Public Service Commission of Wisconsin
Direct Testimony of Alexander Vedvik
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 Alexander J. Vedvik. I am employed as an electrical engineer in the Division of Energy Regulation at the Public Service Commission of Wisconsin (Commission), 4822 Madison Yards Way, North Tower – 6th floor, P.O. Box 7854, Madison, Wisconsin 53707-7854.

Q. Describe your educational background and experience.

A. I graduated in May 2014 with a Bachelor of Science degree in electrical engineering and economics with an emphasis in power systems from the University of Wisconsin-Madison. I joined the Commission full time in June 2014 as a transmission and generation engineer.

I have performed several analyses using the Electric Generation Expansion Analysis System (EGEAS) computer model since joining the Commission. My experience includes participating in Commission staff's collective efforts using EGEAS to evaluate cost and alternatives in docket 6680-CE-176,[1] and analysis of potential impacts of the previously-proposed U.S. Environmental Protection Agency Clean Power Plan on Wisconsin's electric utility sector. In addition, I evaluated the need and economics of the proposed joint acquisition of the Two Creeks and Badger Hollow solar

[1] *Application of Wisconsin Power and Light Company for a Certificate of Public Convenience and Necessity to Build an Approximately 650 Megawatt Natural Gas-Fueled Power Plant at its Riverside Energy Center Facility in the Town of Beloit, Rock County, Wisconsin*, 2016.

facilities in docket 5-BS-228.[2] Furthermore, I have used, and am continuing to use, the PowerWorld and PROMOD models to analyze need and alternatives for dockets involving new major transmission facilities, including: 5-CE-142,[3] 137-CE-166,[4] 137-CE-176,[5] 137-CE-185,[6] 137-CE-188,[7] and 5-CE-146.[8] I am also a voting member of the North American Electric Reliability Corporation (NERC) Standards Committee.

Q. What are your responsibilities in this docket?

A. I am the lead project engineer for this docket. My analysis primarily focuses on the joint applicants' justification for the proposed project. In particular, my review focuses on the overall aspects of the project including: the reliability, economic, and other benefits, the impact of potential transmission system changes on the proposed project, potential alternatives to the project as proposed that could be less costly, and the benefits and estimated cost for both Wisconsin and all Midcontinent Independent System Operator,

[2] *Joint Application of Madison Gas and Electric Company and Wisconsin Public Service Corporation for Approval to Acquire Ownership Interests in Solar Electric Generating Facilities.*

[3] *Joint Application of American Transmission Company LLC and Northern States Power Company-Wisconsin, as Electric Public Utilities, for Authority to Construct and Operate a New Badger-Coulee 345 kV Transmission Line from the La Crosse Area, in La Crosse County, to the Greater Madison Area in Dane County, Wisconsin*, 2015.

[4] *Application of American Transmission Company LLC, as an Electric Public Utility, for Authority to Construct and Place in Service Facilities for the Proposed North Appleton to Morgan (Bay Lake) Project, including Expanding the 345/138 kV North Appleton Substation Located in Outagamie County, Wisconsin; New 138 kV and 345 kV Transmission Lines from the Expanded North Appleton Substation to an Expanded Morgan Substation in Oconto County, Wisconsin; and Associated Substation Facilities in Brown, Kewaunee, Marinette, Oconto, Outagamie, Shawano, and Winnebago Counties, Wisconsin, and Dickinson County, Michigan*, 2015.

[5] *Application of American Transmission Company, as an Electric Public Utility, to Construct a New 345 kV Substation and Associated 345 kV Transmission Lines, and Relocate a Portion of an Existing 138 kV Transmission Line, in the Town of Franklin, Manitowoc County, Wisconsin*, 2015.

[6] *Pre-Application of American Transmission Company LLC as an Electric Public Utility for Authority to Construct and Place in Service a New, Double-Circuit 345 kV Transmission Line from an Existing ATC Transmission Line in the Village of Pleasant Prairie, Kenosha County, Wisconsin to a Proposed New Substation in the Village of Wadsworth, Illinois,* filed 2017, application withdrawn 2018.

[7] *Application of American Transmission Company LLC to Construct and Place in Operation a New 345/138 kV Substation in the Village of Mount Pleasant and 345 kV Transmission Lines to Interconnect with ATC's Existing 345 kV Transmission Network, and to Construct or Reconstruct Other Lines and Facilities in the Area, to be Located Primarily in Racine and Kenosha Counties, Wisconsin*, 2018.

[8] *Joint Application of American Transmission Company LLC, ITC Midwest LLC, and Dairyland Power Cooperative, for Authority to Construct and Operate a New 345 kV Transmission Line from the Existing Hickory Creek Substation in Dubuque County, Iowa, to the Existing Cardinal Substation in Dane County, Wisconsin, to be Known as the Cardinal-Hickory Creek Project,* filed 2018.

Inc. (MISO) transmission customers. I also was responsible for writing Chapter 3 of the Commission's Environmental Impact Statement (EIS).

Q. What are the purposes of your testimony?

A. The purposes of my testimony are as follows:

1. summarize the proposed project;
2. describe the applicants' methodology in determining the need for the proposed project;
3. discuss Commission staff's analysis of the energy cost savings associated with the proposed project, and the results of that analysis;
4. discuss considerations regarding the impact of changes in the transmission system on the economics of the proposed project;
5. discuss Commission staff's analysis of the applicants' stated reliability benefits of the proposed project;
6. discuss Commission staff's analysis of the applicants' stated avoided reliability benefits of the proposed project;
7. discuss Commission staff's analysis of the need for, and location of, the proposed Hill Valley Substation;
8. discuss Commission staff's analysis of the impact of the proposed project on the MISO wholesale energy market;
9. summarize Commission staff's analysis of the benefits and costs of the proposed project to Wisconsin transmission customers; and,
10. provide general observations and conclusions regarding the proposed project.

Q. Have you prepared any exhibits accompanying your testimony?

A. Yes, the following exhibits accompany my testimony:

Ex.-PSC-Vedvik-1 – Summary of gross and net benefits by sensitivity;

Ex.-PSC-Vedvik-2 – Summary of energy cost savings;

Ex.-PSC-Vedvik-3 – Asset Renewal and Avoided Reliability benefits analysis;

Ex.-PSC-Vedvik-4 – MISO market impacts of the proposed project, applicants' original modeling;

Ex.-PSC-Vedvik-5 – MISO market impacts of the proposed project, applicants' supplemental modeling in response to Public Service Commission of Wisconsin (PSC) Data Requests.

Q. Please briefly describe the proposed Cardinal-Hickory Creek project.

A. American Transmission Company LLC (ATC), ITC Midwest LLC (ITC), and Dairyland Power Cooperative (DPC) propose to construct a new 345 kilovolt (kV) transmission line from the existing Hickory Creek Substation in Dubuque County, IA to a new Hill Valley 345/138 kV Substation near the village of Montfort, Wisconsin to the existing Cardinal 345/138 kV Substation in the town of Middleton, Wisconsin. The proposed project was proposed as part of the MISO Multi-Value Project (MVP) portfolio and is being proposed in accordance with the MISO MVP Tariff, which was approved by the Federal Energy Regulatory Commission (FERC) in December 2010, and October 2011.

Q. What is the significance of a transmission project being designated as an MVP?

A. If a transmission project meets all of the standards as defined in the MVP Tariff, the Tariff provides for regional cost-sharing of the project across the MISO footprint. The costs associated with constructing the entire MVP portfolio are "postage-stamped" 100 percent to electricity users on a load-ratio share basis. The proposed

Cardinal-Hickory Creek project is a piece of the 17 MVP projects originally approved by the MISO Board of Directors on December 8, 2011.

