Companies' currently active CCR storage impoundments, whether the Companies are committed to closing each impoundment; and for each such impoundment, identify the date by which the Companies have committed to closing it.
- c) Confirm whether the Companies have any plans to remediate any of their CCR impoundments, closed or active, via excavation. Further, confirm whether the Companies they have performed or consulted any analysis concerning what the cost of doing so might be, and produce any such analysis.

A-14.

- a) Assessment activities at all locations (except LG&E's Cane Run Station, because of a delayed compliance schedule) have been completed. As described previously, most CCR impoundments within the LG&E and KU fleet have identified concentrations of Appendix IV parameters at levels which exceed the SSL relating to the site-specific GPS. The results of the studies presume that the source for the elevated parameters are generally the CCR units.

EPA updated the CCR Rule (Federal Register, Volume 83, Number 146) on July 20, 2018. The update included a provision which allowed the suspension of the initiation of closure of unlined CCR impoundments for exceedances of any GPS at SSLs until October 31, 2020.

- b) LG&E and KU have committed to closing or eliminating all CCR impoundments within its fleet. Some of the aforementioned CCR impoundments have already initiated closure and a few of the smaller units have completed the closure process. A detailed summary with relevant closure dates is provided below:

LG&E-Cane Run Station-ATB

Closure completed August 31, 2017.

LG&E-Mill Creek Station-Dead Storage Pond*

Closure initiated May 1, 2017.

LG&E-Mill Creek Station-Clearwell*, Construction Runoff Pond* & Emergency Pond*

Closure initiated March 21, 2018.

LG&E-Mill Creek Station-Ash Treatment Basin

Closure expected to be initiated on or before October 31, 2020.

LG&E-Trimble County Station-Bottom Ash Pond and Gypsum Storage Pond

Closure expected to be initiated on or before October 31, 2020.

KU-E.W. Brown Station-Auxiliary Pond

Closure expected to be initiated on or before October 31, 2020.

KU-Ghent Station-Ash Treatment Basin #1, Reclaim Pond*, Secondary Pond* & Gypsum Stack*

Closure initiated on the Reclaim Pond on June 16, 2017.

Closure initiated on the Gypsum Stack on June 16, 2017.

Closure expected to be initiated on all other impoundments on or before October 31, 2020.

KU-Ghent Station-Ash Treatment Basin #2

Closure expected to be initiated on or before October 31, 2020.

- c) Yes, the companies have evaluated remediation of their CCR impoundments and the items denoted with an asterisk in the response to part b of this question are being closed using closure-by-removal methods. The analysis resulted in the smaller impoundments that are located at sites with larger CCR impoundments being clean closed and consolidated into the larger impoundment. The companies have not performed a detailed analysis of larger impoundments. Clean closure was included in the 2016 ECR Cases, No. 2016-00026 and No. 2016-00027.

**Louisville Gas and Electric Company and Kentucky Utilities Company
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Case No. 2018-00348

Question No. 15

Witness: David Huff

- Q15. Reference the 2018 IRP at Vol. I, 8-6, and the statement: "The following programs have expired or will expire in 2018: Residential Refrigerator Removal, Residential Incentives, Residential Conservation/Home Energy Performance, Smart Energy Profile, and Customer Education and Public Information. The School Energy Management Program ("SEMP") was not approved."
- a) Discuss whether the Companies may re-propose to the Commission any of these programs, or any other not-currently-approved programs, for (re)instatement in the future.
- A-15.
- a) Yes, the Companies may propose to the Commission any of those expired programs or other programs in the future.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 16

Witness: Robert M. Conroy

- Q-16. Confirm whether KU nor any affiliate of KU has any contractual rights to the output of the Joppa Facilities in Illinois—namely, a six-unit coal-fired generating facility, with a capacity of approximately 948 MW (summer rating), and two gas turbines, located in Joppa, Illinois, under the operation and control of subsidiaries of Dynegy Inc., the majority (80 percent) owner of EEInc.; and further confirm whether KU holds a 20 percent interest in EEInc.
- a) Explain whether/how the power and capacity of the Joppa Facilities, or KU's interest in EEInc, affect the Companies' retail rates and provision of services in Kentucky.
- A-16. KU does not have any contractual rights to the output of the Electric Energy, Inc. ("EEInc") generating facilities. KU's power supply agreement with EEInc expired in 2006.

KU owns 20% of the common stock of EEInc, which owns and operates generating stations in southern Illinois. EEInc generally sells its production into the wholesale market.

- a) KU's investment in EEInc is removed from rate base and does not affect the retail rates and provision of services in Kentucky.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 17

Witness: Stuart A. Wilson

Q-17. Please produce an authentic copy of the current OVEC ICPA

- a) If your response to this request is the same as it was to the same request posed by Sierra Club DR 1-1 in Case Nos. 2018-00294 and 2018-00295, please confirm; or if your response is now different, confirm that and explain how it is different now.

A-17. See attached.

- a) This response is the same as the responses to the referenced questions from Case Nos. 2018-00294 and 2018-00295.

AMENDED AND RESTATED
INTER-COMPANY POWER AGREEMENT
DATED AS OF SEPTEMBER 10, 2010

AMONG

OHIO VALLEY ELECTRIC CORPORATION,
ALLEGHENY ENERGY SUPPLY COMPANY, L.L.C.
APPALACHIAN POWER COMPANY,
BUCKEYE POWER GENERATING, LLC,
COLUMBUS SOUTHERN POWER COMPANY,
THE DAYTON POWER AND LIGHT COMPANY,
DUKE ENERGY OHIO, INC.,
FIRSTENERGY GENERATION CORP.,
INDIANA MICHIGAN POWER COMPANY,
KENTUCKY UTILITIES COMPANY,
LOUISVILLE GAS AND ELECTRIC COMPANY,
MONONGAHELA POWER COMPANY,
OHIO POWER COMPANY,
PENINSULA GENERATION COOPERATIVE, and
SOUTHERN INDIANA GAS AND ELECTRIC COMPANY

INTER-COMPANY POWER AGREEMENT

THIS AGREEMENT, dated as of September 10, 2010 (the "Agreement"), by and among OHIO VALLEY ELECTRIC CORPORATION (herein called OVEC), ALLEGHENY ENERGY SUPPLY COMPANY, L.L.C. (herein called Allegheny), APPALACHIAN POWER COMPANY (herein called Appalachian), BUCKEYE POWER GENERATING, LLC (herein called Buckeye), COLUMBUS SOUTHERN POWER COMPANY (herein called Columbus), THE DAYTON POWER AND LIGHT COMPANY (herein called Dayton), DUKE ENERGY OHIO, INC. (formerly known as The Cincinnati Gas & Electric Company and herein called Duke Ohio), FIRSTENERGY GENERATION CORP. (herein called FirstEnergy), INDIANA MICHIGAN POWER COMPANY (herein called Indiana), KENTUCKY UTILITIES COMPANY (herein called Kentucky), LOUISVILLE GAS AND ELECTRIC COMPANY (herein called Louisville), MONONGAHELA POWER COMPANY (herein called Monongahela), OHIO POWER COMPANY (herein called Ohio Power), PENINSULA GENERATION COOPERATIVE (herein called Peninsula), and SOUTHERN INDIANA GAS AND ELECTRIC COMPANY (herein called Southern Indiana, and all of the foregoing, other than OVEC, being herein sometimes collectively referred to as the Sponsoring Companies and individually as a Sponsoring Company) hereby amends and restates in its entirety, the Inter-Company Power Agreement dated as of March 13, 2006, as amended by Modification No. 1, dated as of March 13, 2006 (herein called the Current Agreement), by and among OVEC and the Sponsoring Companies.

WITNESSETH THAT:

WHEREAS, the Current Agreement amended and restated the original Inter-Company Power Agreement, dated as of July 10, 1953, as amended by Modification No. 1, dated as of June 3, 1966; Modification No. 2, dated as of January 7, 1967; Modification No. 3, dated as of November 15, 1967; Modification No. 4, dated as of November 5, 1975; Modification No. 5, dated as of September 1, 1979; Modification No. 6, dated as of August 1, 1981; Modification No. 7, dated as of January 15, 1992; Modification No. 8, dated as of January 19, 1994; Modification No. 9, dated as of August 17, 1995; Modification No. 10, dated as of January 1, 1998; Modification No. 11, dated as of April 1, 1999; Modification No. 12, dated as of November 1, 1999; Modification No. 13, dated as of May 24, 2000; Modification No. 14, dated as of April 1, 2001; and Modification No. 15, dated as of April 30, 2004 (together, herein called the Original Agreement); and

WHEREAS, OVEC designed, purchased, and constructed, and continues to operate and maintain two steam-electric generating stations, one station (herein called Ohio Station) consisting of five turbo-generators and all other necessary equipment, at a location on the Ohio River near Cheshire, Ohio, and the other station (herein called Indiana Station) consisting of six turbogenerators and all other necessary equipment, at a location on the Ohio River near Madison,

WHEREAS, OVEC also designed, purchased, and constructed, and continues to operate and maintain necessary transmission and general plant facilities (herein called the Project Transmission Facilities) and OVEC established or cause to be established interconnections between the Project Generating Stations and the systems of certain of the Sponsoring Companies; and

WHEREAS, OVEC entered into an agreement, attached hereto as Exhibit A, with Indiana-Kentucky Electric Corporation (herein called IKEC), a corporation organized under the laws of the State of Indiana as a wholly owned subsidiary corporation of OVEC, which has been amended and restated as of the date of this Agreement and embodies the terms and conditions for the ownership and operation by IKEC of the Indiana Station and such portion of the Project Transmission Facilities which are to be owned and operated by it; and

WHEREAS, transmission facilities were constructed by certain of the Sponsoring Companies to interconnect the systems of such Sponsoring Companies, directly or indirectly, with the Project Generating Stations and/or the Project Transmission Facilities, and the Sponsoring Companies have agreed to pay for Available Power, as hereinafter defined, as may be available at the Project Generating Stations; and

WHEREAS, the parties hereto desire to amend and restate in their entirety, the Current Agreement to define the terms and conditions governing the rights of the Sponsoring Companies to receive Available Power from the Project Generating Stations and the obligations of the Sponsoring Companies to pay therefor.

NOW, THEREFORE, the parties hereto agree with each other as follows:

ARTICLE 1

DEFINITIONS

1.01. For the purposes of this Agreement, the following terms, wherever used herein, shall have the following meanings:

1.011 "Affiliate" means, with respect to a specified person, any other person that directly or indirectly through one or more intermediaries controls, is controlled by, or is under common control with, such specified person; provided that "control" for these purposes means the possession, directly or indirectly, of the power to direct or cause the direction of the management and policies of a person, whether through the ownership of voting securities, by contract or otherwise.

1.013 "Available Energy" of the Project Generating Stations means the energy associated with Available Power.

1.014 "Available Power" of the Project Generating Stations at any particular time means the total net kilowatts at the 345-kV busses of the Project Generating Stations which Corporation in its sole discretion will determine that the Project Generating Stations will be capable of safely delivering under conditions then prevailing, including all conditions affecting capability.

1.015 "Corporation" means OVEC, IKEC, and all other subsidiary corporations of OVEC.

1.016 "Decommissioning and Demolition Obligation" has the meaning set forth in Section 5.03(f) hereof.

1.017 "Effective Date" means September 10, 2010, or to the extent necessary, such later date on which Corporation notifies the Sponsoring Companies that all conditions to effectiveness, including all required waiting periods and all required regulatory acceptances or approvals, of this Agreement have been satisfied in form and substance satisfactory to the Corporation.

1.018 "Election Period" has the meaning set forth in Section 9.183(a) hereof.

1.019 "Minimum Generating Unit Output" means 80 MW (net) for each of the Corporation's generation units; provided that such "Minimum Generating Unit Output" shall be confirmed from time to time by operating tests on the Corporation's generation units and shall be adjusted by the Operating Committee as appropriate following such tests.

1.0110 "Minimum Loading Event" means a period of time during which one or more of the Corporation's generation units are operating at below the Minimum Generating Output as a result of the Sponsoring Companies' failure to schedule and take delivery of sufficient Available Energy.

1.0111 "Minimum Loading Event Costs" means the sum of the following costs caused by one or more Minimum Loading Events: (i) the actual costs of any of the Corporation's generating units burning fuel oil; and (ii) the estimated actual additional costs to the Corporation resulting from Minimum Loading Events, including without limitation the incremental costs of additional emissions allowances, reflected in the schedule of charges prepared by the Operating Committee and in effect as of the commencement of any Minimum Loading Event, which schedule may be adjusted from time to time as necessary by the Operating Committee.

1.0112 “Month” means a calendar month.

1.0113 “Nominal Power Available” means an individual Sponsoring Company’s Power Participation Ratio share of the Corporation’s current estimate of the maximum amount of Available Power available for delivery at any given time.

1.0114 “Offer Notice” means the notice required to be given to the other Sponsoring Companies by a Transferring Sponsor offering to sell all or a portion of such Transferring Sponsor’s rights, title and interests in, and obligations under this Agreement. At a minimum, the Offer Notice shall be in writing and shall contain (i) the rights, title and interests in, and obligations under this Agreement that the Transferring Sponsor proposes to Transfer; and (ii) the cash purchase price and any other material terms and conditions of such proposed transfer. An Offer Notice may not contain terms or conditions requiring the purchase of any non-OVEC interests.

1.0115 “Permitted Assignee” means a person that is (a) a Sponsoring Company or its Affiliate whose long-term unsecured non-credit enhanced indebtedness, as of the date of such assignment, has a Standard & Poor’s credit rating of at least BBB- and a Moody’s Investors Service, Inc. credit rating of at least Baa3 (provided that, if the proposed assignee’s long-term unsecured non-credit enhanced indebtedness is not currently rated by one of Standard & Poor’s or Moody, such assignee’s long-term unsecured non-credit enhanced indebtedness, as of the date of such assignment, must have either a Standard & Poor’s credit rating of at least BBB- or a Moody’s Investors Service, Inc. credit rating of at least Baa3); or (b) a Sponsoring Company or its Affiliate that does not meet the criteria in subsection (a) above, if the Sponsoring Company or its Affiliate that is assigning its rights, title and interests in, and obligations under, this Agreement agrees in writing (in form and substance satisfactory to Corporation) to remain obligated to satisfy all of the obligations related to the assigned rights, title and interests to the extent such obligations are not satisfied by the assignee of such rights, title and interests; provided that, in no event shall a person be deemed a “Permitted Assignee” if counsel for the Corporation reasonably determines that the assignment of the rights, title or interests in, or obligations under, this Agreement to such person could cause a termination, default, loss or payment obligation under any security issued, or agreement entered into, by the Corporation prior to such transfer.

1.0116 “Postretirement Benefit Obligation” has the meaning set forth in Section 5.03(e) hereof.

1.0117 “Power Participation Ratio” as applied to each of the Sponsoring Companies refers to the percentage set forth opposite its respective name in the tabulation below:

Company	Power Participation Ratio—Percent
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Allegheny	3.01
Appalachian.....	15.69
Buckeye.....	18.00
Columbus	4.44
Dayton.....	4.90
Duke Ohio.....	9.00
FirstEnergy.....	4.85
Indiana.....	7.85
Kentucky	2.50
Louisville	5.63
Monongahela.....	0.49
Ohio Power	15.49
Peninsula	6.65
Southern Indiana	<u>1.50</u>
Total	100.0

1.0118 “Tariff” means the open access transmission tariff of the Corporation, as amended from time to time, or any successor tariff, as accepted by the Federal Energy Regulatory Commission or any successor agency.

1.0119 “Third Party” means any person other than a Sponsoring Company or its Affiliate.

1.0120 “Total Minimum Generating Output” means the product of the Minimum Generating Unit Output times the number of the Corporation’s generation units available for service at that time.

1.0121 “Transferring Sponsor” has the meaning set forth in Section 9.183(a) hereof.

1.0122 “Uniform System of Accounts” means the Uniform System of Accounts prescribed by the Federal Energy Regulatory Commission as in effect on January 1, 2004.

ARTICLE 2

TRANSMISSION AGREEMENT AND FACILITIES

2.01. *Transmission Agreement.* The Corporation shall enter into a transmission service agreement under the Tariff, and the Corporation shall reserve and schedule transmission service, ancillary services and other transmission-related services in accordance with the Tariff to provide for the delivery of Available Power and Available Energy to the applicable delivery point under this Agreement.

2.02. *Limited Burdening of Corporation's Transmission Facilities.*

Transmission facilities owned by the Corporation, including the Project Transmission Facilities, shall not be burdened by power and energy flows of any Sponsoring Company to an extent which would impair or prevent the transmission of Available Power.

ARTICLE 3

[RESERVED]

ARTICLE 4

AVAILABLE POWER SUPPLY

4.01. *Operation of Project Generating Stations.* Corporation shall operate and maintain the Project Generating Stations in a manner consistent with safe, prudent, and efficient operating practice so that the Available Power available from said stations shall be at the highest practicable level attainable consistent with OVEC's obligations under Reliability *First* Reliability Standard BAL-002-RFC throughout the term of this Agreement.

4.02. *Available Power Entitlement.* The Sponsoring Companies collectively shall be entitled to take from Corporation and Corporation shall be obligated to supply to the Sponsoring Companies any and all Available Power and Available Energy pursuant to the provisions of this Agreement. Each Sponsoring Company's Available Power Entitlement hereunder shall be its Power Participation Ratio, as defined in *subsection 1.0117*, of Available Power.

4.03. *Available Energy.* Corporation shall make Available Energy available to each Sponsoring Company in proportion to said Sponsoring Company's Power Participation Ratio. No Sponsoring Company, however, shall be obligated to avail itself of any Available Energy. Available Energy shall be scheduled and taken by the Sponsoring Companies in accordance with the following procedures:

4.031 Each Sponsoring Company shall schedule the delivery of all or any portion (in whole MW increments) of its entitlement to Available Energy in accordance with scheduling procedures established by the Operating Committee from time to time.

4.032 In the event that any Sponsoring Company does not schedule the delivery of all of its Power Participation Ratio share of Available Energy, then each such other Sponsoring Company may schedule the delivery of all or any portion (in whole MW increments) of any such unscheduled share of Available Energy (through successive allotments if necessary) in proportion to their Power Participation Ratios.

4.033 Notwithstanding any Available Energy schedules made in accordance with this Section 4.03 and the applicable scheduling procedures, (i) the Corporation shall adjust all schedules to the extent that the Corporation's actual generation output is less than or more than the expected Nominal Power Available to all Sponsoring Companies, or to the extent that the Corporation is unable to obtain sufficient transmission service under the Tariff for the delivery of all scheduled Available Energy; and (ii) immediately following a Minimum Loading Event, any Sponsoring Company causing (in whole or part) such Minimum Loading Event shall have its Available Energy schedules increased after the schedules of the Sponsoring Companies not causing such Minimum Load Event, in accordance with the estimated ramp rates associated with the shutdown and start-up of the Corporation's generation units as reflected in the schedules prepared by the Operating Committee and in effect as of the commencement of any Minimum Loading Event, which schedules may be adjusted from time to time as necessary by the Operating Committee.

4.034 Each Sponsoring Company availing itself of Available Energy shall be entitled to an amount of energy (herein called billing kilowatt-hours of Available Energy) equal to its portion, determined as provided in this Section 4.03, of the total Available Energy after deducting therefrom such Sponsoring Company's proportionate share, as defined in this Section 4.03, of all losses as determined in accordance with the Tariff incurred in transmitting the total of such Available Energy from the 345-kV busses of the Project Generating Stations to the applicable delivery points, as scheduled pursuant to Section 9.01, of all Sponsoring Companies availing themselves of Available Energy. The proportionate share of all such losses that shall be so deducted from such Sponsoring Company's portion of Available Energy shall be equal to all such losses multiplied by the ratio of such portion of Available Energy to the total of such Available Energy. Each Sponsoring Company shall have the right, pursuant to this Section 4.03, to avail itself of Available Energy for the purpose of meeting the loads of its own system and/or of supplying energy to other systems in accordance with agreements, other than this Agreement, to which such Sponsoring Company is a party.

4.035 To the extent that, as a result of the failure by one or more Sponsoring Companies to take its respective Power Participation Ratio share of the applicable Total Minimum Generating Output during any hour, a Minimum Loading Event shall occur, then such one or more Sponsoring Companies shall be assessed charges for any Minimum Loading Event Costs in accordance with Section 5.05.

ARTICLE 5

CHARGES FOR AVAILABLE POWER AND MINIMUM LOADING EVENT COSTS

5.01. *Total Monthly Charge.* The amount to be paid to Corporation each month by the Sponsoring Companies for Available Power and Available Energy supplied under this

Agreement shall consist of the sum of an energy charge, a demand charge, and a transmission charge, all determined as set forth in this *Article 5*. Page 9 of 60
Wilson

5.02. *Energy Charge*. The energy charge to be paid each month by the Sponsoring Companies for Available Energy shall be determined by Corporation as follows:

5.021 Determine the aggregate of all expenses for fuel incurred in the operation of the Project Generating Stations, in accordance with Account 501 (Fuel), Account 506.5 (Variable Reagent Costs Associated With Pollution Control Facilities) and 509 (Allowances) of the Uniform System of Accounts.

5.022 Determine for such month the difference between the total cost of fuel as described in subsection 5.021 above and the total cost of fuel included in any Minimum Loading Event Costs payable to the Corporation for such month pursuant to Section 8.03. For the purposes hereof the difference so determined shall be the fuel cost allocable for such month to the total kilowatt-hours of energy generated at the Project Generating Stations for the supply of Available Energy. For Available Energy availed of by the Sponsoring Companies, each Sponsoring Company shall pay Corporation for each such month an amount obtained by multiplying the ratio of the billing kilowatt-hours of such Available Energy availed of by such Sponsoring Company during such month to the aggregate of the billing kilowatt-hours of all Available Energy availed of by all Sponsoring Companies during such month times the total cost of fuel as described in this subsection 5.022 for such month.

5.03. *Demand Charge*. During the period commencing with the Effective Date and for the remainder of the term of this Agreement, demand charges payable by the Sponsoring Companies to Corporation shall be determined by the Corporation as provided below in this Section 5.03. Each Sponsoring Company's share of the aggregate demand charges shall be the percentage of such charges represented by its Power Participation Ratio.

The aggregate demand charge payable each month by the Sponsoring Companies to Corporation shall be equal to the total costs incurred for such month by Corporation resulting from its ownership, operation, and maintenance of the Project Generating Stations and Project Transmission Facilities determined as follows:

As soon as practicable after the close of each calendar month the following components of costs of Corporation (eliminating any duplication of costs which might otherwise be reflected among the corporate entities comprising Corporation) applicable for such month to the ownership, operation and maintenance of the Project Generating Stations and the Project Transmission Facilities, including additional facilities and/or spare parts (such as fuel processing plants, flue gas or waste product processing facilities, and facilities reasonably required to enable the Corporation to limit the emission of pollutants or the discharge of wastes in compliance with governmental requirements) and

replacements necessary or desirable to keep the Project Generating Stations and the Project Transmission Facilities in a dependable and efficient operating condition, and any provision for any taxes that may be applicable to such charges, to be determined and recorded in the following manner:

(a) Component (A) shall consist of fixed charges made up of (i) the amounts of interest properly chargeable to Accounts 427, 430 and 431, less the amount thereof credited to Account 432, of the Uniform System of Accounts, including the interest component of any purchase price, interest, rental or other payment under an installment sale, loan, lease or similar agreement relating to the purchase, lease or acquisition by Corporation of additional facilities and replacements (whether or not such interest or other amounts have come due or are actually payable during such Month), (ii) the amounts of amortization of debt discount or premium and expenses properly chargeable to Accounts 428 and 429, and (iii) an amount equal to the sum of (I) the applicable amount of the debt amortization component for such month required to retire the total amount of indebtedness of Corporation issued and outstanding, (II) the amortization requirement for such month in respect of indebtedness of Corporation incurred in respect of additional facilities and replacements, and (III) to the extent not provided for pursuant to clause (II) of this clause (iii), an appropriate allowance for depreciation of additional facilities and replacements.

(b) Component (B) shall consist of the total operating expenses for labor, maintenance, materials, supplies, services, insurance, administrative and general expense, etc., properly chargeable to the Operation and Maintenance Expense Accounts of the Uniform System of Accounts (exclusive of Accounts 501, 509, 555, 911, 912, 913, 916, and 917 of the Uniform System of Accounts), minus the total of all non-fuel costs included in any Minimum Loading Event Costs payable to the Corporation for such month pursuant to Section 8.03, minus the total of all transmission charges payable to the Corporation for such month pursuant to Section 5.04, and plus any additional amounts which, after provision for all income taxes on such amounts (which shall be included in Component (C) below), shall equal any amounts paid or payable by Corporation as fines or penalties with respect to occasions where it is asserted that Corporation failed to comply with a law or regulation relating to the emission of pollutants or the discharge of wastes.

(c) Component (C) shall consist of the total expenses for taxes, including all taxes on income but excluding any federal income taxes arising from payments to Corporation under Component (D) below, and all operating or other costs or expenses, net of income, not included or

specifically excluded in Components (A) or (B) above, including tax adjustments, regulatory adjustments, net losses for the disposition of property and other net costs or expenses associated with the operation of a utility.

(d) Component (D) shall consist of an amount equal to the product of \$2.089 multiplied by the total number of shares of capital stock of the par value of \$100 per share of Ohio Valley Electric Corporation which shall have been issued and which are outstanding on the last day of such month.

(e) Component (E) shall consist of an amount to be sufficient to pay the costs and other expenses relating to the establishment, maintenance and administration of life insurance, medical insurance and other postretirement benefits other than pensions attributable to the employment and employee service of active employees, retirees, or other employees, including without limitation any premiums due or expected to become due, as well as administrative fees and costs, such amounts being sufficient to provide payment with respect to all periods for which Corporation has committed or is otherwise obligated to make such payments, including amounts attributable to current employee service and any unamortized prior service cost, gain or loss attributable to prior service years (“Postretirement Benefit Obligation”); provided that, the amount payable for Postretirement Benefit Obligations during any month shall be determined by the Corporation based on, among other factors, the Statement of Financial Accounting Standards No. 106 (Employers’ Accounting For Postretirement Benefits Other Than Pensions) and any applicable accounting standards, policies or practices as adopted from time to time relating to accruals with respect to all or any portion of such Postretirement Benefit Obligation.

(f) Component (F) shall consist of an amount that may be incurred in connection with the decommissioning, shutdown, demolition and closing of the Project Generating Stations when production of electric power and energy is discontinued at such Project Generating Stations, which amount shall include, without limitation the following costs (net of any salvage credits): the costs of demolishing the plants’ building structures, disposal of non-salvageable materials, removal and disposal of insulating materials, removal and disposal of storage tanks and associated piping, disposal or removal of materials and supplies (including fuel oil and coal), grading, covering and reclaiming storage and disposal areas, disposing of ash in ash ponds to the extent required by regulatory authorities, undertaking corrective or remedial action required by regulatory authorities, and any other costs incurred in putting the facilities

in a condition necessary to protect health or the environment or which are required by regulatory authorities, or which are incurred to fund continuing obligations to monitor or to correct environmental problems which result, or are later discovered to result, from the facilities' operation, closure or post-closure activities ("Decommissioning and Demolition Obligation") provided that, the amount payable for Decommissioning and Demolition Obligations during any month shall be calculated by Corporation based on, among other factors, the then-estimated useful life of the Project Generating Stations and any applicable accounting standards, policies or practices as adopted from time to time relating to accruals with respect to all or any portion of such Decommissioning and Demolition Obligation, and provided further that, the Corporation shall recalculate the amount payable under this Component (F) for future months from time to time, but in no event later than five (5) years after the most recent calculation.

5.04. *Transmission Charge.* The transmission charges to be paid each month by the Sponsoring Companies shall be equal to the total costs incurred for such month by Corporation for the purchase of transmission service, ancillary services and other transmission-related services under the Tariff as reserved and scheduled by the Corporation to provide for the delivery of Available Power and Available Energy to the applicable delivery point under this Agreement. Each Sponsoring Company's share of the aggregate transmission charges shall be the percentage of such charges represented by its Power Participation Ratio.

5.05. *Minimum Loading Event Costs.* To the extent that, as a result of the failure by one or more Sponsoring Companies to take its respective Power Participation Ratio share of the applicable Total Minimum Generating Output during any hour, a Minimum Loading Event shall occur, then the sum of all Minimum Loading Event Costs relating to such Minimum Loading Event shall be charged to such Sponsoring Company or group of Sponsoring Companies that failed take its respective Power Participation Ratio share of the applicable Total Minimum Generating Output during such period, with such Minimum Loading Event Costs allocated among such Sponsoring Companies on a pro-rata basis in accordance with such Sponsoring Company's MWh share of the MWh reduction in the delivery of Available Energy causing any Minimum Loading Event. The applicable charges for Minimum Loading Event Costs as determined by the corporation in accordance with Section 5.05 shall be paid each month by the applicable Sponsoring Companies.

ARTICLE 6

Metering of Energy Supplied

6.01. *Measuring Instruments.* The parties hereto shall own and maintain such metering equipment as may be necessary to provide complete information regarding the delivery of power and energy to or for the account of any of the parties hereto; and the ownership and

expense of such metering shall be in accordance with agreements among them. Each party will at its own expense make such periodic tests and inspections of its meters as may be necessary to maintain them at the highest practical commercial standard of accuracy and will advise all other interested parties hereto promptly of the results of any such test showing an inaccuracy of more than 1%. Each party will make additional tests of its meters at the request of any other interested party. Other interested parties shall be given notice of, and may have representatives present at, any test and inspection made by another party.

ARTICLE 7

COSTS OF REPLACEMENTS AND ADDITIONAL FACILITIES; PAYMENTS FOR EMPLOYEE BENEFITS; DECOMMISSIONING, SHUTDOWN, DEMOLITION AND CLOSING CHARGES

7.01. *Replacement Costs.* The Sponsoring Companies shall reimburse Corporation for the difference between (a) the total cost of replacements chargeable to property and plant made by Corporation during any month prior thereto (and not previously reimbursed) and (b) the amounts received by Corporation as proceeds of fire or other applicable insurance protection, or amounts recovered from third parties responsible for damages requiring replacement, plus provision for all taxes on income on such difference; provided that, to the extent that the Corporation arranges for the financing of any replacements, the payments due under this Section 7.01 shall equal the amount of all principal, interest, taxes and other costs and expenses related to such financing during any month. Each Sponsoring Company's share of such payment shall be the percentage of such costs represented by its Power Participation Ratio. The term cost of replacements, as used herein, shall include all components of cost, plus removal expense, less salvage.

7.02. *Additional Facility Costs.* The Sponsoring Companies shall reimburse Corporation for the total cost of additional facilities and/or spare parts purchased and/or installed by Corporation during any month prior thereto (and not previously reimbursed), plus provision for all taxes on income on such costs; provided that, to the extent that the Corporation arranges for the financing of any additional facilities and/or spare parts, the payments due under this Section 7.02 shall equal the amount of all principal, interest, taxes and other costs and expenses related to such financing during any month. Each Sponsoring Company's share of such payment shall be the percentage of such costs represented by its Power Participation Ratio.

7.03. *Payments for Employee Benefits.* Not later than the effective date of termination of this Agreement, each Sponsoring Company will pay to Corporation its Power Participation Ratio share of additional amounts, after provision for any taxes that may be applicable thereto, sufficient to cover any shortfall if the amount of the Postretirement Benefit Obligation collected by the Corporation prior to the effective date of termination of the Agreement is insufficient to permit Corporation to fulfill its commitments or obligations with respect to both postemployment benefit obligations under the Statement of Financial Accounting Standards No. 112 and postretirement benefits other than pensions, as determined by Corporation

with the aid of an actuary or actuaries selected by the Corporation based on the terms of the Corporation's then-applicable plans. Page 14 of 60
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7.04. *Decommissioning, Shutdown, Demolition and Closing.* The Sponsoring Companies recognize that a part of the cost of supplying power to it under this Agreement is the amount that may be incurred in connection with the decommissioning, shutdown, demolition and closing of the Project Generating Stations when production of electric power and energy is discontinued at such Project Generating Stations. Not later than the effective date of termination of this Agreement, each Sponsoring Company will pay to Corporation its Power Participation Ratio share of additional amounts, after provision for any taxes that may be applicable thereto, sufficient to cover any shortfall if the amount of the Decommissioning and Demolition Obligation collected by the Corporation prior to the effective date of termination of the Agreement is insufficient to permit Corporation to complete the decommissioning, shutdown, demolition and closing of the Project Generating Stations, based on the Corporation's recalculation of the Decommissioning and Demolition Obligation in accordance with Section 5.03(f) of this Agreement no earlier than twelve (12) months before the effective date of termination of this Agreement.

ARTICLE 8

BILLING AND PAYMENT

8.01. *Available Power, and Replacement and Additional Facility Costs.* As soon as practicable after the end of each month Corporation shall render to each Sponsoring Company a statement of all Available Power and Available Energy supplied to or for the account of such Sponsoring Company during such month, specifying the amount due to the Corporation therefor, including any amounts for reimbursement for the cost of replacements and additional facilities and/or spare parts incurred during such month, pursuant to *Articles 5 and 7* above. Such Sponsoring Company shall make payment therefor promptly upon the receipt of such statement, but in no event later than fifteen (15) days after the date of receipt of such statement. In case any factor entering into the computation of the amount due for Available Power and Available Energy cannot be determined at the time, it shall be estimated subject to adjustment when the actual determination can be made.

8.02. *Provisional Payments for Available Power.* The Sponsoring Companies shall, from time to time, at the request of the Corporation, make provisional semi-monthly payments for Available Power in amounts approximately equal to the estimated amounts payable for Available Power delivered by Corporation to the Sponsoring Companies during each semi-monthly period. As soon as practicable after the end of each semi-monthly period with respect to which Corporation has requested the Sponsoring Companies to make provisional semi-monthly payments for Available Power, Corporation shall render to each Sponsoring Company a separate statement indicating the amount payable by such Sponsoring Company for such semi-monthly period. Such Sponsoring Company shall make payment therefor promptly upon receipt of such statement, but in no event later than fifteen (15) days after the date of receipt of such

statement and the amounts so paid by such Sponsoring Company shall be credited to the account of such Sponsoring Company with respect to future payments to be made pursuant to Articles 5 and 7 above by such Sponsoring Company to Corporation for Available Power.

8.03. *Minimum Loading Event Costs.* As soon as practicable after the end of each month, Corporation shall render to each Sponsoring Company a statement indicating any applicable charges for Minimum Loading Event Costs pursuant to Section 5.05 during such month, specifying the amount due to the Corporation therefor pursuant to *Article 5* above. Such Sponsoring Company shall make payment therefor promptly upon the receipt of such statement, but in no event later than fifteen (15) days after the date of receipt of such statement. In case the computation of the amount due for Minimum Loading Event Costs cannot be determined at the time, it shall be estimated subject to adjustment when the actual determination can be made, and all payments shall be subject to subsequent adjustment.

8.04. *Unconditional Obligation to Pay Demand and Other Charges.* The obligation of each Sponsoring Company to pay its specified portion of the Demand Charge under Section 5.03, the Transmission Charge under Section 5.04, and all charges under *Article 7* for any Month shall not be reduced irrespective of:

(a) whether or not any Available Power or Available Energy are supplied by the Corporation during such calendar month and whether or not any Available Power or Available Energy are accepted by any Sponsoring Company during such calendar month;

(b) the existence of any claim, set-off, defense, reduction, abatement or other right (other than irrevocable payment, performance, satisfaction or discharge in full) that such Sponsoring Company may have, or which may at any time be available to or be asserted by such Sponsoring Company, against the Corporation, any other Sponsoring Company, any creditor of the Corporation or any other Person (including, without limitation, arising as a result of any breach or alleged breach by either the Corporation, any other Sponsoring Company, any creditor of the Corporation or any other Person under this Agreement or any other agreement (whether or not related to the transactions contemplated by this Agreement or any other agreement) to which such party is a party); or

(c) the validity or enforceability against any other Sponsoring Company of this Agreement or any right or obligation hereunder (or any release or discharge thereof) at any time.

