ITC*Transmission*/METC

and

Wolverine Power Supply Cooperative, Inc.

Michigan Wind Zones Transmission Analysis

November 30, 2009

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1. Purpose

This analysis was performed pursuant to the directive in 2008 PA 295, Michigan Public Service Commission ("MPSC") Order U-15899 and the Final Report of the Michigan Wind Energy Resource Zone Board ("Board") to assess the transmission infrastructure needed to deliver the estimated minimum and maximum wind production potential for the four wind zone regions identified in the Board's Final Report.[1]

The analysis and the projects outlined herein focus solely on developing the "backbone" transmission projects that would provide the thermal capability to support the identified minimum and maximum wind penetration levels for each of the regions identified as possible wind zones by the Board.

For efficiency purposes ITC Holdings Corp. ("ITC") and Wolverine Power Supply Cooperative, Inc. ("WPSCI"), both Transmissions Owners in the Midwest Independent Transmission System Operator ("Midwest ISO") area, coordinated to produce a joint transmission report. Each entity was responsible for its own transmission system assumptions and planning analysis. The respective transmission requirements for each company are separately identified in this report.

Currently, transmission planning is performed on a "contractual" basis. In other words, projects are typically constructed for specific "contractual needs." Per the existing Midwest ISO planning processes, transmission system enhancements are proposed to:

(1) Solve planning criteria violations identified when attempting to move existing generation (economically) to existing (and forecasted future) loads;

(2) Move future generation (with signed interconnection agreements) to existing (and forecasted future) loads;

(3) Fulfill transmission service requests; or,

(4) Support regulatory requirements.

As such, the current transmission planning processes focus only on solving the next system problem.

However, through the forward-looking nature of the wind zone process initiated by the State of Michigan, there now is an opportunity to look beyond the next incremental generation interconnection and plan transmission for reasonably expected future development, thus providing more certainty for generator developers regarding their required financial support for transmission-system upgrades. Further, already having the backbone transmission in place allows more timely responses to generation interconnection requests as only the interconnection facilities will need to be planned and constructed. Finally, this comprehensive, forward-looking planning approach will result in an efficiently developed transmission system. In short, a more forward-looking transmission planning process (as embodied in this effort) is conducive to wind development.

1.1. Background

PA 295 ("the Act"), signed into law on October 6, 2008, required the formation of the Wind Energy Resource Zone Board. In accordance with the Act, the MPSC appointed the Board's

[1] http://www.dleg.state.mi.us/mpsc/renewables/windboard/werzb_final_report.pdf

members in December 2008. The Board's required membership includes representation from the MPSC, the Michigan Attorney General's office, the electric utility industry, alternative electric suppliers, the renewable energy industry, independent transmission companies, cities, villages and townships, a statewide environmental organization and the public at large. Among other tasks, the Board was mandated to study and identify a list of regions in the state with the highest wind energy harvest potential and develop a proposed and a final report detailing its findings. The Board's final report included a list of regions in the state with the highest level of wind energy harvest potential; a definition of the estimated maximum and minimum generating capacity in megawatts ("MW") that could be installed in each identified region; an estimate of the annual maximum and minimum energy production potential for each identified region; and an estimate of the maximum wind generation capacity already in service in each identified region. The Board's Final Report was issued on October 15, 2009, after the Board held two public hearings and took public comments on the Board's proposed report.

Section 145, subsection 6 of the Act states:

> "After the Board issues its report under subsection 5, electric utilities, affiliated transmission companies and independent transmission companies with transmission facilities within or adjacent to regions of this state identified in the Board's report shall identify existing or new transmission infrastructure necessary to deliver the maximum and minimum wind energy production potential for each of those regions and shall submit this information to the Board for its review."

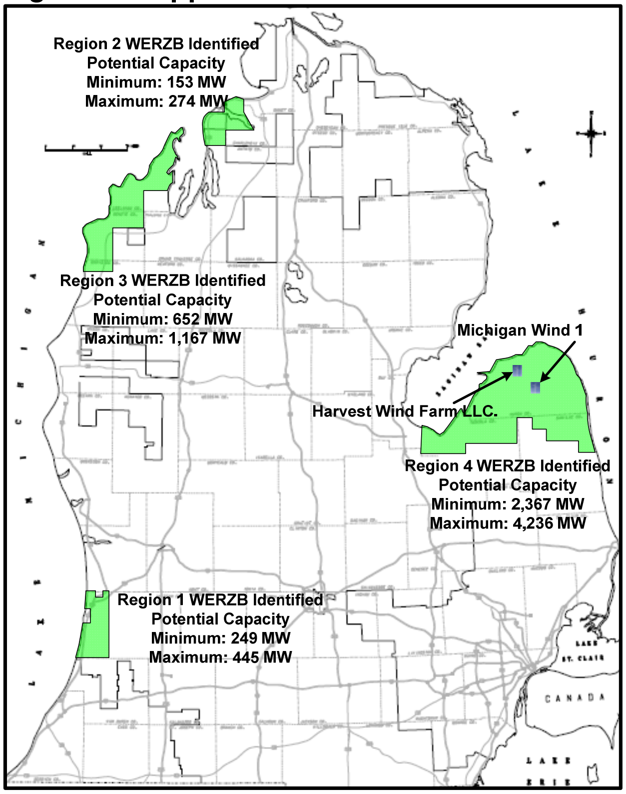
ITC and WPSCI are jointly submitting this transmission report in accordance with this requirement. ITC is the largest independent electricity transmission company in the country. Through its subsidiaries the International Transmission Company, d/b/a ITC*Transmission* ("ITCT"), and Michigan Electric Transmission Company, LLC ("METC"), ITC operates contiguous, regulated, high-voltage transmission systems throughout Michigan's Lower Peninsula, comprising 8,100 circuit miles of transmission lines and 236 stations and substations and covering all four of the regions identified by the Board for potential wind energy development.

WPSCI is a generation and transmission electric cooperative serving the needs of six members (Cherryland Electric Cooperative, Great Lakes Energy Cooperative, HomeWorks Tri-County Electric Cooperative, Presque Isle Electric & Gas Co-op, Wolverine Power Marketing Cooperative, Inc. and Spartan Renewable Energy, Inc.) throughout portions of western and northern Michigan. Wolverine's rural transmission system consists of approximately 1,200 miles of looped transmission lines and associated facilities located in three of the four regions indentified in the Board's Final Report (specifically Region 1, Region 2 and Region 3).

1.2. Description of Proposed Regions

Figure 1 identifies the approximate locations of the four regions identified by the Board. Among the four regions, there are two wind energy systems currently in service, both of which are located on Region 4: Harvest Wind Farm LLC and Michigan Wind I. Both entered into commercial operation in 2008 and represent a total of nearly 122 megawatts of capacity, or 94 percent of the total installed wind energy capacity in Michigan.

Figure 1 – Approximate Locations of Wind Regions



Region 1

As described in the Board's Final Report and highlighted in Figure 1, the area proposed for Region 1 is located within Allegan County in the southwestern region of the Lower Peninsula of Michigan. The minimum and maximum nameplate wind power capabilities identified by Board for this region are 249 MW and 445 MW respectively.

Region 2

The area proposed for Region 2 is located in Antrim and Charlevoix Counties in the northwestern region of the Lower Peninsula of Michigan. The identified minimum and maximum nameplate wind power capabilities for this region are 153 MW and 274 MW respectively.

Region 3

The area proposed for Region 3 lies within Benzie, Leelanau and Manistee Counties in the northwestern region of the Lower Peninsula of Michigan. The identified minimum and maximum nameplate wind power capabilities for this region are 652 MW and 1,167 MW respectively.

Region 4

The area proposed for Region 4 is located in Bay, Huron, Saginaw, Sanilac and Tuscola Counties in the Thumb region of the Lower Peninsula of Michigan. The minimum and maximum nameplate capabilities for this region are 2,367 MW and 4,236 MW respectively.

2. Key Assumptions & Limitations

As noted above, this analysis and the projects outlined in this report focus solely on developing the backbone transmission infrastructure necessary to provide sufficient thermal capability to support[2] the identified minimum and maximum wind production potential for each of the defined wind zone regions identified in the Board's Final Report. In some areas of the system, however, factors not able to be considered within this analysis due to time constraints, may require projects identified herein to be "fine tuned". While we would not anticipate a need for wholesale changes to any of the projects discussed within this report, some of the factors that may require additional "fine tuning" are discussed below.

Planning Analysis

Whenever significant amounts of electric generation are added in an area, overall flow patterns can change significantly enough to cause transmission issues to emerge in areas remote from the area of interest. While this impact is not accounted for in this study, it could become a significant factor if the generation displaced by the new generation is significantly different than that modeled.

In some areas, interaction between the transmission system and networked lower-voltage distribution facilities can be significant. Overloads on the lower-voltage facilities can dictate the need for modifications to the transmission system. And in some areas, voltage, short-circuit and/or transient-stability concerns can be significant and possibly drive different, or additional, system upgrades. Due to time constraints, this analysis did not optimize the interaction between the transmission system and lower-voltage systems, nor did it monitor voltage, short-circuit or transient-stability implications of any of the projects identified.

Additional transmission may be needed to bridge the gap between new generation and the backbone transmission system discussed herein. Transmission interconnection facilities will be highly dependent upon the actual geographic location and size of the wind generation facilities. More detailed studies to determine these interconnection facilities would likely occur through the Midwest ISO generation interconnection process after the specifics regarding wind generation locations and amounts are established. For purposes of this report, the wind generation was modeled as connected directly to the backbone facilities.

Interconnecting transmission is not to be confused with individual wind farm "collector systems." Wind farm collector systems are the systems used to "collect" the energy from each individual wind turbine to a lower voltage (typically around 35 kilovolts ("kV")) network.

For the most part, the four regions identified by the Board are significantly distant geographically from one another (except as noted below). Therefore, this analysis considers each of the four regions independently. If more than one region is designated by the MPSC as a wind zone, additional study would be required to determine whether additional transmission system enhancements would be required. However, because Regions 2 and 3 are geographically close, and the export of wind power from both regions was shown to impact some of the same transmission facilities, this report also considers the combination of Regions 2 and 3 as discussed in Section 3.5 below.

[2] In the context of this report, support for the interconnection of wind generation represents the ability to move wind power from the potential wind zone to the rest of the grid.

Wind Capacity Factors Used in Modeling

For purposes of this report, wind generation was dispatched at 20 percent of nameplate capability in the peak load models and 100 percent of nameplate capability in shoulder peak load models. These study methodologies are consistent with those employed by the Midwest ISO to study the interconnection of wind generation.

Cost Estimates and Project Timelines

Project cost estimates or projected project timelines offered in this report are conceptual; actual costs and timelines could vary depending on many factors including, but not limited to, additional needs related to voltage, short circuit or stability, and actual availability and costs of material and labor.

As noted above, interconnection facilities for each region were modeled to bridge the gap between the proposed wind zone and backbone transmission facilities. Cost estimates were not developed for these interconnection facilities because they are not part of the backbone transmission facilities identified herein.