Q. What are the requirements for a project to be designated as an MVP project?

A. The MVP Tariff requires that for a transmission project to be designated as an MVP, the project must provide substantial economic, reliability, and public policy benefits. In order to be eligible for regional cost-sharing, these benefits are more specifically defined as:

- Economic Benefits – An MVP must lower costs in the wholesale market by more than the cost of the project. This is generally achieved through lowering transmission system congestion. MISO uses an Adjusted Production Cost (APC) method of calculating the market impacts of a given transmission project. The applicants elected to use ATC's Customer Benefit Metric (CBM) methodology, which is based on various assumptions regarding Financial Transmission Rights within the ATC footprint to calculate the projected economic benefits of the proposed project. Direct-PSC-Grant provides more information regarding the differences between the two methodologies in calculating the projected economic benefits of the proposed project.
- Reliability Benefits – An MVP must resolve projected violations of NERC standards. Specifically, an MVP must resolve projected violations of transmission system planning performance requirements. My testimony and Direct-PSC-Rohankar provides more details regarding Commission staff's evaluation of the applicants' stated reliability benefits of the proposed project.
- Public Policy Benefits – The general concept of the MVP Portfolio arose from various initiatives and studies designed to facilitate additional wind generation development in the upper Midwest. The Upper Midwest Transmission Development Initiative (UMTDI) and the Regional Generation Outlet Study (RGOS) identified a list of projects that would be

incorporated into the MVP portfolio. The main public policy objective of these studies and the MVP portfolio was to facilitate the reliable delivery of renewable energy in accordance with state renewable portfolio standards (RPS).

Applicants' Methodology of Calculating the Net Benefits of the Proposed Cardinal Hickory Creek Project

Q. How did the applicants calculate the net benefit/cost of the proposed project to Wisconsin customers?

A. The applicants state that the following formula was used to estimate the potential benefits to Wisconsin transmission customers associated with the proposed project:

$$Net\ Benefit\ (Cost) = \left(\begin{array}{c} \textbf{\textit{GREATER OF}}: \\ Energy\ Cost\ Savings + \\ Insurance\ Value \\ \textbf{\textit{OR}} \\ Avoided\ Reliability\ Benefits + \\ Asset\ Renewal\ Benefits \end{array} \right) + \begin{array}{c} Capacity\ Loss \\ Savings \end{array} - \begin{array}{c} Costs\ to \\ WI\ Customers \end{array}$$

Each of the terms listed in the formula are described in more detail below. Commission staff's review of the economics of the proposed project evaluated the modeling and assumptions used to develop each of the major terms in the formula above. The terms with the most significant impacts on the net benefit formula are the: energy cost savings, the avoided reliability benefits, and the asset renewal benefits. Commission staff's analysis of each of these three terms is discussed in more detail below.

Commission Staff's Review of Applicants' Reported Energy Cost Savings of the Proposed Cardinal Hickory Creek Project

Q. Please summarize the energy cost savings of the proposed project.

A. For the majority of the futures studied by the applicants, the projected energy cost savings element of the proposed Cardinal Hickory Creek project has the largest impact in the formula used to calculate the net economic impact of the proposed project. The

applicants assert that the proposed project would enhance the regional energy market because energy from different generators can travel to different load points with less transmission system congestion, which would then lower wholesale energy market prices.

Q. How did the applicants estimate the energy cost savings associated with each alternative?

A. The applicants' used the PROMOD model to evaluate each studied alternative as compared to the No-Action Alternative. This No-Action Alternative effectively served as a reference case. The applicants' used ATC's CBM method of evaluating the market impacts to ATC customers and MISO's APC methodology of evaluating the market impacts of transmission projects to DPC and Northern States Power Company-Wisconsin (NSPW) customers, instead of using the APC method for all Wisconsin transmission customers. As Mr. Grant's direct testimony in this docket shows, the CBM method is heavily impacted by assumptions about hedging in the Financial Transmission Rights market (FTR). There is not a one-for-one relationship between the amount of transmission system congestion that is hedged by ATC's customers and the actual amount of congestion that exists, and thus may not impact the actual wholesale energy market benefits a project potentially achieves. As evidence, the APC method used by MISO does not use assumptions about the FTR market as a major assumption in calculating the potential benefits of the transmission project. The APC method generally evaluates the overall net wholesale market impacts of a project, which would incorporate the impact of reducing transmission system congestion. The CBM methodology results in higher calculated energy cost savings for the proposed Cardinal Hickory Creek project than the APC methodology in nine of the eleven scenarios evaluated by Commission

staff. More about Commission staff's review of the applicants' stated energy cost savings of the proposed project, including details about the CBM and APC methods of calculating potential benefits of transmission projects, can be found in Commission staff witness Mr. Grant's direct testimony.

The applicants used the PROMOD model to evaluate the proposed project, the Low-Voltage Alternative, and the Non-Transmission Alternative, as compared to the No-Action Alternative, for years 2021, 2026, and 2031. The applicants then took the difference in energy cost savings using the CBM method for each of these years, and used a discounted cash-flow model to calculate the 40-year projected gross benefit of each alternative. The applicants interpolated the results between the years PROMOD was used, and then extrapolated the year 2031 results with inflation until the end of the expected 40-year useful life of the project in year 2063. The applicants applied a nominal 6.4 percent discount rate and assumed a 2.5 percent inflation rate for the discounted cash-flow model assumptions.

Q. What do the results of Commission staff's analysis of the energy cost savings of the proposed project indicate?

A. Ex.-PSC-Grant-4 shows the gross present energy cost savings benefits over a range of potential futures, using both the CBM and APC methodologies. In addition, Ex.-PSC-Vedvik-2 shows these results using both a 6.4 percent nominal discount rate and an 8.41 percent nominal discount rate in the discounted cash flow model.

Using a 6.4 percent nominal discount rate, the modeling in Ex.-PSC-Vedvik-2 using the CBM methodology of assessing benefits shows the proposed project is expected to have gross present value energy cost savings of $41.3 million for the applicants'

updated Existing Fleet future to $405.3 million for the applicants' updated Accelerated Alternative Technology future. When the Badger Hollow and Two Creeks solar farms and the proposed Red Barn wind farm are included in the applicants' updated Policy Regulations future PROMOD modeling, the proposed project is projected to have $61.3 million in gross present value energy cost savings. The applicants state in the application[9] that they "agree with the stakeholder vote that the PR future is the most likely of the three futures to occur."

Using a nominal 6.4 percent discount rate, the modeling in Ex.-PSC-Vedvik-2 using the APC methodology of assessing benefits shows that the proposed project is expected to have gross present value energy cost savings of negative $23.4 million for the applicants' updated Existing Fleet future to positive $375.8 million for the applicants' updated Accelerated Alternative Technology future. When the Commission-approved Badger Hollow and Two Creeks solar farms and the proposed Red Barn wind farm are included in the applicants' updated Policy Regulations future PROMOD modeling, the proposed project is projected to have $21.6 million in gross present value energy cost savings.

Q. Did modeling zero or negative load growth impact the energy cost savings associated with the proposed project?

A. Based on Ex.-PSC-Data Request: Response 8.4,[10] and the results of the sensitivity of the Policy Regulations future with 10 percent load reduction performed by Commission staff, the PROMOD modeling does not show that assuming negative net load growth, by itself, significantly impacts the energy cost savings associated with the proposed project.

