



## **Zone 5 overview**

Zone 5 includes the Wisconsin counties of:

- Kenosha
- Milwaukee
- Ozaukee
- Racine
- Washington
- Waukesha

The physical boundaries of Zone 5 and transmission facilities located in Zone 5 are shown in Figure ZS-26.

Zone 5 encompasses southeast Wisconsin. Land use in Zone 5 is largely urban, though some agricultural uses exist. The major population center in Zone 5 is the metropolitan Milwaukee area.

Zone 5 typically experiences peak demands during the summer months. Large industrial loads in the Milwaukee metropolitan area (such as Charter Steel, Miller Brewing) are among the largest electricity users in the zone.

### ***Demographics***

#### *Historical and Projected Population*

The population of the counties in Zone 5 grew at an annual rate of 0.5% from 2001 to 2010. The highest growth rate occurred in Washington County (1.2%), while the largest increase in population occurred in Waukesha County, which increased about 22,900 people over the period.

Population in Zone 5 is projected to grow at 0.5% annually for the 2011 through 2020 period. Waukesha County is projected to realize the largest increase in population of 43,500, while Washington County is projected to have the highest growth rate (1.5%).

#### *Historical and Projected Employment*

During the same period, the annual employment growth rate declined slightly. The highest growth rate was in Washington County of 0.5% and the highest increase in employment of 3,000.

Employment in Zone 5 is projected to grow at 0.8% annually between 2011 and 2020. Waukesha County is projected to realize the largest increase in employment of 30,400, while Washington County the highest growth rate (1.2%).



<b>Employment</b>			
Annual Growth Rate			
2001-2010		2011-2020	
Zone 5	-0.3	Zone 5	0.8
Washington, WI	0.5	Washington, WI	1.2
Total Increase			
2001-2010		2011-2020	
Zone 5	-29,618	Zone 5	89,609
Washington, WI	3,043	Waukesha, WI	30,458

<b>Population</b>			
Annual Growth Rate			
2001-2010		2011-2020	
Zone 5	0.5	Zone 5	0.5
Washington, WI	1.2	Washington, WI	1.5
Total Increase			
2001-2010		2011-2020	
Zone 5	81,496	Zone 5	90,138
Waukesha, WI	22,973	Waukesha, WI	43,549

**Zone 5 environmental considerations**

Zone 5 encompasses the southeastern portion of the state and is the most densely populated planning zone. The area lies in the Southern Lake Michigan Coastal and Southeast Glacial Plains ecological landscape regions. Most of the zone lies in the drainage basins of the Milwaukee, Root or Fox rivers. The Kettle Moraine State Forest lies in the western portions of the zone, and Lake Michigan forms its eastern boundary. Pre-settlement vegetation varied from prairie and oak savanna in the south, to southern mesic forest in the northern portions of the zone. Agricultural land uses are common throughout this zone.

**Zone 5 electricity demand and generation**

The coincident peak load forecasts for Zone 5 for 2012, 2016, 2021 and 2026 are shown in Table ZS-11. The table also shows existing generation, proposed generation based on projected in-service year, and resultant capacity margins (with and without the proposed generation).



The table shows that load in Zone 5 is projected to grow at roughly 1.25 percent annually from 2012 through 2021. Comparing load with generation (at maximum output) within the zone indicates that Zone 5 has more generation than load during peak load periods.

### ***Zone 5 transmission system issues***

Key transmission facilities in Zone 5 include:

- The southern portion of 345-kV lines from Point Beach and Edgewater,
- The Saukville, Arcadian, Granville, Oak Creek, and Racine 345/138-kV substations,
- The transmission lines emanating from the Pleasant Prairie and Oak Creek power plants,
- 230 kV facilities near Milwaukee,
- A significant 138-kV network in the Milwaukee area, a portion of which is underground,
- Heavy flows on aging facilities, and
- Heavy market flows from and to the south, resulting in high 345-kV and 138-kV line loadings and the need to monitor potential multiple contingency conditions.
- Several provisional projects in past 10-Year Assessments found low voltage and thermal overload issues which did not appear in the 2011 Assessment. The provisional project in-service dates were retained for now until it can be determined in future assessments that these voltage and thermal issues no longer exist.