GENERAL PROVISIONS

9.01. *Characteristics of Supply and Points of Delivery.* All power and energy delivered hereunder shall be 3-phase, 60-cycle, alternating current, at a nominal unregulated voltage designated for the point of delivery as described in this *Article 9*. Available Power and Available Energy to be delivered between Corporation and the Sponsoring Companies pursuant to this Agreement shall be delivered under the terms and conditions of the Tariff at the points, as scheduled by the Sponsoring Company in accordance with procedures established by the Operating Committee and in accordance with Section 9.02, where the transmission facilities of Corporation interconnect with the transmission facilities of any Sponsoring Company (or its successor or predecessor); provided that, to the extent that a joint and common market is established for the sale of power and energy by Sponsoring Companies within one or more of the regional transmission organizations or independent system operators approved by the Federal Energy Regulatory Commission in which the Sponsoring Companies are members or otherwise participate, then Corporation and the Sponsoring Companies shall take such action as reasonably necessary to permit the Sponsoring Companies to bid their entitlement to power and energy from Corporation into such market(s) in accordance with the procedures established for such market(s).

9.02. *Modification of Delivery Schedules Based on Available Transmission Capability.* To the extent that transmission capability available for the delivery of Available Power and Available Energy at any delivery point is less than the total amount of Available Power and Available Energy scheduled for delivery by the Sponsoring Companies at such delivery point in accordance with Section 9.01, then the following procedures shall apply and the Corporation and the applicable Sponsoring Companies shall modify their delivery schedules accordingly until the total amount of Available Power and Available Energy scheduled for delivery at such delivery point is equal to or less than the transmission capability available for the delivery of Available Power and Available Energy: (a) the transmission capability available for the delivery of Available Power and Available Energy at the following delivery points shall be allocated first on a pro rata basis (in whole MW increments) to the following Sponsoring Companies up to their Power Participation Ratio share of the total amount of Available Energy available to all Sponsoring Companies (and as applicable, further allocated among Sponsoring Companies entitled to allocation under this Section 9.02(a) in accordance with their Power Participation Ratios): (i) to Allegheny, Appalachian, Buckeye, Columbus, FirstEnergy, Indiana, Monongahela, Ohio Power and Peninsula (or their successors) for deliveries at the points of interconnection between the Corporation and Appalachian, Columbus, Indiana or Ohio Power, or their successors; (ii) to Duke Ohio (or its successor) for deliveries at the points of interconnection between the Corporation and Duke Ohio or its successor; (iii) to Dayton (or its successor) for deliveries at the points of interconnection between the Corporation and Dayton or its successor; and (iv) to Kentucky, Louisville and Southern Indiana (or their successors) for deliveries at the points of interconnection between the Corporation and Louisville or Kentucky, or their successors; and (b) any remaining transmission capability available for the delivery of

Available Power and Available Energy shall be allocated on a pro rata basis (in whole MW increments) to the Sponsoring Companies in accordance with their Power Participation Ratios. Page 17 of 60
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9.03. *Operation and Maintenance of Systems Involved.* Corporation and the Sponsoring Companies shall operate their systems in parallel, directly or indirectly, except during emergencies that temporarily preclude parallel operation. The parties hereto agree to coordinate their operations to assure maximum continuity of service from the Project Generating Stations, and with relation thereto shall cooperate with one another in the establishment of schedules for maintenance and operation of equipment and shall cooperate in the coordination of relay protection, frequency control, and communication and telemetering systems. The parties shall build, maintain and operate their respective systems in such a manner as to minimize so far as practicable rapid fluctuations in energy flow among the systems. The parties shall cooperate with one another in the operation of reactive capacity so as to assure mutually satisfactory power factor conditions among themselves.

The parties hereto shall exercise due diligence and foresight in carrying out all matters related to the providing and operating of their respective power resources so as to minimize to the extent practicable deviations between actual and scheduled deliveries of power and energy among their systems. The parties hereto shall provide and/or install on their respective systems such communication, telemetering, frequency and/or tie-line control facilities essential to so minimizing such deviations; and shall fully cooperate with one another and with third parties (such third parties whose systems are either directly or indirectly interconnected with the systems of the Sponsoring Companies and who of necessity together with the parties hereto must unify their efforts cooperatively to achieve effective and efficient interconnected systems operation) in developing and executing operating procedures that will enable the parties hereto to avoid to the extent practicable deviations from scheduled deliveries.

In order to foster coordination of the operation and maintenance of Corporation's transmission facilities with those facilities of Sponsoring Companies that are owned or functionally controlled by a regional transmission organization or independent system operator, Corporation shall use commercially reasonable efforts to enter into a coordination agreement with any regional transmission organization or independent system operator approved by the Federal Energy Regulatory Commission that operates transmission facilities that interconnect with Corporation's transmission facilities, and to enter into a mutually agreeable services agreement with a regional transmission organization or independent system operator to provide the Corporation with reliability and security coordination services and other related services.

9.04. *Power Deliveries as Affected by Physical Characteristics of Systems.* It is recognized that the physical and electrical characteristics of the transmission facilities of the interconnected network of which the transmission systems of the Sponsoring Companies, Corporation, and other systems of third parties not parties hereto are a part, may at times preclude the direct delivery at the points of interconnection between the transmission systems of one or more of the Sponsoring Companies and Corporation, of some portion of the energy supplied under this Agreement, and that in each such case, because of said characteristics, some

of the energy will be delivered at points which interconnect the system of one or more of the Sponsoring Companies with systems of companies not parties to this Agreement. The parties hereto shall cooperate in the development of mutually satisfactory arrangements among themselves and with such companies not parties hereto whereby the supply of power and energy contemplated hereunder can be fulfilled.

9.05. *Operating Committee.* There shall be an "Operating Committee" consisting of one member appointed by the Corporation and one member appointed by each of the Sponsoring Companies electing so to do; provided that, if any two or more Sponsoring Companies are Affiliates, then such Affiliates shall together be entitled to appoint only one member to the Operating Committee. The "Operating Committee" shall establish (and modify as necessary) scheduling, operating, testing and maintenance procedures of the Corporation in support of this Agreement, including establishing: (i) procedures for scheduling delivery of Available Energy under Section 4.03, (ii) procedures for power and energy accounting, (iii) procedures for the reservation and scheduling of firm and non-firm transmission service under the Tariff for the delivery of Available Power and Available Energy, (iv) the Minimum Generating Unit Output, and (v) the form of notifications relating to power and energy and the price thereof. In addition, the Operating Committee shall consider and make recommendations to Corporation's Board of Directors with respect to such other problems as may arise affecting the transactions under this Agreement. The decisions of the Operating Committee, including the adoption or modification of any procedure by the Operating Committee pursuant to this Section 9.04, must receive the affirmative vote of at least two-thirds of the members of the Operating Committee, regardless of the number of members of the Operating Committee present at any meeting.

9.06. *Acknowledgment of Certain Rights.* For the avoidance of doubt, all of the parties to this Agreement acknowledge and agree that (i) as of the effective date of the Current Agreement, certain rights and obligations of the Sponsoring Companies or their predecessors under the Original Agreement were changed, modified or otherwise removed, (ii) to the extent that the rights of any Sponsoring Company or their predecessors were thereby changed, modified or otherwise removed as of the effective date of the Current Agreement, such Sponsoring Company may be entitled to rights under applicable law, regulation, rules or orders under the Federal Power Act or otherwise adopted by the Federal Energy Regulatory Commission ("FERC"), (iii) as a result of the elimination as of the effective date of the Current Agreement of the firm transmission service previously provided during the term of the Original Agreement to Sponsoring Companies or their predecessors whose transmission systems were only indirectly connected to the Corporation's facilities through intervening transmission systems by certain Sponsoring Companies or their predecessors whose transmission systems were directly connected to the Corporation's facilities, such Sponsoring Companies or their predecessors whose transmission systems were only indirectly connected to the Corporation's facilities through intervening transmission systems shall have been entitled to such "roll over" firm transmission service for delivery of their entitlement to their Power Participation Ratio share of Surplus Power and Surplus Energy under this Agreement, to the border of such Sponsoring Company system and intervening Sponsoring Company system, as would be accorded a long-

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term firm point-to-point transmission service reservation under the then otherwise applicable FERC Open Access Transmission Tariff (“OATT”), (iv) the obligation of any Sponsoring Company to maintain or expand transmission capacity to accommodate another Sponsoring Company’s “roll over” rights to transmission service for delivery of their entitlement to their Power Participation Ratio share of Surplus Power and Surplus Energy under this Agreement shall be consistent with the obligations it would have for long-term firm point-to-point transmission service provided pursuant to the then otherwise applicable OATT, and (v) the parties shall cooperate with any Sponsoring Company that seeks to obtain and/or exercise any such rights available under applicable law, regulation, rules or orders under the Federal Power Act or otherwise adopted by the FERC. Page 19 of 60
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9.07. *Term of Agreement.* This Agreement shall become effective upon the Effective Date and shall terminate upon the earlier of: (1) June 30, 2040 or (2) the sale or other disposition of all of the facilities of the Project Generating Stations or the permanent cessation of operation of such facilities; provided that, the provisions of *Articles 5, 7 and 8*, this Section 9.07 and Sections 9.08, 9.09, 9.10, 9.11, 9.12, 9.14, 9.15, 9.16, 9.17 and 9.18 shall survive the termination of this Agreement, and no termination of this Agreement, for whatever reason, shall release any Sponsoring Company of any obligations or liabilities incurred prior to such termination.

9.08. *Access to Records.* Corporation shall, at all reasonable times, upon the request of any Sponsoring Company, grant to its representatives reasonable access to the books, records and accounts of the Corporation, and furnish such Sponsoring Company such information as it may reasonably request, to enable it to determine the accuracy and reasonableness of payments made for energy supplied under this Agreement.

9.09. *Modification of Agreement.* Absent the agreement of all parties to this Agreement, the standard for changes to provisions of this Agreement related to rates proposed by a party, a non-party or the Federal Energy Regulatory Commission (or a successor agency) acting sua sponte shall be the “public interest” standard of review set forth in *United Gas Pipeline Co. v. Mobile Gas Serv. Corp.*, 350 U.S. 332 (1956) and *Federal Power Comm’n v. Sierra Pacific Power Co.*, 350 U.S. 348 (1956).

9.10. *Arbitration.* Any controversy, dispute or claim arising out of this Agreement or the refusal by any party hereto to perform the whole or any part thereof, shall be determined by arbitration, in the City of Columbus, Franklin County, Ohio, in accordance with the Commercial Arbitration Rules of the American Arbitration Association or any successor organization, except as otherwise set forth in this Section 9.10.

The party demanding arbitration shall serve notice in writing upon all other parties hereto, setting forth in detail the controversy, dispute or claim with respect to which arbitration is demanded, and the parties shall thereupon endeavor to agree upon an arbitration board, which shall consist of three members (“Arbitration Board”). If all the parties hereto fail so to agree within a period of thirty (30) days from the original notice, the party demanding

arbitration may, by written notice to all other parties hereto, direct that any members of the Arbitration Board that have not been agreed to by the parties shall be selected by the American Arbitration Association, or any successor organization. No person shall be eligible for appointment to the Arbitration Board who is an officer, employee, shareholder of or otherwise interested in any of the parties hereto or in the matter sought to be arbitrated. Page 20 of 60
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The Arbitration Board shall afford adequate opportunity to all parties hereto to present information with respect to the controversy, dispute or claim submitted to arbitration and may request further information from any party hereto; provided, however, that the parties hereto may, by mutual agreement, specify the rules which are to govern any proceeding before the Arbitration Board and limit the matters to be considered by the Arbitration Board, in which event the Arbitration Board shall be governed by the terms and conditions of such agreement.

The determination or award of the Arbitration Board shall be made upon a determination of a majority of the members thereof. The findings and award of the Arbitration Board shall be final and conclusive with respect to the controversy, dispute or claim submitted for arbitration and shall be binding upon the parties hereto, except as otherwise provided by law. The award of the Arbitration Board shall specify the manner and extent of the division of the costs of the arbitration proceeding among the parties hereto.

9.11. *Liability.* The rights and obligations of all the parties hereto shall be several and not joint or joint and several.

9.12. *Force Majeure.* No party hereto shall be held responsible or liable for any loss or damage on account of non-delivery of energy hereunder at any time caused by an event of Force Majeure. "Force Majeure" shall mean the occurrence or non-occurrence of any act or event that could not reasonably have been expected and avoided by exercise of due diligence and foresight and such act or event is beyond the reasonable control of such party, including to the extent caused by act of God, fire, flood, explosion, strike, civil or military authority, insurrection or riot, act of the elements, or failure of equipment. For the avoidance of doubt, "Force Majeure" shall in no event be based on any Sponsoring Company's financial or economic conditions, including without limitation (i) the loss of the Sponsoring Company's markets; or (ii) the Sponsoring Company's inability economically to use or resell the Available Power or Available Energy purchased hereunder.

9.13. *Governing Law.* This Agreement shall be governed by, and construed in accordance with, the laws of the State of Ohio.

9.14. *Regulatory Approvals.* This Agreement is made subject to the jurisdiction of any governmental authority or authorities having jurisdiction in the premises and the performance thereof shall be subject to the following:

- (a) The receipt of all regulatory approvals, in form and substance satisfactory to Corporation, necessary to permit Corporation to perform all the duties and obligations to be performed by Corporation hereunder.

(b) The receipt of all regulatory approvals, in form and substance satisfactory to the Sponsoring Companies, necessary to permit the Sponsoring Companies to carry out all transactions contemplated herein.

9.15. *Notices.* All notices, requests or other communications under this Agreement shall be in writing and shall be sufficient in all respects: (i) if delivered in person or by courier, upon receipt by the intended recipient or an employee that routinely accepts packages or letters from couriers or other persons for delivery to personnel at the address identified above (as confirmed by, if delivered by courier, the records of such courier), (ii) if sent by facsimile transmission, when the sender receives confirmation from the sending facsimile machine that such facsimile transmission was transmitted to the facsimile number of the addressee, or (iii) if mailed, upon the date of delivery as shown by the return receipt therefor.

9.16. *Waiver.* Performance by any party to this Agreement of any responsibility or obligation to be performed by such party or compliance by such party with any condition contained in this Agreement may by a written instrument signed by all other parties to this Agreement be waived in any one or more instances, but the failure of any party to insist in any one or more instances upon strict performance of any of the provisions of this Agreement or to take advantage of any of its rights hereunder shall not be construed as a waiver of any such provisions or the relinquishment of any such rights, but the same shall continue and remain in full force and effect.

9.17. *Titles of Articles and Sections.* The titles of the Articles and Sections in this Agreement have been inserted as a matter of convenience of reference and are not a part of this Agreement.

9.18. *Successors and Assigns.* This Agreement may be executed in any number of counterparts, all of which shall constitute but one and the same document.

9.181 This Agreement shall inure to the benefit of and be binding upon the parties hereto and their respective successors and assigns, but a party to this Agreement may not assign this Agreement or any of its rights, title or interests in or obligations (including without limitation the assumption of debt obligations) under this Agreement, except to a successor to all or substantially all the properties and assets of such party or as provided in Section 9.182 or 9.183, without the written consent of all the other parties hereto.

9.182 Notwithstanding the provisions of Section 9.181, any Sponsoring Company shall be permitted to, upon thirty (30) days notice to the Corporation and each other Sponsoring Company, without any further action by the Corporation or the other Sponsoring Companies, assign all or part of its rights, title and interests in, and obligations under this Agreement to a Permitted Assignee, provided that, the assignee and assignor of the rights, title and interests in, and obligations under, this Agreement have executed an assignment agreement in form and substance acceptable to the Corporation

in its reasonable discretion (including, without limitation, the agreement by the Sponsoring Company assigning such rights, title and interests in, and obligations under, this Agreement to reimburse the Corporation and the other Sponsoring Companies for any fees or expenses required under any security issued, or agreement entered into, by the Corporation as a result of such assignment, including without limitation any consent fee or additional financing costs to the Corporation under the Corporation's then-existing securities or agreements resulting from such assignment).

9.183 Notwithstanding the provisions of Section 9.181, any Sponsoring Company shall be permitted to, subject to compliance with all of the requirements of this Section 9.183, assign all or part of its rights, title and interests in, and obligations under this Agreement to a Third Party without any further action by the Corporation or the other Sponsoring Companies.

(a) A Sponsoring Company (the "Transferring Sponsor") that desires to assign all or part of its rights, title and interests in, and obligations under this Agreement to a Third Party shall deliver an Offer Notice to the Corporation and each other Sponsoring Company. The Offer Notice shall be deemed to be an irrevocable offer of the subject rights, title and interests in, and obligations under this Agreement to each of the other Sponsoring Companies that is not an Affiliate of the Transferring Sponsor, which offer must be held open for no less than thirty (30) days from the date of the Offer Notice (the "Election Period").

(b) The Sponsoring Companies (other than the Transferring Sponsor and its Affiliates) shall first have the right, but not the obligation, to purchase all of the rights, title and interests in, and obligations under this Agreement described in the Offer Notice at the price and on the terms specified therein by delivering written notice of such election to the Transferring Sponsor and the Corporation within the Election Period; provided that, irrespective of the terms and conditions of the Offer Notice, a Sponsoring Company may condition its election to purchase the interest described in the Offer Notice on the receipt of approval or consent from such Sponsoring Company's Board of Directors; provided further that, written notice of such conditional election must be delivered to the Transferring Sponsor and the Corporation within the Election Period and such conditional election shall be deemed withdrawn (as if it had never been provided) unless the Sponsoring Company that delivered such conditional election subsequently delivers written notice to the Transferring Sponsor and the Corporation on or before the tenth (10th) day after the expiration of the Election Period that all necessary approval or consent of such Sponsoring Company's Board of Directors have been obtained. To the extent that more than one Sponsoring Company exercises its right to purchase all of the rights, title and interests in, and

obligations under this Agreement described in the Offer Notice in accordance with the previous sentence, such rights, title and interests in, and obligations under this Agreement shall be allotted (successively if necessary) among the Sponsoring Companies exercising such right in proportion to their respective Power Participation Ratios.

(c) Each Sponsoring Company exercising its right to purchase any rights, title and interests in, and obligations under this Agreement pursuant to this Section 9.183 may choose to have an Affiliate purchase such rights, title and interests in, and obligations under this Agreement; provided that, notwithstanding anything in this Section 9.183 to the contrary, any assignment to a Sponsoring Company or its Affiliate hereunder must comply with the requirements of Section 9.182.

(d) If one or more Sponsoring Companies have elected to purchase all of the rights, title and interests in, and obligations under this Agreement of the Transferring Sponsor pursuant to the Offer Notice, the assignment of such rights, title and interests in, and obligations under this Agreement shall be consummated as soon as practical after the delivery of the election notices, but in any event no later than fifteen (15) days after the filing and receipt, as applicable, of all necessary governmental filings, consents or other approvals and the expiration of all applicable waiting periods. At the closing of the purchase of such rights, title and interests in, and obligations under this Agreement from the Transferring Sponsor, the Transferring Sponsor shall provide representations and warranties customary for transactions of this type, including those as to its title to such securities and that there are no liens or other encumbrances on such securities (other than pursuant to this Agreement) and shall sign such documents as may reasonably be requested by the Corporation and the other Sponsoring Companies. The Sponsoring Companies or their Affiliates shall only be required to pay cash for the rights, title and interests in, and obligations under this Agreement being assigned by the Transferring Sponsor.

(e) To the extent that the Sponsoring Companies have not elected to purchase all of the rights, title and interests in, and obligations under this Agreement described in the Offer Notice, the Transferring Sponsor may, within one-hundred and eighty (180) days after the later of the expiration of the Election Period or the deemed withdrawal of a conditional election by a Sponsoring Company under Section 9.183(b) hereof (if applicable), enter into a definitive agreement to, assign such rights, title and interests in, and obligations under this Agreement to a Third Party at a price no less than 92.5% of the purchase price specified in the Offer Notice and on other material terms and conditions no more

favorable to the such Third Party than those specified in the Offer Notice, **Page 24 of 60**
provided that such purchases shall be conditioned upon: (i) such Third Party having long-term unsecured non-credit enhanced indebtedness, as of the date of such assignment, with a Standard & Poor's credit rating of at least BBB- and a Moody's Investors Service, Inc. credit rating of at least Baa3 (provided that, if such Third Party's long-term unsecured non-credit enhanced indebtedness is not currently rated by one of Standard & Poor's or Moody, such Third Party's long-term unsecured non-credit enhanced indebtedness, as of the date of such assignment, must have either a Standard & Poor's credit rating of at least BBB- or a Moody's Investors Service, Inc. credit rating of at least Baa3); (ii) the filing or receipt, as applicable, of any necessary governmental filings, consents or other approvals; (iii) the determination by counsel for the Corporation that the assignment of the rights, title or interests in, or obligations under, this Agreement to such Third Party would not cause a termination, default, loss or payment obligation under any security issued, or agreement entered into, by the Corporation prior to such transfer; and (iv) such Third Party executing a counterpart of this Agreement, and both such Third Party and the Sponsoring Company which is assigning its rights, title and interests in, and obligations under, this Agreement executing such other documents as may be reasonably requested by the Corporation (including, without limitation, an assignment agreement in form and substance acceptable to the Corporation in its reasonable discretion and containing the agreement by such Sponsoring Company to reimburse the Corporation and the other Sponsoring Companies for any fees or expenses required under any security issued, or agreement entered into, by the Corporation as a result of such assignment, including without limitation any consent fee or additional financing costs to the Corporation under the Corporation's then-existing securities or agreements resulting from such assignment). In the event that the Sponsoring Company and a Third Party have not entered into a definitive agreement to assign the interests specified in the Offer Notice to such Third Party within the later of one-hundred and eighty (180) days after the expiration of the Election Period or the deemed withdrawal of a conditional election by a Sponsoring Company under Section 9.183(b) hereof (if applicable) for any reason or if either the price to be paid by such Third Party would be less than 92.5% of the purchase price specified in the Offer Notice or the other material terms of such assignment would be more favorable to such Third Party than the terms specified in the Offer Notice, then the restrictions provided for herein shall again be effective, and no assignment of any rights, title and interests in, and obligations under this Agreement may be made thereafter without again offering the same to Sponsoring Companies in accordance with this Section 9.183.

Wilson

REPRESENTATIONS AND WARRANTIES

10.01. *Representations and Warranties.* Each Sponsoring Company hereby represents and warrants for itself, on and as of the date of this Agreement, as follows:

(a) it is duly organized, validly existing and in good standing under the laws of its state of organization, with full corporate power, authority and legal right to execute and deliver this Agreement and to perform its obligations hereunder;

(b) it has duly authorized, executed and delivered this Agreement, and upon the execution and delivery by all of the parties hereto, this Agreement will be in full force and effect, and will constitute a legal, valid and binding obligation of such Sponsoring Company, enforceable in accordance with the terms hereof, except as enforceability may be limited by applicable bankruptcy, insolvency, fraudulent conveyance, reorganization, moratorium or other similar laws affecting the enforcement of creditors' rights generally;

(c) Except as set forth in Schedule 10.01(c) hereto, no consents or approvals of, or filings or registrations with, any governmental authority or public regulatory authority or agency, federal state or local, or any other entity or person are required in connection with the execution, delivery and performance by it of this Agreement, except for those which have been duly obtained or made and are in full force and effect, have not been revoked, and are not the subject of a pending appeal; and

(d) the execution, delivery and performance by it of this Agreement will not conflict with or result in any breach of any of the terms, conditions or provisions of, or constitute a default under its charter or by-laws or any indenture or other material agreement or instrument to which it is a party or by which it may be bound or result in the imposition of any liens, claims or encumbrances on any of its property.

ARTICLE 11

EVENTS OF DEFAULT AND REMEDIES

11.01. *Payment Default.* If any Sponsoring Company fails to make full payment to Corporation under this Agreement when due and such failure is not remedied within ten (10) days after receipt of notice of such failure from the Corporation, then such failure shall constitute a "Payment Default" on the part of such Sponsoring Company. Upon a Payment Default, the

Corporation may suspend service to the Sponsoring Company that has caused such Payment Default for all or part of the period of continuing default (and such Sponsoring Company shall be deemed to have notified the Corporation and the other Sponsoring Companies that any Available Energy shall be available for scheduling by such other Sponsoring Companies in accordance with Section 4.032). The Corporation's right to suspend service shall not be exclusive, but shall be in addition to all remedies available to the Corporation at law or in equity. No suspension of service or termination of this Agreement shall relieve any Sponsoring Company of its obligations under this Agreement, which are absolute and unconditional.

Page 26 of 60
Wilson

11.02. *Performance Default.* If the Corporation or any Sponsoring Company fails to comply in any material respect with any of the material terms, conditions and covenants of this Agreement (and such failure does not constitute a Payment Default under Section 11.01), the Corporation (in the case of a default by any Sponsoring Company) and any Sponsoring Company (in the case of a default by the Corporation) shall give the defaulting party written notice of the default ("Performance Default"). To the extent that a Performance Default is not cured within thirty (30) days after receipt of notice thereof (or within such longer period of time, not to exceed sixty (60) additional days, as necessary for the defaulting party with the exercise of reasonable diligence to cure such default), then the Corporation (in the case of a default by any Sponsoring Company) and any Sponsoring Company (in the case of a default by the Corporation) shall have all of the rights and remedies provided at law and in equity, other than termination of this Agreement or any release of the obligation of the Sponsoring Companies to make payments pursuant to this Agreement, which obligation shall remain absolute and unconditional.

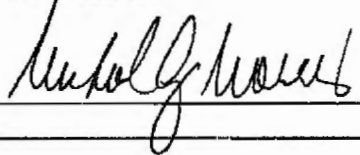
11.03. *Waiver.* No waiver by the Corporation or any Sponsoring Company of any one or more defaults in the performance of any provision of this Agreement shall be construed as a waiver of any other default or defaults, whether of a like kind or different nature.

11.04. *Limitation of Liability and Damages.* TO THE FULLEST EXTENT PERMITTED BY LAW, NEITHER THE CORPORATION, NOR ANY SPONSORING COMPANY SHALL BE LIABLE UNDER THIS AGREEMENT FOR ANY CONSEQUENTIAL, INCIDENTAL, PUNITIVE, EXEMPLARY OR INDIRECT DAMAGES, LOST REVENUES, LOST PROFITS OR OTHER BUSINESS INTERRUPTION DAMAGES, BY STATUTE, IN TORT OR CONTRACT, OR OTHERWISE.

[Signature pages follow]

IN WITNESS WHEREOF, the parties hereto have caused this Amended and Restated Inter-Company Power Agreement to be duly executed and delivered by their proper and duly authorized officers as of September 10, 2010.

OHIO VALLEY ELECTRIC CORPORATION

By 
Its _____

ALLEGHENY ENERGY SUPPLY COMPANY, L.L.C.

By _____
Its _____

APPALACHIAN POWER COMPANY

By _____
Its _____

BUCKEYE POWER GENERATING, LLC

By _____
Its _____

COLUMBUS SOUTHERN POWER COMPANY

By _____
Its _____

THE DAYTON POWER AND LIGHT COMPANY

By _____
Its _____

DUKE ENERGY OHIO, INC.

By _____
Its _____

FIRSTENERGY GENERATION CORP.

By _____
Its _____

INDIANA MICHIGAN POWER COMPANY

By _____
Its _____

KENTUCKY UTILITIES COMPANY

By _____
Its _____

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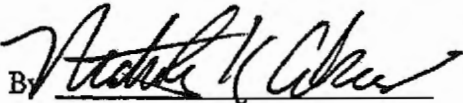
OHIO VALLEY ELECTRIC CORPORATION

By _____
Its _____

ALLEGHENY ENERGY SUPPLY COMPANY, L.L.C.

By _____
Its _____

APPALACHIAN POWER COMPANY

By 
Its _____

BUCKEYE POWER GENERATING, LLC

By _____
Its _____

COLUMBUS SOUTHERN POWER COMPANY

By _____
Its _____

THE DAYTON POWER AND LIGHT COMPANY

By _____
Its _____

DUKE ENERGY OHIO, INC.

By _____
Its _____

FIRSTENERGY GENERATION CORP.

By _____
Its _____

INDIANA MICHIGAN POWER COMPANY

By _____
Its _____

KENTUCKY UTILITIES COMPANY

By _____
Its _____

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OHIO VALLEY ELECTRIC CORPORATION

ALLEGHENY ENERGY SUPPLY COMPANY, L.L.C.

By _____
Its _____

By _____
Its _____

APPALACHIAN POWER COMPANY


BUCKEYE POWER GENERATING, LLC

By _____
Its _____

By _____
Its _____

COLUMBUS SOUTHERN POWER COMPANY

THE DAYTON POWER AND LIGHT COMPANY

By 
Its _____

By _____
Its _____

DUKE ENERGY OHIO, INC.

FIRSTENERGY GENERATION CORP.

By _____
Its _____

By _____
Its _____

INDIANA MICHIGAN POWER COMPANY

KENTUCKY UTILITIES COMPANY

By _____
Its _____

By _____
Its _____

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OHIO VALLEY ELECTRIC CORPORATION

By _____
Its _____

ALLEGHENY ENERGY SUPPLY COMPANY, L.L.C.

By _____
Its _____

APPALACHIAN POWER COMPANY

By _____
Its _____

BUCKEYE POWER GENERATING, LLC

By _____
Its _____

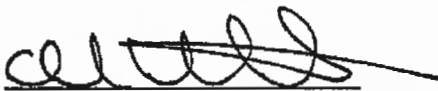
COLUMBUS SOUTHERN POWER COMPANY

By _____
Its _____

THE DAYTON POWER AND LIGHT COMPANY

By _____
Its _____

DUKE ENERGY OHIO, INC.

By 
Its VACE PRESIDENT

FIRSTENERGY GENERATION CORP.

By _____
Its _____

INDIANA MICHIGAN POWER COMPANY

By _____
Its _____

KENTUCKY UTILITIES COMPANY

By _____
Its _____

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OHIO VALLEY ELECTRIC CORPORATION

ALLEGHENY ENERGY SUPPLY COMPANY, L.L.C.

By _____
Its _____

By _____
Its _____

APPALACHIAN POWER COMPANY

BUCKEYE POWER GENERATING, LLC

By _____
Its _____

By _____
Its _____

COLUMBUS SOUTHERN POWER COMPANY

THE DAYTON POWER AND LIGHT COMPANY

By _____
Its _____

By _____
Its _____

DUKE ENERGY OHIO, INC.

FIRSTENERGY GENERATION CORP.

By _____
Its _____

By _____
Its _____

INDIANA MICHIGAN POWER COMPANY

KENTUCKY UTILITIES COMPANY

By *M. G. Lewis*
Its *Vice President*

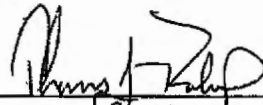
By _____
Its _____

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OHIO VALLEY ELECTRIC CORPORATION

By _____
Its _____

ALLEGHENY ENERGY SUPPLY COMPANY, L.L.C.

By 
Its V. J. ZUP
VICE PRESIDENT

APPALACHIAN POWER COMPANY

By _____
Its _____

BUCKEYE POWER GENERATING, LLC

By _____
Its _____

COLUMBUS SOUTHERN POWER COMPANY

By _____
Its _____

THE DAYTON POWER AND LIGHT COMPANY

By _____
Its _____

DUKE ENERGY OHIO, INC.

By _____
Its _____

FIRSTENERGY GENERATION CORP.

By _____
Its _____

INDIANA MICHIGAN POWER COMPANY

By _____
Its _____

KENTUCKY UTILITIES COMPANY

By _____
Its _____

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OHIO VALLEY ELECTRIC CORPORATION

By _____
Its _____

ALLEGHENY ENERGY SUPPLY COMPANY, L.L.C.

By _____
Its _____

APPALACHIAN POWER COMPANY

By _____
Its _____

BUCKEYE POWER GENERATING, LLC

By 
Its President & CEO

COLUMBUS SOUTHERN POWER COMPANY

By _____
Its _____

THE DAYTON POWER AND LIGHT COMPANY

By _____
Its _____

DUKE ENERGY OHIO, INC.

By _____
Its _____

FIRSTENERGY GENERATION CORP.

By _____
Its _____

INDIANA MICHIGAN POWER COMPANY

By _____
Its _____

KENTUCKY UTILITIES COMPANY

By _____
Its _____

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OHIO VALLEY ELECTRIC CORPORATION

ALLEGHENY ENERGY SUPPLY COMPANY, L.L.C.

By _____
Its _____

By _____
Its _____

APPALACHIAN POWER COMPANY

BUCKEYE POWER GENERATING, LLC

By _____
Its _____

By _____
Its _____

COLUMBUS SOUTHERN POWER COMPANY

THE DAYTON POWER AND LIGHT COMPANY

By _____
Its _____

By *Gary Stephenson*
Its EXECUTIVE VICE PRESIDENT
Gary Stephenson

DUKE ENERGY OHIO, INC.

FIRSTENERGY GENERATION CORP.

By _____
Its _____

By _____
Its _____

INDIANA MICHIGAN POWER COMPANY

KENTUCKY UTILITIES COMPANY

By _____
Its _____

By _____
Its _____

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OHIO VALLEY ELECTRIC CORPORATION

ALLEGHENY ENERGY SUPPLY COMPANY, L.L.C.

By _____
Its _____

By _____
Its _____

APPALACHIAN POWER COMPANY.

BUCKEYE POWER GENERATING, LLC

By _____
Its _____

By _____
Its _____

COLUMBUS SOUTHERN POWER COMPANY

THE DAYTON POWER AND LIGHT COMPANY

By _____
Its _____

By _____
Its _____

DUKE ENERGY OHIO, INC.

FIRSTENERGY GENERATION CORP.

By _____
Its _____

By Mary R. Lerdahl
Its President

INDIANA MICHIGAN POWER COMPANY

KENTUCKY UTILITIES COMPANY

By _____
Its _____

By _____
Its _____

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OHIO VALLEY ELECTRIC CORPORATION

ALLEGHENY ENERGY SUPPLY COMPANY, L.L.C.

By _____
Its _____

By _____
Its _____

APPALACHIAN POWER COMPANY

BUCKEYE POWER GENERATING, LLC

By _____
Its _____

By _____
Its _____

COLUMBUS SOUTHERN POWER COMPANY

THE DAYTON POWER AND LIGHT COMPANY

By _____
Its _____

By _____
Its _____

DUKE ENERGY OHIO, INC.

FIRSTENERGY GENERATION CORP.