[9] Ex.-Applicants-Application, p.43, PSC REF#: 352698
[10] PSC REF#: 361510, PSC REF#: 361515

Q. Why did the applicants use a nominal discount rate of 6.4 percent for assessing the economics of the proposed project?

A. The applicants stated in Ex.-PSC-Data Request: Response 1.181[11] that "the FERC interest rate of 6.4 percent was used as a long-term estimate of the interest rate used by the FERC to compensate utility customers in refund situations." In addition, the applicants stated in their response that the "ATC weighted cost of capital was not selected because it is solely the prevailing rate needed to attract capital for the project." However, for the second quarter of 2019, the FERC published interest rate for electric refunds is 5.45 percent.

Q. Could using ATC's weighted average cost of capital for a nominal discount rate be more appropriate than using the assumed nominal discount rate?

A. Possibly, yes. I question how the FERC interest rate described in Ex.-PSC-Data Request: Response 1.181 is related to the amount of risk transmission service customers face when evaluating the economics of a new transmission project. The applicants state in Ex.-PSC-Data Request: Response 1.169[12] that they assume a weighted cost of capital of 8.41 percent, which could better reflect the actual cost transmission customers are paying for the proposed project, and could be more representative of the risk to Wisconsin transmission service customers associated with the proposed project. Using a higher discount rate would lower both the present value calculations of future year benefits and costs associated with constructing the proposed Cardinal Hickory Creek project. A discount rate of 8.41 percent, as opposed to the 6.4 percent assumed by the applicants,

[11] PSC REF#: 346685
[12] PSC REF#: 347516.

results in more of the scenarios evaluated by Commission staff showing negative net benefits associated with the proposed Cardinal Hickory Creek project.

Commission staff's Review of Applicants' Stated Avoided Reliability Benefits of the Proposed Cardinal Hickory Creek Project

Q. Please summarize the avoided reliability benefit of the proposed project, as described by the applicants.

A. All transmission owners are required to maintain a reliable transmission system, as defined by Bulk Electric System standard promulgated by NERC. In particular, NERC Standard TPL-001-4[13] stipulates the transmission system planning performance requirements all transmission owners must account for as part of transmission planning. The applicants assert that the proposed Cardinal-Hickory Creek project alleviates projected overloads on existing transmission lines in the project study area. To assess the impact of the proposed project on transmission system reliability, the applicants used the Power System Simulator for Engineering (PSS®E) model to calculate power flows in Wisconsin, with and without the proposed project. The applicants describe the avoided reliability benefit of the proposed project to be the present value cost estimate of conceptual projects that would be needed absent construction of the proposed project to eliminate projected local reliability violations. The applicants included a rebuild of the existing Townline Road–Bass Creek 138 kV transmission line, and a conceptual Hickory Creek–Nelson Dewey 345 kV transmission line, as part of the avoided reliability benefit calculation for the proposed project.

Q. Please explain the methodology used to calculate the avoided reliability benefit of each alternative evaluated by the applicants.

[13] Ex.-PSC-Rohankar-3.

A. To calculate the avoided reliability benefit of each alternative, the applicants compared the capital improvements that are projected to be needed to maintain compliance with NERC Standard TPL-001-4[14] under the No-Action alternative to the capital improvements that are projected to be needed under each of the other alternatives. As described by the applicants' Ex.-PSC-Data Request: Response 1.188,[15] the direct upgrade is assumed to have an in-service date of the year 2024, to match the in-service date of the proposed Cardinal-Hickory Creek project. The 2018 projected capital cost of each project is inflated at 2.5 percent per year from 2018 to the in-service date, then discounted back to the year 2018 using a nominal discount rate of 6.4 percent. Then the applicants' calculated avoided reliability benefit is determined by multiplying the present value of the capital cost by a 15 percent adder in order to approximate the overall revenue requirement of each project.

The applicants state that the present value of avoided reliability benefits of the proposed Cardinal-Hickory Creek project is $42.2 million. Table 2.1-8 of the application identifies the two specific conceptual projects that comprise the avoided reliability benefits of the proposed project. The two projects are a new Hickory Creek–Nelson Dewey 345 kV transmission line, which is designed to alleviate the projected Turkey River–Stoneman 161 kV overload and the projected Stoneman–Nelson Dewey 161 kV overload, and a rebuild of the existing Townline Road–Bass Creek 138 kV transmission line.

Q. Describe Commission staff's analysis of the applicants' stated avoided reliability benefits of the proposed project.

[14] Ex.-PSC-Rohankar-3.
[15] PSC REF#: 347526.

A. Commission staff witness Ajinkya Rohankar's direct testimony describes in detail the process used to evaluate the avoided reliability benefits of the proposed project. In general, staff used the PowerWorld model, which is another utility industry standard tool for evaluating power flows, and is comparable to the PSS®E model used by the applicants. Mr. Rohankar's power flow analysis evaluated the transmission system using the transmission planning criteria described in the NERC Transmission System Planning Performance Requirements,[16] which is the same criteria used by the applicants to evaluate the reliability benefits of the proposed Cardinal-Hickory Creek project. Mr. Rohankar has included a copy of this standard as Ex.-PSC-Rohankar-2.

The applicants calculated the avoided reliability benefit of the proposed Cardinal-Hickory Creek project as compared to a "No-Action Alternative," using year 2027 forecasted transmission system topology and demands. The No-Action Alternative is regarded as a base case by the applicants and effectively assumes that no additional re-builds would occur between now and year 2027, and does not consider potential re-builds or uprates of transmission system facilities that would require asset renewal due to age or condition. As discussed in Mr. Rohankar's direct testimony and here, the main transmission elements that are projected to experience overloads in the 2027 power flow models without the proposed Cardinal-Hickory Creek project are old and would be assumed to require asset renewal due to age or condition by year 2030. As such, Commission staff edited the applicants' submitted base case to reflect projected uprates to constrained transmission elements in the project study area that would require asset renewal due to age and condition by the year 2030, regardless of whether the proposed

[16] NERC Standard TPL-001-4.

Cardinal-Hickory Creek project is operational. Commission staff's edits to the applicants' No-Action Alternative is described in more detail below and in Mr. Rohankar's direct testimony and in Ex.-PSC-Rohankar-3, and is referred to as the "base with asset renewal" alternative.

Q. Describe Commission staff's methodology in creating the base with asset renewal alternative.

A. The application identifies three projected transmission line overloads that are specifically resolved by the proposed project, using NERC and ATC transmission planning criteria. These elements are: the existing Turkey River-Stoneman 161 kV transmission line; the existing Stoneman–Nelson Dewey 161 kV transmission line; and, the existing Townline Road–Bass Creek 138 kV transmission line. However, Ex.-PSC-Data Request: Response 4.78[17] states that these transmission lines are older. The Turkey River–Stoneman 161 kV transmission line was originally placed in-service in 1949 and is projected to require asset renewal by year 2024, the Stoneman–Nelson Dewey 161 kV transmission line was originally placed in-service in 1955 and is projected to require asset renewal by year 2030, and the Townline Road–Bass Creek 138 kV transmission line was originally placed in-service in 1952 and is projected to require asset renewal by year 2029. As part of the Commission staff's comparison between the reliability implications of a base or no-action alternative and the proposed project, it is reasonable to project what actions a transmission operator might take to address the reliability issues in the absence of the proposed project.

[17] PSC REF#: 354949

Q. What do the results of the reliability analysis show the effect of targeted asset renewal have on the reliability benefits?