Apart from the analysis performed in this Assessment, there is one major area event that could impact transmission plans in Zone 5. The proposed road rebuild of the Zoo interchange is moving forward with the following in-service dates:

- Expand/update Watertown Plank area (2013),
- Expand/update Highway 100/Highway 45 area (2014), and
- Expand/update remainder of freeway (2015-2018).

The analyses of this road relocation project will likely result in new projects to reconfigure the transmission system around Bluemound and 96<sup>th</sup> Street substations. Further projects may develop depending on the Department of Transportation's plans to rebuild the interchange. Studies are ongoing and plans will be finalized in the 2011-2012 timeframe.



## **Zone 5 – 2012 study results**

Refer to Table ZS-1 and Figure ZS-17

### *Summary of key findings*

- Some of the line loading and low voltage issues in Zone 5 occur as a result of opening substation bus tie breakers; the remedy is to adjust local generation within applicable timeframes.
- Outages of one of the Arcadian – Waukesha 138-kV lines can cause high flows on the other line.

Circuit breaker outages at Pleasant Prairie and Oak Creek can cause transformers at Bain and Oak Creek to exceed their summer emergency ratings. Loading relief can be achieved by backing down local area generation, keeping facilities within applicable ratings.

An outage of either one of the Arcadian–Waukesha 138-kV lines (KK9962 and KK9942) results in the other Arcadian–Waukesha 138-kV line approaching their summer emergency ratings. Re-dispatching local area generation will provide interim relief.

Two 138-kV buses in southeastern Wisconsin indicate marginal bus voltage under single contingency conditions during the summer peak period. The 138-kV buses experiencing marginal bus voltages are Maple and Germantown Substations. Neither bus drops below 90 percent under contingency. ATC Planning Criteria calls for maintaining bus voltages at 90 percent or higher under intact system conditions.

No performance limits were exceeded for Category A conditions for all 2012 analysis except the high voltage on the 138-kV buses found in the Racine, Kenosha and Oak Creek area in the 2012 minimum load model. This issue can be addressed by re-dispatching area generation.



## **Zone 5 – 2016 study results**

Refer to Table ZS-2 and Figure ZS-18

### *Summary of key findings*

- Potential thermal limitations indicate the need for facility upgrades in the Waukesha area,
- Distribution load serving issues will be addressed by the construction of the Milwaukee County interconnection project,
- There are likely to be impacts related to the road interchange reconstruction project near the Milwaukee County Zoo that will generate transmission system projects in the next few years, and
- Load serving issues in Kenosha County and along the ATC/Commonwealth Edison interface will be resolved with a 345-kV line between Pleasant Prairie and Zion Energy Center.

In response to a customer request for a new distribution interconnection, two radial 138-kV transmission lines will be placed in service in 2015 to serve the new Milwaukee County Substation.

Studies are ongoing to determine potential transmission system impacts related to the expansion of the road interchange near the Milwaukee County Zoo. ATC is meeting with the Department of Transportation and We Energies to determine impacts and coordination issues related to those impacts. The current plan for expansion of the interchange area is as follows:

- Expand/update Watertown Plank area (2013),
- Expand/update Highway 100/Highway 45 area (2014), and
- Expand/update remainder of freeway (2015-2018).

Preliminary results indicate that as a result of this road relocation project, the transmission system around the Zoo Interchange could require reconfiguration in the 2013 timeframe. If there are additional transmission impacts as a result of this road expansion, projects will be developed as needed and reported in future Assessments.

Following are the results of the 2016 contingency analysis (NERC Category B or TPL-002-0 conditions) performed on Zone 5.



Circuit breaker outages at Pleasant Prairie continue to cause the transformer at Bain to exceed its summer emergency rating. Temporary load relief can be achieved by backing down local generation. The proposed 345-kV bus reconfiguration at Pleasant Prairie in 2013 will resolve the issue at that substation.

