Public Service Commission of Wisconsin
Direct Testimony of Ajinkya Rohankar
Division of Energy Regulation

American Transmission Company LLC, ITC Midwest LLC, and Dairyland Power Cooperative
Docket 5-CE-146

April 26, 2019

Q. Please state your name, business address, and occupation.

A. My name is Ajinkya P. Rohankar. My business address is 4822 Madison Yards Way, Madison, Wisconsin 53707-7854. I am employed by the Public Service Commission of Wisconsin (Commission) as a Public Service Engineer – Advanced in the Division of Energy Regulation.

Q. Please describe your educational background, professional qualifications, and work experience.

A. I have a Bachelor of Technology degree in Electrical Engineering from University of Mumbai, India. I also have a Master of Science degree in Electrical Engineering with a major in Power Systems from Michigan Technological University. I have worked for a natural gas distribution company in India as a Trainee Project Engineer for about one year. I joined the Commission full time in June 2015 as a Public Service Engineer – Senior.

Since joining the Commission, I have worked on multiple electric generation and transmission construction projects. I have performed the need analyses using Electric Generation Expansion Analysis System computer model for dockets 3270-CE-127 and 5-BS-228. In addition, I have used and am continuing to use PowerWorld software to...

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1 Application of Madison Gas and Electric Company for a Certificate of Authority for Construction, Installation and Placement in Operation of a Wind Electric Generation Facility Known as the Saratoga Wind Farm, in Howard County, Iowa, 2017.

Direct-PSC-Rohankar-1
analyze the need and alternatives for dockets involving major transmission facilities, including 137-CE-185, 5820-CE-104, 137-CE-184, and 137-CE-186.

Q. **What are your responsibilities in this docket?**

A. I am one of the project review engineers for this project. My analysis primarily focuses on the review of the PowerWorld models American Transmission Company LLC (ATC), ITC Midwest LLC (ITC), and Dairyland Power Cooperative (DPC), (together, applicants) submitted to show the reliability benefits of the proposed Cardinal-Hickory Creek 345 kilovolt (kV) transmission line project (Cardinal-Hickory Creek). I was also responsible for writing some sections of Chapter 3 of the draft Environmental Impact Statement for the proposed Cardinal-Hickory Creek project.

Q. **What are the purposes of your testimony?**

A. The purposes of my testimony are to:

1. explain the applicants’ PowerWorld modeling analyses performed regarding the proposed Cardinal-Hickory Creek project;
2. summarize Commission staff’s PowerWorld modeling results; and
3. comment on avoided reliability projects and economic benefits analysis performed by the applicants.

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5 Application of American Transmission Company LLC to Rebuild the Existing 69 kV Transmission Line Between the Finger Road Substation in the City of Green Bay, Brown County, Wisconsin, and the Canal Substation in the City of Sturgeon Bay, Door County, Wisconsin, filed 2016.
6 Application of American Transmission Company LLC, as an Electric Public Utility, for Authority to Construct a New 345 kV Transmission Line, Substation and Related Facilities, from the Existing 345 kV Transmission System, to Interconnect a New Electric Generating Facility, to be Located in the Town of Beloit, Rock County, Wisconsin, filed 2017.
Q. Have you prepared any exhibits accompanying your testimony?

A. Yes, the following exhibits accompany my testimony:

- Ex.-PSC-Rohankar-1 Summary of Results of the PowerWorld Analysis
- Ex.-PSC-Rohankar-2 North American Electric Reliability Corporation (NERC) Transmission System Planning Performance Requirements Standard TPL-001-4
- Ex.-PSC-Rohankar-3 ATC 2019 10-Year Assessment Preliminary Needs Presentation, dated February 28, 2019

Applicants’ PowerWorld Modeling

Q. Please describe the applicants’ PowerWorld modeling.

A. Co-applicant ATC performed all the modeling on behalf of the applicants. ATC used Power System Simulator for Engineering (PSS®E)⁷ to assess the reliability benefits of the proposed Cardinal-Hickory Creek project. PSS®E is a modeling software that can be used to perform a wide variety of analysis functions, including power flow, dynamics, short circuit, contingency analysis, and other analyses. ATC used the PSS®E model to evaluate reliability impacts of each of the studied alternatives. To determine the reliability benefits, ATC calculated the power flows in Wisconsin, with and without the proposed Cardinal-Hickory Creek project. Commission staff uses PowerWorld Simulator which has similar capability and is interchangeable with the modeling software used by ATC.