Ex.-PSC-Data Request: Response 4.77[18] states that the proposed new 161 kV transmission line across the Mississippi River, identified as the Turkey River–Nelson Dewey 161 kV transmission line, would have a summer emergency megavolt-ampere (MVA) rating of 504 MVA. The existing Turkey River–Stoneman 161 kV transmission line has a summer emergency rating of 248 MVA. The new 161 kV circuit is being proposed as part of the proposed project, and is electrically separate from the new 345 kV transmission circuit also being proposed as part of the project. If the proposed Cardinal-Hickory Creek project is not built, it is reasonable to project that the Turkey River-Stoneman 161 kV transmission line and the Stoneman–Nelson Dewey 161 kV transmission line would be rebuilt in the timeframe identified by the applicants. A rebuilt Turkey River–Stoneman 161 kV transmission line and a rebuilt Stoneman–Nelson Dewey 161 kV transmission line could have the same MVA rating as the new 161 kV transmission circuit that is being proposed by the applicants. Rebuilding these circuits with the higher MVA rating would more than double the capacity of the existing river crossing and alleviate the projected overloads and NERC planning violations across these lines. Under such a scenario, the need for a new 345 kV Hickory Creek–Nelson Dewey transmission line as a solution to alleviate the projected overloads on the existing Turkey River–Stoneman 161 kV and Stoneman–Nelson Dewey 161 kV transmission lines would be greatly diminished.

[18] PSC REF#: 354949

The present value avoided reliability benefit of the proposed Cardinal-Hickory Creek project was calculated by the applicants to be $42.2 million due to significant cost associated with the need to construct a new 345 kV Hickory Creek–Nelson Dewey transmission line if the proposed project is not approved. However, the existing Turkey River–Stoneman 161 kV transmission line would require asset renewal around the projected in-service date for the proposed project,[19] and the capacity of this rebuilt 161 kV Mississippi River crossing would be doubled from 248 MVA to 504 MVA. As the existing Turkey River–Stoneman 161 kV transmission line would require asset renewal with or without the proposed Cardinal-Hickory Creek project, it appears the proposed project does not create an avoided reliability benefit for this transmission line, because rebuilding the Turkey River–Stoneman 161 kV transmission line as part of maintaining the system in year 2024 negates the need for a new 345 kV transmission line to alleviate a projected overload of this line. Ex.-PSC-Data Request: Response 4.78[20] shows the present value asset renewal cost for the Turkey River–Stoneman 161 kV transmission line would be $4.6 million. The existing Stoneman–Nelson Dewey 161 kV transmission line would also require asset renewal shortly after the projected in-service date of the proposed project, by the year 2030, regardless of whether the proposed Cardinal-Hickory Creek project would be constructed or which Mississippi River crossing is selected. Ex.-PSC-Data Request: Response 4.78 shows the nominal asset renewal cost of rebuilding the Stoneman – Nelson Dewey 161 kV transmission line in 2030 is $2.7 million, and Ex.-PSC-Vedvik-3 shows the present value asset renewal cost of

[19] The projected in-service date of the proposed Cardinal Hickory Creek project is 12/31/2023 and the existing Turkey River – Stoneman 161 kV transmission line would require asset renewal by year 2024.
[20] PSC REF#: 354949.

rebuilding this line in 2030 is $1.72 million. If a rebuild of this transmission line were to be performed in 2027, this would have a present value asset renewal cost of $1.93 million, a difference of $235,141 as compared to continuing to operate the Stoneman-Nelson Dewey 161 kV transmission line until 2030, the end of its projected useful life. A rebuild of the existing river crossing and the existing Stoneman–Nelson Dewey 161 kV transmission line, would provide similar reliability benefits in the Cassville, Wisconsin area as either the conceptual Hickory Creek–Nelson Dewey 345 kV project, or the proposed Cardinal-Hickory Creek project. The total present value asset renewal cost of rebuilding the Turkey River–Stoneman and Stoneman–Nelson Dewey 161 kV transmission lines is $6.6 million. However, ATC would only incur an anticipated $235,141 present value rebuild costs as a premium to address projected overloads of the existing Turkey River–Stoneman and Stoneman–Nelson Dewey 161 kV transmission lines in 2027 as the lines need to be rebuilt in the near future, regardless of whether the proposed Cardinal-Hickory Creek project is constructed.

The other projected transmission line overload that was identified by the applicants' year 2027 power flow models as being resolved by the proposed Cardinal-Hickory Creek project is the existing Townline Road–Bass Creek 138 kV transmission line. The application states the present value avoided reliability benefit of the proposed project in regards to the Townline Road–Bass Creek 138 kV line is $10.3 million. However, Ex.-PSC-Data Request: Response 4.78 also states this existing transmission line would require asset renewal by the year 2029. According to applicants' models, the projected overloads on the Townline Road–Bass Creek 138 kV transmission line occur only two years before the end of the line's projected useful life. A rebuild of

this transmission line would be expected to increase the emergency rating of 161 MVA to 335 MVA, given the existing terminal equipment were not to be replaced. The Townline Road–Bass Creek 138 kV transmission line would require asset renewal regardless of whether the proposed Cardinal-Hickory Creek project were constructed. Thus, I would conclude the avoided reliability benefit of the proposed project, in regards to the Townline Road – Bass Creek transmission line, is effectively the present value of not requiring asset renewal of the line two years before the end of its expected useful life. The present value asset renewal cost of rebuilding the Townline Road–Bass Creek transmission line in year 2029 is $7.43 million,[21] and the present value asset renewal cost of rebuilding the line in year 2027 is $8.0 million. This represents an approximate $570,000 net present value difference in rebuilding the Townline Road–Bass Creek 138 kV transmission line in year 2027 as compared to rebuilding the line at the end of its projected useful life in year 2029.

Q. Given the age of the transmission assets that are projected to be overloaded without the proposed Cardinal-Hickory Creek project, what do you calculate the avoided reliability benefit of the proposed project to be?

A. As stated previously, the three major constraints that are projected to be resolved by the proposed project would need to be reconstructed by 2030 due to age and condition. I calculated the difference between the present value asset renewal cost of rebuilding these constrained lines by their projected required asset renewal in-service date and the present value asset renewal cost of rebuilding these constrained lines by 2027, the year in which the reliability needs are identified. Under this analysis, the present value avoided

[21] Ex.-PSC-Data Request: Response 4.78, PSC REF#: 354949.

reliability benefit of the proposed Cardinal-Hickory Creek project would be $897,474 using the applicants' discounted cash flow model assumptions. This calculation is included in Ex.-PSC-Vedvik-3.

Q. How would the base with asset renewal alternative perform at interconnecting the Commission-approved Badger Hollow and Two Creeks solar farms, to be located near Cobb, Wisconsin and Two Creeks, Wisconsin, respectively?

A. Mr. Rohankar evaluated the integration of the Badger Hollow and Two Creeks facilities in the Summer Peak 90/10 and Shoulder West to East bias scenarios using the transmission planning criteria stipulated in the NERC TPL-001-4 standard for the applicants' No-Action Alternative, the proposed Cardinal-Hickory Creek alternative, and Commission staff's base with asset renewal alternative. The inclusion of these solar facilities greatly reduces the power flows across the existing Turkey River–Stoneman and Stoneman–Nelson Dewey 161 kV transmission lines, even in the applicants' No-Action Alternative. The inclusion of these solar facilities in the PowerWorld modeling shows lower power flows across the constrained transmission system assets in the project study area for the base with asset renewal alternative, as compared to the proposed Cardinal-Hickory Creek project alternative. Thus, I would conclude that the base with asset renewal alternative also boosts the ability of the transmission system in southwestern Wisconsin to integrate additional new renewable generation in Wisconsin in a similar manner as the proposed Cardinal-Hickory Creek project.