Circuit breaker outages at Oak Creek continue to cause the transformer at Oak Creek to exceed its summer emergency rating. In the 2016 90% E-W bias case, a Granville 345-kV bus outage causes thermal overloads on the 345/138-kV transformer. Thermal relief in these areas can be achieved by backing down local generation.

As was discussed in the 2012 results discussion, an outage of either Arcadian – Waukesha 138-kV line continues to create thermal overload issues in the area. A project to rebuild the Arcadian – Waukesha 138-kV lines will address these issues and is proposed for 2016.

An outage of the Arcadian 345/138-kV transformer #1 causes the other area transformer to approach its summer emergency rating. Project development is underway to replace the existing Arcadian transformers with one or two 500 MVA transformers. Other alternatives are also being considered. Re-dispatching local generation will provide interim relief.

Past 10-Year Assessment found low voltages issues under contingency conditions in the Oak Creek/Bluemound area. Those issues did not appear in the 2011 10-Year Assessment. The previous solution was to install three 75 MVAR capacitor banks at the Bluemound Substation in 2014. This provisional project was retained and delayed one year to 2015 until it can be determined in future 10-Year Assessments that these voltage issues truly no longer exist.

The Bain – Kenosha, Kenosha – Lakeview, and Lakeview – Zion 138-kV lines exceed their summer emergency ratings for certain outages. In addition, the Pleasant Prairie – Zion 345-kV line approaches its summer emergency rating for certain outages. A project to construct a six mile, 345-kV line between Pleasant Prairie and the Zion Energy Center scheduled for 2014 will address these issues. For more information, please refer to Economics.

The Albers – Kenosha 138-kV line exceeds its summer emergency rating for certain outages. Further study is needed to determine the best solution to this issue. Temporary loading relief can be achieved by re-dispatching area generation.

The Harbor – Kansas and Oak Creek – Ramsey 138-kV lines overload under contingency in off-peak scenarios. Further study is needed to determine the best solution to these issues. Temporary loading relief can be achieved by backing down local generation.

No performance limits were exceeded for Category A conditions for all 2016 analysis.



The lead times necessary to implement the corrective plans that are scheduled for 2012 through 2016 were considered and taken into account prior to assigning an in-service date for each associated project. All of the projects scheduled for the near term planning horizon have an “In-service date” that matches the “Need date”, except the following projects:

*Projects whose “Need date” precedes the “In-service date”*

- None

*Projects whose “In-service date” precedes the “Need date”*

- Bluemound capacitor banks as described above.

## **Zone 5 – 2021 study results**

Refer to [Table ZS-3](#) and [Figure ZS-19](#)

### *Summary of key findings*

- Load growth in Waukesha and Washington counties will require voltage and thermal reinforcements. Local generation adjustment is an interim solution, and
- Voltage and thermal issues remain in Zone 5 under contingency conditions.

Following are the results of the 2021 contingency analysis (NERC Category B or TPL-002-0 conditions) performed on Zone 5.

Low probability circuit breaker outages at Oak Creek continue to be a chronic issue. Relief can be provided by reducing the output of area generation.

Certain outages will result in the Albers–Kenosha 138-kV line loading to exceed its summer emergency rating. Re-dispatching local generation will provide relief.

Two 138-kV buses in southeastern Wisconsin indicate low bus voltages under single contingency conditions during off peak periods. The 138-kV buses experiencing marginal bus voltages are Maple and Germantown Substations. Re-dispatching area generation will provide relief.

Loading issues on the Arcadian – Waukesha 138-kV lines and Arcadian transformers under contingency conditions worsen when compared to 2016. Rebuilding the lines with higher capacity conductors and replacing the two smaller transformers at Arcadian are potential solutions. Running local generation provides additional relief.



Loading on the Pleasant Prairie – Zion 345-kV line exceeds its summer emergency rating under contingency conditions. The Kenosha – Lakeview, Lakeview – Zion and Arcadian – Zion 138-kV lines exceed their summer emergency ratings under certain outage conditions. The new Pleasant Prairie – Zion Energy Center (2014) 345-kV line as described in the Zone 5 - 2016 analysis and our Economics section will resolve these issues.