Coordination with Existing Projects in Close Proximity to the Proposed Regions

There are transmission projects in various stages of the existing planning processes in or around each of the four regions. For the wind zone region(s) ultimately designated by the MPSC, all transmission owners would need to evaluate the impacts on any of these existing projects and present a coordinated plan.

Right-of-Way Assumptions

References to right-of-way requirements for any project in any of the regions are based on knowledge gained from previous projects of a similar nature and a preliminary sampling of existing easements. Therefore, actual right-of-way requirements would need to be determined through a more detailed analysis of the actual rights-of-way and would be dependent on actual design parameters including, but not limited to, tower heights, conductor types and operating voltages.

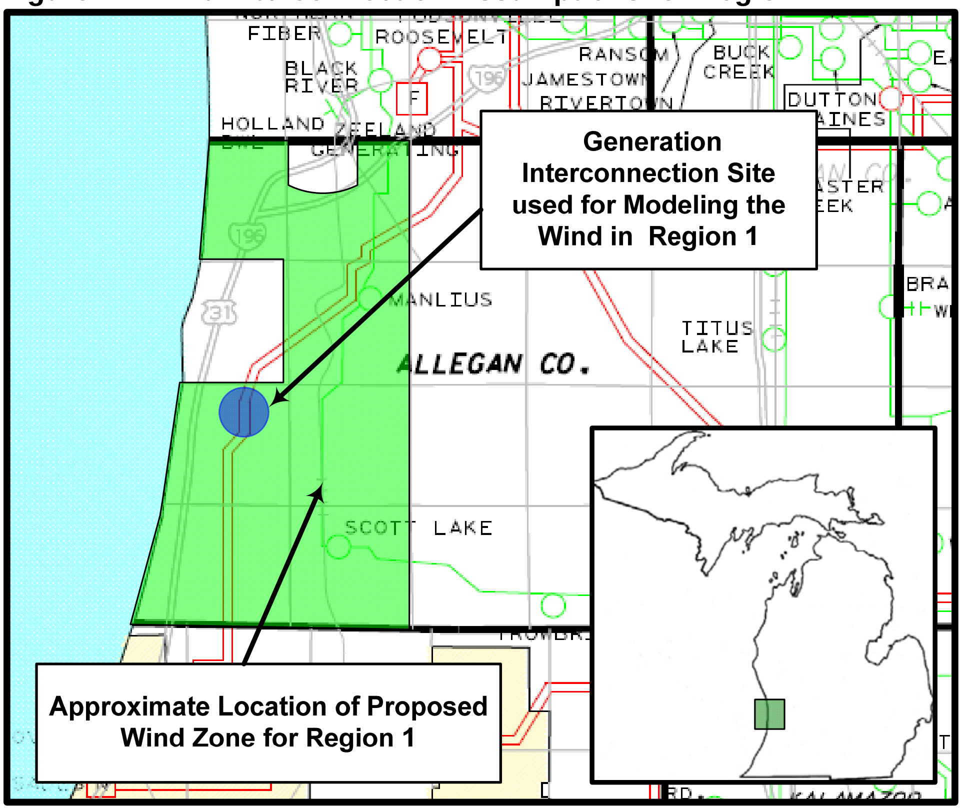
3. Transmission Requirements

3.1. Transmission Requirements for Region 1

For Region 1 the wind was modeled at one interconnected location, a new interconnection station that would tap two existing METC 345 kV circuits that run north and south through the region as depicted in Figure 2.

There are both METC and WPSCI transmission facilities within or adjacent to Region 1.

Figure 2 – Wind Interconnection Assumptions for Region 1



3.1.1. METC Transmission Requirements for Region 1

No enhancements to the METC transmission system would be required for this region to interconnect the minimum or maximum wind generation capacity levels as indicated by the Board.

3.1.2. WPSCI Transmission Requirements for Region 1

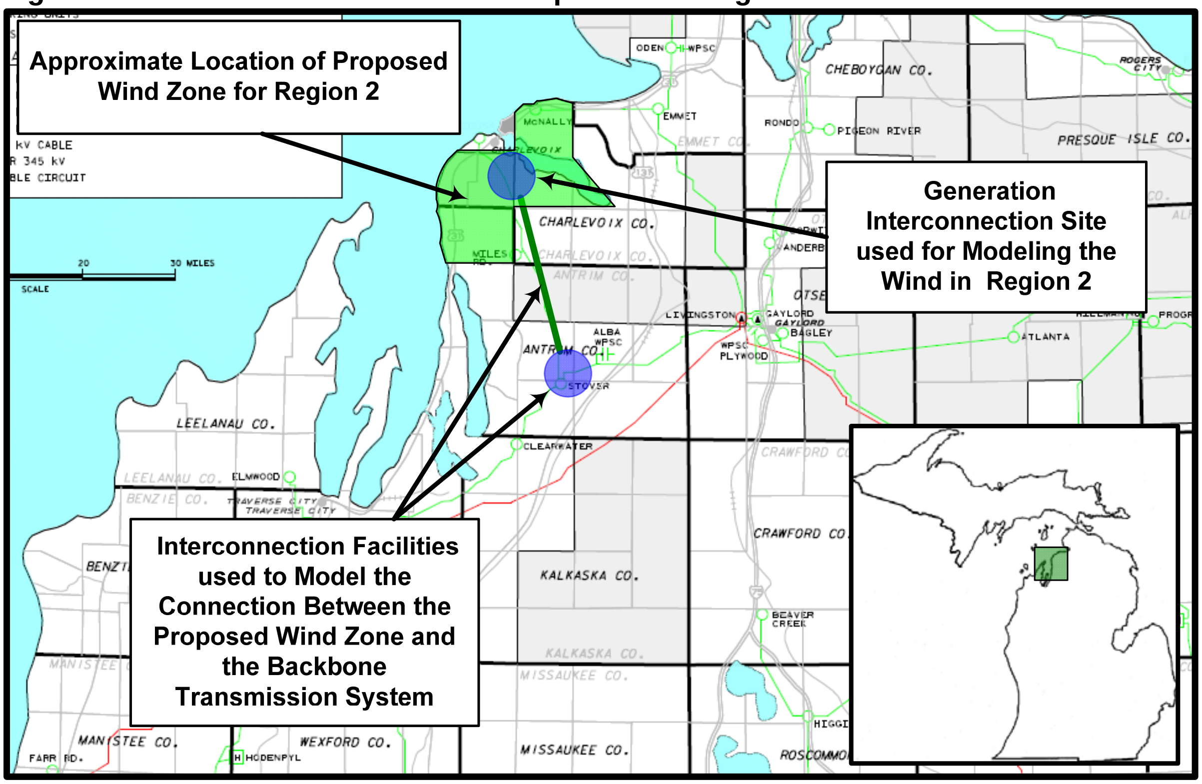
No enhancements to the WPSCI transmission system would be required for this region to interconnect the minimum or maximum wind generation capacity levels as indicated by the Board.

3.2. Transmission Requirements for Region 2

There are no existing backbone transmission facilities within Region 2. For this region, the wind was modeled as interconnected at one interconnection station feeding into the existing METC 138 kV system to the south of the region via a radial 138 kV circuit as depicted in Figure 3. This modeling technique was used to fill the gap between the wind and the backbone system and is not meant to suggest that wind would be connected in this manner or that this radial 138 kV circuit should be part of the backbone transmission upgrades.

There are both METC and WPSCI transmission facilities within or adjacent to Region 2.

Figure 3 – Wind Interconnection Assumptions for Region 2

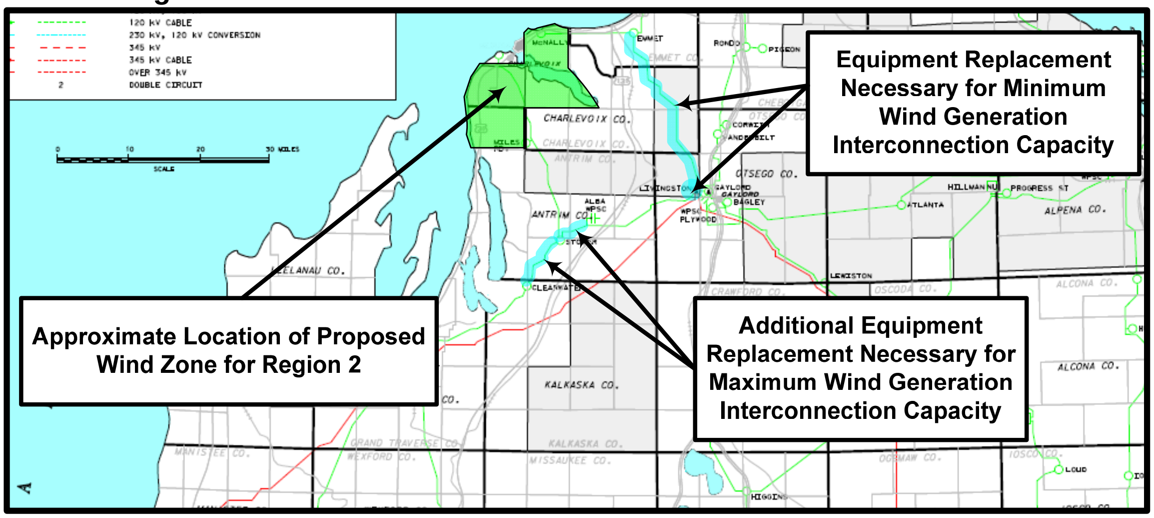


3.2.1. METC Transmission Requirements for Region 2

Several backbone enhancements to the METC transmission system would be required to connect wind generation at the identified minimum or maximum wind capacity levels.

In order to support the minimum wind generation capacity level, equipment replacement on one existing 138 kV METC circuit and in one existing METC station would be required. To support the maximum wind generation capacity level, additional equipment replacement on two existing 138 kV METC circuits would be required. These circuits and stations are highlighted in Figure 4.

Figure 4 – METC Transmission Elements Shown to Overload When Connecting Wind in Region 2



Upgrades to the backbone METC transmission system needed to support the interconnection of wind power in Region 2 up to the minimum capacity level are projected to cost approximately $24 million. Upgrades to the backbone METC transmission system to support the interconnection of wind power in Region 2 to the maximum capacity level would cost approximately $42 million.

While transmission system upgrades would be required for Region 2 for the identified minimum and maximum identified wind capacity levels, these enhancements to the backbone system could most likely be accomplished by utilizing the existing right-of-way.