Commission staff's Review of Applicants' Stated Asset Renewal Benefits of the Proposed Cardinal Hickory Creek Project

Q. Please summarize the asset renewal benefit of the proposed project, as described by the applicants.

A. The applicants state that construction of the proposed Cardinal-Hickory Creek project would involve the replacement of various existing transmission system elements along the route chosen by the Commission. The applicants assert that the rebuilt transmission lines along the project route would need to be replaced at some point during the 40-year expected life of the proposed project. The asset renewal benefit of the proposed Cardinal-Hickory Creek project is the applicants' calculated benefit to Wisconsin customers of avoiding the cost of rebuilding these components in the future by instead including the rebuild as part of constructing the proposed project. The applicants estimate the asset renewal benefit of the proposed Cardinal-Hickory Creek project to be $45 million.

Q. Explain the methodology used by the applicants to calculate the asset renewal benefit of the proposed project.

A. The applicants, based on an estimation of remaining useful asset life, expect each of the existing transmission lines that follow the applicants' preferred route to require asset renewal before the end of the proposed Cardinal-Hickory Creek project's expected 40-year life. The applicants state that Wisconsin customers benefit by avoiding the cost of rebuilding each of these transmission system assets in the future and by instead including the asset renewal of some of these transmission system assets as part of constructing the proposed Cardinal-Hickory Creek project.

The description of the applicants' methodology is described in the application and in the response to Ex.-PSC-Data Request: Response 1.189.[22]

[22] PSC REF#: 347526.

Q. How did Commission staff evaluate the applicants' methodology in calculating the asset renewal benefit of the proposed Cardinal-Hickory Creek project?

A. In calculating the asset renewal benefit for each transmission system element that would be rebuilt as part of the proposed project, the applicants effectively assumed that rebuilding each of the lines would benefit Wisconsin customers for the full value for the expected useful life of each rebuilt transmission line. However, the early asset renewal of these transmission lines would effectively sacrifice the remaining useful life of these assets to Wisconsin customers. The concept of reconstructing these assets early, before the end of the expected life, is also known in the industry as stranded assets. Essentially, from an economic perspective, the early asset renewal associated with construction of the proposed Cardinal-Hickory Creek project, only provides additional asset renewal "benefit" to Wisconsin customers equal to the amount of useful life in the assets that has already been used in serving Wisconsin transmission customers.

An example of this phenomenon is the rebuild that is proposed to be completed as part of the proposed Cardinal-Hickory Creek project of the existing Eden–Dodgeville 69 kV (Y-138) transmission line. The Y-138 transmission line is not projected to require asset renewal until year 2055, yet the applicants are proposing to rebuild the transmission line as part of the proposed Cardinal-Hickory Creek project in year 2023. A rebuild of this line in 2023 would effectively "strand," 32 years of its expected useful life to Wisconsin customers. As the Y-138 transmission line was originally constructed in year 1977, I estimate the true asset renewal benefit of the proposed Cardinal-Hickory Creek project is only ~59 percent of the applicants' calculated asset renewal benefit of renewing the Y-138 transmission line as part of constructing the proposed Cardinal-Hickory Creek

project. This is because a renewal of this line in 2023 would only be renewing 46 years of the Y-138 transmission line's 78 year expected useful life, assuming the depreciable life of the line remains the same.

This methodology of calculating the asset renewal benefit of the proposed Cardinal-Hickory Creek project to Wisconsin transmission customers results in a present value asset renewal benefit of $36.95 million, as compared to the applicants' calculated present value asset renewal benefit of $45.0 million, if the applicants' preferred route is selected. A summary of this calculation is included in Ex.-PSC-Vedvik-3.

Commission Staff's Review of the Need for, and Location of, the Proposed Hill Valley Substation as a Portion of the Proposed Cardinal-Hickory Creek Project

Q. Provide any background history of the proposed Hill Valley Substation.

A. An intermediate 345/138 kV substation was originally proposed in the UMTDI final report to be located in the Spring Green, Wisconsin area. A substation in the Spring Green, Wisconsin area was also included as part of the MVP portfolio. In the development phase of the proposed project, the applicants stated that a decision was made to site the proposed Hill Valley Substation in the Montfort, Wisconsin area in order to avoid the need to cross the Wisconsin River.

Q. What is the applicants' stated need for the proposed Hill Valley Substation?

A. The applicants assert in Ex.-PSC-Data Request: Response 2.16[23] that:

> "Hill Valley Substation provides a connection from the 345 kV system into the 138 kV system in southwest Wisconsin. This connection will provide an additional path for power into southwest Wisconsin during outages … when the load is at summer peak. This connection will also provide an additional path for power out of southwest Wisconsin if current local generator interconnection requests are completed and constructed."

[23] PSC REF#: 348967

The applicants further included a comparison of significant thermal loading results for the proposed Cardinal-Hickory Creek project with and without the Hill Valley Substation. This comparison showed higher thermal loadings at summer peak times, but no NERC planning event violations, on each of these four existing transmission system elements:

- the Turkey River – Stoneman 161 kV transmission line;
- the Stoneman – Nelson Dewey 161 kV transmission line;
- the Townline Road – Bass Creek 138 kV transmission line; and,
- the Albany Tap – Bass Creek 138 kV transmission line.

Q. Do you have any observations regarding the applicants' stated need for the proposed Hill Valley Substation?

A. Yes. I would reference Ex.-PSC-Data Request: Response 4.78,[24] which lists the projected asset renewal in-service dates of certain existing transmission system elements. Each of the near overloads on existing transmission system assets that the proposed Hill Valley Substation is purported to resolve will require asset renewal by the year 2029. In addition, if the applicants' preferred Mississippi River crossing (the Nelson Dewey crossing) is selected, the Turkey River–Stoneman 161 kV transmission line would no longer exist. Also, the electrical configuration of the preferred Mississippi River crossing would alleviate any potential overloads on the existing Stoneman–Nelson Dewey 161 kV transmission line.[25] Thus, the proposed Hill Valley Substation would only reduce year 2027 summer peak thermal loadings on the existing Townline Road–Bass Creek and Albany Tap–Bass Creek 138 kV transmission lines. As both of these lines are projected

[24] PSC REF#: 354949

[25] This constraint would be resolved due to the fact that the Stoneman – Nelson Dewey 161 kV transmission line would no longer be a bottleneck. If the proposed Cardinal-Hickory Creek project is accepted by the Commission, and the applicants' preferred Mississippi River crossing at Nelson Dewey is also selected, then the existing Stoneman – Nelson Dewey 161 kV transmission would effectively become a radial transmission line on the 161 kV transmission system.

to be reconstructed in year 2029 with a higher MVA rating (more than double),[26] the year 2027 summer peak PowerWorld modeling supplied by the applicants does not suggest that the proposed Hill Valley Substation would provide additional thermal loading reliability benefit for the existing transmission system in the project area.

Q. Does the need for the proposed Hill Valley Substation have any impact on the proposed Cardinal-Hickory Creek project as a whole?

A. Yes. The need for, and the decision of where to site the proposed Hill Valley Substation, affects the routing of the proposed Cardinal-Hickory Creek project. The applicants have stated there is a reliability need for the proposed Hill Valley Substation.[27] However, the PowerWorld modeling supplied by the applicants does not show that the Hill Valley substation provides additional thermal loading reliability benefits. The decision to site the Hill Valley substation in Montfort also influenced the selection of the project area for study. [28]

Q. Are there any other locations where the applicants considered siting the proposed Hill Valley Substation in southwestern Wisconsin?