The reliability analysis used four models originally created in the first quarter of 2017 for ATC’s 10-Year Assessment. These models represent the expected electric system in 2027, for varying load forecasts during different times of the year. All the models included in the reliability analysis were based on Midcontinent Independent

assumptions. While the ATC portions of the models were updated as a part of the 2017 10-Year Assessment, the remainder was taken from MISO 2016 Multiregional Modeling Working Group models. Loads included in this study were taken from the 2016 load forecast, and any modifications determined by the various Load Serving Entities within MISO. The four PowerWorld models were:

- 2027 Summer Peak (2027S);
- 2027 Summer Peak 90/10 (2027S 90/10);
- 2027 Shoulder Peak (2027SH); and,
- 2027 Shoulder Peak West-to-East Bias (2027SH W-E Bias).

As part of the application, ATC evaluated the following alternatives: the proposed Cardinal-Hickory Creek project; a Non-Transmission Alternative (NTA); a Low-Voltage Alternative (LVA); and a No-Action alternative (NA) (referred as the “Base” case in my analysis). ATC modeled each alternative using all the four models.

**Q. Please explain the steady state reliability analysis performed by the applicants.**

**A.** ATC performed a steady state reliability analysis for each alternative using the planning event contingencies defined in NERC Standard TPL-001-4. I have included the copy of this standard as Ex.-PSC-Rohankar-2. In particular, NERC standard TPL-001-4 sets forth the requirements that transmission owners need to abide by to ensure that the bulk electric system continues to successfully operate in the event of failure of one or more transmission system elements.

ATC studied various No Load Loss Allowed (NLL) contingencies that focused on the Alliant Energy, Madison Gas and Electric Company, DPC, and ITC areas, but also included selected contingencies in MidAmerican Energy Company, Xcel Energy.
(Northern States Power Company-Wisconsin (NSPW) and Northern States Power Company-Minnesota), and Commonwealth Edison Company areas as well. The controlled Load Loss Allowed contingencies, specifically the events that would be categorized as NERC planning event category P3 and category P6 contingencies, focused on a smaller area within southwest and southcentral Wisconsin with 69 kV, 138 kV, 161 kV, and 345 kV transmission system elements.

The steady state reliability analysis monitored the thermal loading and bus voltages for ATC, DPC, ITC, and NSPW. The impacts of the studied planning event P1.1 contingencies within ATC were screened using the normal operation equipment ratings. The P1.1 contingencies external to ATC were studied using the emergency equipment ratings, consistent with all other P1-P7 contingencies. ATC used an alternating current (AC) power flow solution option for its planning analysis as a part of the application. In response to Commission staff’s various data requests, however, the analysis used a direct current (DC) power flow solution option. The DC contingency analysis is useful since it is much faster and provides a very good approximation of a large AC system.

Q. Discuss Commission staff’s initial review of the reliability analysis performed by the applicants.

A. ATC performed its reliability analysis using projected 2027 load models for all the alternatives considered. Upon receiving the models, Commission staff did verification runs as a part of the application completeness review process and was able to replicate the applicants’ power flow modeling results using the same set of assumptions used and as described by ATC. Commission staff used DC contingency analysis during its review of the proposed Cardinal-Hickory Creek project. Later, Commission staff requested that
ATC update their models to ensure that they accurately reflect the configuration of the current electric system. These updates are discussed in detail in Commission staff witness Daniel Grant’s direct testimony.

Q. Please describe the updated PowerWorld models submitted by the applicants.

A. The Commission’s determination that the application was incomplete also requested updates to the PowerWorld modeling. On September 25, 2018, ATC submitted updated modeling addressing Commission staff’s requests. As a part of the response, ATC made changes in two out of four models; 2027 S 90/10 and 2027 SH W-E Bias.

As a part of an additional data request, Commission staff requested further updates to the models to include the transmission work intended to be performed as a part of the preferred river crossing. On December 10, 2018, ATC updated these two models as a part of its response. I have performed my analysis using these two updated models.

Q. Please describe the additional PowerWorld models submitted by the applicants.

A. On February 11, 2019, as a part of the data request, Commission staff requested additional PowerWorld modeling, which evaluates the reliability analysis with the proposed Hill Valley Substation being electrically connected to, and located in the vicinity of, the existing Hillman Substation in the Platteville, Wisconsin area. On March 7, 2019, ATC provided the data request response.

As a part of the same data request, Commission staff also requested additional PowerWorld modeling, which evaluates the reliability analysis for the “NA” alternative and proposed Cardinal-Hickory Creek project, under zero and negative load growth.