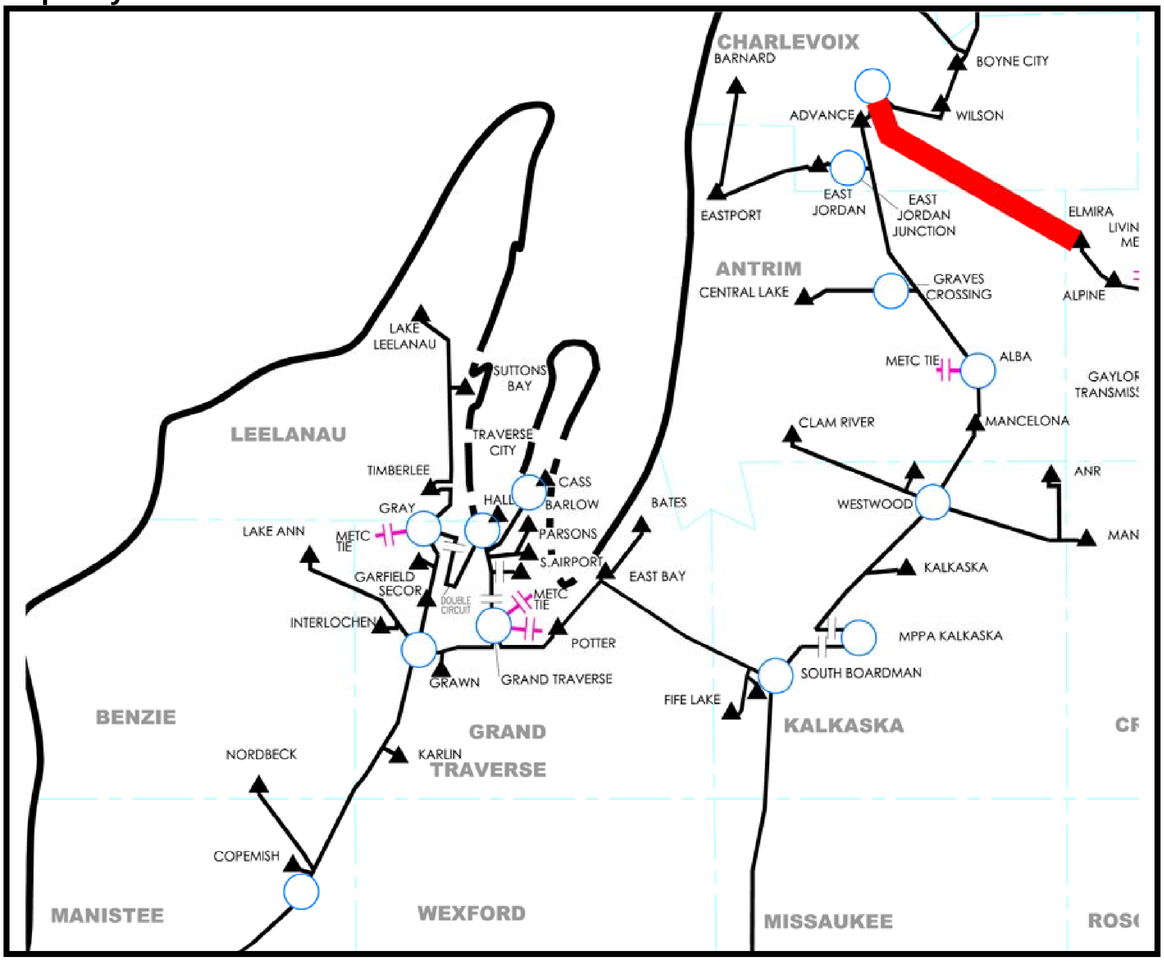
The METC projects identified for Region 2 could be designed and constructed in approximately 12 months once approved. This does not include time to obtain any required approvals to begin design and construction.

3.2.2. WPSCI Transmission Requirements for Region 2

Deficiencies exist in the WPSCI system in Region 2 in both the minimum and maximum cases. For the minimum generation case, some station equipment on the WPSCI system would need to be upgraded. These upgrades could be constructed at a non-binding cost estimate of less than $0.5 million.

For the maximum generation case, some station equipment on the WPSCI system and approximately 16 miles of WPSCI transmission line would need to be upgraded. These upgrades could be constructed at a non-binding cost estimate of $7 million. These facilities are highlighted in Figure 5.

Figure 5 – WPSCI Transmission Facilities Required for Region 2 Maximum Capacity

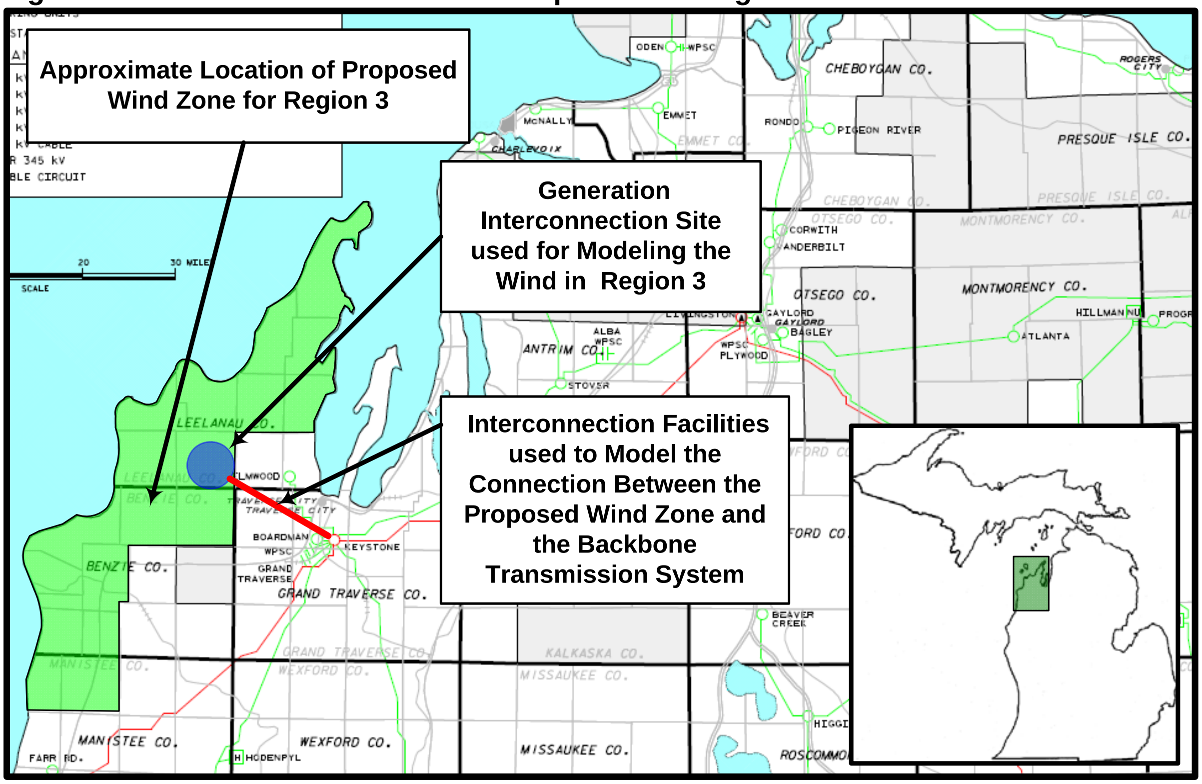


3.3. Transmission Requirements for Region 3

There are no backbone transmission facilities within Region 3. The wind was modeled as interconnected to one interconnection station feeding into the existing METC 345 kV system to the southeast of the proposed zone via a radial 345 kV circuit into the existing Keystone 345 kV station as depicted in Figure 6.

There are both METC and WPSCI transmission facilities within or adjacent to Region 3.

Figure 6 – Wind Interconnection Assumptions for Region 3

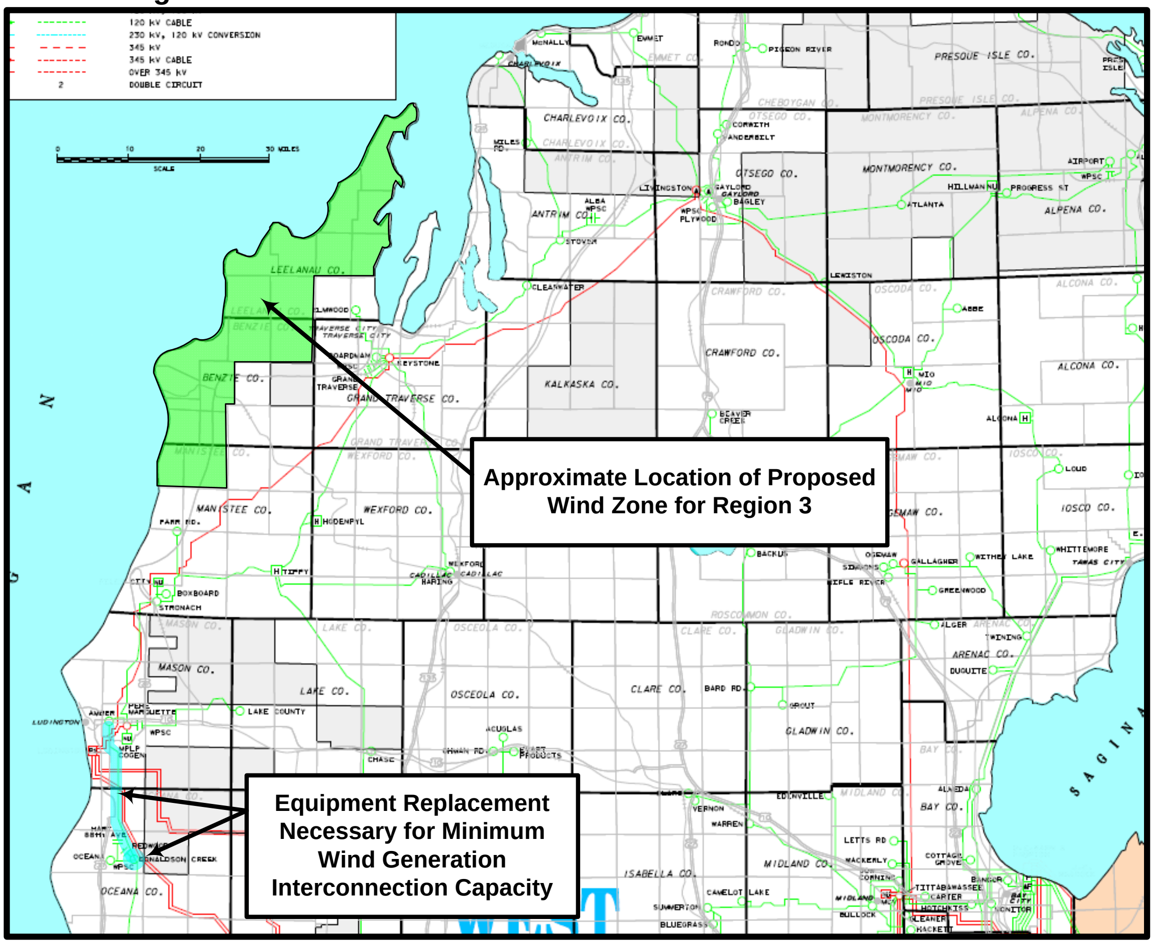


3.3.1. METC Transmission Requirements for Region 3

For Region 3, the results indicate that several backbone transmission system enhancements would be required on the METC system when connecting wind generation at either the Board identified minimum or maximum wind capacity levels.