A. Ex.-PSC-Data Request: Response 4.73[29] stated that ATC considered siting the intermediate substation adjacent to: the Dodgeville 69 kV Substation; the Darlington 138 kV Substation; or, the Eden 138/69 kV Substation. The applicants provided various reasons as to why the Montfort, Wisconsin area was selected as the best available option

[26] The application states the Townline Road – Bass Creek 138 kV transmission line would be uprated to a summer emergency rating of 335 MVA, from the existing line rating of 161 MVA. One could assume that the Albany Tap-Bass Creek 138 kV transmission line would be uprated to the same MVA rating after asset renewal.
[27] Ex.-PSC-Data Request: Response 2.16, PSC REF#: 348967 and Ex.-PSC-Data Request: Response 2.17, PSC REF#: 348967 and Ex.-PSC-Data Request: Response 4.75, PSC REF#: 354949, "the Hill Valley Substation is a necessary component of the proposed project and it is therefore included in all updated models."
[28] Ex.-PSC-Data Request: Response 4.74, PSC REF#: 360184 and Ex.-PSC-Data Request: Response 4.73, PSC REF#: 354949.
[29] PSC REF#: 354949.

of these three locations for siting the intermediate substation, namely that locating the substation near Dodgeville or Darlington would be more expensive due to the need to construct additional transmission lines in Dodgeville, and the fact that Darlington would require an extensive amount of additional 345 kV transmission line construction. Ex.-PSC-Data Request: Response 8.1[30] stated that another potential site adjacent to the existing Hillman 138/69 kV Substation in Platteville, Wisconsin area was excluded from consideration. However, given the apparent lack of electrical constraints, a location like Platteville would potentially avoid transmission routing challenges created by the topography of the proposed route alternatives and may impact project costs.

Q. If the proposed Hill Valley Substation were to be located in the Platteville, Wisconsin area, as opposed to the Montfort, Wisconsin area, how could this impact the general routing of the proposed Cardinal-Hickory Creek project and its cost?

A. Locating the intermediate substation in the Platteville, Wisconsin area would enable additional routing options for the 345 kV transmission line from the proposed Hill Valley Substation to the Cardinal Substation. One route for study that is electrically viable could include the U.S. Highway 151 corridor from Platteville, Wisconsin to Dodgeville, Wisconsin. For purposes of assessing whether the location of the Hill Valley substation could have a meaningful impact on the proposed project's costs, I assumed a hypothetical route that would follow the applicants' alternative route from Cassville, Wisconsin to a new Hill Valley Substation located near Platteville, Wisconsin, then follow the U.S. Highway 151 corridor from Platteville, Wisconsin to Dodgeville, Wisconsin, and then follow the applicants' preferred route along the U.S. Highway 151 corridor from there on.

[30] PSC REF#: 360184.

Ex.-PSC-Data Request: Response 8.3[31] states that this route would add approximately 5.5 miles of 345 kV transmission line, as compared to the applicants' preferred route. The applicants' applied an approximately $3.6 million/mile cost to calculate the cost of this route to be $19.8 million more than the preferred route. However, the applicants have pointed out that as the project is eligible for MVP cost sharing, this $19.8 million increase in capital cost would cost Wisconsin transmission network customers approximately $2 million on a net present value basis. The applicants' alternative route is approximately $51 million more than the applicants' preferred route.

Q. Would siting the proposed Hill Valley Substation adjacent to, and electrically connected to, the existing Hillman 138 kV Substation in the Platteville, Wisconsin area, impact the performance of the proposed Cardinal-Hickory Creek project?

A. No. Ex.-PSC-Data Request: Response 8.2[32] provided PowerWorld modeling of the proposed Cardinal-Hickory Creek project, with the proposed Hill Valley Substation located adjacent to the Hillman 138/69 kV Substation. The applicants' response also states that "changing the intermediate substation location from Montfort to Platteville would not impact the avoided reliability benefits included in the joint application." In summary, siting the proposed Hill Valley Substation adjacent to the Hillman 138/69 kV Substation would not impact the performance or general electrical characteristics of the proposed Cardinal-Hickory Creek project.

[31] PSC REF#: 360184
[32] PSC REF#: 360975

Economic Impact of the Proposed Cardinal Hickory Creek Project on the Whole MISO Market

Q. When developing the MVP portfolio, did MISO evaluate any of the projects in the MVP portfolio individually using the criteria stipulated in the MVP Tariff?

A. No. The applicants have asserted that MISO only evaluates MVPs on a portfolio basis. Neither MISO nor the applicants have evaluated any of the projects approved as part of the MVP portfolio individually, including the proposed Cardinal-Hickory Creek project.

Q. Does the MVP portfolio development process have any effect on the economics associated with the proposed Cardinal Hickory Creek project?

A. Yes. A major driver of the economics of the proposed Cardinal Hickory Creek project is the cost sharing mechanism associated with the MVP tariff, as the proposed project's total costs and total benefits were not evaluated by MISO or the applicants. While it may be useful to evaluate a portfolio of projects as a whole, this alone cannot determine whether one or more projects that are included in the portfolio would have negative net benefits to the MISO market. Economic impacts in the MISO market can impact transmission service revenue requirements that are passed on to Wisconsin Load Serving Entities.

Q. If neither MISO nor the applicants have evaluated any of the projects in the MVP portfolio individually, is it possible that one or more individual projects in the MVP portfolio could have negative net economic benefits to the regions of the MISO footprint in which the costs of the MVP portfolio are shared?

A. Given the fact that neither MISO nor the applicants have evaluated any of the individual projects in the MVP portfolio, it would be impossible for MISO or the applicants to know whether any of the projects in the MVP portfolio would have negative overall net benefits

to the MISO market. While multiple studies have confirmed that the MVP portfolio as a whole does in fact create benefits greater than the costs of the portfolio, it is entirely possible that one or more projects included in the MVP portfolio have benefits that are lower than the costs.

Q. How does MISO evaluate the economics of regionally cost-shared transmission projects?

A. MISO uses the APC method of calculating overall net benefits of economic transmission projects, and for which transmission pricing zones would benefit from an economic transmission project. In general, MISO uses this methodology for calculating the potential benefits of market efficiency and MVP projects.

Q. Has Commission staff analyzed the overall MISO market impact of the proposed Cardinal-Hickory Creek project?

A. Yes. I used the PROMOD results provided by the applicants, and compared these results with the total projected cost of the proposed Cardinal-Hickory Creek project to all MISO-North and MISO-Central transmission customers. However, this analysis was not performed using Commission staff's PROMOD sensitivities as described in Commission staff witness Mr. Grant's direct testimony.

Q. What methodology did you use in calculating the present value energy cost savings of the proposed Cardinal-Hickory Creek project to the MISO market?

A. As part of calculating the economic benefit to Wisconsin customers, the applicants included APC calculations for DPC and NSPW customers, for each of the futures studied by the applicants. In order to calculate the benefits to DPC and NSPW customers, the APC calculations also had the calculations for each Load Serving Entity within MISO. I

was able to extract the gross APC benefits as calculated in the PROMOD model, for each of the applicants studied futures, for MISO-North and MISO-Central, for the years 2021, 2026, and 2031. These are the same years used in the applicants' 40-year benefit calculation, and I applied the same methodology used by the applicants in order to calculate the present-value gross energy cost savings to MISO-North and MISO-Central. I chose MISO-North and MISO-Central since the MVP portfolio was approved before MISO-South was incorporated in the MISO market, and thus, the proposed Cardinal-Hickory Creek project is only regionally cost shared across MISO-North and MISO-Central.