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8 PSC REF#: 343192
9 PSC REF#: 350642.
10 Ex.-PSC-Data Request: Response 4.75, PSC REF#: 350157.
11 Ex.-PSC-Data Request: Response 4.75, PSC REF#: 354949.
12 PSC REF#: 359354
13 Ex.-PSC-Data Request: Response 8.2, PSC REF#: 360975
futures. On March 15, 2019, ATC provided the data request response.\textsuperscript{14} I have replicated these results as provided by the ATC. Commission staff witness Alexander Vedvik’s direct testimony discussed these results in detail.

**Commission Staff’s PowerWorld Modeling**

Q. **Describe Ex.-PSC-Rohankar-1.**

A. Ex.-PSC-Rohankar-1 summarizes the results of the steady state reliability analysis using updated 2027S 90/10 and 2027SH\_W-E Bias PowerWorld models. The exhibit compares the thermal loading of the monitored branches for different alternatives during various worst contingencies that could occur in the electric system. The branch flow is shown as a percentage of the applicable rating measured in amperes. The branch rating is shown in units of mega volt ampere (MVA) as a common convention. The different columns under “Branch Flow” represent different alternatives, as explained below:

1) **Base:** The “Base” case is the “NA” alternative, as discussed in the application. Under this alternative, no additional low or high voltage transmission lines are added to the system and is the alternative against which all other alternatives are compared to determine the reliability benefits of the proposed project.

2) **Base with Badger Hollow & Two Creeks solar:** The “Base with Badger Hollow & Two Creeks solar” alternative represents the “Base” case with two added solar projects.\textsuperscript{15} Two Creeks is a proposed 150 megawatt (MW) AC photovoltaic (PV) solar generating facility to be located in the town of Two Creeks and the city of Two Rivers, Manitowoc and Kewaunee Counties in

\textsuperscript{14} Ex.-PSC-Data Request: Response 8.5, PSC REF#: 361520
\textsuperscript{15} Solar is dispatched to 50 percent of the requested MW in all the models as per MISO MTEP 17 assumptions.
Wisconsin. Badger Hollow is a proposed 300 MW AC PV solar generating facility to be located in the southwestern Wisconsin near the villages of Montfort and Cobb in Iowa County. The Commission issued Final Decisions that approved the Certificate of Public Convenience and Necessity applications for these proposed solar projects in dockets 9696-CE-100\textsuperscript{16} and 9697-CE-100\textsuperscript{17} on April 18, 2019.

3) Base with asset renewal: The “Base with asset renewal” alternative represents the “Base” case with certain transmission lines upgraded to new ratings consistent with current transmission equipment standards. These transmission lines need to be renewed irrespective of the construction of the proposed Cardinal-Hickory Creek project. In Ex.-PSC-Data Request: Response 4.78,\textsuperscript{18} ATC provided the original in service date and expected remaining life of certain transmission lines. As stated in the response, the Turkey River-Stoneman 161 kV line (DPC portion) would require renewal in 2024, with remaining renewal (ITC portion) in 2028. Similarly, Townline Road-Bass Creek 138 kV line would require asset renewal in 2029, with line condition to be reviewed in 2024. In Ex.-PSC-Data Request: Response 9.4,\textsuperscript{19} ATC provided the original in service date and expected remaining life of Portage-Columbia 138 kV transmission circuits 1 and 2. As stated in the response, this line is proposed to be reconductored in 2027.

\textsuperscript{16} Application for a Certificate of Public Convenience and Necessity of Two Creeks Solar, LLC to Construct a Solar Electric Generation Facility, to be Located in Manitowoc and Kewaunee Counties, Wisconsin, filed 2018
\textsuperscript{17} Application for a Certificate of Public Convenience and Necessity of Badger Hollow Solar Farm, LLC to Construct a Solar Electric Generation Facility, to be Located in Iowa County, Wisconsin, filed 2018
\textsuperscript{18} PSC REF# 354949.
\textsuperscript{19} PSC REF# 364045.
Ex.-PSC-Rohankar-3 is an ATC 2019 10-Year Assessment preliminary needs presentation, dated February 28, 2019. On page 12 of that presentation, for 2029 peak model, ATC discussed that the possible mitigation for Stage Coach to West Middleton 69 kV line and Timberlane Tap to West Middleton 69 kV line overloads due to P13, P32 & P33 category contingency, is a rebuild of that line.