Past studies have shown low bus voltages in eastern Jefferson, western Waukesha, and southern Washington counties, all areas where load growth has been and is expected to remain high. To provide relief, a new 345-kV line connecting the Madison area with the Milwaukee area could be considered. Such a line would improve the voltage profile in Jefferson, Waukesha and Washington counties, reduce loading on parallel 138-kV circuits, reduce system losses, and improve ATC’s existing east-west transfer capability in this region. Such a project is not being proposed in this Assessment, but may be justified in future Assessments for analysis beyond the current 10-year horizon. Potential economic benefits will need to be reviewed as the future develops.

As part of our 2021 analyses, we performed a screen to determine the potential impact upon the transmission system given the long lead-time outage of Oak Creek 345/230-kV transformer T884. The results of this screen indicate a potential overload of the Oak Creek – Bluemound 230-kV line under this scenario plus the next contingency. Further study is needed, but a provisional project to uprate the Oak Creek – Bluemound 230-kV line 873 could address this issue.

A provisional project to uprate the Oak Creek-Pennsylvania 138-kV line is being considered in the 2021 timeframe in order to address remaining voltage and thermal issues.

No performance limits were exceeded for Category A conditions for all 2021 analysis.

The lead times necessary to implement the corrective plans that are scheduled for 2017 through 2021 were considered and taken into account prior to assigning an in-service date for each associated project. All of the projects scheduled for the longer term planning horizon have an “In-service date” that matches the “Need date”, except the following projects:

*Projects whose “Need date” precedes the “In-service date”*

- None

*Projects whose “In-service date” precedes the “Need date”*

- Replace two existing 345/138-kV transformers at Arcadian Substation with 1-500 MVA transformer.





## **Zone 5 – 2026 study results**

Refer to [Table ZS-4](#) and [Figure ZS-20](#)

### *Summary of key findings*

- Heavy load growth in Waukesha and Washington counties will require voltage and load support. A new 345-kV line from Rockdale to Mill Road (formerly Lannon Junction) is one option being considered but not yet proposed to solve these problems,
- The Oak Creek-Pennsylvania 138-kV line uprate in-service date was determined considering not only the need date identified in the 2011 10-Year Assessment, but also the need dates identified in both the 2010 and 2009 Assessments. Therefore, the 2011 in-service date precedes the 2011 Assessment need date as described below, and
- Voltage and thermal issues remain in Zone 5 under contingency conditions.

The Brookdale East 138-kV bus, Allerton 138-kV bus and Bluemound 230-kV buses experience marginal bus voltage under NERC Category A or TPL-001-0 conditions (intact system) in 2026.

Following are the results of the 2026 steady state contingency analysis (NERC Category B or TPL-002-0 conditions) performed on Zone 5.

Contingency results were similar to those seen in 2021. The only new finding is the marginal voltage at Pennsylvania in for the outage of Oak Creek – Pennsylvania 138-kV line. The Pennsylvania 138-kV bus does not drop below 90 percent under contingency, so no mitigation is needed in this timeframe. ATC [Planning Criteria](#) calls for maintaining bus voltages at 90 percent or higher under intact system conditions.

Past 10-Year Assessments found thermal overload issues under single contingency conditions for the existing Oak Creek – Pennsylvania 138-kV line. This issue did not appear in the 2011 10-Year Assessment. The past solution was to uprate the Oak Creek – Pennsylvania 138-kV line in 2021. This provisional project in-service date was retained for now until it can be determined in future Assessments that these thermal issues truly no longer exist.

In the [2021 results](#) section, a potential Rockdale–Mill Road 345-kV line was discussed as a way to improve bus voltages in Waukesha, Washington, and Jefferson Counties. Through 2019, our planning models indicate there is generation available that could provide support to the three county region. At some point between 2019 and 2024, all of the available generation will be dispatched. Dispatching local generation has been able to provide



voltage and thermal relief. When all the generation has been dispatched, no additional relief will be available and it will be time to consider other system improvements.