Equipment replacement on one existing 138 kV METC circuit and in one existing METC station would be required to support the minimum wind generation capacity level, and no additional equipment replacement would be required in order to support the maximum wind generation capacity level. These circuits and stations are highlighted in Figure 7.

Figure 7 – METC Transmission Elements Shown to Overload When Connecting Wind in Region 3



Upgrades to the backbone METC transmission system needed to support the interconnection of wind generation in Region 3 up to the minimum or maximum capacity levels would cost approximately $36 million.

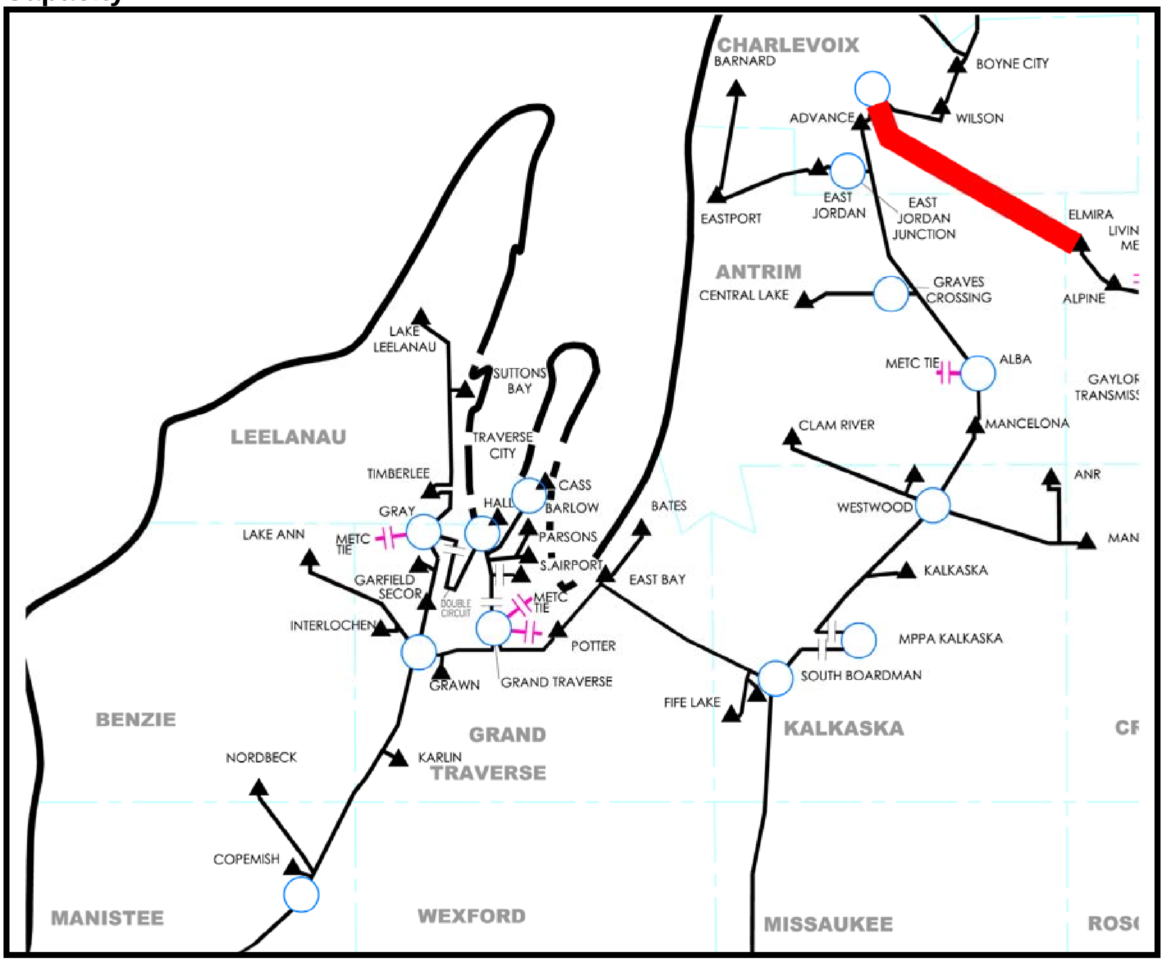
While transmission system upgrades would be required for Region 3 for either of the identified minimum or maximum identified wind capacity levels, the enhancements to the backbone system could most likely be accomplished by utilizing the existing right-of-way.

The METC projects identified for Region 3 would require approximately 12 months to design and construct once approved. This does not include time to obtain any required approvals to begin design and construction.

3.3.2. WPSCI Transmission Requirements for Region 3

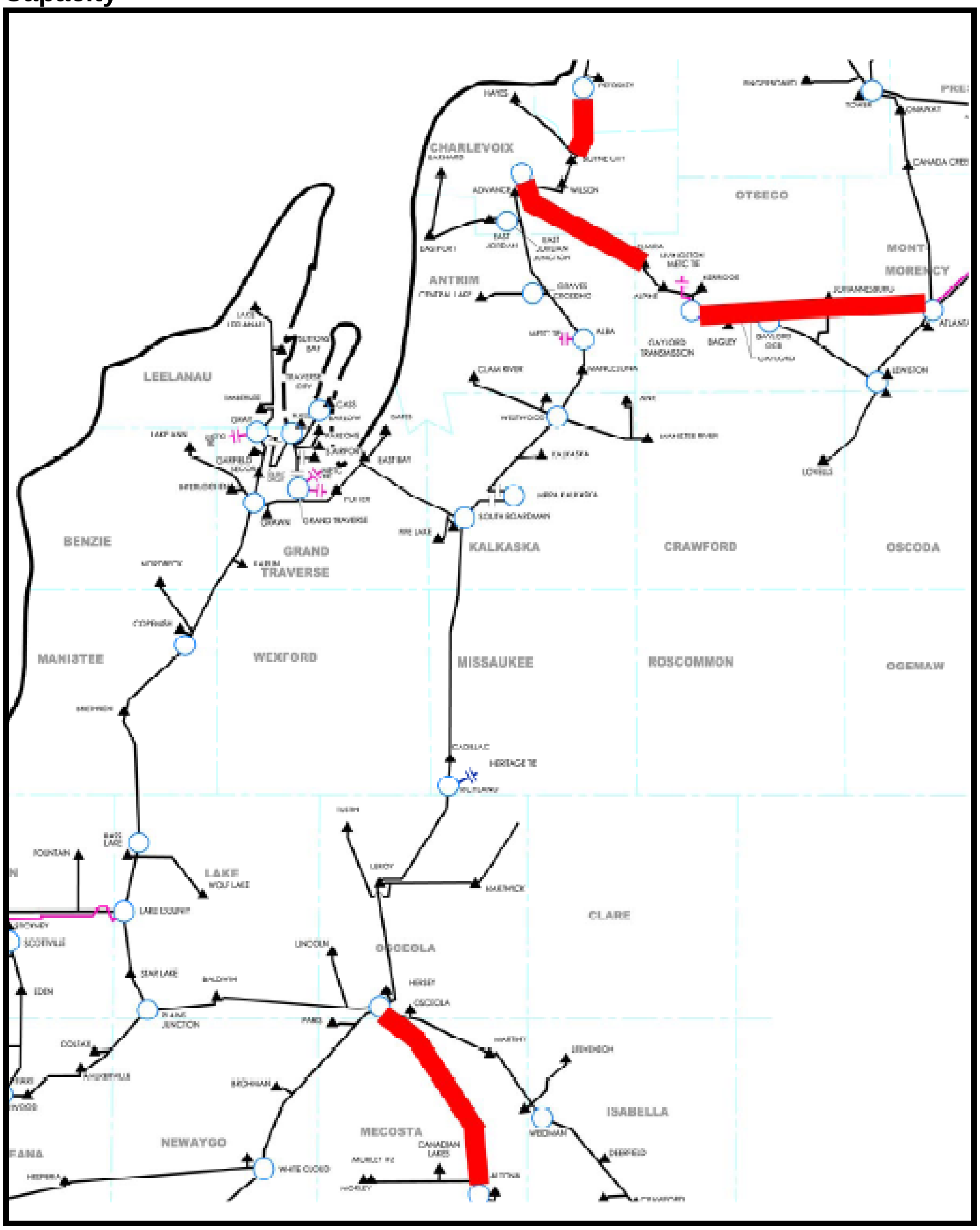
Deficiencies exist on the WPSCI system in Region 3 in both the minimum and maximum cases. For the minimum-generation case, some WPSCI station equipment and approximately 16 miles of WPSCI transmission line would need to be upgraded. These upgrades could be constructed at a non-binding cost estimate of $7 million. These facilities are highlighted in Figure 8.

Figure 8 – WPSCI Transmission Facilities Required for Region 3 Minimum Capacity



For the maximum-generation case, some WPSCI station equipment and approximately 82 miles of WPSCI transmission line would need to be upgraded. These upgrades could be constructed at a non-binding cost estimate of $33 million. These facilities are highlighted in Figure 9.

Figure 9 – WPSCI Transmission Facilities Required for Region 3 Maximum Capacity



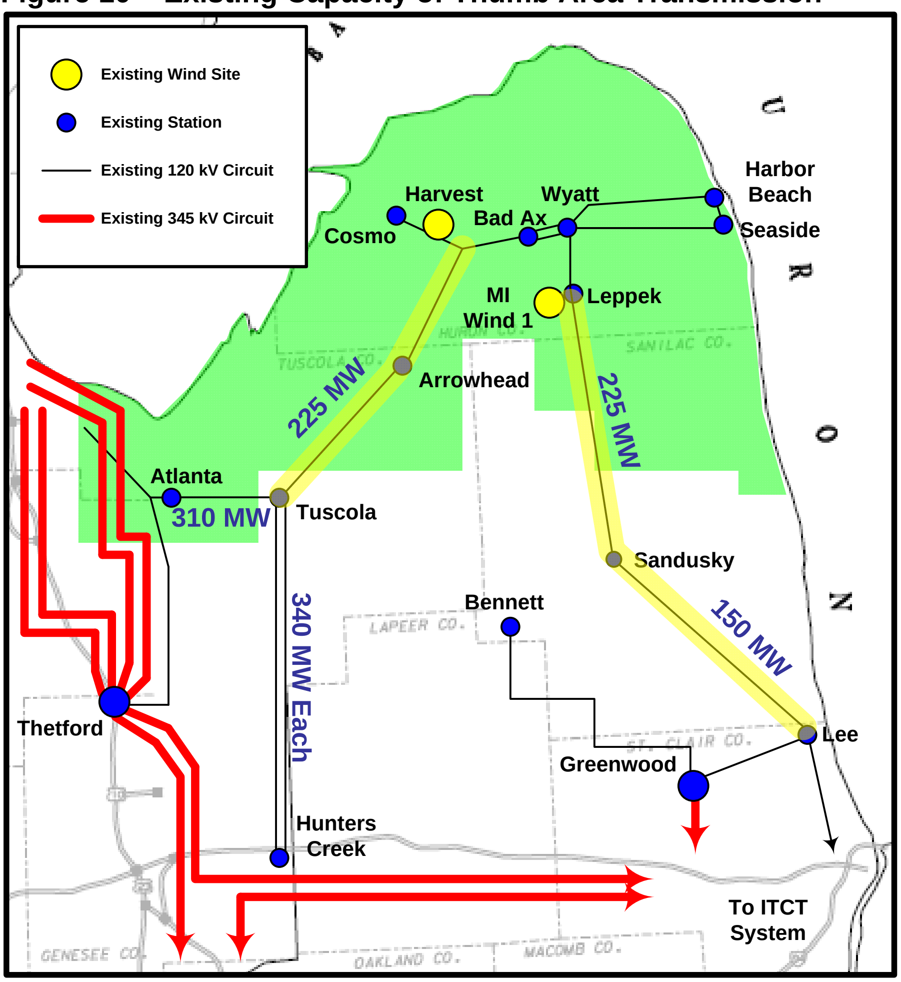
3.4. Transmission Requirements for Region 4

The analysis for Region 4 was significantly more complex than for the other three regions for the following reasons:

1. The ability to move power out of the Thumb area on the existing ITCT transmission facilities within the Thumb area is already at capacity.
2. The identified minimum and maximum wind generation capacity values are significantly higher than those identified for the other zones.
3. There is a large-enough absolute difference between the Board identified minimum and maximum capacity values that, while one project could support both the minimum and maximum wind generation capacities, different backbone systems could be utilized for each case.