By _____
Its _____

By _____
Its _____

INDIANA MICHIGAN POWER COMPANY

KENTUCKY UTILITIES COMPANY

By _____
Its _____

By *[Signature]*
Its *Sr. Vice President*

**LOUISVILLE GAS AND ELECTRIC
COMPANY**

By *John N. Taylor Jr.*
Its *VP Trans. & Generation Services*

**MONONGAHELA POWER
COMPANY**

By _____
Its _____

OHIO POWER COMPANY

By _____
Its _____

**SOUTHERN INDIANA GAS AND
ELECTRIC COMPANY**

By _____
Its _____

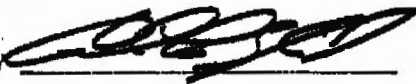
**LOUISVILLE GAS AND ELECTRIC
COMPANY**

By _____
Its _____

**MONONGAHELA POWER
COMPANY**

By _____
Its _____

OHIO POWER COMPANY

By  _____
Its _____


**SOUTHERN INDIANA GAS AND
ELECTRIC COMPANY**

By _____
Its _____

**LOUISVILLE GAS AND ELECTRIC
COMPANY**

By _____
Its _____

**MONONGAHELA POWER
COMPANY**

By 
Its GENERAL MANAGER, ELECTRIC SUPPLY

OHIO POWER COMPANY

By _____
Its _____

**SOUTHERN INDIANA GAS AND
ELECTRIC COMPANY**

By _____
Its _____

**LOUISVILLE GAS AND ELECTRIC
COMPANY**

By _____
Its _____

**MONONGAHELA POWER
COMPANY**

By _____
Its _____


OHIO POWER COMPANY

By _____
Its _____

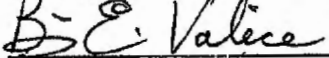
**SOUTHERN INDIANA GAS AND
ELECTRIC COMPANY**

By Ronald E. Christman
Its President

PENINSULA GENERATION COOPERATIVE


By Daniel H. DeCoeur
Its President

APPROVED AS TO FORM:


BRIAN E. VALICE
ATTORNEY FOR PENINSULA
GENERATION COOPERATIVE

Allegheny Energy Supply Company, L.L.C.

and

Monongahela Power Company

Filing with, or consent or approval of, the Federal Energy Regulatory Commission

SCHEDULE 10.01(c)

Appalachian Power Company

Filing with, or consent or approval of, the Federal Energy Regulatory Commission

Approval of the Virginia State Corporation Commission

Filing with the Public Service Commission of West Virginia

Buckeye Power Generating, LLC

None

Columbus Southern Power Company

Filing with, or consent or approval of, the Federal Energy Regulatory Commission

The Dayton Power and Light Company

Filing with, or consent or approval of, the Federal Energy Regulatory Commission

Duke Energy Ohio, Inc.

Filing with, or consent or approval of, the Federal Energy Regulatory Commission

FirstEnergy Generation Corp.

Filing with, or consent or approval of, the Federal Energy Regulatory Commission

Indiana Michigan Power Company

Filing with, or consent or approval of, the Federal Energy Regulatory Commission

Filing with the Indiana Utility Regulatory Commission

Kentucky Utilities Company

Filing with, or consent or approval of, the Federal Energy Regulatory Commission

Consent or approval of, or filings or registrations with, the Kentucky Public Service Commission may be required

Louisville Gas and Electric Company

Filing with, or consent or approval of, the Federal Energy Regulatory Commission

Consent or approval of, or filings or registrations with, the Kentucky Public Service Commission
may be required

Ohio Power Company

Filing with, or consent or approval of, the Federal Energy Regulatory Commission

Peninsula Generation Cooperative

None

Southern Indiana Gas and Electric Company

Filing with, or consent or approval of, the Federal Energy Regulatory Commission

AMENDED AND RESTATED
POWER AGREEMENT

BETWEEN

OHIO VALLEY ELECTRIC CORPORATION

AND

INDIANA-KENTUCKY ELECTRIC CORPORATION

Dated as of September 10, 2010

THIS AGREEMENT, dated as of September 10, 2010 by and between OHIO VALLEY ELECTRIC CORPORATION (herein called OVEC) and INDIANA-KENTUCKY ELECTRIC CORPORATION (herein called IKEC), hereby amends and restates in its entirety, the Power Agreement (herein called the Current Agreement), dated March 13, 2006, between OVEC and IKEC.

WITNESSETH THAT:

WHEREAS, IKEC, a wholly owned subsidiary of OVEC, designed, purchased, and constructed, and continues to own, operate and maintain a steam-electric generating station (herein called Indiana Station) consisting of six turbogenerators and all other necessary equipment, at a location on the Ohio River near Madison, Indiana; and

WHEREAS, OVEC designed, purchased, and constructed, and continues to own, operate and maintain a steam-electric generating stations (herein called Ohio Station) consisting of five turbo-generators and all other necessary equipment, at a location on the Ohio River near Cheshire, Ohio (the Ohio Station and the Indiana Station being herein called the Project Generating Stations); and

WHEREAS, OVEC also designed, purchased, and constructed, and continues to operate and maintain necessary transmission and general plant facilities (herein called the Project Transmission Facilities) and OVEC established or cause to be established interconnections between the Project Generating Stations and/or the Project Transmission Facilities, and the systems of certain of the Sponsoring Companies; and

WHEREAS, IKEC owns and operates the portion of the Project Transmission Facilities located in the State of Indiana; and

WHEREAS, IKEC entered into the Current Agreement with OVEC which embodies the terms and conditions for the ownership and operation by IKEC of the Indiana Station and such portion of the Project Transmission Facilities which are to be owned and operated by it; and

WHEREAS, the owners of OVEC or their affiliates that are parties to an Inter-Company Power Agreement, have amended and restated such Inter-Company Power Agreement as of the date hereof, which defines the terms and conditions governing the rights of the "Sponsoring Companies" (as defined thereunder) to receive "Available Power" (as defined thereunder) from the Project Generating Stations and the obligations of the Sponsoring Companies to pay therefor; and

WHEREAS, concurrent with the amendment and restatement of the Inter-Company Power Agreement, IKEC and OVEC hereto desire to amend and restate in their entirety, the Current Agreement in order for IKEC to continue to sell to OVEC any and all power available at the Indiana Station, and energy associated therewith, and to transmit power and energy as provided herein.

ARTICLE 1

POWER AND ENERGY TRANSACTIONS

1.01 IKEC shall transmit any and all power generated at the Indiana Station by any of the generating units thereof in commercial operation and deliver such power, together with the energy associated therewith, but less the transmission losses in the facilities of IKEC applicable thereto from the 330 kV busses of the Indiana Station, at the points of delivery hereinafter designated in *Section 1.03* hereof, and sell such power and energy at said points of delivery to OVEC. OVEC shall purchase from IKEC all such power so delivered by IKEC to OVEC at said points of delivery, together with the energy associated therewith, and shall from time to time pay IKEC therefor, amounts which, when added to revenues received by IKEC from other sources, will be sufficient to enable IKEC to pay all of its operating and other expenses, including all income and other taxes and any interest and regular amortization requirements applicable to any indebtedness for borrowed funds incurred by IKEC. For the purposes of this *Section 1.01* the term "operating and other expenses" shall also include, without limitation, all amounts payable to suppliers of fuel requirements (including the handling and shipment thereof) in connection with the cancellation of commitments and the extension of delivery schedules, as well as all expenses accrued to pay for postemployment and postretirement benefits and the costs of the decommissioning, shutdown, demolition and closing of the Project Generating Stations.

1.02 IKEC shall transmit and deliver to OVEC at the points of delivery hereinafter designated in *Section 1.03* hereof, all power and the energy associated therewith supplied to IKEC by Sponsoring Companies at the points of delivery hereinafter designated in *Section 1.03* hereof, less the transmission losses in the facilities of IKEC applicable thereto. IKEC shall transmit and deliver to Sponsoring Companies designated by OVEC at the points of delivery hereinafter designated in *Section 1.03* hereof, all power, and the energy associated therewith, supplied to IKEC by OVEC at the points of delivery hereinafter designated in *Section 1.03* hereof, less the transmission losses in the facilities of IKEC applicable thereto.

1.03 All power and energy sold, purchased, transmitted or delivered hereunder shall be 3-phase, 60-cycle, alternating current, at nominal unregulated voltage, designated for the points of delivery hereinbelow described. Power and energy transmitted, delivered and sold by IKEC to OVEC pursuant to the provisions of *Section 1.01* hereof shall be delivered at the points where the transmission facilities of OVEC and the transmission facilities of IKEC interconnect and title to such power and energy shall pass from IKEC to OVEC at said points. Power and energy supplied to IKEC by a Sponsoring Company for transmission to OVEC pursuant to the provisions of *Section 1.02* hereof, shall be delivered by said Sponsoring Company to IKEC at the points where the transmission facilities of said Sponsoring Company and the transmission facilities of IKEC interconnect and shall be delivered by IKEC to OVEC and title thereto shall pass from said Sponsoring Company to OVEC at the points where the transmission facilities of OVEC and the transmission facilities of IKEC interconnect. Power and energy supplied to IKEC

by OVEC for transmission to a Sponsoring Company pursuant to the provisions of Section 1.02 hereof shall be delivered by OVEC to IKEC at the points where the transmission facilities of OVEC and the transmission facilities of IKEC interconnect and title to such power and energy shall pass from OVEC to said Sponsoring Company at said points. Such power and energy shall be delivered by IKEC to said Sponsoring Company at the points where the transmission facilities of IKEC and the transmission facilities of said Sponsoring Company interconnect.

1.04 The parties hereto shall exercise due diligence and foresight in carrying out all matters related to the providing and operating of their respective power resources so as to minimize to the extent practicable deviations between actual and scheduled deliveries of power and energy among their systems. The parties hereto shall provide and/or install on their respective systems such communication, telemetering, frequency and/or tie-line control facilities essential to so minimizing such deviations; and shall fully cooperate with one another and with third parties (such third parties whose systems are either directly or indirectly interconnected with the systems of the Sponsoring Companies and who of necessity together with the Sponsoring Companies and the parties hereto must unify their efforts cooperatively to achieve effective and efficient interconnected system operation) in developing and executing operating procedures that will enable the parties hereto to avoid to the extent practicable deviations from scheduled deliveries.

1.05 OVEC shall reimburse IKEC for the difference between (a) the total cost of replacements chargeable to property and plant made by IKEC, and the total cost of additional facilities and/or spare parts purchased or installed by Corporation, during any month or prior thereto (and not previously reimbursed) and (b) the amounts paid for by IKEC out of proceeds of fire or other applicable insurance protection, or out of amounts recovered from third parties responsible for damages requiring replacement. OVEC shall pay to IKEC such amount in lieu of the amounts to be paid as above provided, which, after provision for all taxes on income, shall equal the costs of the replacements reimbursable by OVEC to IKEC as above provided. The term cost of replacements, as used herein, shall include all components of costs, plus removal expense, less salvage. The amounts reimbursed by OVEC to IKEC for such replacements shall be accounted for on the books of IKEC in a special balance sheet account provided for such purposes.

ARTICLE 2

MISCELLANEOUS

2.01 This Agreement shall become effective on September 10, 2010, or to the extent necessary, such later date on which all conditions to effectiveness, including all required waiting periods and all required regulatory acceptances or approvals, of this Agreement have been satisfied in form and substance satisfactory to OVEC, and shall terminate upon the earlier of: (1) June 30, 2040 or (2) the sale or other disposition of all of the facilities of the Project Generating Stations or the permanent cessation of operation of such facilities.

2.02 No party hereto shall be held responsible or liable for any loss or damage on account of non-delivery of energy hereunder at any time caused by act of God, fire, flood, explosion, strike, civil or military authority, insurrection or riot, act of the elements, failure of equipment, or for any other cause beyond its control.

2.03 This Agreement is made subject to the jurisdiction of any governmental authority or authorities having jurisdiction in the premises and the performance thereof shall be subject to the receipt of all regulatory approvals, in form and substance satisfactory to the parties hereto, necessary to permit the parties hereto to perform all the duties and obligations to be performed by such parties hereunder.

2.04 This Agreement shall inure to the benefit of and be binding upon the parties hereto and their respective successors and assigns, but this Agreement shall not be assigned by either party hereto without the written consent of the other, except (a) to a successor to all or substantially all the properties and assets of such party, or (b) to a trustee under an indenture securing any indebtedness of such party.

2.05 All notices and requests under this Agreement shall be in writing and shall be sufficient in all respects if delivered in person or sent by registered mail addressed to the party to be served at such party's general office or at such other address as such party may from time to time in writing designate.

IN WITNESS WHEREOF the parties hereto have caused this Agreement to be duly executed as of the day and year first above written.

OHIO VALLEY ELECTRIC CORPORATION

By _____
Its

INDIANA-KENTUCKY ELECTRIC CORPORATION

By _____
Its

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 18

Witness: Stuart A. Wilson

- Q-18. Identify, discuss, and provide any study or analysis that the Company has performed or obtained, subsequent to that relied on in Case Nos. 2011-00099 and 2011-00100 before the Commission, regarding the cost-competitiveness of, or need for, its contractual relationship with OVEC or the power and capacity the Company obtains from the OVEC Units.
- a) If your response to this request is the same as it was to the same request posed by Sierra Club DR 1-2 in Case Nos. 2018-00294 and 2018-00295, please confirm; or if your response is now different, confirm that and explain how it is different now.
- A-18. OVEC's continued operation is determined by its board. It is economic for the Companies to continue purchasing energy from OVEC, given the Companies' obligation to participate through 2040 in the ICPA, which was amended in 2010 and approved by the Kentucky Public Service Commission in Case Nos. 2011-00099 and 2011-00100. In addition, the Companies' share of OVEC was evaluated in the "2018 IRP Reserve Margin Analysis," which is located in Volume III of the 2018 IRP.
- a) This response is effectively the same as the responses to the referenced questions from Case Nos. 2018-00294 and 2018-00295.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 19

Witness: Stuart A. Wilson

Q-19. Confirm or deny that the Companies included the assumption of taking and paying for power from OVEC in every scenario presented in the resource planning analysis in the 2018 IRP. If denied, explain.

A-19. Confirmed.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club’s Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 20

Witness: Stuart A. Wilson

Q-20. Reference the 2018 IRP at Vol. I, 5-20, and the statement: “Approximately one-third (2,500+ MW) of the Companies’ existing generation capacity will be 50 years old or older by 2030. As a generation unit ages, the economics of retrofitting the unit to comply with new environmental regulations become less favorable. For these reasons, the IRP considers two operating life scenarios for its generating units: 55-years and 65-years.” Further, reference the 2018 IRP at Vol. I, 5-37, and the statement: “2,428 MW of existing capacity is assumed to be retired by 2033 in the 55-year life scenario; only 49 MW is assumed to be retired in the 65-year life scenario (see Table 5-4).”

- a) Confirm the year(s) in which the OVEC Units were placed into service in the 1950s.
- b) Whereas the Companies assume a useful life of 55 years for almost all of its own generating units, and a useful life of 65 years for the comparatively small remainder, explain whether and why the Companies believe it is reasonable to assume approximately an 85-year useful life for units that are even older than the Companies’ own, 55-year-useful-life units.

A-20.

a)

	In Service Year
Clifty Creek 1	1955
Clifty Creek 2	1955
Clifty Creek 3	1955
Clifty Creek 4	1955
Clifty Creek 5	1955
Clifty Creek 6	1956
Kyger Creek 1	1955
Kyger Creek 2	1955
Kyger Creek 3	1955
Kyger Creek 4	1955
Kyger Creek 5	1955

- b) This question mischaracterizes the Companies' 2018 IRP by conflating the 55-year and 65-year operating life scenarios. The Companies did not "assume a useful life of 55 years for almost all of its own generating units, and a useful life of 65 years for the comparatively small remainder."

In the 2018 IRP, the Companies considered two independent operating life scenarios:

1. a scenario in which each unit operates until it is 55 years old;
2. a scenario in which each unit operates until it is 65 years old.

The use of this range is not intended to suggest that the maximum life of any particular unit is 55 or 65 years. The Companies have no opinion regarding the operating life of the OVEC units. Furthermore, because the Companies do not have the unilateral right to terminate the ICPA or control the management and direction of OVEC, the OVEC contract was assumed to continue through the end of the IRP analysis period.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 21

Witness: Stuart A. Wilson

- Q-21. Identify any and all capital investments or projects that the Companies anticipates will be needed for each of the OVEC Units to comply with (while continuing to be able lawfully to operate) all current, anticipated or foreseeable environmental laws, regulations, or other obligations. For each such investments at the OVEC Units:
- a) Describe each such investment/project; its timeline; and the law, regulation, or other obligation it is needed to comply with.
 - b) Describe the decision-maker(s) (with persons or bodies)—within the LG&E/KU, and/or within OVEC and among its member entities, as may be applicable—that must approve such investments;
 - c) For any such investment/project, provide the following in relation thereto:
 - i) In-service date
 - ii) Current or anticipated status of construction
 - iii) Required outage period for installation and interconnection
 - iv) projected capital cost
 - v) fixed O&M cost
 - vi) variable O&M cost
 - vii) effect on unit heat rate
 - viii) effect on unit availability
 - d) If your responses to this request are the same as to the same request posed by Sierra Club DR 1-3 in Case Nos. 2018-00294 and 2018-00295, please confirm; or if your response is now different, confirm that and explain how it is different now.

A-21.

- a) See the response to Question No. 32.
- b) OVEC's Board of Directors would approve these investments. The OVEC board size is currently set at 15 members, with a majority of directors constituting a quorum. Actions are taken by majority of directors present, unless a greater amount is required by law. OVEC's board currently comprises the following directors:
 - 1. Thomas Alban, Buckeye Power
 - 2. Eric Baker, Wolverine
 - 3. Christian Beam, AEP
 - 4. Lonnie Bellar, LG&E and KU
 - 5. Paul Chodak III, AEP
 - 6. Wayne Games, Vectren
 - 7. James Haney, FirstEnergy¹
 - 8. Lana Hillenbrand, American Electric Power
 - 9. Mark Miller, AES
 - 10. Steven Nelson, Buckeye Power
 - 11. Patrick O'Loughlin, Buckeye Power
 - 12. David Pinter, FirstEnergy
 - 13. Raja Sundararajan, AEP
 - 14. Paul Thompson, LG&E and KU
 - 15. John Verderame, Duke Energy
- c)
 - i) See the response to part (a).
 - ii) None of the projects are under construction. See the projected timelines in the response to Question No. 32.
 - iii) The Companies do not have access to this information.
 - iv) See the response to part (a).
 - v) The Companies do not have access to this information.
 - vi) The Companies do not have access to this information.
 - vii) The Companies do not have access to this information.
 - viii) The Companies do not have access to this information.

¹ James Haney retired June 30, 2019.

- d) This response is different from the responses to the referenced questions from Case Nos. 2018-00294 and 2018-00295 in that the response to part (b) has been updated.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 22

Witness: Christopher M. Garrett

- Q-22. With respect to the OVEC Units, for each month from January 2013 through September 2019, provide the following charges as pertains to the Company:
- a. Total Monthly Charge, pursuant to Article 5.01 of the current ICPA
 - b. Energy Charge, pursuant to Article 5.02 of the ICPA
 - c. Demand Charge, pursuant to Article 5.03 of the ICPA
 - d. Transmission Charge, pursuant to Article 5.04 of the ICPA
 - e. Note that this request is the same as Sierra Club DR 1-4 in Case Nos. 2018-00294 and 2018-00295 except in that it extends the timeframe to September 2019. If your responses to this request are the same, for the period January 2013 through October 2018, as the same request posed by Sierra Club DR 1-4 in Case Nos. 2018-00294 and 2018-00295, please confirm; or if your responses are now different with respect to that timeframe (apart from the Companies' response to the subsequent timeframe leading through September 2019), confirm that and explain how they are different now.
- A-22. The Company's response to Sierra Club DR 1-4 in Case Nos. 2018-00294 and 2018-00295 has not changed. See attachments for the requested information from November 2018 through September 2019.

**LOUISVILLE GAS AND ELECTRIC COMPANY
OVEC CHARGES**

FOR THE 2 MONTHS NOVEMBER 30 AND DECEMBER 31, 2018

	Nov-18	Dec-18	TOTAL
OVEC Energy Charge	\$ 1,289,972	\$ 1,295,234	\$ 2,585,206
OVEC Demand Charge	1,365,025	1,747,784	3,112,809
OVEC Transmission Charge	<u>71,325</u>	<u>79,127</u>	<u>150,451</u>
Total OVEC Monthly Charge	<u>\$ 2,726,322</u>	<u>\$ 3,122,144</u>	<u>5,848,466</u>

FOR THE 9 MONTHS ENDED SEPTEMBER 30, 2019

	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	TOTAL
OVEC Energy Charge	\$ 1,462,956	\$ 886,849	\$ 1,446,869	\$ 842,485	\$ 1,022,859	\$ 1,251,108	\$ 1,316,479	\$ 1,316,735	\$ 1,075,189	\$ 10,621,530
OVEC Demand Charge	1,911,597	1,474,249	1,541,296	2,342,472	1,687,557	1,477,311	1,540,232	1,528,855	1,619,932	15,123,501
OVEC Transmission Charge	68,701	79,031	75,396	78,234	66,191	70,930	74,285	78,853	75,984	667,605
Total OVEC Monthly Charge	<u>\$ 3,443,255</u>	<u>\$ 2,440,129</u>	<u>\$ 3,063,561</u>	<u>\$ 3,263,191</u>	<u>\$ 2,776,607</u>	<u>\$ 2,799,348</u>	<u>\$ 2,930,996</u>	<u>\$ 2,924,444</u>	<u>\$ 2,771,105</u>	<u>26,412,636</u>

**Kentucky Utilities
OVEC CHARGES**

FOR THE 2 MONTHS NOVEMBER 30 AND DECEMBER 31, 2018

	Nov-18	Dec-18	TOTAL
OVEC Energy Charge	\$ 573,438	\$ 575,827	\$ 1,149,265
OVEC Demand Charge	606,130	776,091	1,382,221
OVEC Transmission Charge	31,672	35,136	66,808
Total OVEC Monthly Charge	1,211,240	1,387,055	2,598,294

FOR THE 9 MONTHS ENDED SEPTEMBER 30, 2019

	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	TOTAL
OVEC Energy Charge	\$ 645,898	\$ 392,242	\$ 643,806	\$ 375,394	\$ 455,449	\$ 555,658	\$ 583,337	\$ 583,742	\$ 479,333	\$ 4,714,860
OVEC Demand Charge	848,831	654,630	684,402	1,040,158	749,348	655,990	683,929	678,877	719,320	6,715,485
OVEC Transmission Charge	30,507	35,094	33,479	34,740	29,392	31,496	32,986	35,015	33,741	296,450
Total OVEC Monthly Charge	1,525,237	1,081,966	1,361,687	1,450,292	1,234,189	1,243,144	1,300,252	1,297,634	1,232,393	11,726,795

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 23

Witness: Stuart A. Wilson

Q-23. With respect to the OVEC Generating Units, for each month from January 2019 through December 2026, identify (for those already incurred and known) or project (for future charges) the following charges as pertains to the Company:

- a) Total Monthly Charge, pursuant to Article 5.01 of the ICPA
- b) Energy Charge, pursuant to Article 5.02 of the ICPA
- c) Demand Charge, pursuant to Article 5.03 of the ICPA
- d) Transmission Charge, pursuant to Article 5.04 of the ICPA
- e) If your responses to this request are the same as to the same request posed by Sierra Club DR 1-5 in Case Nos. 2018-00294 and 2018-00295, please confirm; or if your responses are now different, confirm that and explain how they are different now.

A-23.

- a) – d) See attached for the assumed projected OVEC costs. For actual data in January 2019 through September 2019, see the response to Question No. 22. Certain information requested is confidential and proprietary and is being provided under seal pursuant to a petition for confidential protection.
- e) Confirmed.

**OVEC Cost Forecast (\$)
LG&E and KU Share**

	10/1/2019	11/1/2019	12/1/2019	1/1/2020	2/1/2020	3/1/2020	4/1/2020	5/1/2020	6/1/2020	7/1/2020	8/1/2020	9/1/2020
LG&E												
Total Monthly Charge												
Energy Charge												
Demand Charge												
Transmission Charge												
KU												
Total Monthly Charge												
Energy Charge												
Demand Charge												
Transmission Charge												
Combined Companies												
Total Monthly Charge												
Energy Charge												
Demand Charge												
Transmission Charge												

CONFIDENTIAL INFORMATION REDACTED

**OVEC Cost Forecast (\$)
LG&E and KU Share**

LG&E	10/1/2020	11/1/2020	12/1/2020	1/1/2021	2/1/2021	3/1/2021	4/1/2021	5/1/2021	6/1/2021	7/1/2021	8/1/2021	9/1/2021
Total Monthly Charge	[REDACTED]											
Energy Charge	[REDACTED]											
Demand Charge	[REDACTED]											
Transmission Charge	[REDACTED]											

KU	10/1/2020	11/1/2020	12/1/2020	1/1/2021	2/1/2021	3/1/2021	4/1/2021	5/1/2021	6/1/2021	7/1/2021	8/1/2021	9/1/2021
Total Monthly Charge	[REDACTED]											
Energy Charge	[REDACTED]											
Demand Charge	[REDACTED]											
Transmission Charge	[REDACTED]											

Combined Companies	10/1/2020	11/1/2020	12/1/2020	1/1/2021	2/1/2021	3/1/2021	4/1/2021	5/1/2021	6/1/2021	7/1/2021	8/1/2021	9/1/2021
Total Monthly Charge	[REDACTED]											
Energy Charge	[REDACTED]											
Demand Charge	[REDACTED]											
Transmission Charge	[REDACTED]											

CONFIDENTIAL INFORMATION REDACTED

**OVEC Cost Forecast (\$)
LG&E and KU Share**

	10/1/2021	11/1/2021	12/1/2021	1/1/2022	2/1/2022	3/1/2022	4/1/2022	5/1/2022	6/1/2022	7/1/2022	8/1/2022	9/1/2022
LG&E												
Total Monthly Charge												
Energy Charge												
Demand Charge												
Transmission Charge												
KU												
Total Monthly Charge												
Energy Charge												
Demand Charge												
Transmission Charge												
Combined Companies												
Total Monthly Charge												
Energy Charge												
Demand Charge												
Transmission Charge												

CONFIDENTIAL INFORMATION REDACTED

**OVEC Cost Forecast (\$)
LG&E and KU Share**

	10/1/2022	11/1/2022	12/1/2022	1/1/2023	2/1/2023	3/1/2023	4/1/2023	5/1/2023	6/1/2023	7/1/2023	8/1/2023	9/1/2023
LG&E												
Total Monthly Charge												
Energy Charge												
Demand Charge												
Transmission Charge												
KU												
Total Monthly Charge												
Energy Charge												
Demand Charge												
Transmission Charge												
Combined Companies												
Total Monthly Charge												
Energy Charge												
Demand Charge												
Transmission Charge												

CONFIDENTIAL INFORMATION REDACTED

**OVEC Cost Forecast (\$)
LG&E and KU Share**

LG&E	10/1/2023	11/1/2023	12/1/2023	1/1/2024	2/1/2024	3/1/2024	4/1/2024	5/1/2024	6/1/2024	7/1/2024	8/1/2024	9/1/2024
Total Monthly Charge	[REDACTED]											
Energy Charge	[REDACTED]											
Demand Charge	[REDACTED]											
Transmission Charge	[REDACTED]											

KU	10/1/2023	11/1/2023	12/1/2023	1/1/2024	2/1/2024	3/1/2024	4/1/2024	5/1/2024	6/1/2024	7/1/2024	8/1/2024	9/1/2024
Total Monthly Charge	[REDACTED]											
Energy Charge	[REDACTED]											
Demand Charge	[REDACTED]											
Transmission Charge	[REDACTED]											

Combined Companies	10/1/2023	11/1/2023	12/1/2023	1/1/2024	2/1/2024	3/1/2024	4/1/2024	5/1/2024	6/1/2024	7/1/2024	8/1/2024	9/1/2024
Total Monthly Charge	[REDACTED]											
Energy Charge	[REDACTED]											
Demand Charge	[REDACTED]											
Transmission Charge	[REDACTED]											

CONFIDENTIAL INFORMATION REDACTED

**OVEC Cost Forecast (\$)
LG&E and KU Share**

	10/1/2024	11/1/2024	12/1/2024	1/1/2025	2/1/2025	3/1/2025	4/1/2025	5/1/2025	6/1/2025	7/1/2025	8/1/2025	9/1/2025
LG&E												
Total Monthly Charge												
Energy Charge												
Demand Charge												
Transmission Charge												
KU												
Total Monthly Charge												
Energy Charge												
Demand Charge												
Transmission Charge												
Combined Companies												
Total Monthly Charge												
Energy Charge												
Demand Charge												
Transmission Charge												

CONFIDENTIAL INFORMATION REDACTED

**OVEC Cost Forecast (\$)
LG&E and KU Share**

	10/1/2025	11/1/2025	12/1/2025	1/1/2026	2/1/2026	3/1/2026	4/1/2026	5/1/2026	6/1/2026	7/1/2026	8/1/2026	9/1/2026
LG&E												
Total Monthly Charge												
Energy Charge												
Demand Charge												
Transmission Charge												
KU												
Total Monthly Charge												
Energy Charge												
Demand Charge												
Transmission Charge												
Combined Companies												
Total Monthly Charge												
Energy Charge												
Demand Charge												
Transmission Charge												

CONFIDENTIAL INFORMATION REDACTED

**OVEC Cost Forecast (\$)
LG&E and KU Share**

LG&E	10/1/2026	11/1/2026	12/1/2026
Total Monthly Charge			
Energy Charge			
Demand Charge			
Transmission Charge			

KU	10/1/2026	11/1/2026	12/1/2026
Total Monthly Charge			
Energy Charge			
Demand Charge			
Transmission Charge			

Combined Companies	10/1/2026	11/1/2026	12/1/2026
Total Monthly Charge			
Energy Charge			
Demand Charge			
Transmission Charge			

CONFIDENTIAL INFORMATION REDACTED

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 24

Witness: Stuart A. Wilson

- Q-24. Has the Company incurred any charges in connection with Minimum Loading Events, as described in the ICPA Section 5.05, during the period from January 1, 2013, to the present?
- a) If so, describe each such charge, including months incurred and amount of such charge.
 - b) If your responses to this request are the same as to the same request posed by Sierra Club DR 1-6 in Case Nos. 2018-00294 and 2018-00295, please confirm; or if your responses are now different, confirm that and explain how they are different now.
- A-24. No.
- a) Not applicable.
 - b) This response is the same as the responses to the referenced questions from Case Nos. 2018-00294 and 2018-00295.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 25

Witness: Stuart A. Wilson

- Q-25. Provide a record of all funds accrued by OVEC "in connection with the decommissioning, shutdown, demolition and closing" of the OVEC Units as described in Articles 5.03(f) and 7.04 of the ICPA.
- a) If your response to this request is the same as it was to the same request posed by Sierra Club DR 1-7 in Case Nos. 2018-00294 and 2018-00295, please confirm; or if your response is now different, confirm that and explain how it is different now.
- A-25. OVEC's "Total D&D Assets at October 31, 2018" was \$57,188,974, as shown in the response to Question No. 31. OVEC's financial statements, FERC Form 1 reports, and 2018 Annual Report are publicly available on OVEC's website at <http://ovec.com>.
- a) This response differs from the responses to the referenced questions from Case Nos. 2018-00294 and 2018-00295, in that a figure is provided from the information shown in the attachment to the response to Question No. 31.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 26

Witness: Stuart A. Wilson

- Q-26. Provide any assessment of the sufficiency of OVEC's funding to support decommissioning, shutdown, demolition and closing of the OVEC Units.
- a) If your response to this request is the same as it was to the same request posed by Sierra Club DR 1-8 in Case Nos. 2018-00294 and 2018-00295, please confirm; or if your response is now different, confirm that and explain how it is different now.
- A-26. See attached. The Companies do not have OVEC's decommissioning and demolition studies, to which the attached letter refers, or any other responsive documents. OVEC's financial statements, FERC Form 1 reports, and 2018 Annual Report are publicly available on OVEC's website at <http://ovec.com>.
- a) This response is effectively the same as the responses to the referenced questions from Case Nos. 2018-00294 and 2018-00295, except that it refers to the OVEC's 2018 Annual Report.

OHIO VALLEY ELECTRIC CORPORATION ^{Wilson}

P. O. Box 16631

Columbus, Ohio 43216

September 28, 2017

Members of the Boards	Nicholas K. Akins	Mark C. McCullough
	Thomas Alban	Mark E. Miller
	Eric D. Baker	Steven K. Nelson
	Lonnie E. Bellar	Patrick W. O'Loughlin
	Wayne D. Games	David W. Pinter
	James R. Haney	Julie Sloat
	Lana L. Hillebrand	Toby L. Thomas
	Marc E. Lewis	Paul W. Thompson
	David A. Lucas	John A. Verderame

Ladies and Gentlemen:

As discussed in the Boards of Directors' Update Meeting on July 21, 2017, OVEC initiated an updated Decommissioning and Demolition (D&D) Study. OVEC is required, per the Inter-Company Power Agreement, to update the study at a minimum of every five years, with the last study being completed in 2014. OVEC initiated an updated study in advance of the 2019 revision date as a result of the October 19, 2015 Coal Combustion Residual (CCR) rule's added requirements related to the closure and post-closure care of CCR impoundments. The updated D&D Study was recently completed by an independent third party engineering firm and is being audited by our external auditors with completion at the end of September. The updated study, which assumes a June 2040 plant closure date, resulted in approximately \$40 million per plant of additional projected future D&D costs associated with the requirements contained in the CCR rule. The updated D&D Study will be reviewed with the Environmental Sub-committee members in the upcoming meeting in late October.

OVEC initiated a D&D funding holiday at year-end 2014 due to the prior D&D Study results and the current D&D funding balance at that time. The funding holiday originally was forecasted to end in 2020; however, as a result of the new CCR regulations and the updated study's results, OVEC will end the funding holiday in the 4th quarter 2017. The 2017 billable costs to Sponsors will be approximately \$1.4 million billed pro rata over the final quarter and the 2018 annual billable costs are projected to be approximately \$5.5 million. OVEC will continue to monitor any possible challenges to the CCR rule requirements and other regulations that could impact these forecasted costs and will continue to update the Boards on any changes. Please contact me at 614-716-2860/raosborne@aep.com with general questions or Mike Brown at 740-289-7299/mbrown@ovec.com on specific CCR questions.

Sincerely,

Robert A. Osborne

RAO:gln

c: J. Baumann
J. D. Brodt
B. E. Chisling
R. D. Cook
J. J. Cooper
D. Crusey

L. L. Dieck
M. Sebourn
D. J. Sensius
T. Stoner
J. Swez
B. Warner

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 27

Witness: Stuart A. Wilson

Q-27. For each of the years 2013 through 2018, and each month in 2019 to date, and for each of the OVEC Units, identify the:

- a) Capacity factor
- b) Availability
- c) Heat rate
- d) Forced outage rate
- e) Unforced outage rate
- f) Fixed operating and maintenance ("O&M") cost
- g) Variable O&M cost
- h) Fuel cost
- i) Environmental capital cost
- j) Non-environmental capital cost
- k) Depreciation cost
- l) Return on equity
- m) Interest expense
- n) Taxes
- o) Note that this request is the same as Sierra Club DR 1-9 in Case Nos. 2018-00294 and 2018-00295 except in that it extends the timeframe to the present. If your responses to this request are the same, for the period January 2013 through the time period the

Company previously provided, as the same request posed by Sierra Club DR 1-9 in Case Nos. 2018-00294 and 2018-00295, please confirm; or if your responses are now different with respect to that timeframe (apart from the Companies' response to the subsequent timeframe leading through the present), confirm that and explain how they are different now.

A-27. The Companies do not have access to OVEC's detailed corporate, accounting, or operating information. OVEC's financial statements, FERC Form 1 reports, and 2018 Annual Report are publicly available on OVEC's website at <http://ovec.com>. The Companies possess certain relevant historical OVEC data, primarily consolidated at either the station level or the OVEC combined level as indicated below.

a) The OVEC combined capacity factors through 2018 are shown in the following table. The Companies do not have OVEC's capacity factors for 2019. However, OVEC's monthly net generation through July 2019 is publicly available from the U.S. Energy Information Administration Form EIA-923, which can be found at <https://www.eia.gov/electricity/data/eia923/>.