Q. What are the gross present value energy cost savings of the proposed Cardinal-Hickory Creek project to the MISO footprint, as calculated by the applicants' modeling?

A. I evaluated the results from both the original modeling submitted by the applicants, and the applicants' most recent updated modeling.

Using the results of the applicants' originally submitted modeling, the APC results to the MISO footprint are shown in Ex.-PSC-Vedvik-4. The results range from a present value gross energy cost savings benefit of $11.4 million in the Existing Fleet future, to $61.9 million in the Policy Regulations Low Demand and Energy future, to $69 million in the Policy Regulations future, to $70.7 million in the Policy Regulations including Foxconn future, to $1.36 billion in the Accelerated Alternative Technologies future.

Using the results of the most recent modeling submitted by the applicants, the APC results are shown in Ex.-PSC-Vedvik-5. The results range from a present value

gross energy cost savings benefit of $51.5 million in the updated Existing Fleet future, to $361.3 million in the updated Policy Regulations future, to $1.9 billion in the updated Accelerated Alternative Technologies future.

Q. What does the proposed Cardinal Hickory Creek project cost, both to the MISO footprint, and to Wisconsin transmission customers?

A. The capital cost of the proposed Cardinal-Hickory Creek project is between $474 million and $560 million, in year-of-occurrence dollars. The applicants' preferred route is projected to cost $492 million in year-of-occurrence dollars. However, this does not represent the total 40-year present value revenue requirement of the project to the MISO footprint. Using the capital cost associated with the applicants' preferred route, the full present value revenue requirement of the proposed Cardinal-Hickory Creek project is approximately $628 million. This cost includes all the projected costs associated with the proposed Cardinal-Hickory Creek project and includes both the cost to finance the project and to operate and maintain the project over its expected 40-year life. This is the cost that would be allocated on a load ratio share basis to the MISO-North and MISO-Central footprint. The present value revenue requirement to Wisconsin transmission customers is projected to be $67 million because the project is eligible for MVP cost sharing.

Q. Using the results of the applicants' PROMOD modeling, what are the net costs/benefits of the proposed Cardinal Hickory Creek project to the MISO market?

A. Using a present value revenue requirement that will be the basis for the MVP cost allocation of approximately $628 million, and using the results of the APC calculation that was submitted by the applicants, I found the proposed Cardinal-Hickory Creek project could have negative net benefits to the MISO footprint in all futures except the

Accelerated Alternative Technologies future. Using the results of the applicants' original PROMOD modeling, the proposed Cardinal-Hickory Creek project had approximate net present wholesale energy market benefits of (negative net benefits would represent net costs):

- Negative $570.96 million for the Existing Fleet future;
- Negative $318.54 million for the Policy Regulations with Low Demand and Energy future;
- Negative $283.04 million for the Policy Regulations future;
- Negative $274.58 million for the Policy Regulations with Foxconn future; and,
- Positive $1.36 billion for the Accelerated Alternative Technologies future.

Using the results of the applicants' most recent updated PROMOD modeling, in response to Commission staff Data Requests, the proposed Cardinal-Hickory Creek project had approximate net present wholesale energy market benefits of:

- Negative $576.53 million for the updated Existing Fleet future;
- Negative $266.68 million for the updated Policy Regulations future; and,
- Positive $1.28 billion for the updated Accelerated Alternative Technologies future.

Ex.-PSC-Vedvik-4 and Ex.-PSC-Vedvik-5 show the results of this analysis. Another result of this analysis shows that the applicants' Low-Voltage Alternative may have better net benefits to the MISO market than the proposed Cardinal-Hickory Creek project. In addition, it appears the Low-Voltage Alternative has net benefits to the MISO market in more futures than the proposed Cardinal-Hickory Creek project. This is likely

due to the fact that the Low-Voltage Alternative is expected to be significantly less expensive than the proposed Cardinal-Hickory Creek project.

Q. Do you draw any general conclusions from examining the economic impact of the proposed Cardinal-Hickory Creek project on the MISO market, and whether this could have an impact on Wisconsin transmission customers?

A. Yes. MISO only evaluated the economic impacts of the MVP portfolio as a portfolio, and did not evaluate the economic impacts of any of the MVP projects individually. As the proposed Cardinal-Hickory Creek project is projected to be the last of the MVP projects approved in the MTEP11 MVP portfolio to be placed in-service, each of the other sixteen projects in the MVP portfolio were included in the all of the applicants' modeling. The Policy Regulations future was determined by the MISO stakeholders to be the most likely of the MTEP17 futures to occur, and thus the MISO stakeholders' process placed the most emphasis on this future. It appears that the proposed Cardinal-Hickory Creek project had negative net economic benefits to the MISO market in the PROMOD modeling submitted by the applicants, for all sensitivities using the Policy Regulations future as a basis. This is also relevant to the economics of the proposed project to Wisconsin transmission customers since it is an aspect of the economics of the proposed project that is not accounted for in the applicants' formula. The proposed project impacts all MISO wholesale energy market participants, through an increase in transmission service revenue requirements, which will be passed on to Load Serving Entities.

Net Benefits of the Proposed Cardinal-Hickory Creek Project to Wisconsin Transmission Customers

Q. What are the net benefits of the proposed Cardinal-Hickory Creek project to Wisconsin customers, using the futures and scenarios submitted by the applicants, and the futures and scenarios evaluated by Commission staff?

A. Ex.-PSC-Vedvik-1 shows the overall net benefits of the proposed Cardinal-Hickory Creek project, using the applicants' formula for calculating the net benefits/costs of the proposed project. The table in Ex.-PSC-Vedvik-1 shows the net benefits for all eleven scenarios evaluated by Commission staff, and includes the results of Commission staff's evaluation of the energy cost savings, asset renewal benefits, and avoided reliability benefits of the proposed Cardinal-Hickory Creek project. The table also includes Commission staff's calculation of the energy cost savings using both the applicants' CBM and MISO's APC methodologies.

In Commission staff's analysis, if a nominal discount rate of 6.4 percent and the applicants' CBM methodology is used to calculate the energy cost savings of the proposed Cardinal-Hickory Creek project, then the project has net present benefits to Wisconsin transmission customers of negative $17.21 million to positive $346.81 million, depending on the future or scenario evaluated. The proposed project had negative net benefits in four of the eleven Commission staff evaluated scenarios. In the Policy Regulations future with likely Wisconsin renewable generation added, the proposed Cardinal-Hickory Creek project had 40-year net present benefits of $2.87 million.

If a nominal discount rate of 6.4 percent and MISO's APC methodology is used to calculate the energy cost savings of the proposed Cardinal-Hickory Creek project, then

the project has net present benefits to Wisconsin transmission customers of negative $26.66 million to positive $317.25 million, depending on the future or scenario evaluated. The proposed project had negative net benefits in eight of the eleven Commission staff evaluated scenarios. In the Policy Regulations future with likely Wisconsin renewables added, the proposed Cardinal-Hickory Creek project had 40-year energy cost savings and insurance value benefits that were less than the asset renewal and avoided reliability benefits associated with the proposed project. Thus, this scenario resulted in 40-year net present benefits of negative $26.66 million.