The current transmission system in the Thumb area consists of two relatively low-capacity 120 kV transmission circuits: one traversing south in the western half of the region that can support approximately 225 MW, and another traversing south along the eastern half of the region that can support approximately 150 MW. These are shown in Figure 10.

Figure 10 – Existing Capacity of Thumb Area Transmission

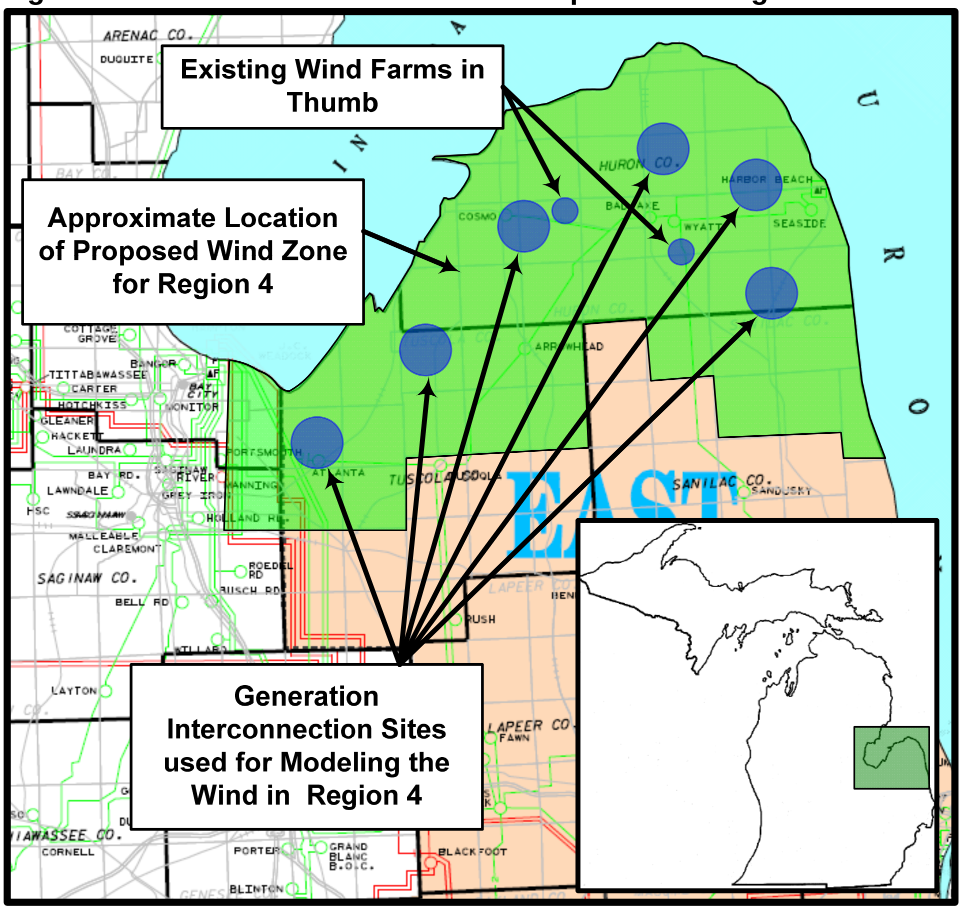


The current capacity of these transmission facilities is much lower than the Board identified minimum and maximum wind capacity levels (2,367 MW and 4,236 MW respectively) for Region 4. In fact, numerous generation interconnection studies[3] have documented the fact that there is essentially no additional transmission capacity available in the Thumb area.

The generation for Region 4 was initially modeled at six interconnection stations that directly connected to the existing 120 kV system in Region 4 as depicted in Figure 11. Using this as a starting point, the results indicated that significant backbone transmission system enhancements would be required. Specifically, significant overloads were identified on the two existing 120 kV circuits that travel south out of the Thumb.

There are both METC and ITCT transmission facilities within or adjacent to Region 4. There are no WPSCI facilities within or adjacent to Region 4.

Figure 11 – Wind Interconnection Assumptions for Region 4



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[3] Various generation interconnection study reports for the Thumb area are available on the Midwest ISO Generation Interconnection website at: http://www.midwestmarket.org/publish/Folder/7be606_10b7aacd66e_-79870a48324a?rev=1

3.4.1. Transmission Requirements Within Region 4

The effort to develop a transmission backbone capable of supporting the Board-identified minimum and maximum wind generation capacity for this region began by attempting to utilize the existing 120 kV rights-of-way to the extent possible. This was first done by considering a rebuild of the 120 kV circuits that traverse the Thumb region from the southwest region of the Thumb to the north central region and down the southeast side, referred to herein as the "Thumb Loop," utilizing the a typical 230 kV double-circuit tower configuration. This would be accomplished by replacing the existing single-circuit 120 kV structures with double-circuit 230 kV structures. Such a configuration would provide four 230 kV circuits exiting the Thumb area.[4] However, this approach was insufficient to carry the minimum (and thus maximum) wind capacity identified by the Board.

The next consideration was increasing the conductor size. The 230 kV double-circuit tower configuration was modeled using a larger, more expensive conductor than that typically used for 230 kV. This conductor can carry more power because it can be operated at higher temperatures. However, these 230 kV double-circuit tower configurations utilizing existing rights-of-way to the extent possible were found to be insufficient even for the minimum capacity.

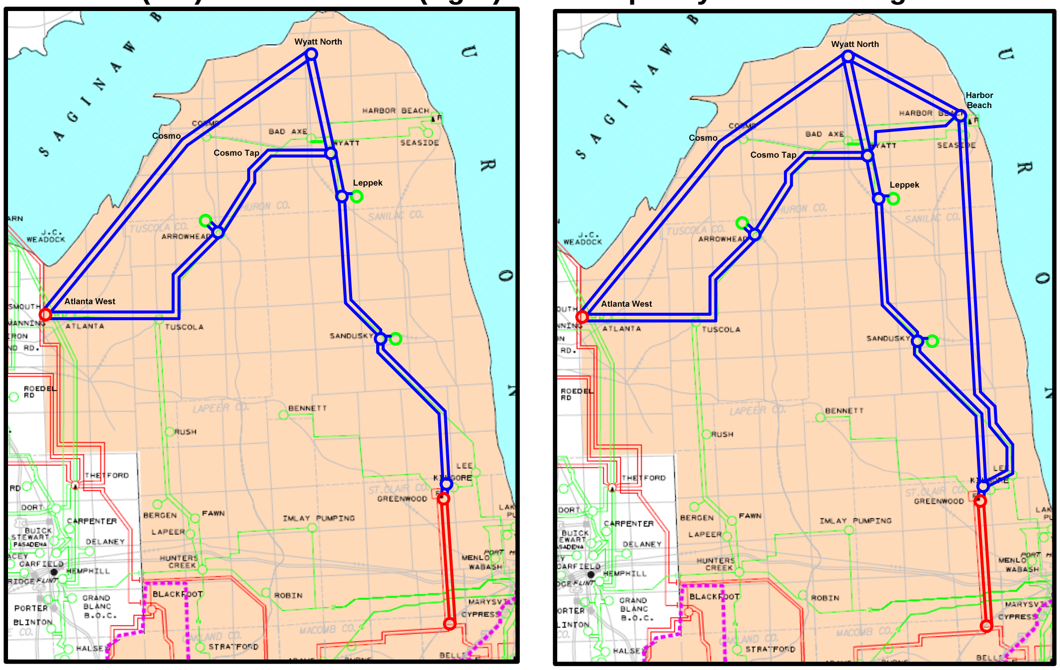
Because the double-circuit 230 kV configurations discussed above were found to be inadequate for the minimum wind generation capacity, it would be necessary either to continue a 230 kV build-out by adding additional 230 kV circuits exiting the Thumb area, or to rebuild the existing Thumb Loop utilizing a higher voltage configuration.

In order to support the identified minimum and maximum capacities with 230 kV facilities, a rebuild of the existing 120 kV Thumb Loop was modeled with double-circuit 230 kV towers and the larger conductor that can be operated at higher temperatures, plus the addition of two more circuits on a new double-circuit tower line that would extend north from a 230 kV station at or near the existing Wyatt station and run south down the west side of the Thumb to a new station that would connect the four new 230 kV circuits to the existing 345 kV system that traverses north and south just west of the Thumb area. As depicted in Figure 12, this configuration would allow six 230 kV circuits to exit the Thumb area: two along the east side and four along the west side. Based on the input assumptions considered, this configuration would be able to support the minimum identified wind generation capacity but not the maximum.

The connection of wind generation up to the maximum identified capacity utilizing 230 kV facilities would require the addition of two more 230 kV circuits exiting the Thumb area and at least one 230 kV circuit within the Thumb area. The two new facilities exiting the Thumb area would extend from a new station north of the existing Wyatt station down the west side of the Thumb to the existing Greenwood station. A new 230 kV facility within the Thumb was modeled from the existing Wyatt station to a new 230 kV station near the existing Harbor Beach station. This is depicted in the diagram on the right in Figure 12 and would allow eight 230 kV circuits to exit the Thumb area: four along the east side and four along the west side.

[4] The four circuits come from two circuits on the double circuit tower in the western thumb loop and two circuits on the double circuit tower in the eastern thumb loop.

Figure 12 – Minimum Transmission Requirements at 230 kV for Board-Identified minimum (left) and maximum (right) Wind Capacity Level for Region 4



The second option considered to support the Board-identified minimum and maximum capacities was a rebuild of the existing 120 kV Thumb Loop with double-circuit 345 kV towers. This would require rights-of-way wider than those for the existing 120 kV circuits. This is depicted in Figure 13. It would allow four 345 kV circuits to exit the Thumb area as opposed to six or eight circuits as mentioned in the previous 230 kV scenarios.