	Capacity Factor
2013	55.4%
2014	60.4%
2015	47.1%
2016	52.5%
2017	63.2%
2018 (projected as of Dec. 2018)	61%

b) OVEC's combined equivalent availability for 2014 through 2018 is shown on p. 42 of OVEC's publicly available 2018 Annual Report. The Companies do not have the availability figures for 2019.

c) OVEC's combined heat rate for 2014 through 2018 is shown on p. 42 of OVEC's publicly available 2018 Annual Report. The Companies have OVEC's historical station-level heat rates shown in the following table.

Heat Rate (Btu/kWh)	Kyger Creek	Clifty Creek
2015	10,577	10,768
2016	10,815	10,992
2017	10,501	10,741
2018	10,412	10,657
January through June 2019	10,657	10,730

- d) See attached. Certain information requested is confidential and proprietary and is being provided under seal pursuant to a petition for confidential protection.
- e) The Companies do not have the information requested.
- f) See the aforementioned publicly available OVEC financial statements, FERC Form 1 reports, and 2018 Annual Report. The Companies are not aware of a reported distinction between OVEC’s historical “Fixed” and “Variable” O&M costs. The following table summarizes OVEC’s 2019 monthly operating expenses as billed through August.

2019 Operating Expenses (\$)	Total Fuel Cost	O&M	Interest and Debt Expense	Taxes
January	26,095,910	11,175,268	6,935,508	1,021,679
February	22,256,493	10,834,085	6,624,493	920,591
March	25,627,189	15,018,622	6,883,260	976,546
April	13,775,064	21,701,844	6,715,616	1,215,580
May	19,498,700	17,495,800	6,990,400	994,908
June	21,727,221	10,852,552	6,614,599	944,634
July	26,307,557	13,053,692	6,911,816	1,249,440
August	24,345,802	12,109,802	6,760,790	952,530

- g) See the response to part (f).
- h) See the response to part (f).
- i) See the aforementioned publicly available OVEC financial statements, FERC Form 1 reports, and 2018 Annual Report. The Companies are not aware of a reported distinction between OVEC’s historical “Environmental” and “Non-environmental” capital costs. The Companies do not have access to monthly OVEC financial statements for 2019.
- j) See the response to part (i).
- k) See the response to part (f). The Companies do not have the monthly depreciation figures for 2019.
- l) See the aforementioned publicly available OVEC financial statements. The Companies do not have access to monthly OVEC financial statements for 2019.
- m) See the response to part (f).

- n) See the response to part (f).
- o) This response is different from the responses to the referenced questions from Case Nos. 2018-00294 and 2018-00295 in that the response to part (d) has been updated to include additional unit-level EFOR data.

EFOR	2013	2014	2015	2016	2017	2018	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19
Clifty Creek 1	10.1%	14.5%	7.3%												
Clifty Creek 2	7.2%	8.4%	9.5%												
Clifty Creek 3	19.1%	25.9%	16.0%												
Clifty Creek 4	19.2%	12.4%	12.6%												
Clifty Creek 5	6.8%	11.7%	10.3%												
Clifty Creek 6	15.5%	16.2%	24.8%												
Clifty Creek Station	12.7%	14.2%	13.5%	7.5%	7.1%	7.8%									
Kyger Creek 1	12.6%	9.4%	16.5%												
Kyger Creek 2	8.7%	17.8%	25.5%												
Kyger Creek 3	13.2%	20.2%	19.7%												
Kyger Creek 4	4.2%	12.1%	45.5%												
Kyger Creek 5	8.9%	11.5%	22.5%												
Kyger Creek Station	9.3%	14.1%	26.1%	9.3%	5.7%	5.3%									

CONFIDENTIAL INFORMATION REDACTED

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 28

Witness: Stuart A. Wilson

Q-28. For each of the years 2019 through 2030, for each of the OVEC Units, identify each unit's projected:

- a) Capacity factor
- b) Availability
- c) Heat rate
- d) Forced outage rate
- e) Unforced outage rate
- f) Fixed O&M cost
- g) Variable O&M cost
- h) Fuel cost
- i) Environmental capital cost
- j) Non-environmental capital cost
- k) Depreciation cost
- l) Return on equity
- m) Interest expense
- n) Taxes
- o) If your responses to this request are the same as to the same request posed by Sierra Club DR 1-10 in Case Nos. 2018-00294 and 2018-00295, please confirm; or if your responses are now different, confirm that and explain how they are different now.

- A-28. The Companies do not have the information requested at the OVEC unit level. Some of the information is available for the OVEC units as a whole. Certain information requested is confidential and proprietary and is being provided under seal pursuant to a petition for confidential protection.
- a) See attached.
 - b) See the response to Question No. 29.
 - c) The Companies do not have access to the information requested.
 - d) OVEC's forecasted equivalent unplanned outage rate is 10%.
 - e) The Companies do not have access to the information requested. See the response to Question No. 29.
 - f) See the response to part a.
 - g) See the response to part a.
 - h) See the response to part a.
 - i) See the response to part a.
 - j) See the response to part a.
 - k) The Companies do not have access to the information requested.
 - l) See the response to part a.
 - m) See the response to part a.
 - n) See the response to part a.
 - o) This response is the same as the responses to the referenced questions from Case Nos. 2018-00294 and 2018-00295.

OVEC Capacity Factor and Cost Forecast (\$000)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Capacity Factor												
Fixed O&M												
Variable O&M												
Fuel Cost												
Capital Costs*												
Return on Equity												
Interest Expense												
Taxes												

[Redacted]

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**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 29

Witness: Stuart A. Wilson

Q-29. With regard to each of the OVEC Units:

- a) Describe in detail any planned outages for maintenance or repair scheduled between January 1, 2019, and June 1, 2025, including the duration of each such outage and the estimated cost of such maintenance or repairs.
- b) Describe in detail any unplanned outages that have occurred since January 1, 2010, including the duration of each such outage, steps taken to address the cause of each such outage, and the cost of such steps.
- c) If your responses to this request are the same as to the same request posed by Sierra Club DR 1-11 in Case Nos. 2018-00294 and 2018-00295, please confirm; or if your responses are now different, confirm that and explain how they are different now

A-29.

- a) See attachments. Certain information requested is confidential and proprietary and is being provided under seal pursuant to a petition for confidential protection.
- b) The Companies do not have access to this information.
- c) This response is the same as the responses to the referenced questions from Case Nos. 2018-00294 and 2018-00295.

**Ohio Valley Electric Corporation - Indiana-Kentucky Electric Corporation
Unit Outage Schedule - 2020**

Date Issue: 8/7/2018

Issued By: Tim Fulk

		2020 Planned Outages												
Beginning Date	Ending Date	Days	January	February	March	April	May	June	July	August	September	October	November	December
Clifty 1														
[Outage Bar]														
Clifty 2														
[Outage Bar]														
Clifty 3														
[Outage Bar]														
Clifty 4														
[Outage Bar]														
Clifty 5														
[Outage Bar]														
Clifty 6														
[Outage Bar]														
Kyger 1														
[Outage Bar]														
Kyger 2														
[Outage Bar]														
Kyger 3														
[Outage Bar]														
Kyger 4														
[Outage Bar]														
Kyger 5														
[Outage Bar]														
PJM No Fly Zone 6/8/20 - 9/4/20														

Planned Outage Summary		
	Outage Days	Planned Availability
Clifty Creek	183	91.7%
Kyger Creek	188	89.7%
System	371	90.8%

- | | | | |
|------------------------------------|--------------------------------|--------------------------------------|------------------------------|
| AB - Air Heater Baskets | CR - Catalyst Replacement | ND - NDT Turbine Valve Bodies | SV - Set Safety Valves |
| BC - Boiler Chemical Clean | GH - Generator Inspection - HP | PF - Furnace Floor & 1st Baffle Wall | TH - Turbine Inspection - HP |
| BF - JBR Booster Fan Rebuild | GL - Generator Inspection - LP | RC - Retube Condenser | TI - Turbine Inspection - IP |
| BT - Boiler & Turbine Maintenance | GR - Generator Rewind | RT - Reheat Tube Replacement | TL - Turbine Inspection - LP |
| BW - Boiler Water Wall Tubes | I - Insurance Inspection | SF - Sloping Floor & Screen Tubes | TV - Turbine Valves |
| CH - Thrust Collar Inspection - HP | JB - JBR Inspection | SO - Strainer Outage | |
| CL - Thrust Collar Inspection - LP | M - MATS Designated Outage | SSH - Secondary Superheater Tubes | |

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**Ohio Valley Electric Corporation - Indiana-Kentucky Electric Corporation
Unit Outage Schedule - 2021**

Date Issue: 8/7/2018

Issued By: Tim Fulk

		2021 Planned Outages												
Beginning Date	Ending Date	Days	January	February	March	April	May	June	July	August	September	October	November	December
Clifty 1			[Redacted Content]											
Clifty 2														
Clifty 3														
Clifty 4														
Clifty 5														
Clifty 6														
Kyger 1														
Kyger 2														
Kyger 3														
Kyger 4														
Kyger 5														

PJM No Fly Zone 6/14/21 to 9/10/21

Planned Outage Summary		
	Outage Days	Planned Availability
Clifty Creek	169	92.3%
Kyger Creek	138	92.4%
System	307	92.4%

- | | | | |
|------------------------------------|--------------------------------|--------------------------------------|------------------------------|
| AB - Air Heater Baskets | CR - Catalyst Replacement | ND - NDT Turbine Valve Bodies | SV - Set Safety Valves |
| BC - Boiler Chemical Clean | GH - Generator Inspection - HP | PF - Furnace Floor & 1st Baffle Wall | TH - Turbine Inspection - HP |
| BF - JBR Booster Fan Rebuild | GL - Generator Inspection - LP | RC - Retube Condenser | TI - Turbine Inspection - IP |
| BT - Boiler & Turbine Maintenance | GR - Generator Rewind | RT - Reheat Tube Replacement | TL - Turbine Inspection - LP |
| BW - Boiler Water Wall Tubes | I - Insurance Inspection | SF - Sloping Floor & Screen Tubes | TV - Turbine Valves |
| CH - Thrust Collar Inspection - HP | JB - JBR Inspection | SO - Strainer Outage | |
| CL - Thrust Collar Inspection - LP | M - MATS Designated Outage | SSH - Secondary Superheater Tubes | |

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**Ohio Valley Electric Corporation - Indiana-Kentucky Electric Corporation
Unit Outage Schedule - 2022**

Date Issue: 8/7/2018

Issued By: Tim Fulk

			2022 Planned Outages																							
Beginning Date	Ending Date	Days	January	February	March	April	May	June	July	August	September	October	November	December												
Clifty 1			[Redacted]																							
Clifty 2															[Redacted]											
Clifty 3			[Redacted]																							
Clifty 4															[Redacted]											
Clifty 5			[Redacted]																							
Clifty 6															[Redacted]											
Kyger 1			[Redacted]																							
Kyger 2															[Redacted]											
Kyger 3			[Redacted]																							
Kyger 4															[Redacted]											
Kyger 5			[Redacted]																							
															PJM No Fly Zone 6/13/22 to 9/9/22											

Planned Outage Summary		
	Outage Days	Planned Availability
Clifty Creek	197	91.0%
Kyger Creek	196	89.3%
System	393	90.2%

- | | | | |
|------------------------------------|--------------------------------|--------------------------------------|------------------------------|
| AB - Air Heater Baskets | CR - Catalyst Replacement | ND - NDT Turbine Valve Bodies | SV - Set Safety Valves |
| BC - Boiler Chemical Clean | GH - Generator Inspection - HP | PF - Furnace Floor & 1st Baffle Wall | TH - Turbine Inspection - HP |
| BF - JBR Booster Fan Rebuild | GL - Generator Inspection - LP | RC - Retube Condenser | TI - Turbine Inspection - IP |
| BT - Boiler & Turbine Maintenance | GR - Generator Rewind | RT - Reheat Tube Replacement | TL - Turbine Inspection - LP |
| BW - Boiler Water Wall Tubes | I - Insurance Inspection | SF - Sloping Floor & Screen Tubes | TV - Turbine Valves |
| CH - Thrust Collar Inspection - HP | JB - JBR Inspection | SO - Strainer Outage | |
| CL - Thrust Collar Inspection - LP | M - MATS Designated Outage | SSH - Secondary Superheater Tubes | |

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**Ohio Valley Electric Corporation - Indiana-Kentucky Electric Corporation
Unit Outage Schedule - 2023**

Date Issue: 8/7/2018

Issued By: Tim Fulk

		2023 Planned Outages												
Beginning Date	Ending Date	Days	January	February	March	April	May	June	July	August	September	October	November	December
Clifty 1			[Redacted]											
Clifty 2			[Redacted]											
Clifty 3			[Redacted]											
Clifty 4			[Redacted]											
Clifty 5			[Redacted]											
Clifty 6			[Redacted]											
Kyger 1			[Redacted]											
Kyger 2			[Redacted]											
Kyger 3			[Redacted]											
Kyger 4			[Redacted]											
Kyger 5			[Redacted]											

PJM No Fly Zone 6/13/22 to 9/9/22

	Outage Days	Planned Availability
Clifty Creek	182	91.7%
Kyger Creek	149	91.8%
System	332	91.7%

- | | | | |
|------------------------------------|--------------------------------|--------------------------------------|------------------------------|
| AB - Air Heater Baskets | CR - Catalyst Replacement | ND - NDT Turbine Valve Bodies | SV - Set Safety Valves |
| BC - Boiler Chemical Clean | GH - Generator Inspection - HP | PF - Furnace Floor & 1st Baffle Wall | TH - Turbine Inspection - HP |
| BF - JBR Booster Fan Rebuild | GL - Generator Inspection - LP | RC - Retube Condenser | TI - Turbine Inspection - IP |
| BT - Boiler & Turbine Maintenance | GR - Generator Rewind | RT - Reheat Tube Replacement | TL - Turbine Inspection - LP |
| BW - Boiler Water Wall Tubes | I - Insurance Inspection | SF - Sloping Floor & Screen Tubes | TV - Turbine Valves |
| CH - Thrust Collar Inspection - HP | JB - JBR Inspection | SO - Strainer Outage | |
| CL - Thrust Collar Inspection - LP | M - MATS Designated Outage | SSH - Secondary Superheater Tubes | |

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**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 30

Witness: Stuart A. Wilson

Q-30. Identify the currently planned retirement date for each of the OVEC Units.

a) If your response to this request is the same as it was to the same request posed by Sierra Club DR 1-12 in Case Nos. 2018-00294 and 2018-00295, please confirm; or if your response is now different, confirm that and explain how it is different now.

A-30. There are no planned retirement dates for OVEC's units. It is expected that OVEC will continue to operate the units at least until June 30, 2040, through the term of the Inter-Company Power Agreement.

a) This response is the same as the responses to the referenced questions from Case Nos. 2018-00294 and 2018-00295.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 31

Witness: Stuart A. Wilson

- Q-31. Produce the minutes from each meeting of the OVEC Board of Directors since January 1, 2015.
- a) If your response to this request is the same as it was to the same request posed by Sierra Club DR 1-13 in Case Nos. 2018-00294 and 2018-00295, please confirm; or if your response is now different, confirm that and explain how it is different now.
- A-31. See attached. Proposed final OVEC board minutes as routinely provided to and in the Companies' possession are provided. Certain actions of OVEC's board are taken via unanimous written consent, but the Companies do not routinely receive or possess completed final versions of such consents. Certain information requested is confidential and proprietary and is being provided under seal pursuant to a petition for confidential protection.
- a) This response includes minutes from Board meetings that have occurred since the responses to the same questions posed by the Sierra Club in Case Nos. 2018-00294 and 2018-00295 were prepared.

OHIO VALLEY ELECTRIC CORPORATION
Minutes of Special Meeting of the
Board of Directors held December 1, 2015

A Special Meeting of the Board of Directors of **OHIO VALLEY ELECTRIC CORPORATION** (OVEC) was called to order by Mr. Mark C. McCullough at 1 Riverside Plaza, Columbus, Ohio, on Tuesday, December 1, 2015, at 10:00 a.m., pursuant to notice duly given. On a motion duly made, seconded, and unanimously adopted, it was

RESOLVED, that in accordance with Article IV, Section 3 of the Code of Regulations of this Corporation, Mr. Mark C. McCullough be elected Chairman of this Meeting on December 1, 2015, in the absence of the President of this Corporation.

Mr. McCullough acted as Chairman of the meeting, and John D. Brodt, Chief Financial Officer, Secretary and Treasurer of the Corporation, acted as Secretary of the Meeting.

Mr. Brodt reported that the following Directors were present for the meeting:

Nicholas K. Akins (Phone)	Mark E. Miller
Thomas Alban	Donald A. Moul
Eric D. Baker (Phone)	Steven K. Nelson
Wayne D. Games	Patrick W. O'Loughlin
James R. Haney	Paul W. Thompson
Lana L. Hillebrand	John A. Verderame
Mark C. McCullough	

Mr. Brodt reported that the Minutes of the Special Meeting of the Board of Directors of this Corporation, held on December 5, 2014, have been sent to each of the Directors. He asked that, if there were no corrections, such minutes be approved in the form in which they were circulated. On a motion duly made, seconded, and unanimously adopted, it was

RESOLVED, that the Minutes of the Special Meeting of the Board of Directors of this Corporation, held on December 5, 2014, are approved.

At the request of Mr. McCullough, Mr. Justin Cooper reported on the 2013 – 2016 LEAN Cost Structure cost profile. Mr. Cooper reviewed the results of the 2015 continuous improvements (LEAN) reductions and the operating, maintenance, and capital cost benchmarking budgets. Mr. Cooper reported that OVEC's operating, maintenance, and capital

cost profile was projected to [REDACTED] in 2016 compared with 2013. The energy cost [REDACTED] was expected to be [REDACTED].

Mr. McCullough asked Mr. Robert Osborne to give an update on the boiler floor refractory wastage issue and the replacement of floor tubes. The replacement of floor tubes has occurred on three boilers and four more will be replaced in 2016. Mr. Osborne discussed unit reliability and process health of the units.

Mr. McCullough asked Mr. Clifford Carnes and Ms. Annette Hope to report on operating activities for the Clifty Creek and Kyger Creek Plants, respectively. Mr. Carnes and Ms. Hope reviewed operating statistics and environmental and safety records for 2015 at each plant. Mr. Carnes and Ms. Hope reported on the sustainability of the LEAN process and the Open Book Leadership.

Mr. McCullough asked Mr. Copper to review the 2016 Construction Budget and the 2017-2020 Construction Budget Forecast. Mr. Cooper commented that the 2016 Construction Budget is a [REDACTED] compared with the [REDACTED] annual capital spending prior to implementation of OVEC's LEAN initiative. Mr. Cooper reported that the Construction Budget for 2016 indicates estimated total expenditures of [REDACTED], representing [REDACTED] and [REDACTED].

[REDACTED] On a motion duly made, seconded, and unanimously adopted, it was

RESOLVED, that the OVEC-IKEC Construction Budget for 2016, indicating estimated total expenditures of [REDACTED] which totals [REDACTED], is approved.

Mr. McCullough asked Mr. Brown to give an update on the OVEC and IKEC environmental compliance and to report on future environmental capital projects. Mr. Brown reported on Section 316(b) of the Clean Water Act, Coal Combustion Residual (CCR) Rule, and Effluent Limitations Guidelines compliance. Mr. Brown indicated the estimated cost of compliance may reach [REDACTED] during the [REDACTED] time frame. Mr. Brown requested authorization to complete entrainment studies at Kyger Creek and Clifty Creek Stations associated with the initial phase of 316(b) compliance, to perform Phase I engineering studies on the boiler slag complexes and FGD wastewater treatment plant systems, to perform additional analyses using results and findings of Kyger Creek Dry Fly Ash Conversion Project Phase I engineering study, to perform compliance activities and evaluations associated with the CCR Rule at the Kyger Creek and Clifty Creek Stations, and to perform engineering study and

capital work associated with modifications to the Kyger Creek Landfill stackout pad and leachate collections systems. On a motion duly made, seconded, and unanimously adopted, it was

RESOLVED, that the Company is authorized to proceed to perform the following environmental compliance activities:

1. Complete entrainment studies and other compliance activities at the Kyger Creek and Clifty Creek Stations associated with the initial phase of 316(b) compliance;
2. Perform Phase I engineering studies on the boiler slag complexes and FGD wastewater treatment plant systems at the Kyger Creek and Clifty Creek Stations to evaluate capital costs and options for compliance with the final version of the Steam Electric Effluent Limitations Guidelines (ELGs);
3. Perform additional analyses using results and findings of Kyger Creek Dry Fly Ash Conversion Project Phase I engineering study relative to the final ELGs;
4. Perform compliance activities and evaluations associated with the CCR Rule at the Kyger Creek and Clifty Creek Stations;
5. Perform engineering study and capital work associated with modifications to the Kyger Creek Landfill stackout pad and leachate collections systems to meet NPDES water quality based limits.

The cost for the scope of work described above is forecasted to be a total of [REDACTED] for 2016 and 2017 inclusive. The results of these studies will be used to refine future environmental capital project costs prior to requesting the Boards' approval to complete each associated environmental capital project.

At the request of Mr. McCullough, Mr. Ken Tamms of the AEP Service Corporation reviewed the merchant plant analysis. A handout was provided to the Board, which indicated that [REDACTED]

At the request of Mr. McCullough, Mr. Charles West of the AEP Service Corporation discussed the coal and transportation contracts. A handout was provided to the Board, and a discussion followed describing the fuel supplies currently at each power plant as well as future commitments. Mr. West discussed [REDACTED] at both plants.

At the request of Mr. McCullough, Mr. Brodt provided information and discussed OVEC's year-to-date power costs estimated for 2015 and projections for 2016-2020. Mr. Brodt stated that based on current estimates OVEC expected to end 2015 with an average power cost of [REDACTED] and an available power use factor of [REDACTED]. Mr. Brodt stated that the

projected average power cost for OVEC power, delivered under the terms of the Inter-Company Power Agreement, ranges from [REDACTED] in 2016 to [REDACTED] in 2020 using an estimated available power use factor of [REDACTED].

Mr. McCullough asked Mr. Scott Cunningham to report on the OVEC Operating Committee. Mr. Cunningham reported that the PJM pseudo-tie was scheduled to start in June 2016 and that the Operating Committee was studying PJM membership for OVEC.

At the request of Mr. McCullough, Mr. Brodt reviewed the 2015 Service Corporation general expenditures, which were expected to be approximately [REDACTED]. Mr. Brodt requested authorization for 2016 general expenditures for services from the AEP Service Corporation up to [REDACTED]. The primary general expenditures are expected to be in the areas of operation and maintenance, environmental activities, fuel procurement, and coal transportation. Mr. Brodt stated that the 2016 Budget is similar to the 2015 Budget except that the 2016 Budget request of [REDACTED]

[REDACTED]
[REDACTED] On a motion duly made, seconded, and
unanimously adopted, it was

RESOLVED, that the officers of Ohio Valley Electric Corporation may request and obligate Ohio Valley Electric Corporation to pay for general services, exclusive of services for specific projects previously approved, under the Agreement among American Gas and Electric Service Corporation (now American Electric Power Service Corporation), Ohio Valley Electric Corporation, and Indiana-Kentucky Electric Corporation dated December 15, 1956, in an amount which, when added to amounts paid for general services by Indiana-Kentucky Electric Corporation, exclusive of services for specific projects previously approved, would aggregate a maximum of [REDACTED] for calendar year 2016.

At the request of Mr. McCullough, Mr. Brodt reported on the status of the Corporation's finances. Mr. Brodt distributed to all members present a copy of the Treasurer's Report that included the following statistics:

**OHIO VALLEY ELECTRIC CORPORATION (OVEC)
INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC)
Treasurer's Report
Boards of Directors' Meeting
December 1, 2015**

	<u>OVEC</u>	<u>IKEC</u>	<u>Consolidated</u>
<u>EQUITY</u>			
Common Stock, 100,000 shares outstanding	\$ 10,000,000	\$ 3,400,000	\$ 10,000,000
Retained Earnings	7,771,843	-	7,771,843
Total Equity at October 31, 2015	<u>\$ 17,771,843</u>	<u>\$ 3,400,000</u>	<u>\$ 17,771,843</u>
(OVEC's ownership of IKEC's Capital Stock (17,000 shares) is eliminated in consolidation.)			
<u>CASH AND INVESTMENTS</u>			
Cash and Short-Term Investments	\$ 11,534,278	\$ -	\$ 11,534,278
Reserve Account - Long Term Investments	78,666,596	-	78,666,596
Total Cash and Investments at October 31, 2015	<u>\$ 90,200,874</u>	<u>\$ -</u>	<u>\$ 90,200,874</u>
<u>DIVIDENDS</u>			
Total 2015 Dividends	<u>\$ -</u>	<u>\$ -</u>	<u>\$ -</u>
<u>LONG-TERM DEBT</u>			
2006 Senior Unsecured Notes, Series A, 5.80%, due February 15, 2026	\$ 245,132,192	\$ -	\$ 245,132,192
2006 Senior Unsecured Notes, Series B, 6.40% due June 15, 2040	58,583,884	-	58,583,884
2007 Senior Unsecured Notes, Series AA, AB & AC, 5.90%, due February 15, 2026	172,329,341	-	172,329,341
2007 Senior Unsecured Notes, Series BA, BB & BC, 6.50% due June 15, 2040	44,425,396	-	44,425,396
2008 Senior Unsecured Notes, Series A, 5.92%, due February 15, 2026	35,718,051	-	35,718,051
2008 Senior Unsecured Notes, Series B & C, 6.71%, due February 15, 2026	141,148,369	-	141,148,369
2008 Senior Unsecured Notes, Series D & E, 6.91% due June 15, 2040	85,617,277	-	85,617,277
2013 Senior Unsecured Notes, Series A, Floating Rate, due February 15, 2018	100,000,000	-	100,000,000
2009 Tax Exempt Bonds, \$100M Series A-D, Floating Rate, due February 1, 2026	100,000,000	-	100,000,000
2009 Tax Exempt Bonds, \$100M Series E, 5.625%, due October 1, 2019	100,000,000	-	100,000,000
2010 Tax Exempt Bonds, \$100M Series A & B, Floating Rate, due February 1, 2040	100,000,000	-	100,000,000
2012 Tax Exempt Bonds, \$200M Series A, 5%, due June 1, 2039	200,000,000	-	200,000,000
2012 Tax Exempt Bonds, \$100M Series B & C, Floating Rate, due June 1, 2040	100,000,000	-	100,000,000
Total Long-Term Debt Outstanding at October 31, 2015	<u>\$ 1,482,954,510</u>	<u>\$ -</u>	<u>\$ 1,482,954,510</u>
<u>SHORT-TERM DEBT</u>			
Total Short-Term Debt Outstanding at October 31, 2015	<u>\$ 20,000,000</u>	<u>\$ -</u>	<u>\$ 20,000,000</u>
<u>EMPLOYEE BENEFIT PLAN ASSETS</u>			
Pension Plan			\$ [REDACTED]
Supplemental Pension & Savings Plan			[REDACTED]
Union Retiree Medical VEBA Trust			[REDACTED]
Retiree Medical VEBA Trust			[REDACTED]
Retiree Life Insurance VEBA Trust			[REDACTED]
401(h) - Retiree Medical			[REDACTED]
Total Benefit Plan Assets at October 31, 2015			<u>\$ [REDACTED]</u>
<u>PLANT DECOMMISSIONING & DEMOLITION (D&D) FUND</u>			
Total D&D Assets at October 31, 2015	<u>\$ 18,155,970</u>	<u>\$ 25,042,284</u>	<u>\$ 43,198,254</u>

Mr. McCullough asked Mr. Brodt to discuss the OVEC 2015 financing plan. Mr. Brodt reported that OVEC's investment grade ratings of Baa3 (Moody's), BBB- (S&P), and BBB- (Fitch) had been affirmed with stable outlooks. Mr. Brodt stated that [REDACTED]

Mr. McCullough introduced Mr. Bob Bitter of Deloitte & Touche. Mr. Bitter reported that Deloitte & Touche just began its audit to certify the 2015 Financial Statements that would be finalized in April 2016.

Mr. McCullough asked Mr. Brown to discuss the Department of Energy (DOE) Arranged Power Agreement. Mr. Brown stated that DOE is working with a Sponsoring Company to provide power to DOE and end the Arranged Power Agreement with OVEC.

The Board moved to an Executive Session to hear the Human Resources Committee report.

There being no further business to come before the Board, the meeting was adjourned.



Secretary
OHIO VALLEY ELECTRIC CORPORATION

OHIO VALLEY ELECTRIC CORPORATION
Minutes of Special Meeting of the
Board of Directors held December 1, 2016

A Special Meeting of the Board of Directors of **OHIO VALLEY ELECTRIC CORPORATION** (OVEC) was called to order by the President at 1 Riverside Plaza, Columbus, Ohio, on Thursday, December 1, 2016, at 10:00 a.m., pursuant to notice duly given.

Nicholas K. Akins, President of the Corporation, acted as Chairman of the meeting, and John D. Brodt, Chief Financial Officer, Secretary and Treasurer of the Corporation, acted as Secretary of the Meeting.

Mr. Brodt reported that the following Directors were present for the meeting:

Nicholas K. Akins	Mark E. Miller
Thomas Alban	Donald A. Moul
Eric D. Baker	Patrick W. O'Loughlin
Wayne D. Games	Julie Sloat (Phone)
Lana L. Hillebrand	Paul W. Thompson
Mark C. McCullough	John A. Verderame

Mr. Brodt reported that the Minutes of the Special Meeting of the Board of Directors of this Corporation, held on December 1, 2015, have been sent to each of the Directors. He asked that, if there were no corrections, such minutes be approved in the form in which they were circulated. On a motion duly made, seconded, and unanimously adopted, it was

RESOLVED, that the Minutes of the Special Meeting of the Board of Directors of this Corporation, held on December 1, 2015, are approved.

At the request of Mr. Akins, Mr. Brodt reviewed the 2016 Service Corporation general expenditures, which were expected to be approximately [REDACTED]. Mr. Brodt requested authorization for 2017 general expenditures for services from the AEP Service Corporation up to [REDACTED]. The primary general expenditures are expected to be in the areas of operation and maintenance, environmental activities, fuel procurement, and coal transportation. Mr. Brodt stated that the 2017 Budget is similar to the 2016 Budget except that the 2017 Budget request of [REDACTED] [REDACTED] [REDACTED] [REDACTED]. The [REDACTED] [REDACTED] in the 2017 Budget is related to [REDACTED] [REDACTED] [REDACTED]

██████████. On a motion duly made, seconded, and unanimously adopted, it was

RESOLVED, that the officers of Ohio Valley Electric Corporation may request and obligate Ohio Valley Electric Corporation to pay for general services, exclusive of services for specific projects previously approved, under the Agreement among American Gas and Electric Service Corporation (now American Electric Power Service Corporation), Ohio Valley Electric Corporation, and Indiana-Kentucky Electric Corporation dated December 15, 1956, in an amount which, when added to amounts paid for general services by Indiana-Kentucky Electric Corporation, exclusive of services for specific projects previously approved, would aggregate a maximum of ██████████ for calendar year 2017.

Mr. Akins asked Mr. Mike Brown to give an update on the OVEC and IKEC environmental compliance status and to report on the work to develop cost estimates for future environmental capital projects. Mr. Brown reported on the status of developing cost estimates to comply with Effluent Limitations Guidelines, which include the construction of two closed loop boiler slag systems, two FGD wastewater ABMet and MBR treatment systems, and Kyger Creek dry fly ash conversion. In addition, Mr. Brown provided an update on cost estimates to comply with Section 316(b) and the Coal Combustion Residual (CCR) rule. OVEC's current environmental capital investment "best-case" cost estimate for these projects is ██████████, and the current "worst-case" cost estimate is ██████████. An investment decision for additional funding for conceptual engineering and design will be required by year-end 2017.

At the request of Mr. Akins, Mr. Justin Cooper reported on the 2013 – 2017 LEAN Cost Structure cost profile. Mr. Cooper reviewed the results of the 2016 continuous improvements (LEAN) reductions and the operating, maintenance, and capital cost benchmarking budgets. Mr. Cooper reported that OVEC's operating, maintenance, and capital cost profile was projected to ██████████ in 2017 compared with 2013. The energy cost ██████████ ██████████ ██████████.

Mr. Akins asked Mr. Cooper to review the 2017 Construction Budget and the 2018-2021 Construction Budget Forecast. Mr. Cooper commented that the 2017 Construction Budget is a ██████████ ██████████ with the original 2017 budget forecast with prioritization of economic benefit, risk, and fiscal impact. Mr. Akins requested that a list of future high-risk capital budget items be provided at the next meeting. Mr. Cooper reported that the Construction Budget for 2017 indicates estimated total expenditures of ██████████, representing

[REDACTED] motion duly made, seconded, and unanimously adopted, it was

RESOLVED, that the OVEC-IKEC Construction Budget for 2017, indicating estimated total expenditures of [REDACTED]

Mr. Akins asked Mr. Osborne to report on operating activities for the Clifty Creek and Kyger Creek plants. Mr. Osborne reviewed the operating statistics and discussed how the Open Book Leadership scoreboard is being used to track key areas of concern. Mr. Osborne also reviewed the 2016 safety performance statistics and the need to focus on recognizing hazards.

At the request of Mr. Akins, Mr. Ken Tamms of the AEP Service Corporation reviewed the merchant plant analysis. A handout was provided to the Board, which indicated that [REDACTED]

At the request of Mr. Akins, Mr. Brodt provided information and discussed OVEC's year-to-date power costs estimated for 2016 and projections for 2017-2021. Mr. Brodt stated that based on current estimates OVEC expected to end 2016 with an average power cost of [REDACTED] and an available power use factor of [REDACTED]. Mr. Brodt stated that the projected average power cost for OVEC power, delivered under the terms of the Inter-Company Power Agreement, ranges from [REDACTED] to [REDACTED] using an estimated available power use factor of [REDACTED].

Mr. Akins asked Mr. Scott Cunningham to report on the OVEC Operating Committee. Mr. Cunningham reported that the Operating Committee recommended a fuel cost policy revision to use replacement fuel cost versus weighted cost of inventory. This revision is expected to be made during the first quarter 2017. The Operating Committee made no recommendation to the Board to proceed with the integration of the OVEC-IKEC transmission system into PJM.