The “Base with asset renewal” alternative represents a “Base” case with all of above mentioned transmission lines upgraded to their new ratings. Following table lists the new ratings used in my analysis for this alternative:

<table>
<thead>
<tr>
<th>No.</th>
<th>Transmission Branch</th>
<th>Upgraded Rating (MVA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Turkey River-Stoneman 161 kV Stoneman-Nelson Dewey 161 kV</td>
<td>478/504</td>
</tr>
<tr>
<td>2</td>
<td>Townline-Bass Creek 138 kV</td>
<td>321/426</td>
</tr>
<tr>
<td>3</td>
<td>Portage B2-Columbia 138 kV Columbia-Portage 138 kV</td>
<td>321/426</td>
</tr>
<tr>
<td>4</td>
<td>West Middleton-Timberlane Tap 69 kV Timberlane Tap-Stagecoach 69 kV</td>
<td>146/201</td>
</tr>
</tbody>
</table>

In Ex.-PSC-Data Request: Response 4.77, ATC provided the new ratings for Turkey River-Stoneman-Nelson Dewey 161 kV line. For other transmission branches, the new ratings came from other existing 69 and 138 kV lines. For the Townline-Bass Creek and Columbia-Portage 138 kV lines, I used the ratings of existing Townline Road-Paddock 138 kV line. For West Middleton-Timberlane Tap-Stagecoach 69 kV line, I used the ratings of existing Richmond-KAT 69 kV line.

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20 PSC REF# 354949
21 ATC provided similar rating in case of rebuild of the Townline - Bass Creek 138 kV line as a part of avoided reliability projects & economic benefit analysis, PSC REF# 341714
Since the reliability analysis performed by ATC used the projected load models for 2027 and most of the transmission lines described in Table 1 would require upgrade before or in 2027, I included this alternative in my analysis to test whether any targeted build projects are available which would provide similar reliability benefits to those provided by the proposed Cardinal-Hickory Creek project.

4) Base with asset renewal with Badger Hollow & Two Creeks solar: As name suggests, the “Base with asset renewal with Badger Hollow & Two Creeks solar” represents “Base with asset renewal” alternative with added two solar projects as discussed earlier.

5) Cardinal-Hickory Creek with river crossing at Nelson Dewey: This alternative represents the proposed Cardinal-Hickory Creek project with transmission work intended to be performed as a part of preferred Mississippi River crossing at the Nelson Dewey location.

6) Cardinal-Hickory Creek with river crossing at Nelson Dewey with Badger Hollow & Two Creeks solar: This alternative represents the proposed Cardinal-Hickory Creek project with preferred river crossing with the two added solar projects discussed earlier. I have included this alternative to show the effect on the branch flows when both Cardinal-Hickory Creek project and additional solar units exist in the system.

7) Cardinal-Hickory Creek with river crossing at Stoneman: This alternative represents the proposed Cardinal-Hickory Creek project as described in the application. This alternative assumes the existing Mississippi River crossing at the Stoneman location.
Q. Please explain why you did not include the LVA and NTA in your analysis as performed by the applicants.

A. As a part of the application, ATC included the LVA and NTA in order to evaluate whether these alternatives could provide the same overall net benefits as the proposed Cardinal-Hickory Creek project. The LVA is a combination of a new 138 kV and 345 kV transmission lines assumed to follow the same general route as the Cardinal-Hickory Creek project. Unlike the proposed project, the LVA has not been approved for cost-sharing under MISO 2011 Multi-Value Project (MVP) portfolio. The NTA is a mix of local energy efficiency, demand response, residential solar facilities, and a utility-scale solar plant connected to the Nelson Dewey 138 kV substation. The NTA would not include a transmission connection between Iowa and Wisconsin and thus would not increase the transfer capability by nearly as much as the LVA or the proposed Cardinal-Hickory Creek project. Since the LVA does not qualify for the MVP treatment and NTA, as stated by the ATC, would not provide the overall net benefits as that of the proposed Cardinal-Hickory Creek project, preference was given to the NA alternative and the proposed Cardinal-Hickory Creek project for further analysis. Even though I did not include the LVA and NTA in my analysis, I have replicated the results as provided by the ATC.

Q. Please summarize the results of your PowerWorld analysis.

A. Ex.-PSC-Rohankar-1 summarizes the results of steady state reliability analysis for different alternatives. A summary of my analysis follows.