A Rockdale – Mill Road 345-kV line could consist of the following components:

- Construct a new 345/138-kV Mill Road Substation (formerly known as Lannon Junction) at the intersection of the Cypress-Arcadian 345-kV line, the Arcadian-Granville 345-kV line, Germantown-Bark River 138-kV line and Sussex-Tamarack 138-kV line. This project will improve the 138-kV voltage profile in the area and facilitate expansion of the 345-kV network to the west of this substation. A 500 MVA, 345/138-kV transformer will be installed.
- Construct a Rockdale-Concord 345-kV line adjacent to the existing Rockdale-Jefferson-Concord 138-kV line on existing double-width right-of-way and install a 500 MVA, 345/138-kV transformer at Concord.
- Convert the Bark River-Mill Road 138-kV line (currently built to 345-kV standards) to 345-kV operation and install a 500 MVA, 345/138-kV transformer at Bark River.
- Construct a new 345-kV line from Concord to Bark River.

No performance limits were exceeded for Category A conditions for all 2026 analysis.

### ***Assessment of Steady State Compliance with NERC Standards***

The mitigation plans comprised of planned, proposed and provisional projects identified for Zone 5 in this Assessment will allow the ATC system in Zone 5 to meet the steady state portions of NERC standards TPL-001 and TPL-002 in each of the five years 2012-2016, and for the 2016-2021 planning horizon.

Table ZS-1  
2012 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2012 Summer Peak Case		2012 Minimum Load Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
1	Base case loading criteria exceeded	FALSE	--	FALSE	--	System Intact
1	Base case voltage criteria exceeded	--	FALSE	--	FALSE	System Intact
1	Council Creek 138-kV bus	--	89.1% - 89.2%	--	--	Council Creek - Petenwell 138-kV line ACEC Badger West - Saratoga 138 KV line ACEC Badger West - Petenwell 138 KV line Saratoga - Petenwell 138-KV line
1	Badger West 138-kV bus	--	89.3%	--	--	ACEC Badger West - Saratoga 138 KV line
1	Petenwell 138-kV bus	--	89.3%	--	--	ACEC Badger West - Saratoga 138 KV line ACEC Badger West - Petenwell 138 KV line Saratoga - Petenwell 138-KV line
2	Base case loading criteria exceeded	FALSE	--	FALSE	--	System Intact
2	Base case voltage criteria exceeded	--	FALSE	--	TRUE	System Intact
2	M38 – Atlantic 69-kV line	94.6%	--	--	--	M38 – Atlantic 138-kV line M38 – Atlantic 138-kV line <sup>5</sup>
2	Chandler – Lakehead Tap 69-kV line Masonville – Lakehead Tap 69-kV line Gladstone – North Bluff 69-kV line Madonville – Gladstone 69-kV line	108.5% 104.3% 97.3% 97.2%	--	--	--	Delta – Mead 69-kV line
2	Delta – Mead 69-kV line	97.3%	--	--	--	Chandler – Lakehead 69-kV line
2	Engadine, Newberry, LouPac, Newberry Hospital, Newberry Village, Roberts 69-kV buses	--	90.9 - 91.3%	--	--	Hiawatha – Engadine 69-kV line
2	North Bluff, Bay View, Mead, Gladstone, Masonville and Lakehead 69-kV buses	--	84.2 - 89.1%	--	--	Delta – Mead 69-kV line
2	Mead and Bay View 69-kV buses	--	--	--	90.4-91.0%	Delta – Mead 69-kV line
2	Alger Delta, Munising, Alger 69-kV buses	--	--	--	105.4-105.5%	System Intact
2	Atlantic 138-kV bus	--	--	--	113.7%	Atlantic – M38 138-kV line
3	Base Case Loading Criteria Exceeded	FALSE	--	FALSE	--	System Intact
3	Base Case Voltage Criteria Exceeded	--	FALSE	--	TRUE	System Intact
3	Royster – AGA Gas Tap 69-kV line	109.0%	--	--	--	Fitchburg – Syene 69-kV line
3	Royster – Sycamore 69-kV line	95.5%	--	--	--	Femrite 138/69-kV transformer
3	Darlington 138-kV bus	--	--	--	105.2%	System Intact
3	Huiskamp 138-kV bus	--	90.5%	--	114.8%	Huiskamp – North Madison 138-kV line
3	Verona 138-kV bus	--	90.9%	--	114.6%	Verona – Oak Ridge 138-kV line