At the request of Mr. Akins, Mr. Brodt reported on the status of the Corporation's finances. Mr. Brodt distributed to all members present a copy of the Treasurer's Report that included the following statistics:

**OHIO VALLEY ELECTRIC CORPORATION (OVEC)
INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC)
Treasurer's Report
Boards of Directors' Meeting
December 1, 2016**

	<u>OVEC</u>	<u>IKEC</u>	<u>Consolidated</u>
<u>EQUITY</u>			
Common Stock, 100,000 shares outstanding	\$ 10,000,000	\$ 3,400,000	\$ 10,000,000
Retained Earnings	8,653,536	-	8,653,536
Total Equity at October 31, 2016	<u>\$ 18,653,536</u>	<u>\$ 3,400,000</u>	<u>\$ 18,653,536</u>
<small>(OVEC's ownership of IKEC's Capital Stock (17,000 shares) is eliminated in consolidation.)</small>			
<u>CASH AND INVESTMENTS</u>			
Cash and Short-Term Investments	\$ 46,793,706	\$ -	\$ 46,793,706
Employee PRB Benefits Reserve Account	77,697,759	-	77,697,759
Total Cash and Investments at October 31, 2016	<u>\$ 124,491,465</u>	<u>\$ -</u>	<u>\$ 124,491,465</u>
<u>DIVIDENDS</u>			
Total 2016 Dividends	<u>\$ -</u>	<u>\$ -</u>	<u>\$ -</u>
<u>LONG-TERM DEBT</u>			
2006 Senior Unsecured Notes, Series A, 5.80%, due February 15, 2026	\$ 227,600,578	\$ -	\$ 227,600,578
2006 Senior Unsecured Notes, Series B, 6.40% due June 15, 2040	57,576,242	-	57,576,242
2007 Senior Unsecured Notes, Series AA, AB & AC, 5.90%, due February 15, 2026	160,320,832	-	160,320,832
2007 Senior Unsecured Notes, Series BA, BB & BC, 6.50% due June 15, 2040	43,682,246	-	43,682,246
2008 Senior Unsecured Notes, Series A, 5.92%, due February 15, 2026	33,231,642	-	33,231,642
2008 Senior Unsecured Notes, Series B & C, 6.71%, due February 15, 2026	131,104,353	-	131,104,353
2008 Senior Unsecured Notes, Series D & E, 6.91% due June 15, 2040	84,231,146	-	84,231,146
2013 Senior Unsecured Notes, Series A, Floating Rate, due February 15, 2018	100,000,000	-	100,000,000
2009 Tax Exempt Bonds, \$100M Series A-D, Floating Rate, due February 1, 2026	100,000,000	-	100,000,000
2009 Tax Exempt Bonds, \$100M Series E, 5.625%, due October 1, 2019	100,000,000	-	100,000,000
2010 Tax Exempt Bonds, \$100M Series A & B, Floating Rate, due February 1, 2040	100,000,000	-	100,000,000
2012 Tax Exempt Bonds, \$200M Series A, 5%, due June 1, 2039	200,000,000	-	200,000,000
2012 Tax Exempt Bonds, \$100M Series B & C, Floating Rate, due June 1, 2040	100,000,000	-	100,000,000
Total Long-Term Debt Outstanding at October 31, 2016	<u>\$ 1,437,747,039</u>	<u>\$ -</u>	<u>\$ 1,437,747,039</u>
<u>SHORT-TERM DEBT</u>			
Total Short-Term Debt Outstanding at October 31, 2016	<u>\$ 85,000,000</u>	<u>\$ -</u>	<u>\$ 85,000,000</u>
<u>EMPLOYEE BENEFIT PLAN ASSETS</u>			
Pension Plan			\$ [REDACTED]
Supplemental Pension & Savings Plan			[REDACTED]
Union Retiree Medical VEBA Trust			[REDACTED]
Retiree Medical VEBA Trust			[REDACTED]
Retiree Life Insurance VEBA Trust			[REDACTED]
401(h)			[REDACTED]
Total Benefit Plan Assets at October 31, 2016			<u>\$ [REDACTED]</u>
<u>PLANT DECOMMISSIONING & DEMOLITION (D&D) FUND</u>			
Total D&D Assets at October 31, 2016	<u>\$ 19,001,239</u>	<u>\$ 26,239,806</u>	<u>\$ 45,241,045</u>

Mr. Akins introduced Mr. Bob Bitter of Deloitte & Touche. Mr. Bitter reported that Deloitte & Touche just began its audit to certify the 2016 Financial Statements that would be finalized in April 2017.

The Board moved to an Executive Session.

There being no further business to come before the Board, the meeting was adjourned.



Secretary
OHIO VALLEY ELECTRIC CORPORATION

OHIO VALLEY ELECTRIC CORPORATION
Minutes of Special Meeting of the
Board of Directors' Meeting via Teleconference
January 30, 2017

A Special Meeting of the Board of Directors of **OHIO VALLEY ELECTRIC CORPORATION** (OVEC) via teleconference was called to order by the President on Monday, January 30, 2017, at 8:45 a.m., pursuant to notice duly given.

Nicholas K. Akins, President of the Corporation, acted as Chairman of the meeting, and John D. Brodt, Chief Financial Officer, Secretary and Treasurer of the Corporation, acted as Secretary of the meeting.

Mr. Brodt reported that the following Directors were present for the meeting:

Nicholas K. Akins	Mark E. Miller
Thomas Alban	Steven K. Nelson
Eric D. Baker	Patrick W. O'Loughlin
Lee E. Barrett	David W. Pinter
Wayne D. Games	Julie Sloat
Mark C. McCullough	Paul W. Thompson
John N. Voyles, Jr.	

Mr. Akins advised that Donald A. Moul would be resigning from the OVEC and IKEC Boards of Directors and as a member of both Executive Committees, pending the election of his replacement. Mr. Akins recommended that Mr. David W. Pinter, Executive Director, Business Development for FirstEnergy Corp., be nominated to succeed Mr. Moul on both the OVEC and IKEC Boards of Directors and be appointed to the Executive Committees of both OVEC and IKEC. Mr. Akins also recommended that Lee E. Barrett be appointed to the OVEC Executive Committee. On a motion duly made, seconded, and unanimously adopted, it was

RESOLVED, that subject to any necessary action by the Federal Energy Regulatory Commission under Section 305 of the Federal Power Act, Mr. David W. Pinter be elected a Director and appointed a member of the Executive Committee of this Corporation; and further

RESOLVED, that subject to any necessary action by the Federal Energy Regulatory Commission under Section 305 of the Federal Power Act, Mr. Lee E. Barrett be appointed a member of the Executive Committee of this Corporation.

Mr. Akins asked Mr. Justin Cooper to review the handout, "OVEC in PJM Cost/Benefit Analysis," prepared by the OVEC Operating Committee. Mr. Cooper reported that a [REDACTED]

[REDACTED]

[REDACTED]. He also stated that some costs are approximations and difficult to quantify at this time. The Board provided feedback to Mr. Cooper for OVEC to review the possible additional benefit from energy value from changing the delivery point.

At the request of Mr. Akins, Mr. Brian Chisling, with Simpson Thacher & Bartlett LLP, highlighted the plan of OVEC moving forward with the process of applying for membership in PJM. The motion was duly made and seconded. The resolution was adopted based upon a vote of [REDACTED]

[REDACTED].
The motion was approved as

RESOLVED, that Ohio Valley Electric Corporation is to move forward with the process of applying for membership in PJM to further validate assumptions prior to a final Board vote to join PJM.

There being no further business to come before the Board, the meeting was adjourned.

Secretary
OHIO VALLEY ELECTRIC CORPORATION

**OHIO VALLEY ELECTRIC CORPORATION
Minutes of Special Meeting of the
Board of Directors held December 8, 2017**

A Special Meeting of the Board of Directors of **OHIO VALLEY ELECTRIC CORPORATION** (OVEC) was called to order by the President at 1 Riverside Plaza, Columbus, Ohio, on Friday, December 8, 2017, at 2:00 p.m., pursuant to notice duly given.

Nicholas K. Akins, President of the Corporation, acted as Chairman of the meeting, and John D. Brodt, Chief Financial Officer, Secretary and Treasurer of the Corporation, acted as Secretary of the Meeting.

Mr. Brodt reported that the following Directors were present for the meeting:

Nicholas K. Akins	Mark C. McCullough
Thomas Alban	Steven K. Nelson
Lonnie E. Beller	Patrick W. O'Loughlin
Wayne D. Games	David W. Pinter (Phone)
James R. Haney (Phone)	Paul W. Thompson
Lana L. Hillebrand	John A. Verderame

Mr. Brodt reported that the Minutes of the Special Meeting of the Board of Directors of this Corporation, held on December 1, 2016, have been sent to each of the Directors. He asked that, if there were no corrections, such minutes be approved in the form in which they were circulated. On a motion duly made, seconded, and unanimously adopted, it was

RESOLVED, that the Minutes of the Special Meeting of the Board of Directors of this Corporation, held on December 1, 2016, are approved.

At the request of Mr. Akins, Mr. Brodt reviewed the 2017 Service Corporation general expenditures, which were expected to be approximately [REDACTED]. Mr. Brodt requested authorization for 2018 general expenditures for services from the AEP Service Corporation up to [REDACTED]. The primary general expenditures are expected to be in the areas of operation and maintenance, environmental activities, fuel procurement, and coal transportation. Mr. Brodt stated that the 2018 Budget is similar to the 2017 Budget except that the 2018 Budget request of [REDACTED] [REDACTED] the 2017 Budget request of [REDACTED]. The [REDACTED] [REDACTED] [REDACTED] [REDACTED]

[REDACTED]. On a motion duly made, seconded, and unanimously adopted, it was

RESOLVED, that the officers of Ohio Valley Electric Corporation may request and obligate Ohio Valley Electric Corporation to pay for general services, exclusive of services for specific projects previously approved, under the Agreement among American Gas and Electric Service Corporation (now American Electric Power Service Corporation), Ohio Valley Electric Corporation, and Indiana-Kentucky Electric Corporation dated December 15, 1956, in an amount which, when added to amounts paid for general services by Indiana-Kentucky Electric Corporation, exclusive of services for specific projects previously approved, would aggregate a maximum of [REDACTED] for calendar year 2018.

At the request of Mr. Akins, Mr. Justin Cooper reported on the 2018 LEAN demand costs. Mr. Cooper reviewed the results of the 2017 continuous improvements (LEAN) reductions and the operating, maintenance, and capital cost benchmarking budgets. Mr. Cooper reported that OVEC's operating, maintenance, and capital cost profile was projected to [REDACTED] in 2018 compared with 2013. The energy cost [REDACTED] [REDACTED].

Mr. Akins asked Mr. Mike Brown to give an update on the OVEC and IKEC environmental compliance status and to report on the work to develop cost estimates for future environmental capital projects. Mr. Brown reported that the OVEC and IKEC 2017 ozone season NO_x performance was better than expected. The 2017 ozone season NO_x emissions were reduced by approximately [REDACTED] at Kyger Creek and [REDACTED] at Clifty Creek compared with the 2012-2016 average. Mr. Brown reported on the status of developing cost estimates to comply with Effluent Limitations Guidelines, [REDACTED], and Kyger Creek dry fly ash conversion. In addition, Mr. Brown provided an update on cost estimates to comply with Section 316(b) and the Coal Combustion Residual (CCR) rule. OVEC's current environmental capital investment "best-case" cost estimate for these projects is [REDACTED], and the current "worst-case" cost estimate is [REDACTED]. An investment decision for additional funding for conceptual engineering and design will be required by mid-year 2019 to mid-year 2020.

Mr. Akins asked Mr. Cooper to review the 2018 Construction Budget and the 2019-2022 Construction Budget Forecast. Mr. Cooper commented that the 2018 Construction Budget is a [REDACTED] compared with the original 2018 budget forecast with prioritization of

economic benefit, risk, and fiscal impact. Mr. Cooper reported that the Construction Budget for 2018 indicates estimated total expenditures of [REDACTED], representing [REDACTED] [REDACTED] [REDACTED] [REDACTED]. On a motion duly made, seconded, and unanimously adopted, it was

RESOLVED, that the OVEC-IKEC Construction Budget for 2018, indicating estimated total expenditures of [REDACTED] [REDACTED] [REDACTED]

Mr. Akins asked Mr. Osborne to report on operating activities for the Clifty Creek and Kyger Creek plants. Mr. Osborne reviewed the operating statistics and the results of the 2017 Culture Survey. Mr. Osborne recognized that the Clifty Creek employees completed one year without a recordable injury. Mr. Osborne asked Clifty Creek Plant Manager Cliff Carnes and Kyger Creek Plant Manager Annette Hope to report on the 2017 Strategic Plan for each respective location highlighting three areas of success and three areas of opportunities.

Mr. Akins asked Mr. Scott Cunningham to report on the OVEC Operating Committee. Mr. Cunningham reviewed a projected OVEC-PJM integration timeline of the basic steps OVEC intends to pursue regarding full integration into PJM.

At the request of Mr. Akins, Mr. Brodt reported on the status and timeline of the Corporation's finance activities. Mr. Brodt distributed to all members present a copy of the Treasurer's Report that included the following statistics:

OHIO VALLEY ELECTRIC CORPORATION (OVEC)
INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC)
Treasurer and Finance Report
Boards of Directors' Meeting
December 8, 2017

	<u>OVEC</u>	<u>IKEC</u>	<u>Consolidated</u>
<u>CASH AND INVESTMENTS</u>			
Cash and Short-Term Investments	\$ 53,878,779		\$ 53,878,779
Employee PRB Benefits Reserve Account	71,625,576		71,625,576
Debt Reserve Account	20,306,082		20,306,082
Total Cash and Investments at October 31, 2017	<u>\$ 145,810,437</u>		<u>\$ 145,810,437</u>
<u>PLANT DECOMMISSIONING & DEMOLITION (D&D) FUND</u>			
Total D&D Assets at October 31, 2017	<u>\$ 21,892,091</u>	<u>\$ 30,195,452</u>	<u>\$ 52,087,543</u>
<u>EMPLOYEE BENEFIT PLAN ASSETS</u>			
Pension Plan			\$ [REDACTED]
Supplemental Pension & Savings Plan			[REDACTED]
Union Retiree Medical VEBA Trust			[REDACTED]
Retiree Medical VEBA Trust			[REDACTED]
Retiree Life Insurance VEBA Trust			[REDACTED]
Retiree Medical 401(h)			[REDACTED]
Total Benefit Plan Assets at October 31, 2017			<u>\$ [REDACTED]</u>
<u>EQUITY</u>			
Common Stock, 100,000 shares outstanding	\$ 10,000,000	\$ 3,400,000	\$ 10,000,000
Retained Earnings	9,893,759	-	9,893,759
Total Equity at October 31, 2017	<u>\$ 19,893,759</u>	<u>\$ 3,400,000</u>	<u>\$ 19,893,759</u>
<small>(OVEC's ownership of IKEC's Capital Stock (17,000 shares) is eliminated in consolidation.)</small>			
<u>LONG-TERM DEBT</u>			
2006 Senior Unsecured Notes, Series A, 5.80%, due February 15, 2026	\$ 209,037,387		\$ 209,037,387
2006 Senior Unsecured Notes, Series B, 6.40% due June 15, 2040	56,503,080		56,503,080
2007 Senior Unsecured Notes, Series AA, AB & AC, 5.90%, due February 15, 2026	147,593,370		147,593,370
2007 Senior Unsecured Notes, Series BA, BB & BC, 6.50% due June 15, 2040	42,890,007		42,890,007
2008 Senior Unsecured Notes, Series A, 5.92%, due February 15, 2026	30,595,859		30,595,859
2008 Senior Unsecured Notes, Series B & C, 6.71%, due February 15, 2026	120,374,809		120,374,809
2008 Senior Unsecured Notes, Series D & E, 6.91% due June 15, 2040	82,747,579		82,747,579
2017 Senior Unsecured Notes, Series A, Floating Rate, due August 4, 2022	100,000,000		100,000,000
2009 Tax Exempt Bonds, \$100M Series A-D, Floating Rate, due February 1, 2026	75,000,000		75,000,000
2009 Tax Exempt Bonds, \$100M Series E, 5.625%, due October 1, 2019	100,000,000		100,000,000
2010 Tax Exempt Bonds, \$100M Series A & B, Floating Rate, due February 1, 2040	100,000,000		100,000,000
2012 Tax Exempt Bonds, \$200M Series A, 5%, due June 1, 2039	200,000,000		200,000,000
2012 Tax Exempt Bonds, \$100M Series B & C, Floating Rate, due June 1, 2040	100,000,000		100,000,000
Total Long-Term Debt Outstanding at October 31, 2017	<u>\$ 1,364,742,091</u>		<u>\$ 1,364,742,091</u>
<u>SHORT-TERM DEBT</u>			
\$200M Revolving Credit Facility (extension date November 14, 2019)			
Total Short-Term Debt Outstanding at October 31, 2017	<u>\$ 85,000,000</u>		<u>\$ 85,000,000</u>
<u>CORPORATE UNSECURED CREDIT RATINGS</u>			
Standard & Poor's (rating affirmed February 13, 2017)		BBB-, Stable Outlook	
Fitch (rating affirmed November 14, 2017)		BBB-, Negative Outlook	
Moody's (rating downgrade December 20, 2016)		Ba1, Negative Outlook	
<u>FINANCE WORKING GROUP</u>			
[REDACTED]			

At the request of Mr. Akins, Mr. Brodt provided information and discussed OVEC's year-to-date power costs estimated for 2017 and projections for 2018-2022. Mr. Brodt stated that based on current estimates OVEC expected to end 2017 with an average power cost of [REDACTED] and an available power use factor of [REDACTED]. Mr. Brodt stated that the projected average power cost for OVEC power, delivered under the terms of the Inter-Company Power Agreement, ranges from [REDACTED] in 2018 to [REDACTED] in 2022 using an estimated available power use factor of [REDACTED].

Mr. Akins introduced Mr. Bob Bitter of Deloitte & Touche. Mr. Bitter reported that Deloitte & Touche just began its audit to certify the 2017 Financial Statements that would be finalized in April 2018.

The OVEC and IKEC Boards of Directors recognized John D. Brodt for his contributions to the corporations upon his upcoming January 1, 2018, retirement from the Company. On a motion duly made, seconded, and unanimously adopted

WHEREAS, John D. Brodt has provided exemplary leadership and guidance to OVEC-IKEC during a period of unprecedented change in the electric utility industry throughout his career; and

WHEREAS, John D. Brodt has drawn upon the wisdom and experience he has gained as Secretary and Treasurer/Chief Financial Officer, which enabled him to provide dedicated and effective service to the Company, to the electric utility industry and to his community during a tenure as Secretary and Treasurer/Chief Financial Officer that began in 1988.

NOW, THEREFORE BE IT

RESOLVED, that John D. Brodt is recognized by the Directors of OVEC and IKEC for his steadfast commitment and superb judgment throughout his years of illustrious service to the Company; and further

RESOLVED, that the Directors of OVEC and IKEC hereby acknowledge the important contributions made by John D. Brodt to the success, growth and well-being of the Company during a most challenging period in his history; and further

RESOLVED, that the Directors of OVEC and IKEC thank John D. Brodt for his 41 years of service and extend their best wishes upon his upcoming retirement from the Company, along with their sincere desire that his retirement years will be long, enjoyable and fulfilling; and further

RESOLVED, that a copy of these resolutions and their preambles shall be delivered to John D. Brodt as an expression of the deep appreciation and hearty good wishes of the Directors of OVEC and IKEC upon his retirement.

The Board moved to an Executive Session.

There being no further business to come before the Board, the meeting was adjourned.

A handwritten signature in black ink, appearing to be "JJS", is written above a horizontal line.

Secretary
OHIO VALLEY ELECTRIC CORPORATION

**OHIO VALLEY ELECTRIC CORPORATION
Minutes of Special Meeting of the
Board of Directors' Meeting via Teleconference
February 21, 2018**

A Special Meeting of the Board of Directors of **OHIO VALLEY ELECTRIC CORPORATION** (OVEC) via teleconference was called to order by the President on Wednesday, February 21, 2018, at 9:00 a.m., pursuant to notice duly given.

Nicholas K. Akins, President of the Corporation, acted as Chairman of the meeting, and Justin J. Cooper, Chief Financial Officer, Secretary and Treasurer of the Corporation, acted as Secretary of the meeting.

Mr. Cooper reported that the following Directors were present for the meeting:

Nicholas K. Akins	Mark C. McCullough
Thomas Alban	Mark E. Miller
Eric D. Baker	Steven K. Nelson
Lonnie E. Bellar	Patrick W. O'Loughlin
Wayne D. Games	David W. Pinter
James R. Haney	Paul W. Thompson
Lana L. Hillebrand	John A. Verderame

At the request of Mr. Akins, Mr. Brian Chisling, with Simpson Thacher & Bartlett LLP, reviewed the Cost/Benefit Analysis of OVEC integrating into PJM. Mr. Chisling stated that, as specified in such analysis, there would be [REDACTED]

[REDACTED]. On a motion duly made, seconded, and unanimously adopted, it was

RESOLVED, that in accordance with the order of the Federal Energy Regulatory Commission (FERC) approving OVEC's application for membership in PJM Interconnection, L.L.C. (PJM), previously provided to the Board (the "FERC PJM Order"), OVEC is hereby authorized and approved to execute and deliver all of the agreements and other documents described therein and otherwise in accordance with the rules and regulations of PJM (together, the "Integration Agreements") in order for OVEC to become a full member of, and fully integrate the OVEC and IKEC generating facilities and transmission system into, PJM; and it is further

RESOLVED, that, in furtherance of the foregoing, any Officer of OVEC (each an "Authorized Officer") is hereby authorized, approved and directed in the name of and on behalf of OVEC, to execute and deliver such Integration Agreements with such changes, deletions and additions thereto as deemed appropriate or proper by any such Authorized Officer, the execution and delivery of such Integration Agreements being conclusive evidence of such determination; and it is further

RESOLVED, that each Officer of OVEC is authorized and directed to prepare, execute and file, or cause to be prepared, executed and filed, all agreements, certificates, statements, reports, documents, instruments and papers required to be filed by OVEC in accordance with the Integration Agreements, the FERC PJM Order and the PJM tariff and in order for OVEC to comply with all applicable requirements and rules and regulations of PJM, FERC and applicable law and any other administrative or governmental agency (domestic or foreign) in connection with the Integration Agreements, the FERC PJM Order or any other matter relating to PJM integration and to prepare, sign, seal, execute, file, record and deliver such other agreements, certificates, statements, termination and other notices, reports, documents, instruments and papers, from time to time necessary, desirable or appropriate, as may be executed by any such Officer pursuant to the Integration Agreements, the FERC PJM Order, the PJM tariff and these resolutions and the transactions contemplated thereby and hereby, and to do any and all other acts and things, in each case to effectuate the purpose and intent of these resolutions.

There being no further business to come before the Board, the meeting was adjourned.



Secretary
OHIO VALLEY ELECTRIC CORPORATION

OHIO VALLEY ELECTRIC CORPORATION
Minutes of Special Meeting of the
Board of Directors' Meeting via Teleconference
April 27, 2018

A Special Meeting of the Board of Directors of **OHIO VALLEY ELECTRIC CORPORATION** (OVEC) via teleconference was called to order by Mark C. McCullough on Friday, April 27, 2018, at 8:30 a.m., pursuant to notice duly given. On a motion duly made, seconded, and unanimously adopted, it was

RESOLVED, that in accordance with Article IV, Section 3 of the Code of Regulations of this Corporation, Mr. Mark C. McCullough be elected Chairman of this Meeting on April 27, 2018 in the absence of the President of this Corporation.

Mr. McCullough acted as Chairman of the meeting, and Justin J. Cooper, Chief Financial Officer, Secretary and Treasurer of the Corporation, acted as Secretary of the meeting.

Mr. Cooper reported that the following Directors were present for the meeting:

Thomas Alban	Mark C. McCullough
Eric D. Baker	Mark E. Miller
Lonnie E. Bellar	Steven K. Nelson
Wayne D. Games	Patrick W. O'Loughlin
James R. Haney	Julie Sloat
Lana L. Hillebrand	Paul W. Thompson
John A. Verderame	

WHEREAS, effective as of the election of the persons specified herein, Mr. Nicholas K. Akins will be resigning as a member of the Board of Directors (Board) of each of OVEC and IKEC and as a member of the Executive Committee and as president of OVEC and IKEC;

WHEREAS, effective as of the election of the persons specified herein, Mr. Mark C. McCullough will be resigning as a member and Chairman of the Human Resources Committee of OVEC; and

WHEREAS, OVEC and IKEC management have recommended to the remaining members of their respective Boards those persons named below to be elected and/or appointed as Directors to the Boards, as officers and/or as members of Committees of OVEC and IKEC as described below.

NOW, THEREFORE, BE IT:

RESOLVED, that, subject to any necessary action by the Federal Energy Regulatory Commission (FERC) under Section 305 of the Federal Power Act, Mr. Mark C. McCullough be elected as the president of OVEC; and it is further

RESOLVED, that, subject to any necessary action by FERC, under Section 305 of the Federal Power Act, Mr. Chris T. Beam be elected a Director of the Board of OVEC and appointed as a member of the Human Resources Committee of OVEC; and it is further

RESOLVED, that, subject to any necessary action by FERC under Section 305 of the Federal Power Act, Ms. Julie Sloat be appointed as a member of the Executive Committee of OVEC; and it is further

RESOLVED, that subject to any necessary action by FERC under Section 305 of the Federal Power Act, Ms. Lana L. Hillebrand be appointed as Chairwoman of the Human Resources Committee of OVEC.

At the request of Mr. McCullough, Mr. Brian Chisling, with Simpson Thacher & Bartlett LLP, [REDACTED]
[REDACTED]
[REDACTED].

There being no further business to come before the Board, the meeting was adjourned.



Secretary
OHIO VALLEY ELECTRIC CORPORATION

**OHIO VALLEY ELECTRIC CORPORATION
Minutes of Special Meeting of the
Board of Directors' Meeting via Teleconference
June 15, 2018**

A Special Meeting of the Board of Directors of **OHIO VALLEY ELECTRIC CORPORATION** (OVEC) via teleconference was called to order by the President on Friday, June 15, 2018, at 3:00 p.m., pursuant to notice duly given.

Mark C. McCullough, President of the Corporation, acted as Chairman of the meeting, and Justin J. Cooper, Chief Financial Officer, Secretary and Treasurer of the Corporation, acted as Secretary of the meeting.

Mr. Cooper reported that the following Directors were present for the meeting:

Thomas Alban	Mark E. Miller
Eric D. Baker	Patrick W. O'Loughlin
Lonnie E. Bellar	Julie Sloat
Mark C. McCullough	John A. Verderame

At the request of Mr. McCullough, Mr. Brian Chisling, with Simpson Thacher & Bartlett LLP, [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED].

There being no further business to come before the Board, the meeting was adjourned.



Secretary
OHIO VALLEY ELECTRIC CORPORATION

OHIO VALLEY ELECTRIC CORPORATION
Minutes of Special Meeting of the
Board of Directors' Meeting via Teleconference
June 28, 2018

A Special Meeting of the Board of Directors of **OHIO VALLEY ELECTRIC CORPORATION** (OVEC) via teleconference was called to order by the President on Thursday, June 28, 2018, at 3:00 p.m., pursuant to notice duly given.

Mark C. McCullough, President of the Corporation, acted as Chairman of the meeting, and Justin J. Cooper, Chief Financial Officer, Secretary and Treasurer of the Corporation, acted as Secretary of the meeting.

Mr. Cooper reported that the following Directors were present for the meeting:

Thomas Alban	Mark C. McCullough
Eric D. Baker	Mark E. Miller
Christian T. Beam	Steven K. Nelson
Lonnie E. Bellar	Patrick W. O'Loughlin
James R. Haney	Julie Sloat
Lana L. Hillebrand	John A. Verderame
Wayne D. Games	

At the request of Mr. McCullough, Mr. Brian Chisling, with Simpson Thacher & Bartlett LLP, [REDACTED]

[REDACTED]. After discussion on these topics and related matters by the Board, a motion duly made, seconded, and adopted, it was:

RESOLVED, that OVEC's integration into PJM as a full member should proceed, with a target integration date of December 1, 2018; and that certain PJM administrative charges not otherwise payable absent such integration are to be properly allocated to those Sponsoring Companies under the Inter-Company Power Agreement that participate in the PJM market.

There being no further business to come before the Board, the meeting was adjourned.



Secretary
OHIO VALLEY ELECTRIC CORPORATION

OHIO VALLEY ELECTRIC CORPORATION
Minutes of Special Meeting of the
Board of Directors held December 5, 2018

A Special Meeting of the Board of Directors of **OHIO VALLEY ELECTRIC CORPORATION** (OVEC) was called to order by the President at 1 Riverside Plaza, Columbus, Ohio, on Wednesday, December 5, 2018, at 2:00 p.m., pursuant to notice duly given.

Mark C. McCullough, President of the Corporation, acted as Chairman of the meeting, and Justin J. Cooper, Chief Financial Officer, Secretary and Treasurer of the Corporation, acted as Secretary of the Meeting.

Mr. Cooper reported that the following Directors were present for the meeting:

Thomas Alban	Mark E. Miller
Eric D. Baker (Phone)	Steven K. Nelson
Lonnie E. Beller (Phone)	Patrick W. O'Loughlin
Wayne D. Games (Phone)	David W. Pinter (Phone)
James R. Haney (Phone)	Julie Sloat (Phone)
Lana L. Hillebrand	Paul W. Thompson (Phone)
Mark C. McCullough	John A. Verderame

Mr. McCullough presented the following resolutions and on a motion duly made, seconded, and unanimously adopted, it was

WHEREAS, effective as of the election of Mr. Paul Chodak III specified herein, Mr. Mark C. McCullough will be resigning as a member of the Board of Directors (Board) of each of OVEC and IKEC and as a member of the Executive Committee and any other committees of the Board of each of OVEC and IKEC and as president of each of OVEC and IKEC; and

WHEREAS, OVEC and IKEC management have recommended to the remaining members of their respective Boards Mr. Paul Chodak III to be elected and/or appointed as a Director to the Boards and as president and as a member of Committees of OVEC and IKEC as described below.

RESOLVED, that, subject to any necessary action by the Federal Energy Regulatory Commission (FERC) under Section 305 of the Federal Power Act, Mr. Paul Chodak III be elected a Director of the Board of OVEC and appointed the president of OVEC and a member of the Executive Committee of OVEC.

RESOLVED, that the foregoing resignations, elections and appointments shall be effective as of January 1, 2019.

AND

WHEREAS, effective as of the election of the persons specified herein, Ms. Julie Sloat will be resigning as a member of the Board of Directors (Board) of OVEC and as a member of the Executive Committee and any other committees of the Board of OVEC;

WHEREAS, effective as of the election of the persons specified herein, Ms. Lonnie Dieck will be resigning as Assistant Secretary and Assistant Treasurer of OVEC and IKEC; and

WHEREAS, OVEC and IKEC management has recommended to the remaining members of their respective Boards those persons named below to be elected and/or appointed as Director to the OVEC Board and as officers of OVEC and IKEC as described below.

NOW, THEREFORE, BE IT:

RESOLVED, that, subject to any necessary action by FERC under Section 305 of the Federal Power Act, Mr. Raja Sundararajan be elected a Director of the Board of OVEC and appointed as a member of the Executive Committee of OVEC; and it is further

RESOLVED, that, subject to any necessary action by FERC under Section 305 of the Federal Power Act, Ms. Julie Sloat be appointed as Assistant Secretary and Assistant Treasurer of OVEC and IKEC, and it is further

RESOLVED, that the foregoing resignations, elections and appointments shall be effective as of January 1, 2019.

Mr. Cooper reported that the Minutes of the Special Meetings of the Board of Directors of this Corporation, held on December 8, 2017, February 21, 2018, April 27, 2018, June 15, 2018, and June 28, 2018, have been sent to each of the Directors. He asked that, if there were no corrections, such minutes be approved in the form in which they were circulated. On a motion duly made, seconded, and unanimously adopted, it was

RESOLVED, that the Minutes of the Special Meeting of the Board of Directors of this Corporation, held on December 8, 2017, February 21, 2018, April 27, 2018, June 15, 2018, and June 28, 2018, are approved.

At the request of Mr. McCullough, Ms. Kay Martin reviewed the 2018 Service Corporation general expenditures, which were expected to be approximately [REDACTED]. Ms. Martin requested authorization for 2019 general expenditures for services from the AEP Service Corporation up to [REDACTED]. The primary general expenditures are expected to be in the areas of operation and maintenance, environmental activities, fuel procurement, and coal

transportation. Ms. Martin stated that the 2019 Budget is similar to the 2018 Budget. On a motion duly made, seconded, and unanimously adopted, it was

RESOLVED, that the officers of Ohio Valley Electric Corporation may request and obligate Ohio Valley Electric Corporation to pay for general services, exclusive of services for specific projects previously approved, under the Agreement among American Gas and Electric Service Corporation (now American Electric Power Service Corporation), Ohio Valley Electric Corporation, and Indiana-Kentucky Electric Corporation dated December 15, 1956, in an amount which, when added to amounts paid for general services by Indiana-Kentucky Electric Corporation, exclusive of services for specific projects previously approved, would aggregate a maximum of [REDACTED] for calendar year 2019.

At the request of Mr. McCullough, Mr. Justin Cooper reported on the 2018 LEAN cost structure. Mr. Cooper reviewed the results of the 2018 continuous improvements (LEAN) reductions and the operating, maintenance, and capital cost benchmarking budgets. Mr. Cooper reported that OVEC's operating, maintenance, and capital cost profile was projected to [REDACTED]. The energy cost [REDACTED]. [REDACTED] Mr. Cooper also reviewed OVEC's key performance factors from 2015 to 2018.

Mr. McCullough asked Mr. Mike Brown to give an update on the OVEC and IKEC environmental compliance status and to report on the work to develop cost estimates for future environmental capital projects. Mr. Brown reported that the OVEC and IKEC 2018 ozone season NO_x emission rates and overall performance was better than expected. Both plants successfully operated within their NO_x emission targets under the new ozone rules for the second year in a row. In addition OVEC and IKEC generated more megawatts during the 2018 ozone season compared to 2017. Mr. Brown also reported on the MATS compliance status at each plant. Mr. Brown also reported on the status of developing cost estimates to comply with Effluent Limitations Guidelines, which may include the construction of closed loop boiler slag systems and/or FGD wastewater biological treatment systems at each plant; however, the cost estimates are contingent on additional anticipated EPA rulemaking on the effluent guidelines applicable to these wastewater discharges. Mr. Brown also reported on the status and next steps surrounding cost estimates for the conversion to dry fly ash handling at Kyger Creek Station. In addition, Mr. Brown provided an update on cost estimates to comply with Section 316(b) and the Coal Combustion Residual (CCR) rule. OVEC's current environmental capital investment "best-case" cost estimate for these projects is [REDACTED] and the current "worst-

case" cost estimate is [REDACTED]. An investment decision for additional funding for conceptual engineering and design will be required by [REDACTED].

Mr. McCullough asked Mr. Cooper to review the 2019 Construction Budget and the 2020-2021 Construction Budget Forecast. Mr. Cooper commented that the 2019 Construction projects highlight continued replacement of original boiler tubing to address current and future reliability issues with an additional focus on replacement of obsolete unit controls. Mr. Cooper reported that the Construction Budget for 2019 indicates estimated total expenditures of [REDACTED] representing [REDACTED] and [REDACTED] Management Reserve. On a motion duly made, seconded, and unanimously adopted, it was

RESOLVED, that the OVEC-IKEC Construction Budget for 2019, indicating estimated total expenditures of [REDACTED] and [REDACTED] which totals [REDACTED] is approved.

Mr. McCullough asked Mr. Osborne to report on operating activities for the Clifty Creek and Kyger Creek plants. Mr. Osborne asked Clifty Creek Plant Manager Cliff Carnes and Kyger Creek Plant Manager Annette Hope to report on the 2018 Strategic Plan for each respective location highlighting three areas of success and three areas of opportunities.

Mr. McCullough asked Mr. Scott Cunningham to report on the OVEC Operating Committee and the status of OVEC's integration into PJM.

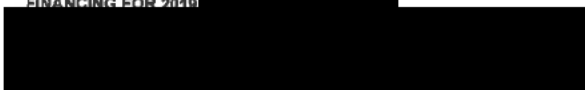
Mr. McCullough asked Mr. Brian Chisling to report on the DOE separation and the termination of the OVEC and DOE contract.