In the “Base” case, during different contingencies, branch flows are more than 95 percent; and in most cases, more than 100 percent of the applicable rating. The “Base with Badger Hollow & Two Creeks solar” alternative results in a reduction for most
contingencies, meaning those transmission lines are no longer overloaded. Flows under
“Base with Badger Hollow & Two Creeks solar” alternative compared to
“Cardinal-Hickory Creek with river crossing at Nelson Dewey” alternative are similar
during most of the contingencies with the exception of Turkey River–Stoneman–Nelson
Dewey 161 kV lines. The “N/A” in the results means “not applicable,” as the Turkey
River-Stoneman 161 kV branch is disconnected and a new Turkey River-Nelson Dewey
161 kV line with updated rating is inserted as a part of the preferred Mississippi River
crossing. For the Stoneman-Nelson Dewey 161 kV line, branch flows are negligible in
“Cardinal-Hickory Creek with river crossing at Nelson Dewey” alternative as compared
with other alternatives because of the change in transmission topography.

For “Base with asset renewal” alternative, overall, flows are much lower than any
other alternatives because of the upgraded MVA ratings of some of the transmission
lines. When proposed solar projects were included with asset renewal alternative, branch
flows are reduced further. I have added the two proposed solar projects in the “Cardinal-
Hickory Creek with river crossing at Nelson Dewey” alternative as well to see how
Cardinal-Hickory Creek would perform under these contingencies when additional solar
units exist in the system. The flows are similar in “Cardinal-Hickory Creek with river
crossing at Nelson Dewey” and “Cardinal-Hickory Creek with river crossing at Nelson
Dewey with Badger Hollow & Two Creeks solar” alternatives. The flows in
Cardinal-Hickory Creek alternatives are similar for most of the contingencies, as the only
change in the models are the transmission facilities immediately adjacent to the river. I
would note that in the 2027 S 90/10 model, certain monitored branches are still
overloaded during some of the worst contingencies even when proposed
Cardinal-Hickory Creek transmission line is present in the system.
The complete steady state reliability results with NLL, P2-P7, P3 and P6 category contingencies are included in Ex.-PSC-Rohankar-1, tables 1 through 8. The data under “Worst Contingency” column contains Critical Energy Infrastructure Information and is available for inspection at the Commission’s offices, subject to any and all confidentiality considerations.

Avoided Reliability Projects and Economic Benefits Analysis

Q. Did you review the avoided reliability projects and economic benefits analysis as described by the applicants?

A. Yes. For avoided reliability benefits calculation, ATC added cost estimates for projects that would be needed to eliminate the local reliability violations. These identified projects are needed to resolve system conditions for thermal overloads with NLL contingencies that could occur on the system. Additional overloads due to other NERC categories, such as P3, P6 and P2-P7 are not included in these calculations, as system adjustments can be made after the first contingency and before the second contingency. The economic benefit calculation includes conceptual projects needed to resolve three overloaded branches, namely; Turkey River-Stoneman 161 kV line, Stoneman-Nelson Dewey 161 kV line and Townline Road-Bass Creek 138 kV line.

Q. Do you have any comments about these overloaded branches involved in the avoided reliability benefits calculation?

A. Yes. From Ex.-PSC-Rohankar-1, Tables 1 and 2, it is clear that the proposed Cardinal-Hickory Creek project helps in relieving the NLL contingencies for these overloaded branches, however it is also clear that some of these contingencies can be relieved when the two proposed solar projects are present in the “Base” case.
Commission staff witness Mr. Vedvik discusses the avoided reliability projects and economic benefits analysis in detail in his direct testimony.

Q. **What do you conclude from your analysis?**

A. After reviewing various contingency analysis results, it is clear that the proposed Cardinal-Hickory Creek project would provide overall reliability benefits. However, my analysis also shows that the addition of more renewables (solar) in Wisconsin helps in improving the power flows on those monitored transmission branches. The “NA” alternative with two upcoming solar projects shows similar branch flows as the proposed Cardinal-Hickory Creek project for some of the monitored branches. The targeted build alternative, “Base with asset renewal” avoided all the overloads of the monitored branches by relieving some of the worst contingencies.

The results of any engineering model are only as good as the inputs considered by the modeler. I understand that my reliability analysis has its limitations; as it is impossible to anticipate and model each and every scenario. I also understand that the reliability analysis results could change as new electric generation comes online in the future within the Cardinal-Hickory Creek project study area. Since it is impossible to predict the future, the best one can do is to cover a range of alternatives when reviewing such complex project. As such, the intent of my analysis is to augment the applicants’ analysis, not replace it.

Q. **Does this conclude your direct testimony?**

A. Yes it does, however I reserve the right to file supplemental direct testimony if needed.