Figure 13 – Minimum 345 kV Transmission Requirements for Board-Identified Maximum Wind Capacity Level for Region 4

Based on the input assumptions considered, this configuration was shown to be capable of supporting both the minimum and maximum wind generation capacities identified in Region 4.

Table 1 provides a comparison of the various backbone transmission system options for Region 4. It highlights the costs for each option, the approximate amount of wind generation capacity that could be connected in Region 4 for each configuration, the possible right-of-way requirements and a comparison of the total METC and ITCT transmission system loses including the losses in the networked lower voltage[5] systems included in the transmission system models on the combined[6] ITCT/METC systems with wind connected in Region 4 up to the minimum and maximum levels.

The new backbone system in the Thumb area could be designed and constructed in approximately 3 years following approval. This does not include time to obtain any required approvals to begin design and construction.

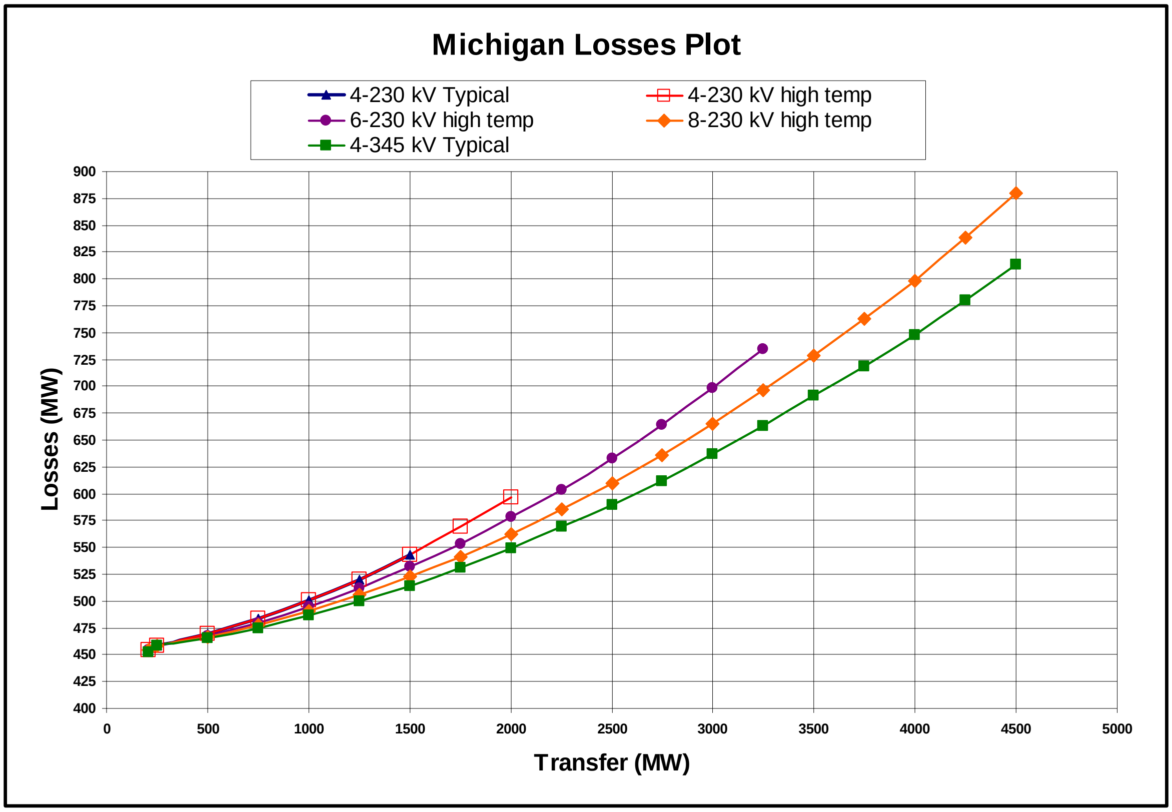
Table 1 – Capability & Cost Comparison for Region 4 Options

Configuration	4-230 kV Typical[7]	4-230 kV High Temp[8]	6-230 kV High Temp[8]	8-230 kV High Temp[8]	4-345 kV Typical[7]
Cost Estimates (in Millions)	$390	$420	$560	$740	$510
Wind Interconnection Capability	1,500 MW	2,000 MW	3,250 MW	4,750 MW	5,000 MW
Can Support Minimum Wind Capacity Identified by The Board	No	No	Yes	Yes	Yes
Can Support Maximum Wind Capacity Identified by the Board	No	No	No	Yes	Yes
ROW Requirements	Minimal Impact	Possible Expansion	Possible Expansion and New ROW	Possible Expansion and New ROW	Expansion Required
Total losses[6] with 2,367[9] MW Region 4 Injection	N/A[10]	N/A[10]	618 MW	596 MW	578 MW
Total losses[6] with 4,236[11] MW region 4 Injection	N/A[10]	N/A[10]	N/A[10]	836 MW	778 MW

[5] Only losses on the lower voltage facilities contained within the models are included in these numbers. Non-networked distribution is not explicitly modeled in the models used for transmission system studies.
[6] The base system losses within the METC and ITCT and underlying modeled networked distribution systems for the model used were about 450 MW. These represent the total system losses with only the existing wind modeled in Region 4.
[7] "Typical" refers to a typical configuration utilized for the voltage class denoted.
[8] "High Temp" refers to the utilization of a conductor that can be operated to higher temperatures than that which is typically utilized.
[9] Minimum wind generation capacity identified by the Board for Region 4.
[10] This configuration does not support this level of wind injection.
[11] Maximum wind generation capacity identified by the Board for Region 4.

Figure 14 depicts the total ITCT and METC transmission system and networked lower voltage system losses for varying levels of wind generation interconnected in Region 4 for the options discussed previously and highlighted in Table 1. As can be seen, with no additional wind connected in Region 4 the total transmission system (including networked distribution system included in the model) losses were around 450 MW. As additional power is connected in Region 4 the losses increase for each of the configurations considered.

Figure 14 – Losses Comparison Chart[12]



As noted earlier, costs for the conceptual wind generation interconnection stations utilized for this analysis were not developed for this report. These interconnection sites were used for modeling purposes only and are not intended to suggest where generators might physically locate.

3.4.2. Transmission Requirements External to Region 4

To support wind generation in Region 4 at the minimum or maximum levels identified by the Board, backbone transmission system upgrades in addition to those within Region 4 discussed above would be required. The upgrades would not be expected to be dependent on the backbone configuration within Region 4 and would be necessary for either the 230 kV or 345 kV Thumb Loop configurations.

[12] Losses in chart are based on one snapshot of the system and meant to depict relative differences. Actual system losses would depend on actual generation dispatch patterns.

While there would be backbone transmission system upgrades required for Region 4 beyond the Thumb Loop for either the minimum or maximum wind capacity levels, these enhancements likely could be accomplished utilizing the existing rights-of-way for the most part.

Several issues prevented the exploration of solutions for issues external to the Thumb, including a lack of sufficient time to perform the additional study work that would be necessary to determine how changes in existing generation dispatch patterns with the addition of significant amounts of wind generation would affect the region.

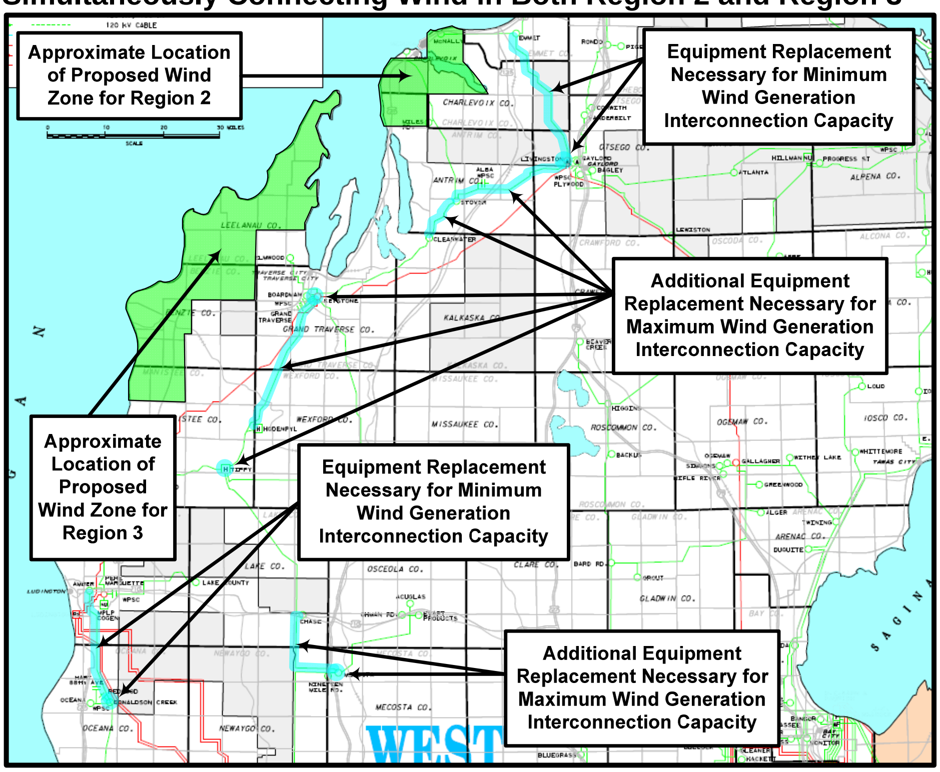
3.5. Transmission Requirements for Regions 2 and 3 Combined

3.5.1. METC Transmission Requirements for Regions 2 and 3 Combined

Using the interconnection assumptions for Regions 2 and 3, if wind generation is simultaneously connected in Regions 2 and 3, study results indicate that several backbone transmission system enhancements would be required on the METC system.

In order to support the minimum wind generation capacity level for both Regions 2 and 3, equipment replacement on two existing 138 kV METC circuits and in two existing METC stations would be required. In order to support the maximum wind generation capacity level, additional equipment replacement on four existing 138 kV METC circuits and in three existing METC stations would be required. These circuits and stations are highlighted in Figure 15.

Figure 15 – METC Transmission Elements Shown to Overload When Simultaneously Connecting Wind in Both Region 2 and Region 3



Upgrades to the backbone METC transmission system needed to support the interconnection of wind power in Regions 2 and 3 up to the minimum capacity levels would cost approximately $59 million. Upgrades to the backbone METC transmission system needed to support the interconnection of wind power in Regions 2 and 3 up to the maximum capacity levels would cost approximately $129 million.

Although transmission system upgrades would be required for the combination of Regions 2 and 3 for either the Board-identified minimum or maximum wind capacity levels, these enhancements to the backbone system could most likely be accomplished by utilizing existing right-of-way.