At the request of Mr. McCullough, Mr. Cooper reported on the status and timeline of the Corporation's finance activities. Mr. Cooper distributed to all members present a copy of the Treasurer's Report that included the following statistics:

**OHIO VALLEY ELECTRIC CORPORATION (OVEC)
INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC)
Treasurer's Report
Boards of Directors' Meeting
December 5, 2018**

	<u>OVEC</u>	<u>IKEC</u>	<u>Consolidated</u>
<u>CASH AND INVESTMENTS</u>			
Cash and Short-Term Investments	\$ 65,544,112	\$ -	\$ 65,544,112
DOE Settlement Reserve Account	70,946,302	-	70,946,302
Debt Reserve Account	49,912,681	-	49,912,681
Total Cash and Investments at October 31, 2018	<u>\$ 186,403,395</u>	<u>\$ -</u>	<u>\$ 186,403,395</u>
<u>PLANT DECOMMISSIONING & DEMOLITION (D&D) FUND</u>			
Total D&D Assets at October 31, 2018	<u>\$ 24,517,225</u>	<u>\$ 32,671,749</u>	<u>\$ 57,188,974</u>
<u>EMPLOYEE BENEFIT PLAN ASSETS</u>			
Pension Plan			\$ [REDACTED]
Supplemental Pension & Savings Plan			\$ [REDACTED]
Union Retiree Medical VEBA Trust			\$ [REDACTED]
Retiree Medical VEBA Trust			\$ [REDACTED]
Retiree Life Insurance VEBA Trust			\$ [REDACTED]
401(h)			\$ [REDACTED]
Total Benefit Plan Assets at October 31, 2018			\$ [REDACTED]
<u>EQUITY</u>			
Common Stock, 100,000 shares outstanding	\$ 10,000,000	\$ 3,400,000	\$ 10,000,000
Retained Earnings	13,267,908	-	13,267,908
Total Equity at October 31, 2018	<u>\$ 23,267,908</u>	<u>\$ 3,400,000</u>	<u>\$ 23,267,908</u>
<small>(OVEC's ownership of IKEC's Capital Stock (17,000 shares) is eliminated in consolidation.)</small>			
<u>LONG-TERM DEBT</u>			
2006 Senior Unsecured Notes, Series A, 5.80%, due February 15, 2026	\$ 189,381,919	\$ -	\$ 189,381,919
2006 Senior Unsecured Notes, Series B, 6.40% due June 15, 2040	55,380,136	-	55,380,136
2007 Senior Unsecured Notes, Series AA, AB & AC, 5.90%, due February 15, 2026	134,103,911	-	134,103,911
2007 Senior Unsecured Notes, Series BA, BB & BC, 6.50% due June 15, 2040	42,045,436	-	42,045,436
2008 Senior Unsecured Notes, Series A, 6.92%, due February 15, 2026	27,801,729	-	27,801,729
2008 Senior Unsecured Notes, Series B & C, 6.71%, due February 15, 2026	108,913,236	-	108,913,236
2008 Senior Unsecured Notes, Series D & E, 6.91% due June 15, 2040	81,159,727	-	81,159,727
2017 Senior Unsecured Notes, Series A, Floating Rate, due August 4, 2022	100,000,000	-	100,000,000
2009 Tax Exempt Bonds, \$100M Series A-D, Floating Rate, due February 1, 2026	75,000,000	-	75,000,000
2009 Tax Exempt Bonds, \$100M Series E, 5.625%, due October 1, 2019	100,000,000	-	100,000,000
2010 Tax Exempt Bonds, \$100M Series A & B, Floating Rate, due February 1, 2040	100,000,000	-	100,000,000
2012 Tax Exempt Bonds, \$200M Series A, 5%, due June 1, 2036	200,000,000	-	200,000,000
2012 Tax Exempt Bonds, \$100M Series B & C, Floating Rate, due June 1, 2040	100,000,000	-	100,000,000
Total Long-Term Debt Outstanding at October 31, 2018	<u>\$ 1,313,766,094</u>	<u>\$ -</u>	<u>\$ 1,313,766,094</u>
<u>SHORT-TERM DEBT</u>			
Total Short-Term Debt Outstanding at October 31, 2018	<u>\$ 85,000,000</u>	<u>\$ -</u>	<u>\$ 85,000,000</u>
<u>CORPORATE UNSECURED CREDIT RATINGS</u>			
Fitch (rating affirmed November 9, 2018)		BBB-, Negative Outlook	
Standard & Poor's (rating affirmed December 15, 2017)		BBB-, Negative Outlook	
Moody's (rating affirmed December 20, 2017)		Ba1, Negative Outlook	

FINANCING FOR 2019



Wilson

At the request of Mr. McCullough, Mr. Cooper provided information and discussed OVEC's year-to-date power costs estimated for 2018 and projections for 2019-2021. Mr. Cooper stated that based on current estimates OVEC expected to end 2018 with an average power cost of [REDACTED] per MWhr and an available power use factor of [REDACTED]. Mr. Cooper stated that the projected average power cost for OVEC power, delivered under the terms of the Inter-Company Power Agreement, ranges from [REDACTED] in 2019 to [REDACTED] in 2021 using an estimated available power use factor of [REDACTED].

Mr. McCullough introduced Mr. Bob Bitter of Deloitte & Touche. Mr. Bitter reported that Deloitte & Touche just began its audit to certify the 2018 Financial Statements that would be finalized in April 2019.

The Board moved to an Executive Session.

There being no further business to come before the Board, the meeting was adjourned.



Secretary
OHIO VALLEY ELECTRIC CORPORATION

OHIO VALLEY ELECTRIC CORPORATION
Actions Taken by Board of Directors
April 2019

Paul Chodak III, President of OHIO VALLEY ELECTRIC CORPORATION (OVEC), in a letter dated April 2, 2019, stated that OVEC maintains a revolving credit facility for the short-term funding of working capital including inventories (fuel, fuel related, and material and supply) and interim financing of capital expenditures. This facility is OVEC's primary source of short-term liquidity to cover costs incurred other than income from the Inter-Company Power Agreement monthly billings. The current Revolving Credit Agreement (the "Agreement") has been in place since June 18, 2010 with the last extension on November 14, 2014, and the Agreement is scheduled to expire on November 14, 2019.

OVEC has been working with AEP Service Corporation Finance Department representatives along with KeyBank and PNC, the joint leads of the facility, on a three-year extension. The extended Agreement will reduce the current credit limit from \$200 million to \$185 million but will maintain the current interest rate. The reduced capacity impact on OVEC's access to liquidity will be mitigated by refinancing \$25 million of 2009A OVEC tax exempt bonds currently being held under the Agreement. The refinancing, which is projected to be in the second or third quarter of 2019, will reduce OVEC's current drawn balance of \$85 million by \$25 million and provide additional capacity that exists under the current Agreement. As discussed at the December 5, 2018 meeting of the Boards, the extension of the Agreement is critical to maintaining the current OVEC credit ratings and OVEC's future financial stability.

Signed authorizations have been received from all the Directors, and, accordingly, it was unanimously resolved as follows:

WHEREAS, the Corporation has in place an existing revolving credit facility with aggregate loan commitments of \$200 million (the "**Existing Revolving Credit Facility**"), for the purposes of funding the working capital requirements and other general corporate purposes of the Corporation (including capital expenditures);

WHEREAS, the commitments under the Existing Revolving Credit Facility are set to expire, and all outstanding loans under the Existing Revolving Credit Facility are set to mature, on November 14, 2019;

WHEREAS, the Corporation has determined that it should refinance and modify certain of the terms of the Existing Credit Facility, including, but not limited to, extending the commitment period and the final maturity of the loans and reducing the aggregate commitments to not more than \$185 million (the "**Amended Revolving Credit Facility**"); and

WHEREAS, pursuant to an engagement letter dated March 14, 2019 (the "**Engagement Letter**"), the Corporation has engaged KeyBank National Association to serve as the administrative agent under the Amended Revolving Credit Facility (the "**Administrative Agent**") and each of KeyBanc Capital Markets Inc. and PNC Capital Markets LLC to serve as joint lead arrangers (the "**Joint Lead Arrangers**") to obtain commitments for the Amended Revolving Credit Facility from a syndicate of lenders.

NOW, THEREFORE, BE IT:

RESOLVED, that the Corporation's entering into a credit agreement, or an amendment to the credit agreement for the Existing Revolving Credit Facility, and other agreements, documents and instruments in connection therewith in order to effectuate the Amended Revolving Credit Facility as the Corporation shall deem necessary, proper, desirable or appropriate, with aggregate commitments of not more than \$185 million and otherwise on terms substantially consistent with the summary of terms attached to the Engagement Letter and such other terms as the Corporation may deem necessary, proper, desirable or appropriate (the "**Amended Documents**") is hereby approved. Such approval of the Corporation shall be evidenced by the execution of the Amended Documents by any of the President, any Vice President, the Secretary, the Treasurer or any Assistant Secretary or Assistant Treasurer of the Corporation (each, an "**Authorized Officer**"); and further

RESOLVED, that each Authorized Officer is authorized and directed to execute and deliver on behalf of the Corporation the Amended Documents to which the Corporation is to be a party; and further

RESOLVED, that each Authorized Officer of the Corporation is authorized and directed to execute and deliver on behalf of the Corporation such other agreements, instruments, financing statements, documents or certificates and to do and perform such things and acts, as they shall deem necessary or appropriate to carry out the transactions authorized by this resolution or contemplated by the Amended Documents, including but not limited to one or more future agreements entered into by the Corporation or any one or more future instruments, documents or certificates to be signed by the Corporation under any of the Amended Documents or otherwise for such purpose; and further

RESOLVED, that the Authorized Officers of the Corporation are each hereby authorized to negotiate, execute and deliver from time to time one or more agreements with counterparties selected by such Authorized Officer, the purpose of which is to manage the transactions contemplated herein, all upon such terms and conditions as said officer shall approve, said approval to be conclusively presumed by their execution and delivery of the Amended Documents; and further

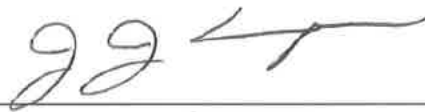
RESOLVED, that the Authorized Officers of the Corporation are each hereby authorized and directed, in the name and on behalf of the Corporation, to do and perform, or cause to be done and performed, any and all such acts, deeds and things, to make, execute and deliver, or cause to be made, executed and delivered, all such consents, agreements, undertakings, documents, instruments or certificates, or to effect any necessary filings, with any and all appropriate regulatory authorities, state and federal, in the name and on behalf of the Corporation, to incur and pay all such fees and expenses and to engage such persons as each such Authorized Officer may, in the judgment of such Authorized Officer, deem necessary, proper, desirable

or appropriate to effectuate or carry out fully the intent and purposes of the foregoing resolutions, including, but not limited to, the performance of the obligations of the Corporation under any agreement or document referred to herein or therein; and the execution by such Authorized Officers of any such consent, agreement, undertakings, document, instrument or certificate or the payment of any such fees and expenses or the engagement of such persons or the doing by them of any act in connection with the foregoing matters shall conclusively establish their authority therefor and the approval and ratification of the agreements, undertakings, documents, instruments or certificates so executed, the expenses so paid, the persons so engaged and the actions so taken; and further

RESOLVED, that the Secretary or an Assistant Secretary of the Corporation be and hereby is authorized and empowered, for and on behalf of the Corporation, to certify and attest to any documents which such Secretary or Assistant Secretary may deem necessary, proper, advisable or appropriate to consummate the transactions contemplated by the documents heretofore authorized and empowered; provided, that such attestation shall not be required for the due authorization, execution and delivery or validity of the particular document; and further

RESOLVED, that all actions previously taken and expenses incurred by any officer or director of the Corporation in connection with the transactions contemplated by the foregoing resolutions, including but not limited to the Corporation's entering into the Engagement Letter and engaging the Administrative Agent, the Joint Lead Arrangers and the other parties to the Engagement Letter to provide the services described in the Engagement Letter, are hereby adopted, ratified, confirmed and approved in all respects; and further;

RESOLVED, that these actions by the Directors of this Corporation be filed in the minute book of this Corporation.



Secretary

OHIO VALLEY ELECTRIC CORPORATION

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 32

Witness: Stuart A. Wilson

- Q-32. Produce any and all presentations made to the OVEC Board of Directors regarding environmental capital projects subsequent to the presentation made on October 22, 2014.
- a) If your response to this request is the same as it was to the same request posed by Sierra Club DR 1-14 in Case Nos. 2018-00294 and 2018-00295, please confirm; or if your response is now different, confirm that and explain how it is different now.
- A-32. Responsive excerpts from presentations made to the OVEC Board of Directors regarding environmental capital projects subsequent to the presentation made on October 22, 2014 are attached. Certain information requested is confidential and proprietary and is being provided under seal pursuant to a petition for confidential protection.
- a) This response includes excerpts from Board presentations that have occurred since the responses to the same questions posed by the Sierra Club in Case Nos. 2018-00294 and 2018-00295 were prepared.

**OHIO VALLEY ELECTRIC CORPORATION (OVEC)
INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC)
Agenda
Boards of Directors' Meeting
December 1, 2015**



OVEC Future Environmental Capital Projects – Projected Costs and Power Cost Impact (in thousands of dollars)

Project	Regulatory Driver	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Landfill Expansions:											
Kyger FGD Landfill - Phase 2 & 3	Landfill Expansion				█	█	█		█	█	█
Clifty FGD Landfill - Phase 2 & 3	Landfill Expansion					█	█				█
316 (b) Compliance											
Clifty compliance with 316(b)	316(b) Rule	█	█			█	█	█			
Kyger compliance with 316(b)	316(b) Rule	█	█				█	█	█		
Dry Fly Ash Conversion (Kyger)											
Kyger Dry Fly Ash Conversion	ELG						█	█	█		
Kyger New North Settlement Pond - WWT	ELG/CCR Rules						█	█	█		
Kyger South Fly Ash Pond Closure	ELG/CCR Rules							█	█	█	
Other ELG/CCR/NPDES Compliance											
Kyger BioReactor - FGD WWTP	ELG					█	█	█			
Kyger Dry Conversion/Closed Loop Boiler Slag Study & CCR Compliance	ELG/CCR Rules	█	█	█		█	█	█			
Clifty BioReactor - FGD WWTP	ELG					█	█	█			
Clifty Dry Conversion/Closed Loop Boiler Slag Study & CCR Compliance	ELG/CCR Rules	█	█	█		█	█	█			
Kyger Landfill Water Compliance	NPDES			█							
Total Major Environmental Projects		█	█	█	█	█	█	█	█	█	█

Impact to OVEC-IKEC Power Cost -

Long Term Debt Expense -	█	█	█	█	█	█	█	█	█	█	█
Total Debt Expense (ICPA Component A)	█	█	█	█	█	█	█	█	█	█	█
Projected Power Cost \$/MWhr	█	█	█	█	█	█	█	█	█	█	█
Projected Power Cost \$/MWhr	█	█	█	█	█	█	█	█	█	█	█
Projected Power Cost \$/MWhr	█	█	█	█	█	█	█	█	█	█	█

1) █

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OHIO VALLEY ELECTRIC CORPORATION (OVEC)
INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC)
OVEC-IKEC Section 316(b), ELG, Water Quality Standards,
and CCR Studies and Evaluations
Boards of Directors' Meeting
December 1, 2015

OVEC-IKEC

RESOLVED, that the Company is authorized to proceed to perform the following environmental compliance activities:

1. Complete entrainment studies and other compliance activities at the Kyger Creek and Clifty Creek Stations associated with the initial phase of 316(b) compliance;
2. Perform Phase I engineering studies on the boiler slag complexes and FGD wastewater treatment plant systems at the Kyger Creek and Clifty Creek Stations to evaluate capital costs and options for compliance with the final version of the Steam Electric Effluent Limitations Guidelines (ELGs);
3. Perform additional analyses using results and findings of Kyger Creek Dry Fly Ash Conversion Project Phase I engineering study relative to the final ELGs;
4. Perform compliance activities and evaluations associated with the CCR Rule at the Kyger Creek and Clifty Creek Stations;
5. Perform engineering study and capital work associated with modifications to the Kyger Creek Landfill stackout pad and leachate collections systems to meet NPDES water quality based limits.

The cost for the scope of work described above is forecasted to be a total of [REDACTED] [REDACTED]. The results of these studies will be used to refine future environmental capital project costs prior to requesting the Boards' approval to complete each associated environmental capital project.

**OHIO VALLEY ELECTRIC CORPORATION
(OVEC) INDIANA-KENTUCKY ELECTRIC
CORPORATION (IKEC) Agenda
Boards of Directors' Meeting
July 29, 2016**



Boards of Directors' Informational Meeting

Environmental Compliance Update

July 29, 2016

Environmental Compliance Update

From December 2015 Board Meeting

- **Implementing Strategy to Refine Capital Forecast for ELG, 316(b) and CCR Compliance activities**
 - ELG rule became effective on January 4, 2016, CCR Rule became effective on October 19, 2016, 316(b) Rule became effective on October 14, 2014
- **Environmental Subcommittee Formed**
 - Two meetings held – June 7 at Clifty Creek and July 19 (conference call), a third meeting will be held in the fall
- **Engineering Studies To Update Capital Forecast Initiated**
 - Project Requirements Established
 - Risk Balanced Technical Options (RBTO) Approach

Environmental Compliance Update

Effluent Limitation Guidelines

- **Risk Balanced Technical Options (RBTO) Approach**

- RBTO approach under way for Clifty Creek and Kyger Creek
 - ELG waste streams – Boiler Slag Ponds, FGD Wastewater Streams, Landfill Leachate, and Fly Ash Pond (Kyger only)
 - Water Balance Studies have been initiated – results will be used to increase accuracy of analysis and to augment analytical data used to design required treatment technologies.
- Leveraging AEP Engineering
 - Expect the RBTO approach to be completed sometime this fall. The selected technology options will be reviewed and discussed with the Environmental Subcommittee prior to the Board meeting in December.
 - Technology Options will also allow for a refinement in the capital forecast.
- Phased Approval
 - Projects will be approved in a phased approach.

Environmental Compliance Update

Effluent Limitation Guidelines

- **Clifty Creek NPDES Permit Renewal**

- NPDES permit renewal application filing deadline is August 4, 2016.
- The filing will include ELG applicability date justification with a phased approach regarding ELG compliance.
 - Meeting with IDEM on 6/27/16 – discussed RBTO process and schedule.
 - Leveraging UWAG guidance and AEP resources to draft proposed compliance schedule.
- OVEC-IKEC's current draft ELG applicability date justification and schedule requests 65 months to complete all required engineering studies, receive approval to spend capital, procure materials, construct, and then optimize any systems required for compliance.
- First NPDES permit renewal since ELG Rules became final – some uncertainty in how successful we will be in negotiating our preferred timeline to install and optimize selected waste treatment systems.

Environmental Compliance Update

Effluent Limitation Guidelines

- **Kyger Creek NPDES Permit Renewal**

- The Kyger Creek Station's NPDES permit renewal application to be filed no later than October 30, 2018.
- It will include ELG applicability date justification, which will propose a phased approach regarding ELG compliance.
 - Discussions have been held with OEPA regarding ELG compliance and we expect the agency to be amenable to the compliance strategy and schedule we intend to propose.
- Kyger wastewater subject to new ELG requirements include:
 - Dry Fly Ash conversion
 - Closed loop system for boiler slag
 - FGD wastewater treatment system (chlorides purge stream) modifications

Environmental Compliance Update

316(b)

- **We are evaluating two 316(b) technologies:**
 - Fish friendly modified traveling water screens and submerged cylindrical screens
 - Equipment assessment to be based on [REDACTED]
 - OVEC-IKEC is also using feedback supplied by Sponsor representatives
- **Clifty Creek and Kyger Creek**
 - Entrainment characterization study plans were filed on January 8, 2015.
 - ORERP entrainment sampling program that is now in its second year.
 - Clifty's entrainment study and supporting information will be filed by January 31, 2018.
 - Kyger's entrainment study and supporting information will be filed by October 30, 2018.
 - Submittal of these plans are a prerequisite for IDEM and OEPA to approve the technology, schedule and compliance date for upgrading cooling water intake systems at each plant.

Environmental Compliance Update

CCR

- **We are in the process of evaluating CCR compliance at the Clifty Creek and Kyger Creek Plants.**
 - All required plans, inspections, and submittals have been made in accordance with the Rule.
 - Both plants have installed new monitoring well systems that meet the intent of the Rule and have collected three rounds of background data.
 - Based on current groundwater data, OVEC-IKEC is not expecting any issues regarding the CCR Rule compliance.
 - OVEC-IKEC is actively involved in Indiana and Ohio's efforts to incorporate CCR Rule requirements into their respective State programs.
- **To date, no concerns or complaints have been received regarding either plants' CCR Rule compliance.**

Environmental Compliance Update

Opportunities and Risks

- **Opportunities:**

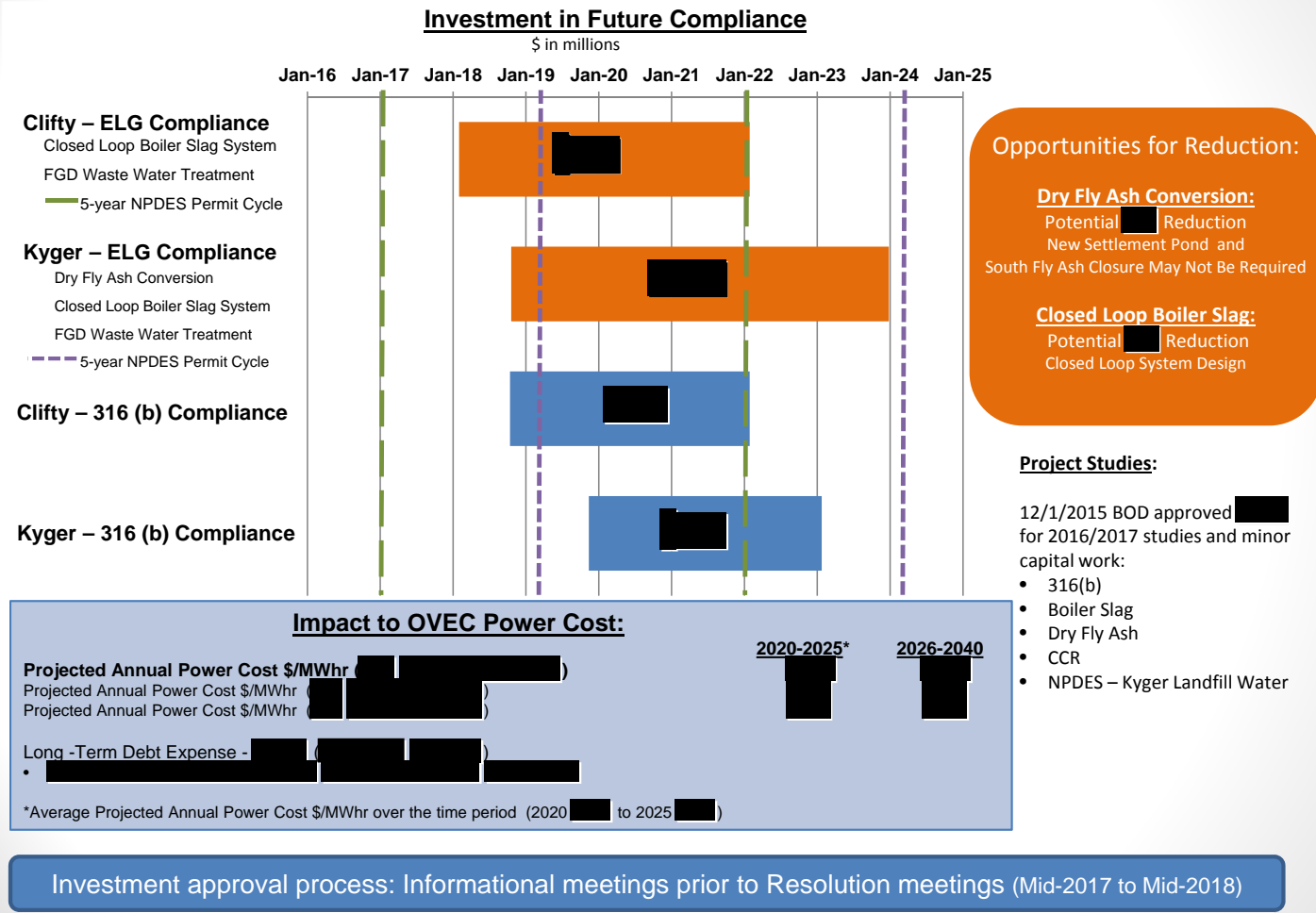
- Engineering analysis from RBTO may allow us to reduce or defer capital costs for:
 - Boiler slag pond relining – both plants
 - Kyger Creek fly ash pond closure and new wastewater treatment system construction

- **Risks:**

- CCR Rule groundwater monitoring data trigger at either site
- Risk related decisions around Kyger Creek fly ash pond (repurpose vs. closure vs. clean closure)

OVEC Future Environmental Capital Projects

Timeline of Investments and Power Cost Impact



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**OHIO VALLEY ELECTRIC CORPORATION (OVEC)
INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC)**

Agenda

Boards of Directors' Meeting

December 1, 2016



OVEC - Environmental Capital Investment

- **Environmental Projects**

- ELG Compliance
 - Closed Loop Boiler Slag System
 - FGD Wastewater Treatment
 - Dry Fly Ash Conversion (Kyger Only)
- 316 (b) Compliance

- **Investment Estimate Prior to Final Rules**

- Project Costs [REDACTED]
- Funding Plan - [REDACTED]
 - [REDACTED]

- **Current Estimate: Best Case**

- Project Costs [REDACTED]
 - Opportunities Identified from Challenging Prior Assumptions:
 - Closed Loop Boiler Slag System – Boiler slag pond partial relining
 - Dry Fly Ash Conversion (Kyger Only) – “Dry Fly Ash Lite” lower capital option
- [REDACTED]
 - [REDACTED]

- **Current Estimate: Worst Case**

- Project Costs [REDACTED]
- [REDACTED]
 - [REDACTED]
 - [REDACTED]

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OVEC - Environmental Capital Investment Next Steps

- **ELG Projects – Begin Conceptual Engineering and Design** (with remaining funds)
 - Two Closed Loop Boiler Slag Systems
 - Two FGD Wastewater ABMet and MBR Treatment Systems
 - Dry Fly Ash Conversion (Kyger Only)

 - **316 (b) Projects**
 - Complete and File Entrainment Studies – January 31, 2018 (Clifty) and October 30, 2018 (Kyger)
 - Continue Technology Evaluation and include final recommendation with studies

 - **CCR Compliance**
 - Complete initial eight rounds of groundwater monitoring
 - Check and adjust if necessary
-
- **Additional Funding**
 - Mid 2017 to Mid 2018 – additional funding for Conceptual Engineering & Design
 - **Investment Decision** – Year end 2017 to Year end 2018



OVEC - Environmental Capital Investment "Best Case" Cost Estimate

Environmental Projects - Estimate: Best Case							
In thousands of dollars							
	Conceptual Engineering & Design 2017-2019	2019	2020	2021	2022	2023	Total
316 (b) Compliance							
Clifty compliance with Section 316(b) of Clean Water Act (6)	█	█	█	█	█		█
Kyger compliance with Section 316(b) of Clean Water Act (6)	█	█	█	█	█		█
Dry Fly Ash Conversion (Kyger)							
Kyger Dry Fly Ash Conversion	█	█	█	█	█	█	█
Other ELG/CCR Compliance							
Clifty BioReactor - FGD WWTP	█	█	█	█	█		█
Clifty West Boiler Slag Dry Conversion/Closed Loop Study	█	█	█	█	█		█
Kyger BioReactor - FGD WWTP	█	█	█	█	█	█	█
Kyger Boiler Slag Dry Conversion/Closed Loop Study	█	█	█	█	█	█	█
Total Major Environmental Projects Capital Costs	█	█	█	█	█	█	█
Assumptions:							
<i>Any Pond Closures will be funded through D&D Reserves</i>							

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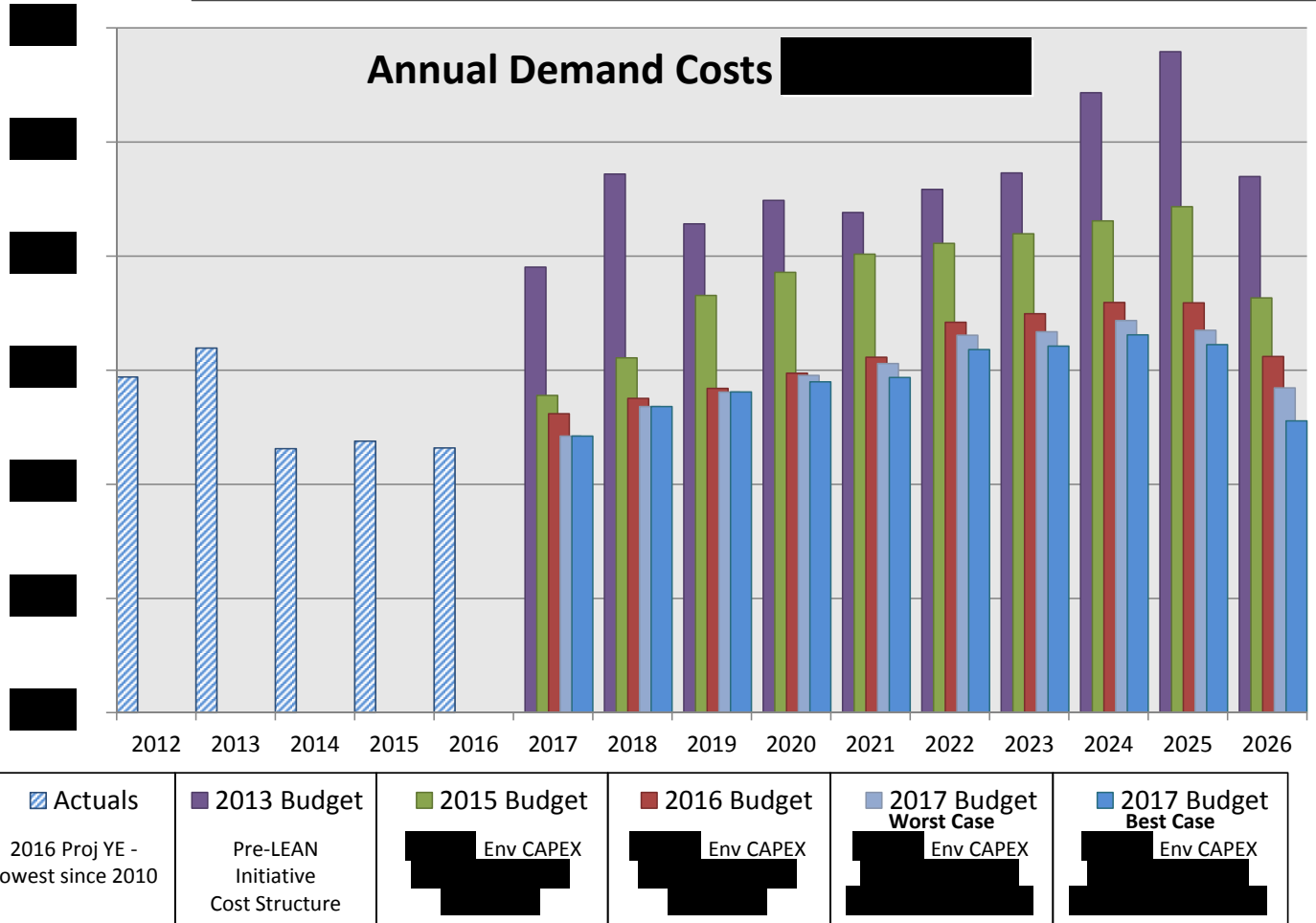
OVEC - Environmental Capital Investment "Worst Case" Cost Estimate

Environmental Projects - Estimate: Worst Case							
In thousands of dollars							
	Conceptual Engineering & Design 2017-2019	2019	2020	2021	2022	2023	Total
	316 (b) Compliance						
Clifty compliance with Section 316(b) of Clean Water Act (6)	█	█	█	█	█	█	█
Kyger compliance with Section 316(b) of Clean Water Act (6)	█	█	█	█	█	█	█
Dry Fly Ash Conversion (Kyger)							
Kyger Dry Fly Ash Conversion	█	█	█	█	█	█	█
Other ELG/CCR Compliance							
Clifty BioReactor - FGD WWTP	█	█	█	█	█	█	█
Clifty West Boiler Slag Dry Conversion/Closed Loop Study	█	█	█	█	█	█	█
Kyger BioReactor - FGD WWTP	█	█	█	█	█	█	█
Kyger Boiler Slag Dry Conversion/Closed Loop Study	█	█	█	█	█	█	█
Total Major Environmental Projects Capital Costs	█	█	█	█	█	█	█
Assumptions:							
<i>Any Pond Closures will be funded through D&D Reserves</i>							

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Long Term LEAN Cost Structure - Demand Environmental Investment Impact



*Demand Costs consist of Operating Costs (Capital, O&M, A&G, T&D), Debt Service (Principle and Interest), and all other non-fuel costs
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**OHIO VALLEY ELECTRIC CORPORATION (OVEC)
INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC)
Agenda Boards of Directors' Meeting
July 21, 2017**

Regulatory and Litigation Update

Regulatory Update

- April 12, 2017, EPA Administration granted the industries' petition and signed an administrative "stay" of the rule's compliance deadlines for FGD wastewater, fly ash transport water, and bottom ash transport water, among others.
- On April 24, 2017, the 5th Circuit Court granted EPA's motion to hold the ELG litigation in abeyance. The administrative stay expires in mid August. We anticipate the EPA could seek remand at this stage for any portion of the rule they intend to reconsider.
 - The 5th Circuit Court granting of a stay has been challenged by the non-governmental organizations.
- June 6, 2017, EPA issued a proposed rule to formally postpone certain compliance dates for the ELG rules applicable to Steam Electric Generating Plants – comments were due on July 6, 2017.

Regulatory and Legal Next Steps

- EPA has scheduled a public hearing on ELG rule postponement for July 31, 2017.
- EPA should file a motion with the 5th Circuit Court by mid August outlining what it plans to do with the ELG rule and likely ask the court to remand portions of the rule back to EPA for reconsideration.
- EPA should take action on finalizing the proposed rule to postpone ELG compliance dates perhaps as early September.
- The D.C. Circuit Court has set a briefing schedule that runs through September 11, 2017, to hear the legal challenge of the original ELG rule administrative stay. A court decision may not be needed on that legal challenge if EPA separately issues a final rule on the EGL rule compliance date postponement.

ELG Rule Future

By the Year End:

- We should have a final ELG compliance date postponement rule and know what wastewater discharges EPA has asked the 5th Circuit Court to remand back to the agency for further reconsideration and new rulemaking.
- We should also know if the legal challenge in the D.C. Circuit Court will proceed.
- We should have a clear path forward to approach IDEM and request a Clifty Creek NPDES Permit Modification (ideally an administrative modification) to eliminate the April 1, 2022, ELG applicability dates in the permit.
- Improved forecast on timing of required investment.