Table ZS-1  
2012 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2012 Summer Peak Case		2012 Minimum Load Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
3	Hubbard and Hustisford 138-kV buses	--	87.5% 88.1% 88.1%	--	90.1% 90.2% 90.2%	Rubicon – Hustisford 138-kV line Hustisford – Hubbard 138-kV line Rubicon – Hustisford – Hubbard 138-kV line
4	Base case loading criteria exceeded	FALSE	--	FALSE	--	System Intact
4	Base case voltage criteria exceeded	--	FALSE	--	FALSE	System Intact
4	Sunset Point – Pearl Avenue 69-kV line	106.7% 106.4%	--	--	--	Ellinwood – 12th Avenue 69-kV line Ellinwood 138/69-kV transformer <sup>3</sup>
5	Base Case Loading Criteria Exceeded	FALSE	--	FALSE	--	System Intact
5	Base Case Voltage Criteria Exceeded	--	FALSE	--	TRUE	System Intact
5	Albers, Allerton, Hayes, Kenosha, Nicholson, Oak Creek, Pennsylvania, Racine, Ramsey, St. Rita, and Somers 138-kV buses	--	--	--	105-106.1%	System Intact
5	Maple and Germantown 138-kV buses	--	91.7% 91.2%	--	--	Maple – Saukville 138-kV line
5	Bain 345/138-kV transformer #5	108.3% 158.2%	--	--	--	Split Pleasant Prairie 345-kV bus 34 Split Pleasant Prairie 345-kV bus 23
5	Oak Creek 345/230-kV transformer T895	104% 100.1%	--	--	--	Split Oak Creek 230-kV bus 78 Split Oak Creek 230-kV bus 67
5	Arcadian4 – Waukesha1 138-kV line	98.8%	--	--	--	Arcadian6 – Waukesha3 138-kV line
5	Arcadian6 – Waukesha3 138-kV line	95.7%	--	--	--	Arcadian4 – Waukesha1 138-kV line Split Waukesha 138-kV bus 12
5	Harbor – Kansas 138-kV line	94.8%	--	--	--	Kansas – Norwich 138-kV line