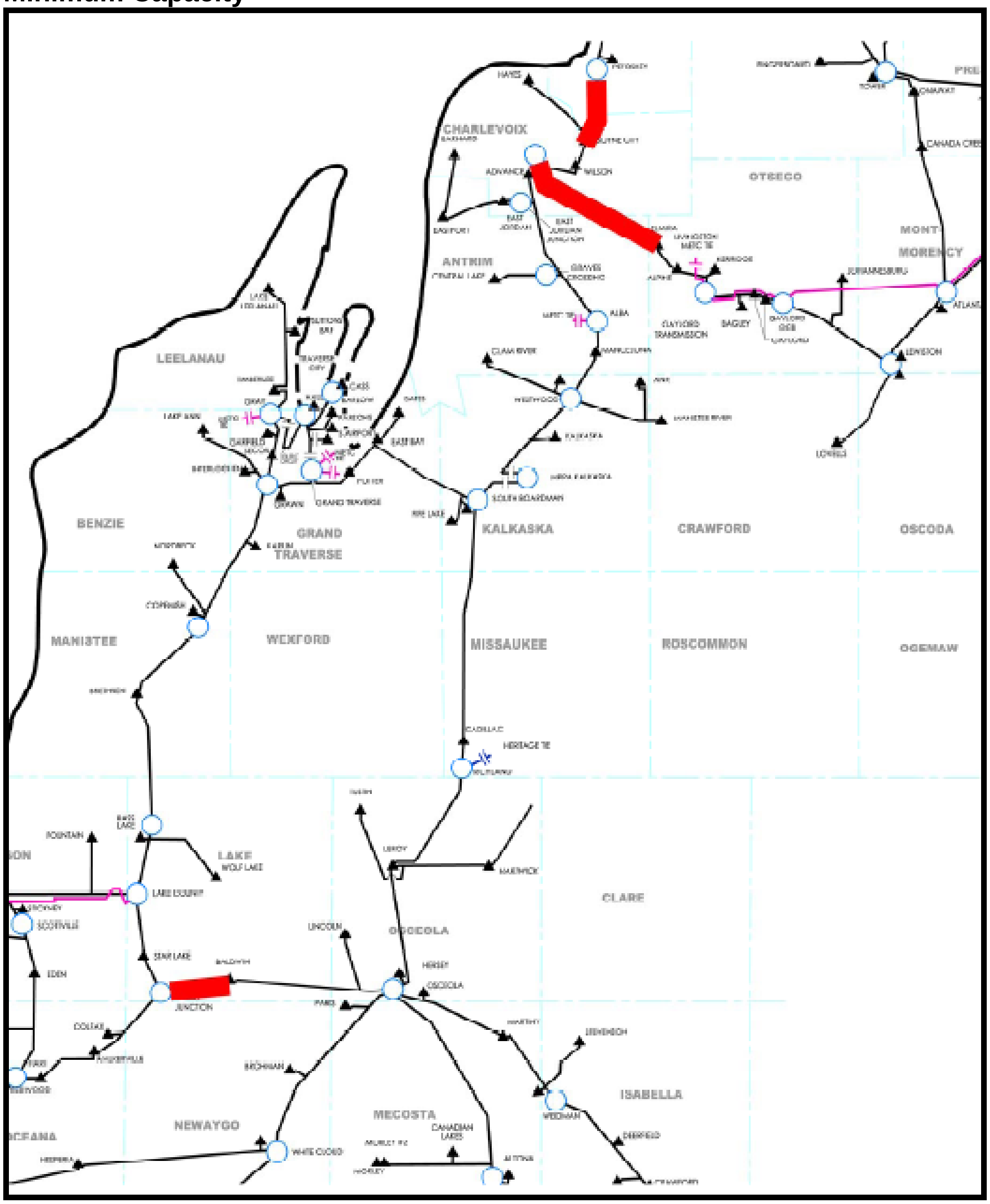
The METC projects identified for the combination of Regions 2 and 3 would not be expected to require more than 12 months to design and construct once approved.

3.5.2. WPSCI Transmission Requirements for Regions 2 and 3 Combined

Simultaneously connecting Regions 2 and 3 would require upgrades to the WPSCI system in both the minimum and maximum cases.

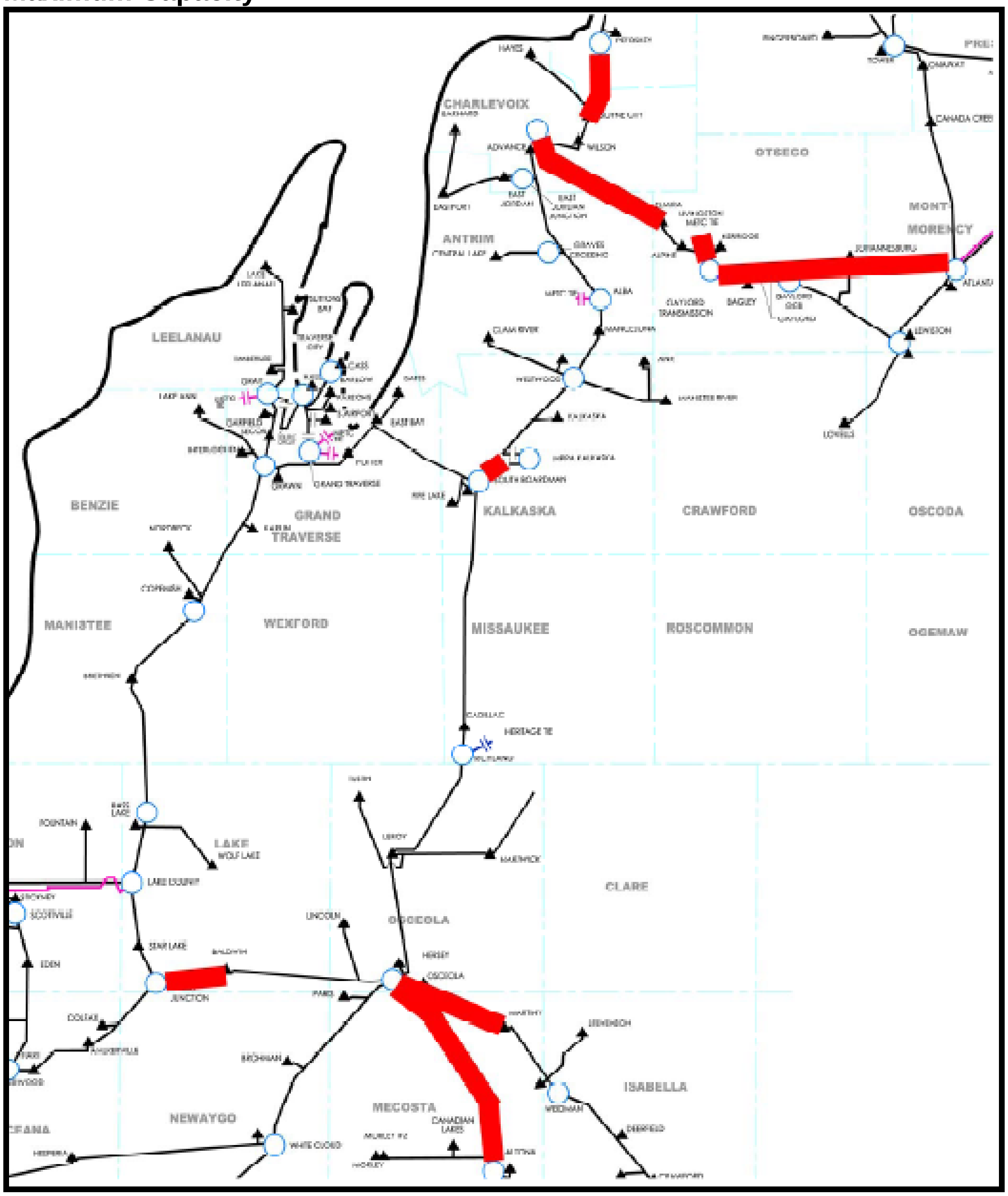
For the minimum-generation case, some WPSCI station equipment and approximately 34 miles of WPSCI transmission line would need to be upgraded. These upgrades could be constructed at a non-binding cost estimate of $14 million. These facilities are highlighted in Figure 16.

Figure 16 – WPSCI Transmission Facilities Required for Region 2 and Region 3 Minimum Capacity



For the maximum-generation case, some WPSCI station equipment, one transformer and approximately 110 miles of WPSCI transmission line would need to be upgraded. These upgrades could be constructed at a non-binding cost estimate of $47 million. These facilities are highlighted in Figure 17.

Figure 17 – WPSCI Transmission Facilities Required for Region 2 and Region 3 Maximum Capacity



4. Study Methodologies

In order to identify the transmission infrastructure that may be needed to interconnect the estimated maximum and minimum wind generation capacities for each of the four regions as identified in the Board's Final Report, this analysis considered various aspects of the Michigan Wind Energy Transmission Study Phase II scope document[13] developed with input from the Michigan Planning Consortium's Renewable and Other Generation Integration Working Group.[14]

4.1. General Assumptions

Model Development

All models utilized for this analysis were built starting with the Midwest ISO Regional Merit Order dispatch ("RMD") 2009 Midwest Transmission Expansion Plan ("MTEP") summer peak load model for the year 2014. For the Michigan systems, Midwest ISO Appendix A future projects included in the Midwest ISO Appendix A and expected to be in-service prior to the end of 2009 and in close proximity to the designated areas were included in the base model.

The 50-percent probability peak load forecast for the Lower Peninsula of Michigan for the 2014 summer as of April 24, 2009 was utilized to develop system loading on the ITCT and METC[15] transmission systems. The total projected load plus system losses for the METC[15] footprint was approximately 10,400 MW and the total projected load plus system losses for the ITCT footprint was approximately 11,000 MW.

Off-peak models (80 percent to 85 percent of summer peak loading levels) were developed from the peak models and were used to test wind output levels at or near 100 percent of identified nameplate capabilities.

Generation was dispatched per typical planning processes, where generators throughout Michigan along with all other generators within the Midwest ISO market are modeled as being dispatched to economically serve load within the Midwest ISO market while maintaining system reliability. All wind generators were dispatched to 20 percent of indicated nameplate capability in the peak load models and 100 percent of indicated nameplate capability in the off-peak models. These study methodologies are consistent with those used by the Midwest ISO to study wind generation interconnections.

Wind Interconnections

As noted above, this study focused on identifying the backbone transmission projects that would be required to support wind development in the regions identified.

The study did not attempt to develop "interconnecting" transmission (transmission between the wind generators and the backbone transmission) due to lack of sufficient information regarding the exact amounts and locations of future wind generation sites. For purposes of

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[13] http://www.dleg.state.mi.us/mpsc/electric/workgroups/mpc/michigan_wind_energy_transmission_study_scope041509_draft.pdf

[14] In July 2008, the Michigan Public Service Commission (MPSC) issued an order in Case No. U-15590 which established the Michigan Planning Consortium (MPC) to improve the planning process for electricity infrastructure projects and identify possible ways to reduce costs to ratepayers. More information can be found at the following website: http://www.michigan.gov/mpsc/0,1607,7-159-16377_47107_51195---,00.html.