OVEC – Projected Environmental Capital Investment

- Investment Estimates Prior to Final Rules
 - Original Projected Cost [REDACTED] [REDACTED] (2017–2022)

- Current Estimates Range:
 - Best Case [REDACTED]
 - Reduced from [REDACTED]
 - High probability based on current administration and industry feedback
 - Potential reduction of an additional [REDACTED] (based on current administration possible actions)

 - Worst Case [REDACTED]
 - Reduced from [REDACTED]
 - Very low probability based on current administration and industry feedback

OVEC BOD Environmental Investment Decision – Current Estimate
Mid-Year 2018 to Mid-Year 2020

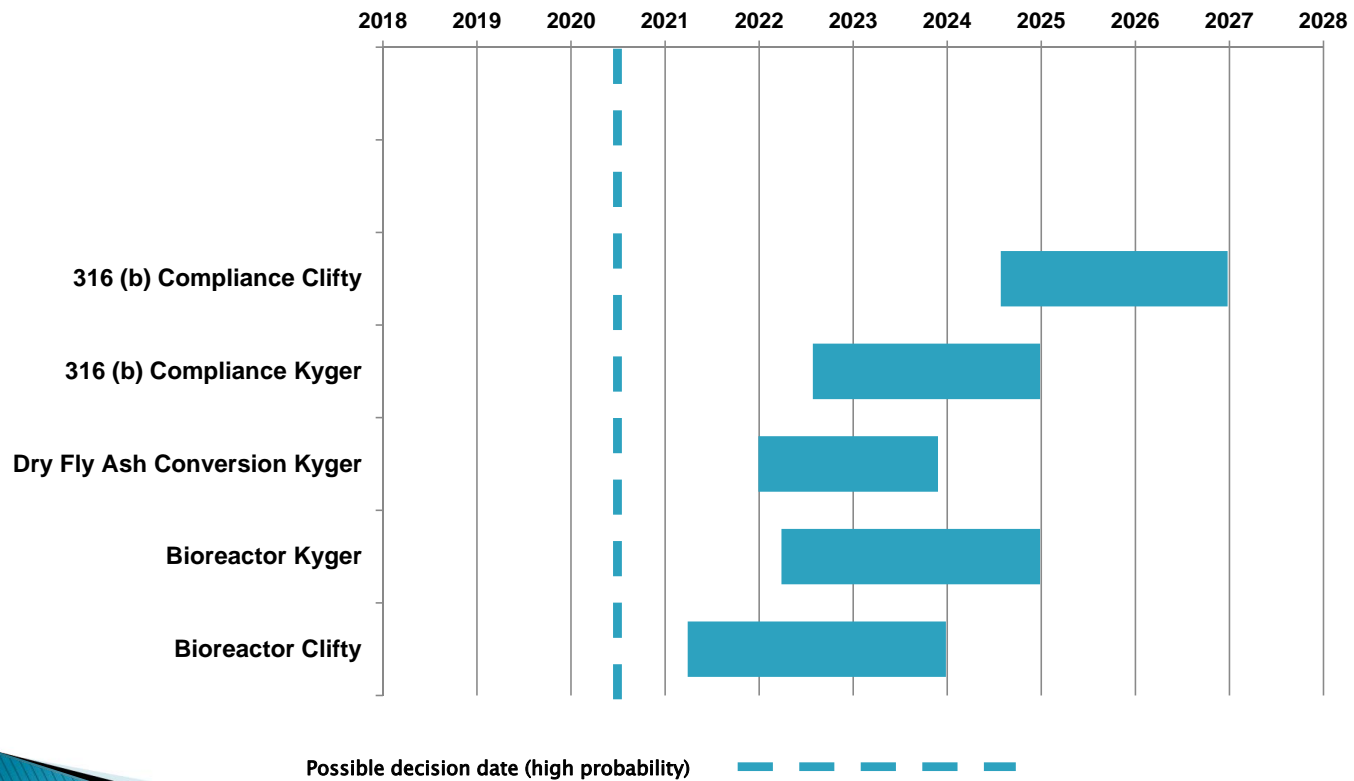
- high probability of 2+ year delay

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OVEC Future Environmental Capital Projects – TIMELINE OF INVESTMENTS – BEST CASE ESTIMATE

Investments: Future Compliance



"Best Case" Cost Estimate

Environmental Projects - Estimate: Best Case										
In thousands of dollars										
Conceptual Engineering & Design 2017-2020	2019	2020	2021	2022	2023	2024	2025	2026	Total	
316 (b) Compliance										
Clifty compliance with Section 316(b) of Clean Water Act (6)										
Kyger compliance with Section 316(b) of Clean Water Act (6)										
Dry Fly Ash Conversion (Kyger)										
Kyger Dry Fly Ash Conversion										
Other ELG/CCR Compliance										
Clifty Bioreactor - FGD WWTP										
Clifty West Boiler Slag Dry Conversion/Closed Loop Study										
Kyger Bioreactor - FGD WWTP										
Kyger Boiler Slag Dry Conversion/Closed Loop Study										
Total Major Environmental Projects Capital Costs										

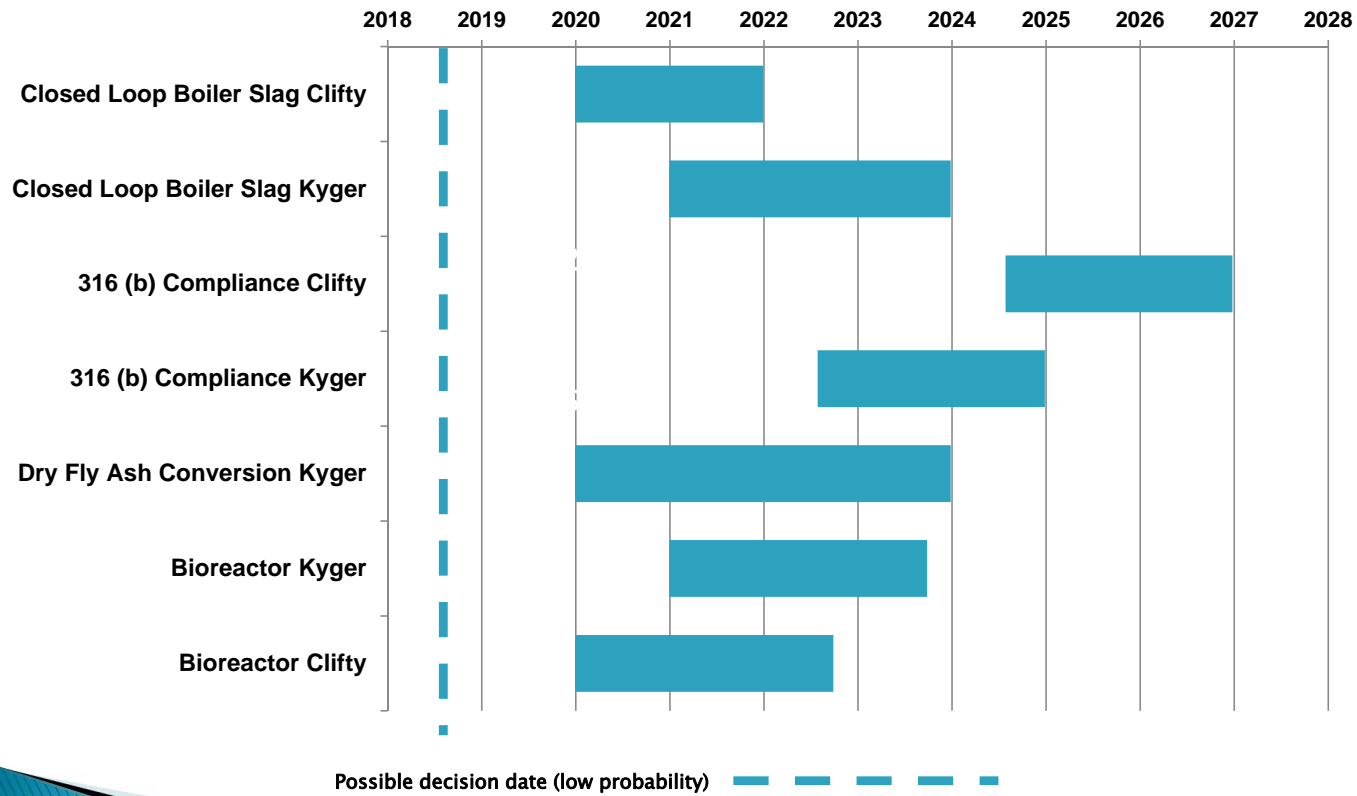
Assumptions:
 Current ELG stay results in a reissue of the rule:

- FGD Wastewater Treatment requirements will have less stringent limits
 - Possible approval of current Wastewater Treatment as best technology
 - **Potential to Reduce Best Case by an additional** [REDACTED]
- Boiler Slag Dry Conversion (Bottom Ash) not required

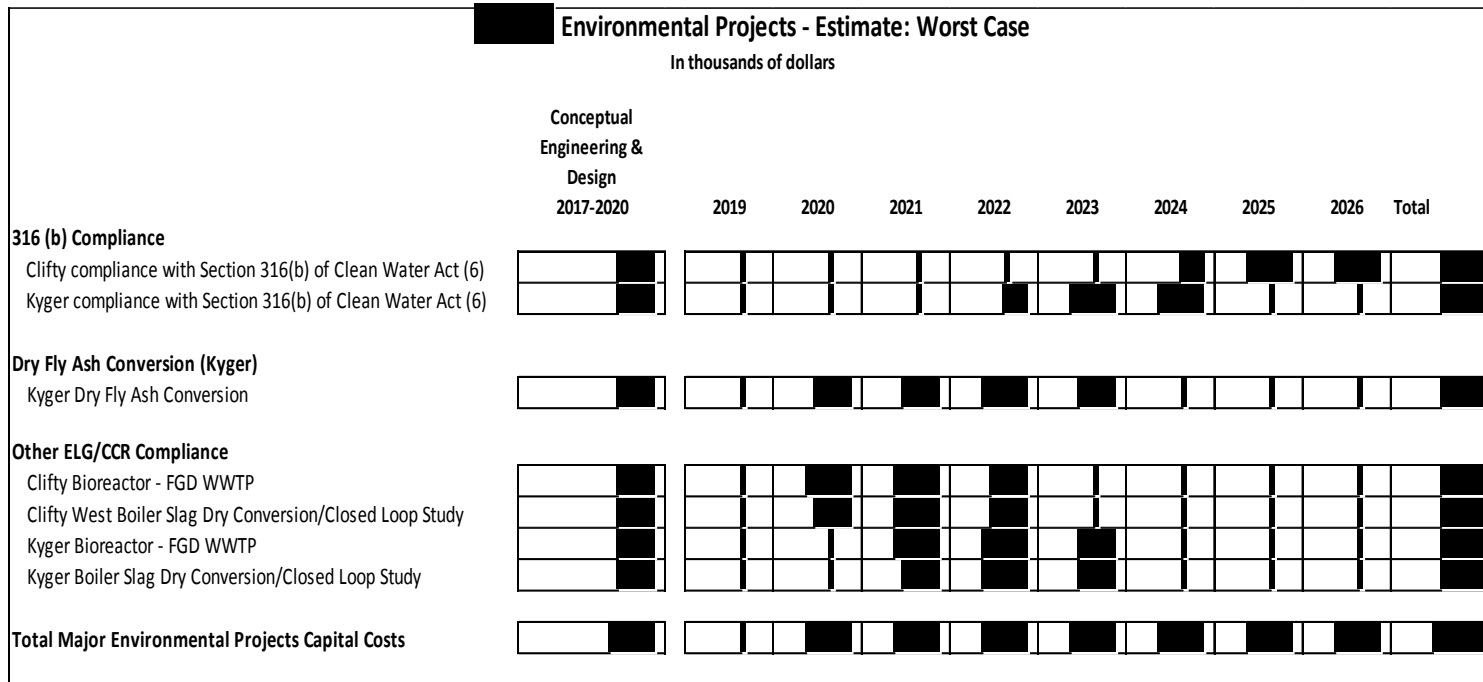
Any pond closure requirements will be funded through decommissioning reserves already collected (current fund [REDACTED])

OVEC Future Environmental Capital Projects – TIMELINE OF INVESTMENTS – WORST CASE ESTIMATE

Investments: Future Compliance



"Worst Case" Cost Estimate



Assumptions:
Any pond closure requirements will be funded through decommissioning reserves already collected (current fund █)

Potential Future Impacts:
Current ELG stay results in a reissue of the rule (as shown in Best Case): █ **Reduction of Worst Case**

- FGD Wastewater Treatment requirements will have less stringent limits
 - Possible approval of current Wastewater Treatment as best technology
 - **Potential to Reduce Worst Case by an additional** █
- Boiler Slag Dry Conversion (Bottom Ash) not required

**OHIO VALLEY ELECTRIC CORPORATION (OVEC)
INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC)
Agenda
Boards of Directors' Meeting
December 8, 2017**

OVEC and IKEC Environmental Compliance Update



Environmental Policy Update

Effluent Limitation Guidelines (ELG) Update

August 2017 ELG Developments

- EPA announces plans to reconsider ELG Rules
- EPA files motion with 5th Circuit announcing details and requesting court action
- 5th Circuit grants EPA request to sever and hold in abeyance legal challenges to ELGs subject to reconsideration

September 2017 ELG Developments

- EPA issues Final ELG Postponement Rule
 - EPA to reconsider rule applicability to FGD wastewater (FGDWW) and bottom ash transport water (BATW)
 - Delays initial compliance window for BATW and FGDWW for two years
 - Keeps remainder of ELG rule in tact
 - Announces plans to issue a new rule BATW and FGDWW by late 2020

Next Steps for ELG compliance

- Continue with Dry Fly Ash conversion analysis for Kyger Creek
 - Economic evaluation with elimination of continued fly ash mediation costs
- File permit modification request for Clifty Creek
- Complete Clifty bioreactor pilot and then defer further action on BATW and FGDWW



Environmental Policy Update

Clean Power Plan Update

- EPA proposes repeal of current CPP rule
- EPA may consider a replacement rulemaking
 - Industry will be evaluating what could be supported in a replacement rule
 - Goal: to have a lawful, durable, and simple replacement rule

Coal Combustion Residual (CCR) Update

- EPA to reconsider CCR Rule - September 13, 2017
- EPA requests and D.C. Circuit Court approves holding CCR rule litigation in abeyance
- EPA identified what portions of CCR rule it will be reconsidering – November 15, 2017

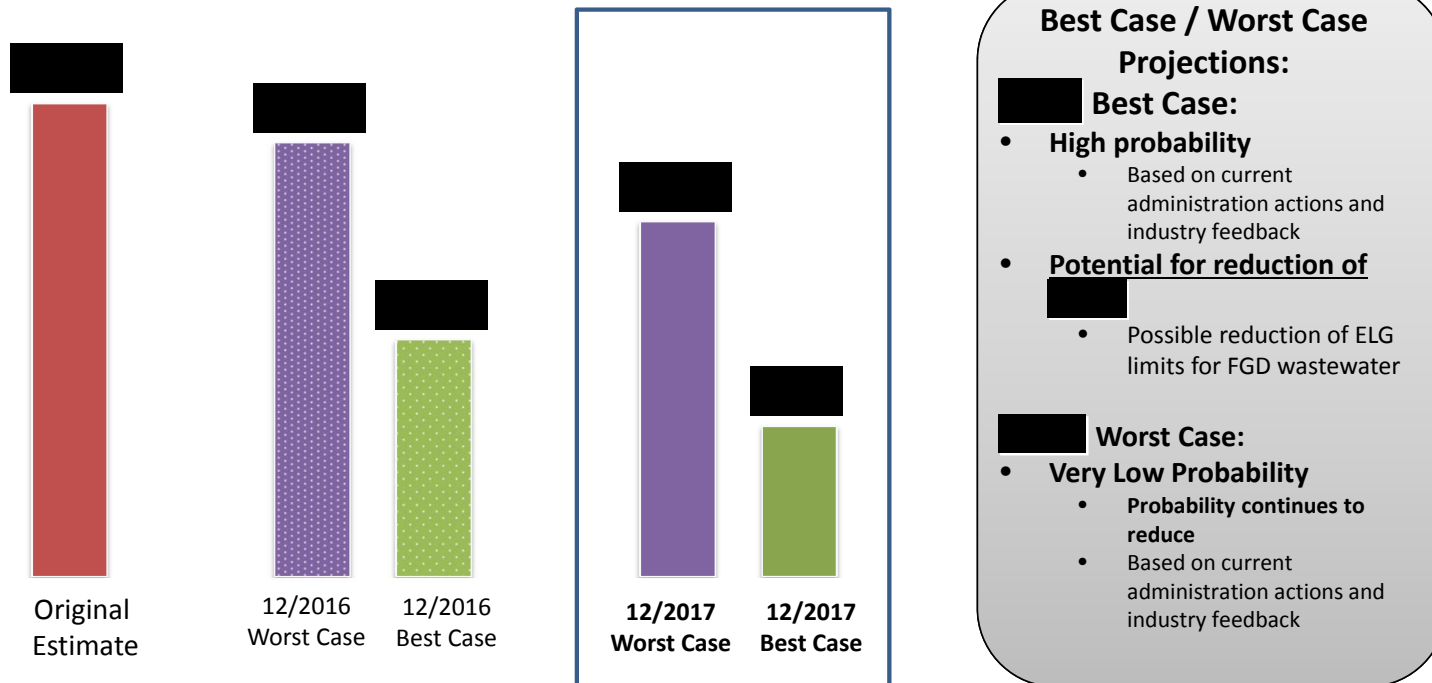
OVEC CCR Compliance Status/Next Steps

- Meeting all CCR requirements YTD
- Groundwater monitoring system in place and all background data collected
- Some statistical increases in data are likely, most to be mitigated with alternative source demonstrations
- Continue to work with QPE on compliance while we await further action from EPA



Projected Environmental Investment

OVEC continues to challenge and evaluate current Environmental Project Cost Projections

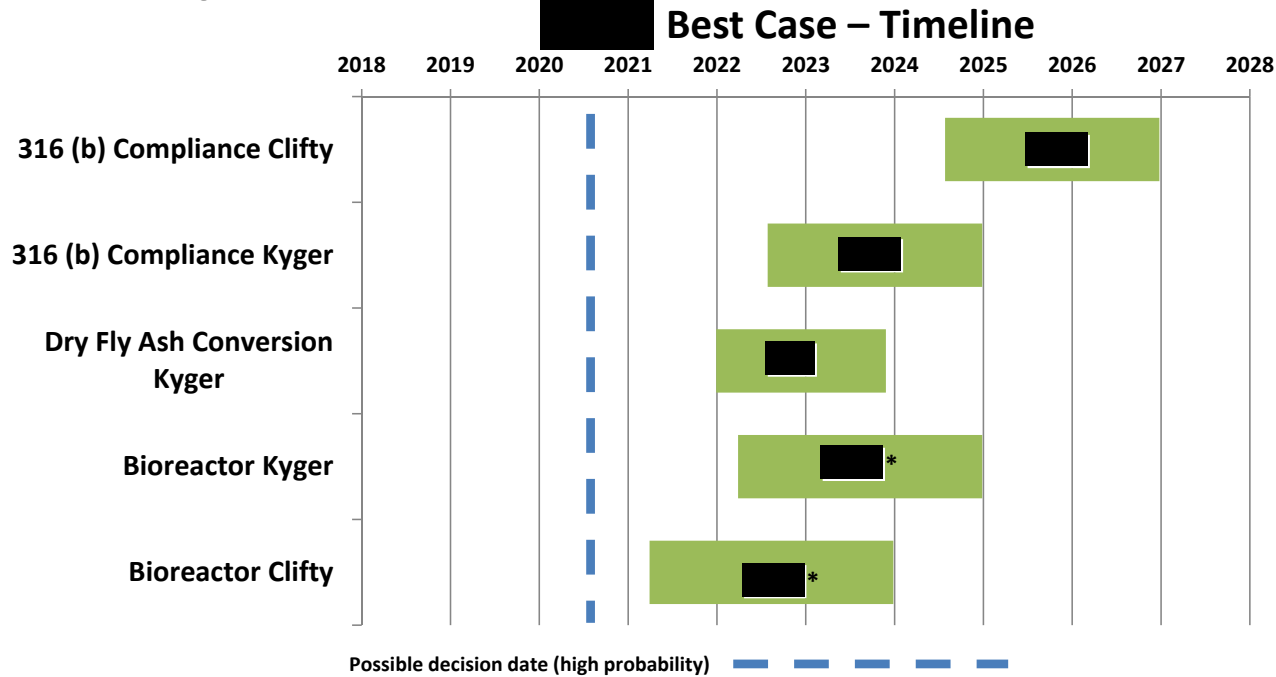


Projected OVEC BOD Environmental Investment Decision:
Mid-Year 2019 to Mid-Year 2020 (high probability of 2+ year delay)

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Projected Environmental Investment



Assumptions:
 Current ELG reconsideration results in a revision of the rule:

- **FGD Wastewater Treatment requirements will have less stringent limits**
 - Possible approval of current Wastewater Treatment as best technology
 - **Potential to Reduce Best Case by ██████████**
- **Boiler Slag Dry Conversion (Bottom Ash) not required**
 Any pond closure requirements will be funded through decommissioning reserves

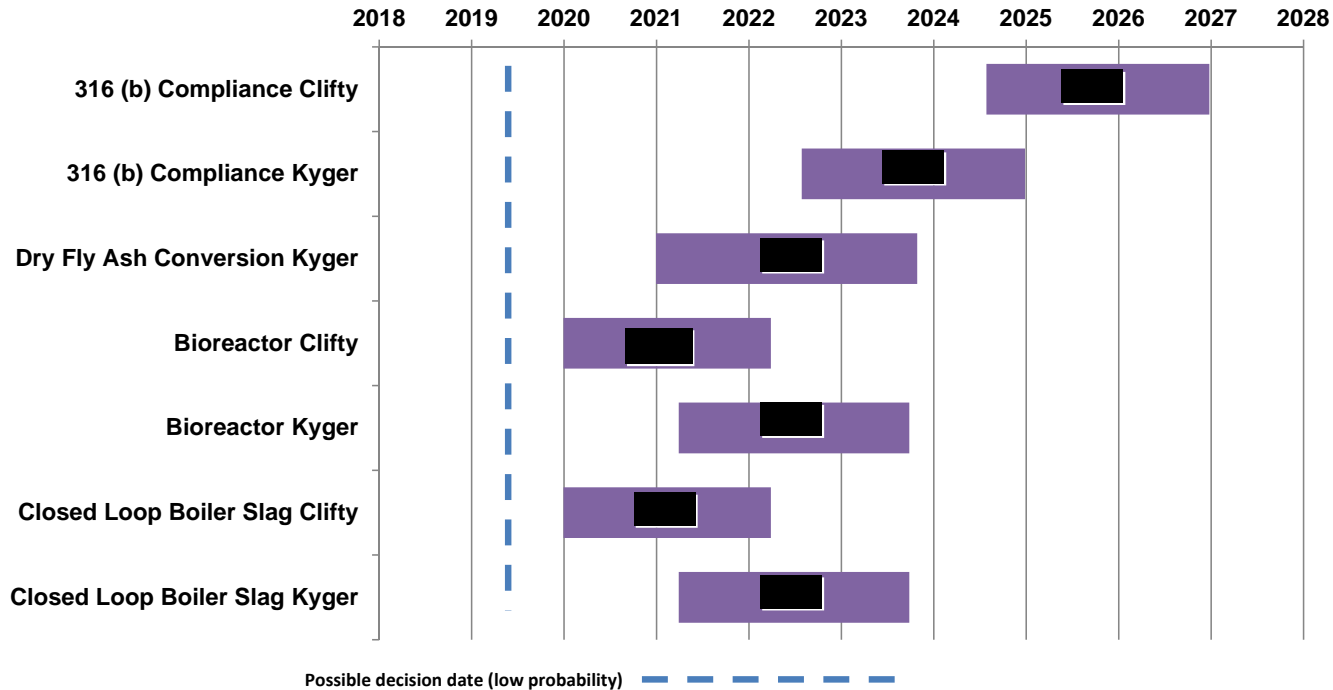
1) Graph excludes approx. ██████████ of conceptual engineering studies for Boiler Slag while reissue of the ELG rule is pending

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Projected Environmental Investment

Worst Case – Timeline



Assumptions:
 Current ELG reconsideration results in reaffirming current rule and requirements
 Any pond closure requirements will be funded through decommissioning reserves

Potential Future Impacts:
 Current ELG reconsideration results in revision of the rule (as shown in Best Case): **Reduction of Worst Case**

- FGD Wastewater Treatment requirements will have less stringent limits
- Boiler Slag Dry Conversion (Bottom Ash) not required

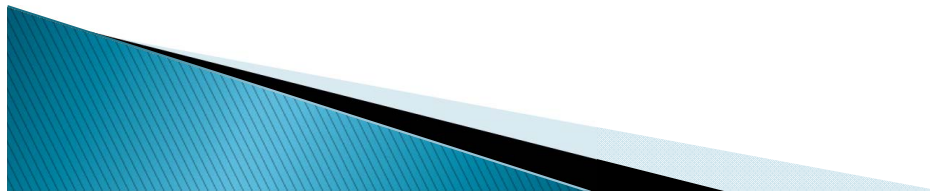
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**OHIO VALLEY ELECTRIC CORPORATION
(OVEC) INDIANA-KENTUCKY ELECTRIC
CORPORATION (IKEC) Agenda
Boards of Directors' Meeting
August 1, 2018**

ELG Environmental Regulatory Update

Effluent Limitations Guidelines Update

- EPA issued final ELG Postponement Rule in September 2017 for FGD Wastewater (FGDWW), bottom ash transport water (BATW).
- Postponement rule includes a two year delay in initial compliance window for FGDWW and BATW, keeps the remainder of ELG rule in tact.
- May 2, 2018 Federal Register Notice on Biennial ELG Report – EPA intends to issue a new draft rule on best available technology (BAT) effluent limits for bottom ash transport water and FGD wastewater by December 2018 and a final rule by December 2019.
- EPA engaging industry to obtain additional data as part of that rulemaking effort.
- EPA issuance of draft rule by end of year will give OVEC an opportunity to improve forecast, costs and timing of required investment.



ELG Environmental Regulatory Update

➤ Clifty Creek

- Permit Modification Request was filed with IDEM to remove the April 1, 2022 ELG compliance dates for FGDWW and BATW.
- IKEC anticipates IDEM will act on request if EPA completes its new rule with new dates and/or new BAT limits.
- Field testing of pilot bioreactor conducted in spring 2018.

➤ Kyger Creek

- NPDES Permit Renewal Application to be filed in October 2018 – new permit expected in April 2019.
- Continue evaluation of ELG compliance options and provide update to Board in December 2018.
- Move into next phase of engineering evaluation of dry fly ash conversion options.



CCR Environmental Regulatory Update

OVEC–IKEC has two landfills and four ponds that meet the definition of a CCR Unit

- Groundwater analysis from spring of 2018 shows statistically significant increases (SSIs) at the landfill runoff collection pond complex at Clifty Creek and the boiler slag pond at Kyger Creek.
- Currently performing alternative source demonstrations (ASDs) – results available around the end of August.
- Next steps will be driven by ASD results – will work with our Qualified Professional Engineer on compliance activities while waiting on additional EPA action.
- EPA issued new CCR rule harmonizing compliance timeline with ELG and providing some additional compliance flexibility.



316(b) Environmental Regulatory Update

Kyger Creek

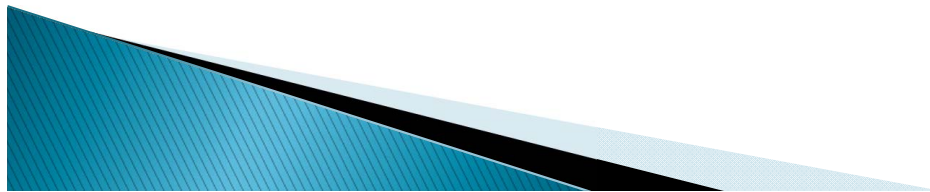
- 316(b) Section 122.21(r) report complete and under peer review.
- Report to be filed with Ohio EPA as part of the NPDES permit renewal application in October 2018.
- Timing of Ohio EPA action expected to be part of permit renewal negotiations.

Clifty Creek

- 316(b) Section 122.21(r) report nearly complete and will undergo peer review in third/fourth quarter 2018.
- Report to be filed with IDEM by end of January 2019.
- IDEM to act on cooling system upgrades next permit cycle.

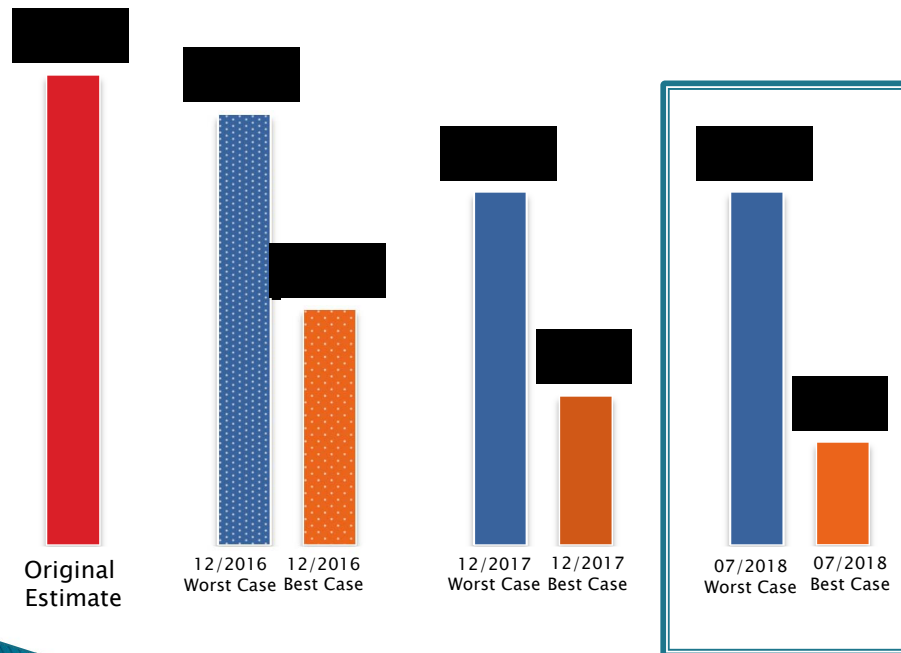
Clean Power Plan (CPP) Environmental Regulatory Update

- EPA repeal of current CPP pending.
- EPA proposed replacement CPP – lawful, durable and simple – rule at OMB.
- Expect both regulatory actions to take place in second half of 2018.
- D.C. Circuit Court of Appeals has not issued ruling on prior legal challenge.
- Supreme Court “stay” remains in place.



Projected Environmental Investment

OVEC continues to challenge and evaluate current Environmental Project Cost Projections



Best Case / Worst Case Projections:

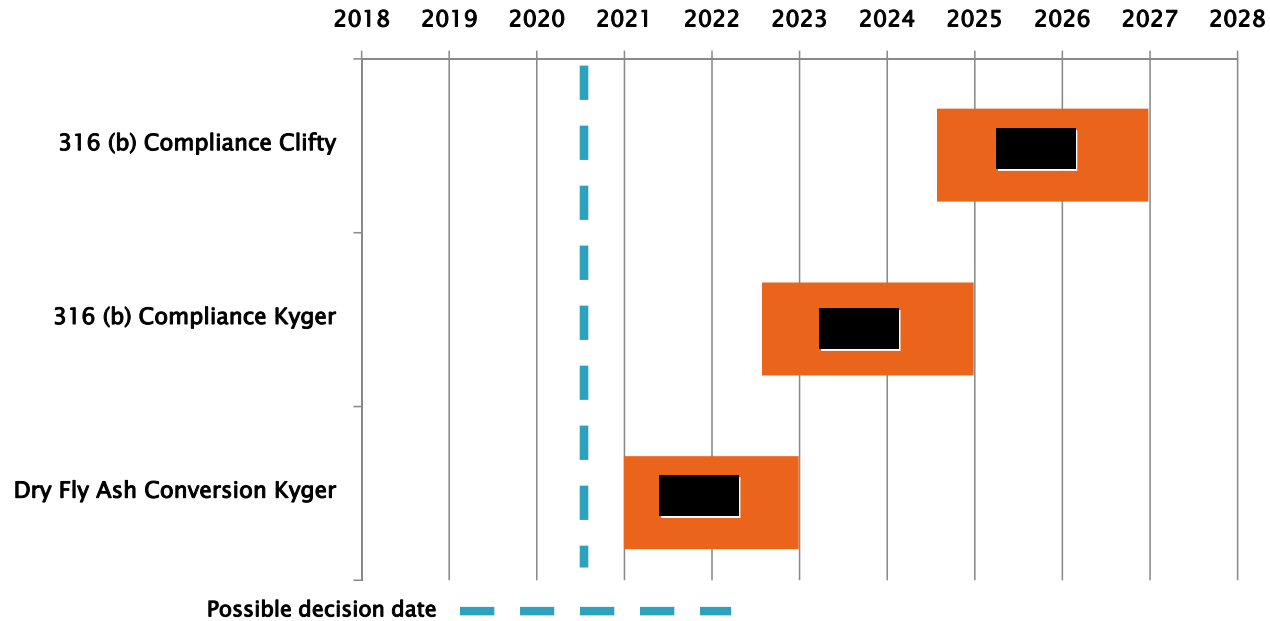
- Best Case:**
 - Based on current administration actions and industry feedback
- Worst Case:**
 - Potential for reduction for Boiler Slag and FGD Wastewater requirements

Projected OVEC BOD Environmental Investment Decision:
Mid-Year 2019 to Mid-Year 2020

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Projected Environmental Investment

Best Case - Timeline



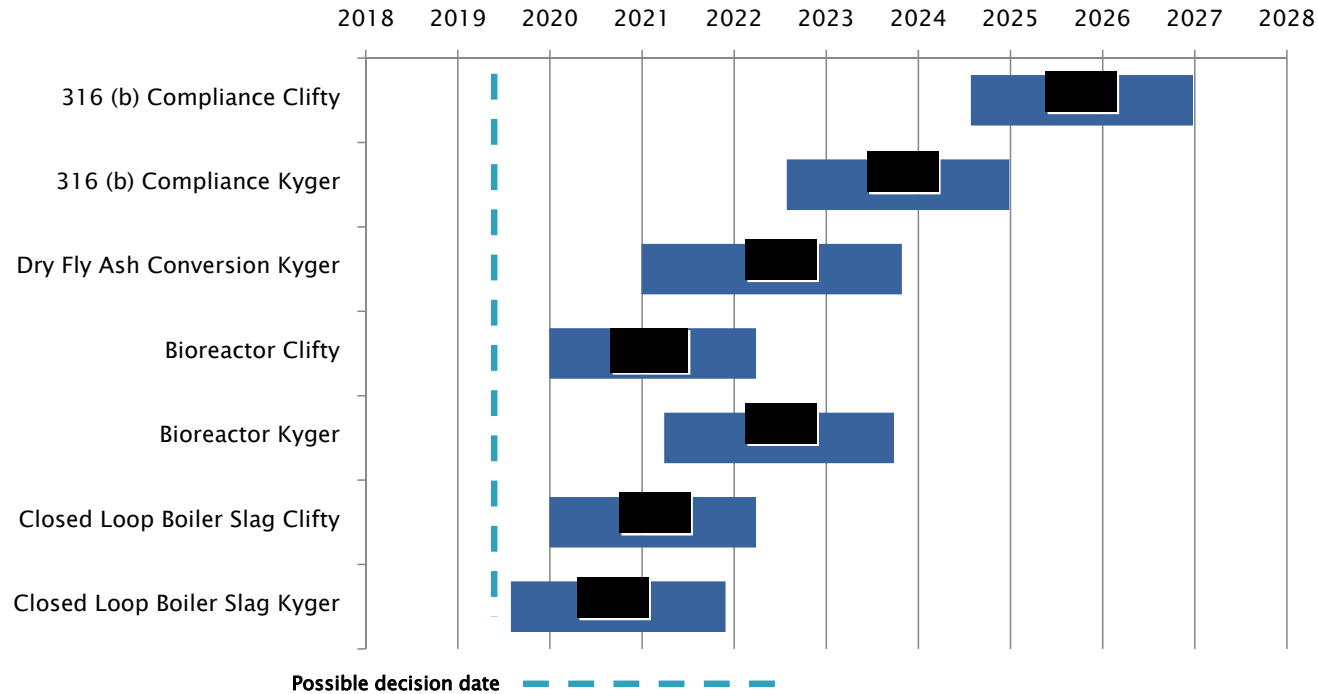
Assumptions:

- Current ELG reconsideration results in a revision of the rule:
 - Current installed FGD Wastewater Treatment considered best technology
 - Boiler Slag Dry Conversion (Bottom Ash) not required
- Any pond closure requirements will be funded through decommissioning reserves

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Projected Environmental Investment

Worst Case - Timeline



Assumptions:
 Current ELG reconsideration results in reaffirming current rule and requirements
 Any pond closure requirements will be funded through decommissioning reserves

Potential Future Impacts:
 Current ELG reconsideration results in revision of the rule (as shown in Best Case): Up to [REDACTED] Reduction of Worst Case

- Current installed FGD Wastewater Treatment considered best technology
- Boiler Slag Dry Conversion (Bottom Ash) not required

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**12/5/18 Boards of Directors' Meeting
Presentation**

Environmental Compliance Update



Environmental Policy Update

Effluent Limitation Guidelines (ELG) 2018 Update

- EPA is continuing to revise the ELG Rule requirements for FGD wastewater and bottom ash transport water. Revised draft rule may not be available until early 2019, final rule targeted for late 2019 or early 2020.
 - Impact of changes in political, regulatory, or legal climate may impact risk and cost from future EPA requirements;
 - OVEC-IKEC remains optimistic EPA will add some flexibility into the rule for the size of units and/or for flexibility allowing limited discharges from bottom ash pond impoundments – e.g., high rainfall or maintenance activities;
 - OVEC-IKEC anticipates there may be a continued opportunity to secure some relief from the original overly stringent FGD WWTP final effluent limits that would have required biological treatment; and
 - Dry fly ash conversion at Kyger Creek remains a compliance obligation.