If a nominal discount rate of 8.41 percent (ATC's weighted average cost of capital) and the applicants' CBM methodology is used to calculate the energy cost savings of the proposed Cardinal-Hickory Creek project, then the project has net present benefits to Wisconsin transmission customers of negative $18.3 million to positive $227.22 million, depending on the future or scenario evaluated. The proposed project had negative net benefits in six of the eleven Commission staff evaluated scenarios. In the Policy Regulations future with likely Wisconsin renewables added, the proposed Cardinal Hickory Creek project had 40-year net present benefits of negative $4.35 million.

If a nominal discount rate of 8.41 percent and MISO's APC methodology is used to calculate the energy cost savings of the proposed Cardinal-Hickory Creek project, then the project has net benefits to Wisconsin transmission customers of negative $25.41 million to positive $203.69 million, depending on the future or scenario evaluated. The proposed project had negative net benefits in eight of the eleven Commission staff evaluated scenarios. In the Policy Regulations future with likely Wisconsin renewables

added, the proposed Cardinal-Hickory Creek project had 40-year energy cost savings and insurance value benefits that were less than the asset renewal and avoided reliability benefits associated with the proposed project. Thus, this scenario resulted in 40-year net present benefits of negative $25.41 million.

Q. How does the inclusion of the Badger Hollow and Two Creeks solar facilities, and inclusion of the proposed Red Barn Wind Farm, impact the potential energy cost savings of the proposed Cardinal-Hickory Creek project?

A. The scenarios evaluated by Commission staff are the scenarios described as:

- Existing Fleet Future with WI Likely Renewables;
- Policy Regulations Future with WI Likely Renewables;
- Accelerated Alternative Technologies with WI Likely Renewables;
- Policy Regulations Future with WI Likely Renewables and 10 Percent Load Reduction;
- Policy Regulations Future with WI Likely Renewables and Targeted Asset Renewal;
- Policy Regulations Future with WI Likely Renewables and Duane Arnold Out; and,
- Policy Regulations Future with WI Likely Renewables and Announced PJM Nuclear Retirements Out.

The inclusion of the Commission approved Badger Hollow and Two Creeks solar facilities and the proposed Red Barn Wind Farm in the Policy Regulations and Accelerated Alternative Technologies futures lowered the calculated energy cost savings associated with the proposed Cardinal-Hickory Creek project. The present value 40-year

gross energy cost savings associated with the proposed project were lowered by $124 million in the Policy Regulations future, from $185.37 million to $61.37 million. The present value 40-year gross energy cost savings associated with the proposed Cardinal-Hickory Creek project were lowered by $312.95 million in the Accelerated Alternative Technologies future, from $405.31 million to $92.36 million. These scenarios are described in more detail in Commission staff witness Mr. Grant's direct testimony.

Q. When are the Badger Hollow and Two Creek solar facilities expected to commence commercial operation?

A. These solar facilities are expected to be placed in-service in December of 2020.[33] They would need to interconnect with the existing transmission system approximately three years before the applicants intend to place the proposed Cardinal-Hickory Creek project in-service.

General Observations and Conclusions Regarding the Proposed Cardinal Hickory Creek Project

Q. What do you conclude about the applicants' stated benefits of the proposed Cardinal-Hickory Creek project to Wisconsin transmission customers?

A. The results of Commission staff's analysis presented here and in Commission staff witnesses Mr. Grant and Mr. Rohankar's direct testimony appear to suggest that the proposed Cardinal-Hickory Creek project may have net positive, or net negative economic benefits to Wisconsin transmission customers. The results of Mr. Grant's PROMOD analysis appear to suggest that targeted integration of new renewable resources in southwestern Wisconsin can drop the energy cost savings associated with the

[33] Docket 5-BS-228, Badger Hollow Two Creeks Joint CA Application, p. 26, PSC REF#: 343600

proposed Cardinal-Hickory Creek project by 66 to 77 percent, in the Policy Regulations and Accelerated Alternative Technologies futures.[34] The results of Mr. Rohankar's PowerWorld analysis appear to suggest that the incorporation of forecasted asset renewal projects in the modeling would alleviate the major constraints on the existing transmission system in southwestern Wisconsin, and that the proposed Cardinal-Hickory Creek project provides a gross avoided reliability benefit of $897,474, when using the NERC Transmission Planning Criteria stipulated in NERC TPL-001-4. In addition, Mr. Rohankar's PowerWorld analysis examined the ability of the proposed Cardinal-Hickory Creek project, and the base case with asset renewal alternative, to integrate planned renewable projects in southwestern Wisconsin. The results of his analysis showed the incorporation of the Commission approved Badger Hollow and Two Creeks solar facilities greatly reduced flows across existing constrained transmission system elements in Wisconsin in the absence of the proposed Cardinal-Hickory Creek project.

The MISO stakeholders and the applicants agree that the Policy Regulations future is the most likely future,[35] and Commission staff's analysis of the PROMOD modeling of the Policy Regulations future that includes certain new renewable projects in Wisconsin shows near zero 40-year net benefits ($2.87 million using a nominal discount rate of 6.4 percent and negative $4.35 million using a nominal discount rate of 8.41 percent) to Wisconsin transmission customers, using the applicants' formula and methodology.

[34] A reduction of benefit by: $124 million of the original $185.37 million in the Policy Regulations future and $312.95 million of the original $405.31 million in the Accelerated Alternative Technologies future, represents a reduction in benefit of 66.9 percent to 76.8 percent, respectively.

[35] Ex.Applicants-Application at 43, "the Applicants agree with the stakeholder vote that the PR future is the most likely of the three futures to occur."

Various assumptions about the generation and transmission system topology have a significant impact on the results of the PROMOD modeling of the proposed Cardinal-Hickory Creek project. A range of four to eight of the eleven scenarios evaluated by Commission staff showed negative net economic benefits to Wisconsin transmission customers, depending on the assumptions used in the PROMOD modeling, the methodology used to assess the energy cost savings associated with the proposed Cardinal-Hickory Creek project, and the assumed nominal discount rate in the discounted cash flow analysis of the benefits and costs of the proposed project.

Q. Does the proposed Cardinal-Hickory Creek project create benefits greater than its costs to the MISO market?

A. As discussed earlier, the APC calculations of the applicants' modeling results do not indicate energy cost savings to MISO-North and MISO-Central Load Serving Entities are greater than the proposed Cardinal Hickory Creek project's total costs to the MISO footprint in all futures. The proposed Cardinal-Hickory Creek project shows energy cost savings to the MISO footprint that are greater than its costs are most likely in the Accelerated Alternative Technologies future.

Q. Do you have any other general comments and/or suggestions regarding the routing of the proposed Cardinal-Hickory Creek project?

A. Yes. If the Commission chooses the Stoneman crossing of the Mississippi River, it would be reasonable to multi-circuit the existing Stoneman – Nelson Dewey 161 kV transmission line onto the new Cardinal-Hickory Creek 345 kV transmission structures. The existing Stoneman – Nelson Dewey 161 kV transmission line would require asset renewal by year 2030, and rebuilding this line as part of the proposed Cardinal-Hickory

Creek project could provide additional asset renewal benefits associated with the proposed project. In addition, by multi-circuiting the existing Stoneman–Nelson Dewey 161 kV transmission line with Cardinal-Hickory Creek, the existing Stoneman–Nelson Dewey 161 kV transmission line would no longer be located directly over the Cassville, Wisconsin elementary school which is discussed in further detail in the forthcoming Final Environmental Impact Statement for the project.

Q. Does this conclude your direct testimony?

A. Yes, it does.

AJV:JLT:jar:jlt:DL: 01674316