[15] This includes the Wolverine system load.

this study, it was assumed that the interconnecting transmission would be determined via other study processes. The likely venue for the determination of the interconnection transmission is specific Midwest ISO generator interconnection studies.

In order to proceed with development of the backbone, some unspecified interconnecting transmission was assumed. This assumption manifested itself through modeling wind generation directly to the backbone as described above. It is important to note that the backbone transmission system described herein would not be expected to materially change if specific details were available that would allow for the design of the interconnecting transmission system.

Project Development via Transfer Analysis

The transmission analysis process related to the potential wind zones began with a traditional First Contingency Incremental Transfer Capability ("FCITC") analysis to determine where overloads would develop on the transmission system as the power generated from the wind resources is transmitted to both Michigan and the entire Midwest ISO market. FCITC analysis helps determine where overloads on the transmission system would be anticipated as power is transmitted in various directions across the transmission system while ensuring the system can withstand the loss of any one facility. This is consistent with accepted industry practice and standards.

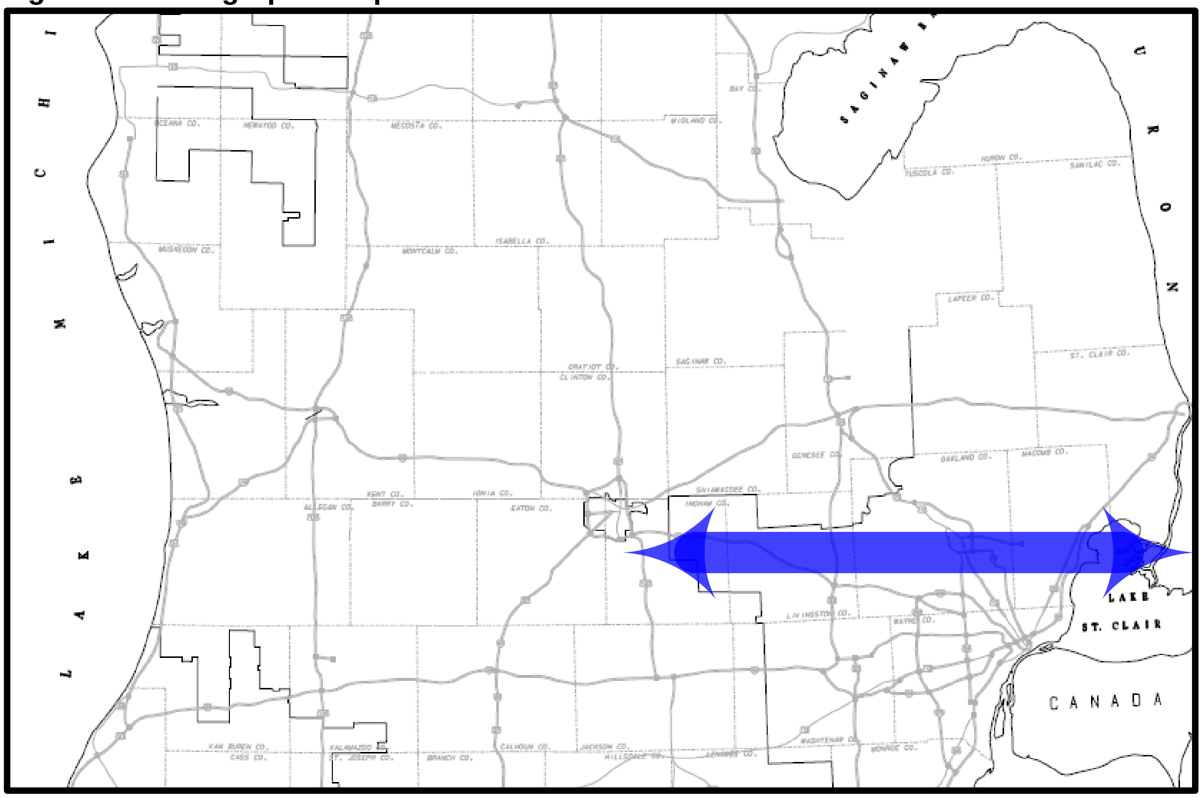
This analysis helped determine one (or several) sets of system upgrades that might support future wind generation in the proposed wind zones. This study serves as a starting point for project development but it is not an exhaustive analysis. Further analysis was necessary as described below.

Project Refinement via System Robustness Analysis

The preliminary projects developed in the FCITC analysis described above were tested further to determine how well they would perform under various system conditions. This was done by dispatching the wind generation in each individual region to both the minimum and maximum identified levels and allowing variations in system conditions (both system topology and generation dispatch variations) that could be anticipated to impact the ability to export wind at the identified levels. This could include various combinations of power transfers across the system in a range of directions or variations in generation in close proximity to the regions(s) or transmission system facilities in close proximity to the regions(s) being unavailable (either for system maintenance or due to some condition that would cause a facility to be forced out of service).

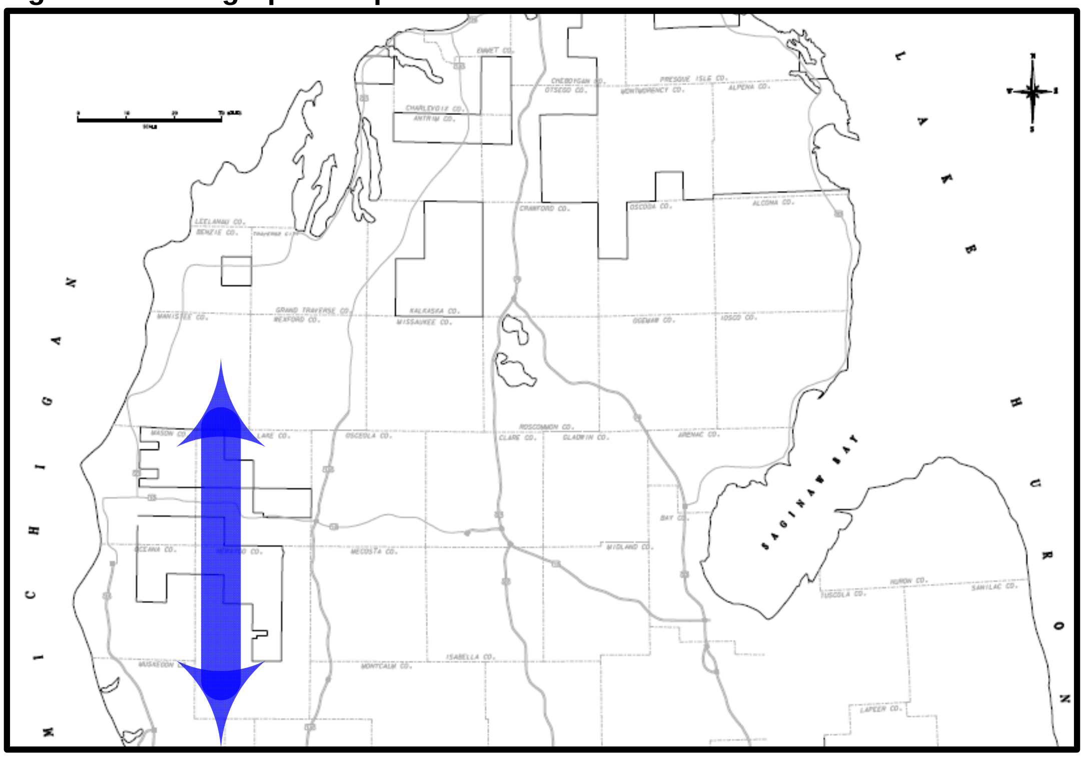
Power transfers across the system from east to west or west to east were simulated by increasing power flows across the Michigan-Ontario interface. This will have the largest implications in Region 4. See Figure 18 for a geographic representation of these transfers.

Figure 18 – Geographic Representation of Transfer Flows West and East



Power transfers across the system from north to south or south to north were simulated by modeling the Ludington Pumped Storage facility located in Ludington Michigan both as a generator and as a load in the off-peak models. This will have the largest impact on Regions 1, 2 and 3. See Figure 19 for a geographic representation of these transfers.

Figure 19 – Geographic Representation of Transfer Flows North and South



These scenarios are appropriate to study because they have occurred during actual system operating conditions in Michigan.

Transmission-system facility outages related to maintenance or some other condition that would cause a facility to be forced out of service were considered by simulating any two facilities in close proximity to the regions as being forced out of service at the same time. This is typically done in planning studies for off-peak system models to ensure the system can withstand any one single facility being out of service for planned maintenance without violating any reliability criteria. Without this ability, necessary planned transmission system maintenance may never be able to be scheduled or completed.

The loss of any two circuits that are (or would be) physically located on the same set of towers, referred to as a double-circuit tower line, was also simulated. These types of low-probability outages would leave no time for the system operator to react to mitigate the problem and therefore would need to be studied further to ensure that in the event of the loss of a double circuit tower line, no transmission system equipment damage would occur.

5. Summary

5.1. ITCT/METC

Region 1

No enhancements to the METC transmission system would be required for this region to interconnect the minimum or maximum wind generation capacity levels as indicated by the Board.

Region 2

To support the minimum wind generation capacity level, equipment replacement on one existing 138 kV METC circuit and in one existing METC station would be required at a cost of approximately $24 million. To support the maximum wind generation capacity level, additional equipment replacement on two existing 138 kV METC circuits would be required at a cost of approximately $42 million.

Region 3

Equipment replacement on one existing 138 kV METC circuit and in one existing METC station would be required to support the minimum wind generation capacity level and would cost approximately $36 million and no additional equipment replacement would be required in order to support the maximum wind generation capacity level.

Region 4

Significant backbone transmission system enhancements would be required in this region due to the fact that the capacity of the transmission facilities in this region is already lower than the Board identified minimum and maximum wind generation capacity levels. Options presented include six 230 kV high-temperature circuits at an approximate cost of $560 million to support the minimum wind generation capacity level, and eight 230 kV high-temperature circuits or four 345 kV circuits to support the maximum wind generation capacity level at approximate costs of $740 million and $510 million respectively.

Regions 2 and 3 Combined

To support the minimum wind generation capacity level for both Regions 2 and 3, equipment replacement on two existing 138 kV METC circuits and in two existing METC stations would be required and would cost approximately $59 million. To support the maximum wind generation capacity level, additional equipment replacement on four existing 138 kV METC circuits and in three existing METC stations would be required at a cost of approximately $129 million.

5.2. WPSCI

With the wind generation connected to the METC “backbone" network, constraints were still found to exist on the WPSCI system in Zone 2 and Zone 3. For the WPSCI system, the constraints found in Zone 2 require some station equipment upgrades and up to 16 miles of transmission line upgrades at a non-binding cost estimate of $7 million. For the WPSCI system, the constraints found in Zone 3 require some station equipment upgrades and up to 82 miles of transmission line upgrades at a non-binding cost estimate of $33 million. For the WPSCI system, the Zone 2 and 3 combination scenario was found to cause constraints requiring some station equipment upgrades, a transformer upgrade, and up to 110 miles of transmission line upgrades at a non-binding cost estimate of $47 million.