Next Steps for ELG compliance

- **Kyger Creek:** Continue with Dry Fly Ash conversion analysis
 - Requested a compliance date of December 31, 2023 in NPDES Permit renewal filed on November 1, 2018.
- **Clifty Creek:** File permit modification request once new ELG Rule is issued.



Environmental Policy Update

316(b) Update

- Section 122.21(r) of the 316(b) rules require submittal of comprehensive studies and recommendations on cooling water intake structure upgrades
 - **Kyger Creek:** Report submitted with the NPDES permit renewal package filed November 1, 2018;
 - **Clifty Creek:** Report being finalized and will be submitted in early 2019.
 - Both reports request consultation with state regulatory agencies and their subsequent site-specific determination of what constitutes BAT consistent with Section 125.98(f) of the 316(b) Rule; and
 - State agency determination will be requested before developing detailed costs and establishing a schedule for cooling water system intake upgrades.



Environmental Policy Update

Coal Combustion Residual (CCR) Update

- Portions of the CCR Rule are being reconsidered and additional rulemaking is expected.
 - Reconsideration may introduce the risk of higher compliance costs.
- On August 21, 2018, the D.C. Circuit Court issued a decision regarding multiple issues contained in the CCR Rule that had been brought by multiple petitioners, including USWAG, environmental groups, and EPA.
 - The Court ruled that EPA’s decisions to exempt legacy impoundments at closed facilities, allow unlined surface impoundments to continue to operate, and to classify surface impoundments with two feet of compacted clay as “lined ponds” were arbitrary and capricious;
 - EPA did not file a request for reconsideration; and
 - The industry is expecting EPA to begin a new rule making addressing the Court’s decision, which we anticipate will contain new requirements for these CCR surface impoundments.

OVEC CCR Compliance Status/Next Steps

- Meeting all CCR recordkeeping, reporting and monitoring requirements YTD;
- Groundwater monitoring system in place, background data collected, and detection monitoring continues;
- Some statistical increases in data have been observed, alternative source demonstrations were conducted;
- Assessment monitoring at two of our CCR surface impoundments has been initiated; and
- OVEC continues to work with our Qualified Professional Engineer, our state regulatory agencies, and our trade associations on regulatory issues while we await further action from EPA on CCR Rule revisions.

Case No. 2018-00348

Attachment to Response to SC-1 Question No. 32

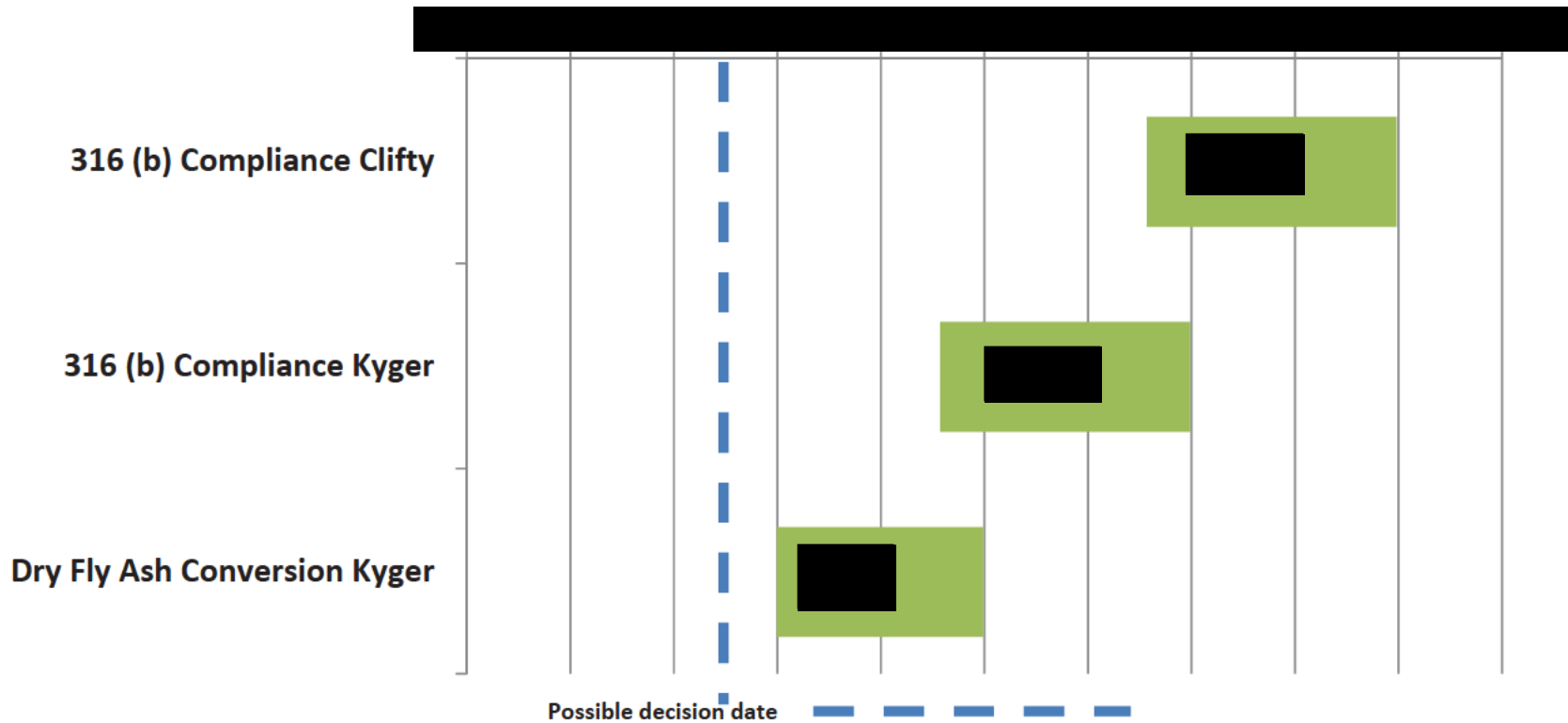
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Projected Environmental Investment

Best Case – Timeline



Assumptions:
Current ELG reconsideration results in a revision of the rule:

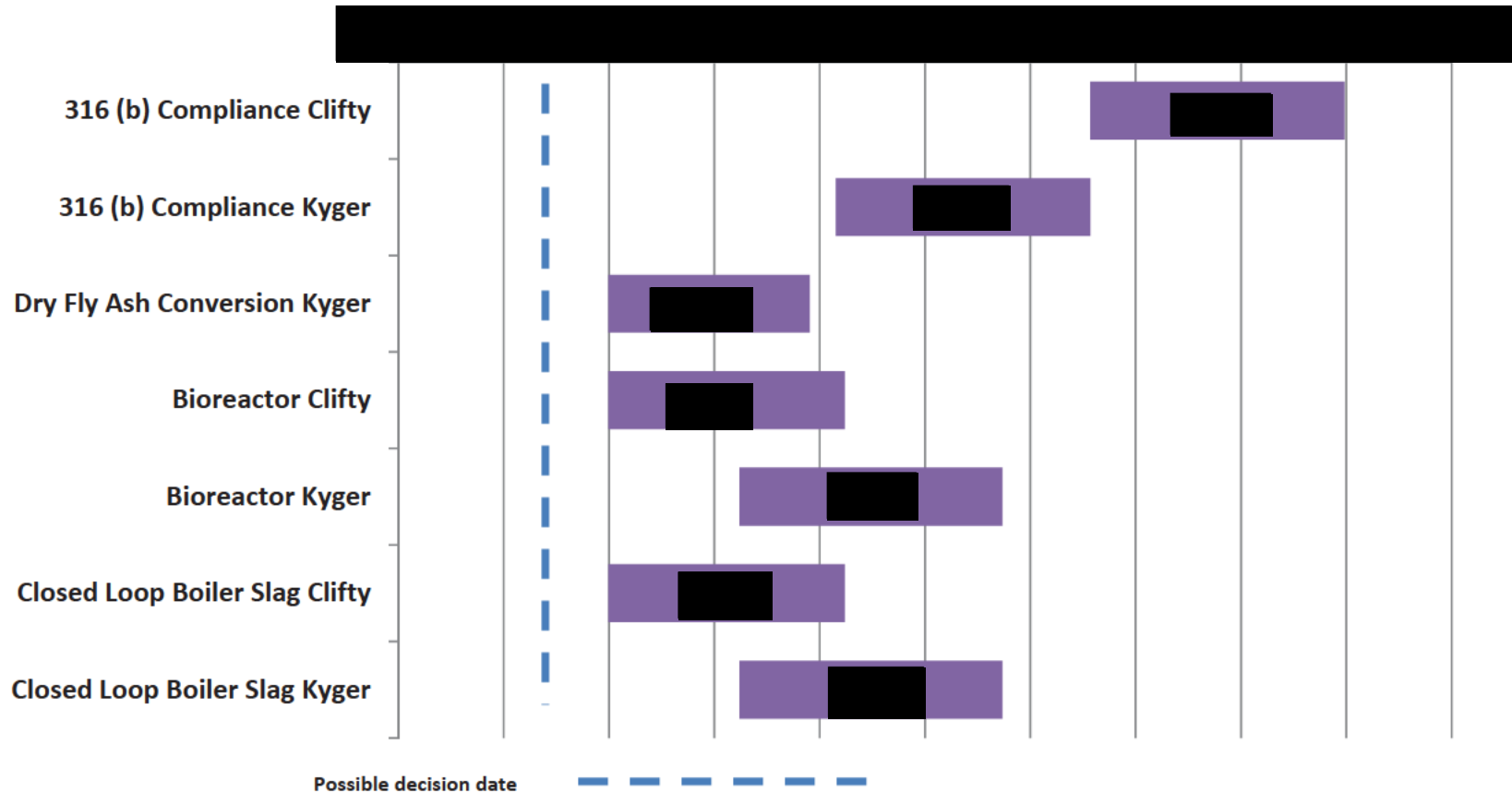
- Current installed FGD Wastewater Treatment considered best technology
- Boiler Slag Dry Conversion (Bottom Ash) not required

If applicable, separate pond closure requirements will be funded through decommissioning reserves



Projected Environmental Investment

██████████ Potential Case – Timeline



Assumptions:
 Current ELG reconsideration results in reaffirming current rule and requirements
 Any pond closure requirements will be funded through decommissioning reserves

Potential Future Impacts:
 Current ELG reconsideration results in revision of the rule (as shown in Best Case): Up to ██████████

- Current installed FGD Wastewater Treatment considered best technology
- Boiler Slag Dry Conversion (Bottom Ash) not required

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Longer-Term Opportunities/Compliance Obligations

- **Fly Ash at Kyger**
 - Researching partnerships in fly ash marketing and in Capital Investment
Impact: [REDACTED] in Dry Fly Ash conversion costs at Kyger Creek and improved opportunities to market dry fly ash
- **Gypsum:**
 - Establishment of long-term gypsum transport/loading solutions at both plants
- **Clean Power Plan (CPP)**
 - On August 21, 2018, EPA proposed Affordable Clean Energy (ACE) Rule as an alternative to the CPP.
 - Industry generally supports the ACE rule (legal, inside the fence, etc.). Comment deadline was October 31, 2018, final rule possible in mid to late 2019;
 - Anticipate the formal repeal of CPP shortly before or concurrent with issuance of final ACE rule; and
 - Compliance obligations to be determined at State level.
- **Future Environmental Obligations**
 - Impact of changes in political, regulatory, or legal climate may impact risk and cost from future EPA requirements

OVEC-IKEC

Boards of Directors' Update

August 1, 2019

Environmental Update

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ELG Environmental Regulatory Update

Effluent Limitations Guidelines Update

- EPA issued final ELG Postponement Rule in September 2017 for FGD Wastewater (FGDWW) and bottom ash transport water (BATW).
- EPA delayed the original compliance window for both wastewaters by two years, leaving the remainder of ELG Rule in tact.
- A new draft rule revising effluent limits was expected by December 2018 and a final rule by December 2019. However, the new rule's issuance has been delayed.
- Timely issuance of the new draft rule by end of 2018 would have given us an opportunity to improve forecast, costs and timing of required investment. The delay in issuing a draft rule will delay refinement in updated compliance cost estimates.
- Indications are that EPA may issue a new rule with some additional flexibility/optionality.

ELG Legal Update

United States Court of Appeals for the 5th Circuit Decision on eNGO legal challenge of portions of ELG Rule

- Unfavorable court decision issued on 4/12/19.
- The Court determined EPA was “arbitrary and capricious” in its ELG rule determinations relative to legacy wastewater and landfill leachate.
- The Court vacated and remanded these portions of the rule back to EPA for further consideration.
- EPA did not file appeal, and will need to update record

➤ [REDACTED]

■ [REDACTED]

■ [REDACTED]



ELG Environmental Compliance Update

➤ Clifty Creek

- Permit Modification Request was filed with IDEM to remove the April 1, 2022 ELG compliance dates for FGDWW and BATW. IDEM has not taken any formal action.
- IDEM is expected to act on modification request when EPA completes its new rule determining new compliance dates and/or new BAT limits.
- EPA delay in issuing new ELG rules results in some risk at Clifty Creek.

➤ Kyger Creek

- NPDES Permit Renewal Application was filed in October 2018. OEPA is still working to draft a renewal NPDES permit.
- Updated engineering evaluation of dry fly ash conversion has been completed, and cost estimate range has been narrowed to [REDACTED] range. Updated economic analysis and business case determination now under way.

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CCR Environmental Compliance Update

OVEC-IKEC has two landfills and four ponds that meet the definition of a CCR Unit

- Groundwater analysis shows statistically significant increases (SSIs) at one pond at each plant.
 - The landfill runoff collection pond complex at Clifty Creek,
 - The boiler slag pond at Kyger Creek, and
 - Any pond closure requirements will be funded through decommissioning reserves.
- Alternative source demonstrations (ASDs) were conducted in 2018 and early 2019, and no alternative sources were definitively identified.
- Additional evaluations have shown no off-site migration of SSI parameters from either pond.
- We continue to work with our Qualified Professional Engineer on compliance activities while waiting on additional EPA rulemaking.
- Public meetings on the CCR ponds and optionality on next steps will be held in the fall.
- EPA expected to undergo additional CCR regulatory action within the next year as well.

316(b) Environmental Compliance Update

Kyger Creek

- 316(b) Section 122.21(r) reports were completed and submitted to Ohio EPA as part of the NPDES permit renewal application in November 2018.
- OEPA has not taken action on 316(b) report or the NPDES permit renewal. We have been in discussions with OEPA and will have an opportunity to provide feedback prior to permit renewal.

Clifty Creek

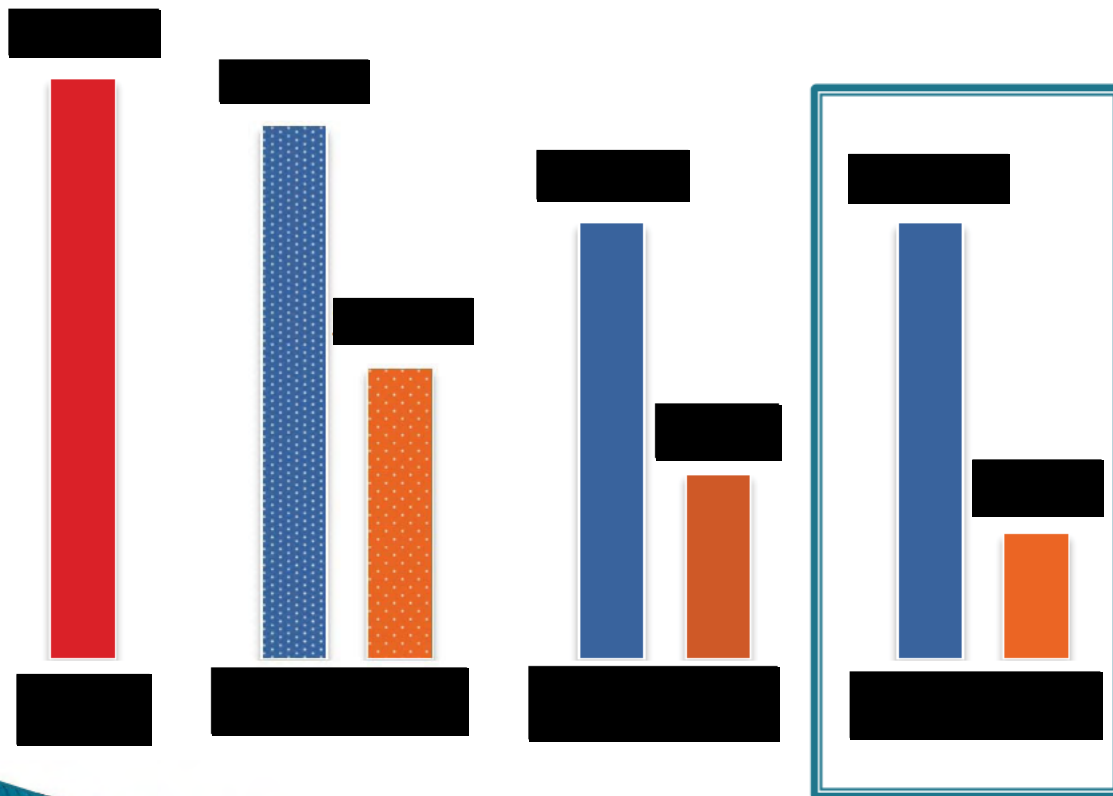
- 316(b) Section 122.21(r) report filed with IDEM in January 2019.
- IDEM to act on cooling system upgrades next permit cycle (i.e. during the 2022 NPDES permit renewal).

Clean Power Plan (CPP)/Affordable Clean Energy (ACE) Rule Update

- USEPA repealed CPP and in a separate action issued ACE Rule on July 8, 2019. Both actions will undergo legal challenges.
- ACE rule becomes effective on September 6, 2019.
 - Inside the fence line Heat Rate Improvements at the unit level is defined as the Best System of Emissions Reduction (BSER).
 - States have three years from ACE effective date to submit implementation plans.
 - States have a lot of flexibility in crafting state implementation plans; however, ACE is somewhat inflexible regarding EGU compliance options.
 - No emissions trading and no fleet, facility or common stack averaging.

Projected Environmental Investment

OVEC continues to challenge and evaluate current Environmental Project Cost Projections



Best Case / Worst Case Projections:

- Best Case:**
 - Based on current administration actions and industry feedback
- Worst Case:**
 - Potential for reduction for Boiler Slag and FGD Wastewater requirements

Projected OVEC BOD Environmental Investment Decision:

[Redacted]

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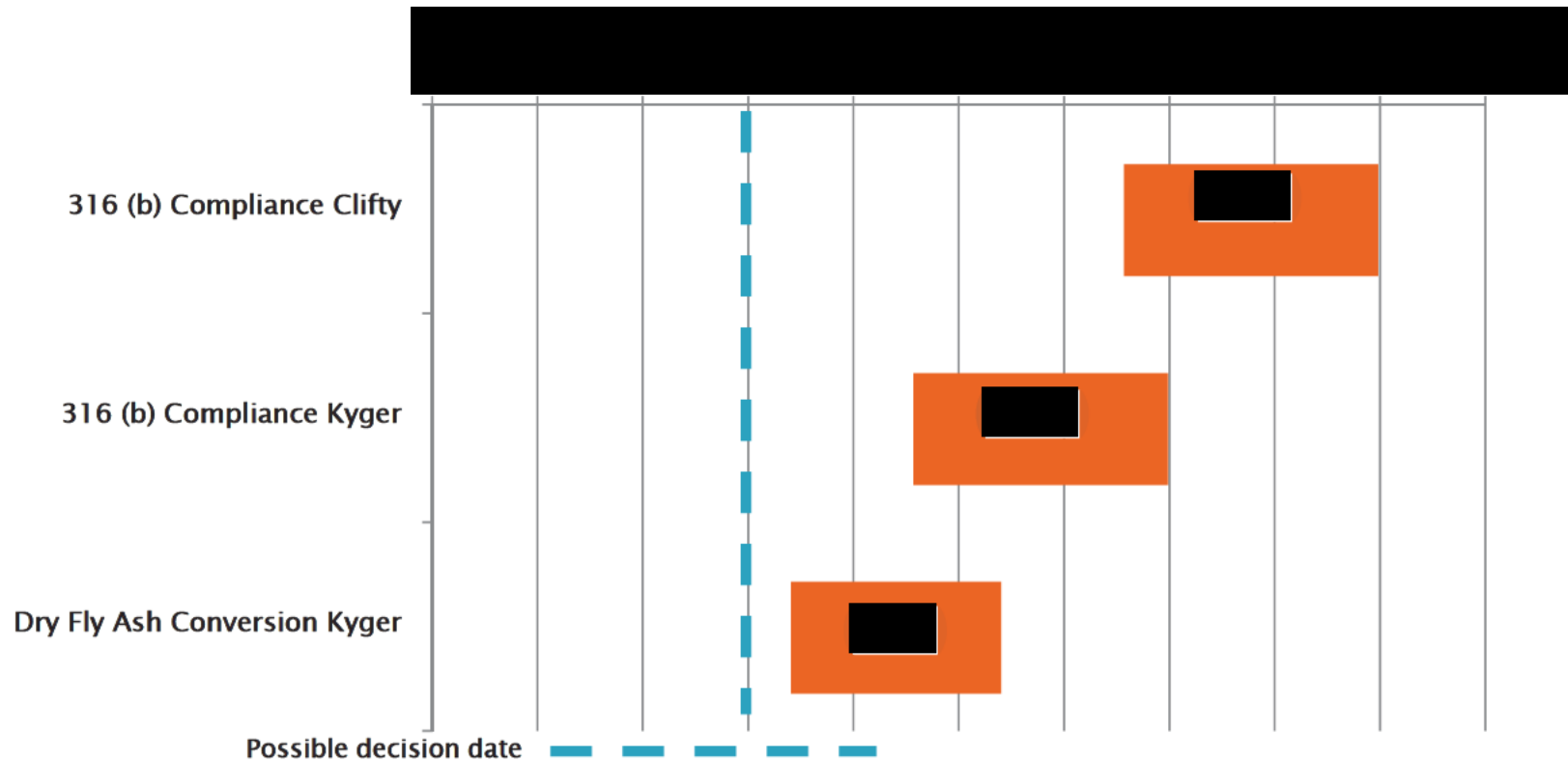
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Projected Environmental Investment

Best Case - Timeline



Assumptions:

Current ELG reconsideration results in a revision of the rule:

- Current installed FGD Wastewater Treatment considered best technology
- Boiler Slag Dry Conversion (Bottom Ash) not required

Any pond closure requirements will be funded through decommissioning reserves

Case No. 2018-00348

Attachment to Response to SC-1 Question No. 32

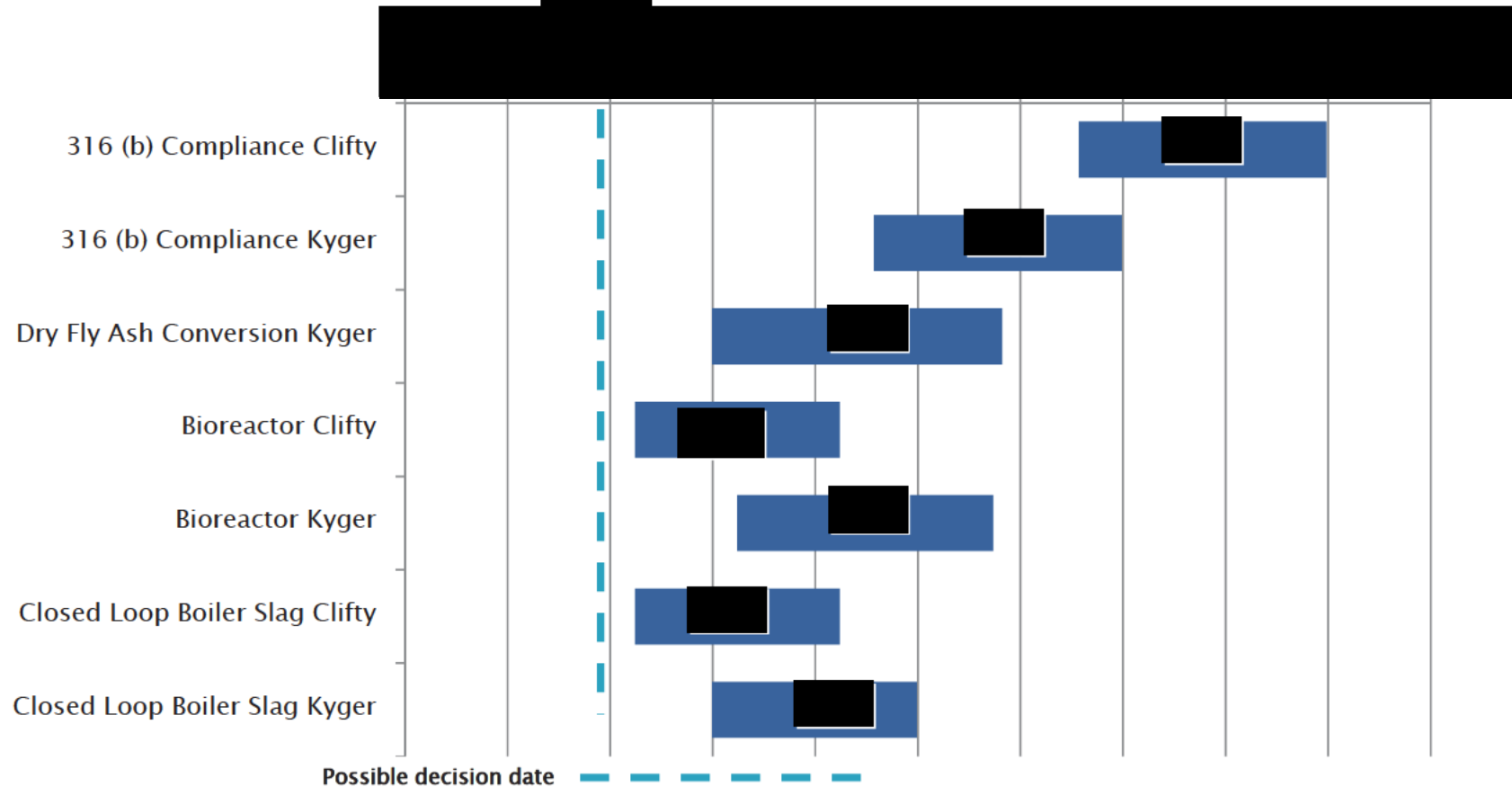
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Projected Environmental Investment

Worst Case - Timeline



Assumptions:

Current ELG reconsideration results in rule revisions that require material modifications to current FGDWW treatment and BATW treatment.

Any pond closure requirements will be funded through decommissioning reserves.

Potential Future Impacts:

- Current ELG reconsideration results in revision of the rule (as shown in Best Case): Up to [redacted] of Worst Case
- Current installed FGDWW Treatment considered best technology and BATW dry conversion not required

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**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 33

Witness: Stuart A. Wilson

- Q-33. For each of the years 2013 through 2018 and 2019 to date, for each of the OVEC Units, identify the forced outage rate.
- a) Note that this request is the same as Sierra Club DR 1-15 in Case Nos. 2018-00294 and 2018-00295 except in that it extends the timeframe to the present. If your responses to this request are the same, for the period January 2013 through the time period the Company previously provided, as the same request posed by Sierra Club DR 1-15 in Case Nos. 2018-00294 and 2018-00295, please confirm; or if your responses are now different with respect to that timeframe (apart from the Companies' response to the subsequent timeframe leading through the present), confirm that and explain how they are different now.
- A-33. See the response to Question No. 27(d).
- a) This response is effectively the same as the responses to the referenced questions from Case Nos. 2018-00294 and 2018-00295.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 34

Witness: Stuart A. Wilson

- Q-34. Confirm or deny, with respect to each coal ash storage unit at Clifty Creek and Kyger Creek, that each coal ash storage unit has transitioned to Assessment Monitoring pursuant to the Coal Combustion Residuals ("CCR") Rule, see generally 40 C.F.R. Part 257; 80 Fed. Reg. 21,302 (Apr. 17, 2015).
- a) If confirmed, provide a list for each coal ash storage unit of all Appendix III constituents for which OVEC found a "statistically significant increase" over background groundwater levels.
 - b) If denied, explain whether (and when, if applicable) such transition is anticipated.
 - c) Provide an estimate of the cost of closure of each coal ash storage unit.
 - d) If your responses to this request are the same as to the same request posed by Sierra Club DR 1-16 in Case Nos. 2018-00294 and 2018-00295, please confirm; or if your responses are now different, confirm that and explain how they are different now.
- A-34. The Companies do not maintain or monitor the records for OVEC's ash storage units. However, OVEC's CCR Rule Compliance Data and Information is publicly available on OVEC's website at <http://ovec.com/CCRCCompliance.php>.
- a) Not applicable. See the response above and the response to Question No. 32.
 - b) Not applicable. See the response above.
 - c) See the response to Question No. 32.
 - d) This response differs from the responses to the referenced questions from Case Nos. 2018-00294 and 2018-00295 in that the response to part (c) has been updated.

Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019

Case No. 2018-00348

Question No. 35

Witness: Daniel K. Arbough

- Q-35. Explain whether it is the Companies' understanding that, under the ICPA, each of OVEC's Sponsoring Companies is responsible for guaranteeing OVEC's debt, such as in the event OVEC were to dissolve or to file for bankruptcy.
- a) If not, explain the Companies' understanding otherwise, including why the Company does not interpret Article 5.03 of the ICPA to impose such obligation.
 - b) Conversely, if so, explain how the Companies reconcile that understanding with the Commission's August 11, 2011, Order in Case Nos. 2011-00099 and 2011-00100, providing (at 3) that "LG&E and KU will not act as guarantors of OVEC's debts nor will they issue securities or other evidence of indebtedness for the purpose of financing their participation in the Amended ICPA."
 - c) If your responses to this request are the same as to the same request posed by Sierra Club DR 1-17 in Case Nos. 2018-00294 and 2018-00295, please confirm; or if your responses are now different, confirm that and explain how they are different now.
- A-35. The Company objects to the request to the extent it asserts a legal argument including, but not limited to, regarding outcomes in a bankruptcy proceeding. Without waiver of this objection, the Company replies as follows:
- a) The Company does not agree with the statement that it is responsible for guaranteeing OVEC's debt. Article 5.03 states that the Company will pay the percentage of aggregate demand charges represented by its Power Participation Ratio. Also, Article 9.11 of the ICPA states, "The rights and obligations of the parties hereto shall be several and not joint or joint and several". Consequently, the Company is only obligated to pay to OVEC its pro rata share of a properly calculated Demand Charge. If OVEC fails to make a debt service payment, it is the Company's position that OVEC (or any other party) cannot seek further payment from the Company for such debt amounts so long as the Company's pro rata share has been paid.
 - b) Not applicable.
 - c) The responses are the same as the responses to the request posed in Case Nos. 2018-00294 and 2018-00295.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 36

Witness: Daniel K. Arbough / Christopher M. Garrett

Q-36. Reference Attachment to Filing Requirement 807 KAR 5:001 Section 16(7)(k), pp. 56, 102-103 (Garrett), in the Companies' rate application filed in Case Nos. 2018-00294 and 2018-00295.

- a) Explain the characterization of the Companies' investment in OVEC as "not significant."
- b) Without limitation, explain the consistency of that characterization with the Companies' assertions that:
 - i) The Companies are "conditionally responsible for a pro-rata share of certain OVEC obligations" (and please identify the "certain OVEC obligations" to which the Companies refer).
 - ii) The Companies are "obligated to pay for its share of OVEC's excess debt service, post-retirement and decommissioning costs, as well as any shortfall from amounts included within a demand charge designed and expected to cover these costs over the term of the contract," with the Companies' "proportionate share of OVEC's outstanding debt [being] \$81 million at December 31, 2017."
 - iii) The Companies' "maximum exposure and the expiration date of these potential obligations are not presently determinable"

A-36.

- a) LG&E owns 5.63% and KU owns 2.5% of OVEC's common stock. This represents an investment of \$594,286 for LG&E and \$250,000 for KU, which the Companies deem to be not significant.
- b) Separate from the investment referenced in part (a) of the question, LG&E and KU are also parties to a power purchase agreement (ICPA) with OVEC in which LG&E and KU are contractually entitled to a specified percentage (also 5.63% and 2.5%, respectively) of OVEC's output. It is under the ICPA in which LG&E and KU are responsible for a pro-rata share of certain OVEC obligations, which primarily include OVEC's debt service, post-retirement and decommissioning costs, as well as any shortfall from amounts included within a demand charge designed and expected to

cover these costs over the term of the contract. Because many of the referenced costs relate to future events, the estimated timing, duration and expense of which have significant variability or uncertainty, LG&E's and KU's exposure for obligations under the ICPA is not presently determinable. The statement referenced in part (a) of the question is appropriate as this relates to LG&E's and KU's OVEC investment (ownership) relationship, while the statements quoted in part (b) of the question relate specifically to LG&E's and KU's OVEC ICPA (contractual) relationship.

**Louisville Gas and Electric Company and Kentucky Utilities Company
Response to Sierra Club's Initial Request for Information
Dated October 4, 2019**

Case No. 2018-00348

Question No. 37

Witness: Stuart A. Wilson / Counsel

- Q-37. Identify and produce any request(s) the Company has issued, from 2015 through the present, for proposals for new or substitute generation capacity (whether or not connected to the question of OVEC).
- a) Identify and produce any responses thereto.
 - b) If your responses to this request are the same as to the same request posed by Sierra Club DR 1-20 in Case Nos. 2018-00294 and 2018-00295, please confirm; or if your responses are now different, confirm that and explain how they are different now.
- A-37. The Commission's scope in an IRP proceeding is limited to the processes used in the IRP by the utility to prepare the resource assessment and adequacy under review. The Commission's role under 807 KAR 5:058 is limited to addressing procedural issues and not substantive issues.

As discussed on page 5-6 of Volume I of the IRP, the Companies evaluate all market available alternatives before committing to a particular course of action. The adequacy of the Companies' evaluation of the market alternatives is considered in connection with a request for a certificate of public convenience and necessity and not in the course of reviewing the Companies' processes for load forecasting and resource assessment.

Without waiver of the forgoing objection, on February 4, 2019, the Companies issued a request for proposals ("RFP") to purchase up to 200 MW of renewable electrical power and energy. See <https://lge-ku.com/sites/default/files/2019-02/RFP-February-2019.pdf>. The IRP under review in this case was filed on October 19, 2018 and does not reference this RFP or rely upon it for any the least-cost, most reasonable options considered in the 2018 resource planning process.

- a) The RFP responses are not available for production as the evaluation and negotiations are currently ongoing. Disclosure even with confidential protection can possibly prejudice, if not impair, the Companies' negotiations at this time.
- b) This response differs from responses to the referenced questions from Case Nos. 2018-00294 and 2018-00295 in that it discusses the Companies' 2019 RFP.