Table ZS-2  
2016 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2016 Summer Peak Case		2016 70% Load Case		2016 90% Load Case		2016 105% Load Case		2016 65% High W-E Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
1	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
1	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	TRUE	--	FALSE	--	TRUE	System Intact
1	Council Creek 138-kV bus	--	104.9%	--	--	--	105.3%	--	--	--	105.4%	System Intact
1	Dartford 69-kV bus	--	91.2 - 91.4%	--	--	--	--	--	--	--	--	Ripon - Northwest Ripon Tap 69-KV line Metomen - Ripon 69-KV line
1	Petenwell 138/69 KV transformer	98.0 - 95.2%	--	--	--	--	--	98.1%	--	115.5%	--	Castle Rock - Quincy ACEC 69-KV line Hilltop - Buckhorn Tap 69-KV line Castle Rock - McKenna 69-kV line <sup>1</sup> McKenna - Quincy ACEC 69-KV line
1	ACEC Badger West - Saratoga 138-kV line	--	--	95.2 - 96.8%	--	--	--	--	--	95.8 - 100.9%	--	Arpin - Eau Claire 345-kV line King - Eau Claire - Arpin 345-kV line <sup>5</sup>
1	ACEC Badger West - Petenwell 138-kV line	--	--	98.2 - 99.8%	--	--	--	--	--	95.8 - 103.9%	--	Arpin - Eau Claire 345-kV line King - Eau Claire - Arpin 345-kV line <sup>5</sup>
2	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
2	Base case voltage criteria exceeded	--	FALSE	--	TRUE	--	FALSE	--	FALSE	--	FALSE	System Intact
2	Mead and Chandler 69-kV buses	--	--	--	--	--	--	--	--	--	95.1 - 95.9%	System Intact
2	Munising, Alger, Alger-Delta 69-kV buses	--	--	--	105-105.5%	--	--	--	--	--	--	System Intact
2	Lakota Road 115-kV bus	--	--	--	105.30%	--	--	--	--	--	--	System Intact
2	Indian Lake 69-kV bus	--	--	--	--	--	--	--	--	--	92.0% 91.1% 91.6% 91.7%	Pleasant Prairie – Zion 345-kV line Pleasant Prairie – Zion 345-kV line <sup>27</sup> Indian Lake 69-kV capacitor bank Perkins 138-kV capacitor bank
2	Indian Lake 138/69-kV transformer #1 Indian Lake 138/69-kV transformer #2	--	--	--	--	--	--	--	--	97.2-98.2%	--	Indian Lake 138/69-kV transformer #2 Indian Lake 138/69-kV transformer #1
2	Delta – Mead 69-kV line	102.3% 97.4% 97.1%	--	--	--	--	--	101.7% 96.8% 96.7%	--	--	--	Chandler – Lakehead Tap 69-kV line Masonville – Lakehead Tap 69-kV line Chandler - Lakehead - Masonville 69-kV line <sup>26</sup>
2	Chandler – Lakehead Tap 69-kV line Masonville – Gladstone 69-kV line Masonville – Lakehead Tap 69-kV line	112.8% 96.9% 108.5%	--	101.8% 90.7% 98.8%	--	108.6% 94.3% 104.7%	--	114.8% 97.9% 110.2%	--	103.9% 93.4% 101.1%	--	Delta – Mead 69-kV line
2	M38 – Atlantic 69-kV line	--	--	--	--	--	--	96.3% 96.5% 100%	--	--	--	M38 – Atlantic 138-kV line Atlantic 138/69-kV transformer M38 – Atlantic 69-kV line <sup>23</sup>
2	Engadine, Newberry, Newberry Hospital, Roberts, LouPac, Newberry Village, Hulbert and Eckerman 69-kV buses	--	90.3-90.7%	--	--	--	91.5-91.9%	--	91.3-91.7%	--	--	Hiawatha – Engadine 69-kV line
2	North Bluff, Bay View, Mead, Gladstone, Lakehead, Masonville 69-kV buses	--	84.7-91.8%	--	85.5-90.1%	--	84.9-89.6%	--	83.7-91.6%	--	82.3-90.5%	Delta – Mead 69-kV line
2	Empire - Presque Isle 138-kV line	--	--	--	--	--	--	--	--	100.6%	--	Split Empire 138-kV bus #23
2	Escanaba and West 69-kV buses	--	91.4-91.9%	--	--	--	--	--	--	--	--	Delta - West Tap 69-kV line
2	Nordic – Mountain 69-kV line	--	--	--	--	--	--	--	--	102.0% 110.5%	--	Empire – Forsyth 138-kV line Plains – Arnold 138-kV line

Table ZS-2  
2016 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2016 Summer Peak Case		2016 70% Load Case		2016 90% Load Case		2016 105% Load Case		2016 65% High W-E Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
3	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
3	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	System Intact
	Royster – Sycamore 69-kV line	98.2%	--	--	--	--	--	--	104.5%	--	--	Femrite 138/69-kV transformer
3	Verona 138-kV bus	--	89.4%	--	--	--	89.9%	--	88.8%	--	--	Verona – Oak Ridge 138-kV line
3	Huiskamp 138-kV bus	--	89.9%	--	91.7%	--	90.4%	--	89.9%	--	91.7%	Huiskamp – North Madison 138-kV line
3	Darlington – North Monroe 138-kV line	--	--	--	--	--	--	--	--	102.0 – 95%	--	Paddock 345/138-kV transformer Darlington 138/69-kV transformer Darlington – DPC Gratiot 69-kV line
3	Eden – Mineral Point 69-kV line	--	--	--	--	--	--	--	--	95.3%	--	Darlington – Lafayette Wind 138-kV line
3	South Monroe – Browntown 69-kV line	--	--	--	--	--	--	--	--	97.0%	--	Darlington – North Monroe 138-kV line
3	Concord 138-kV bus	--	--	--	--	--	--	--	96.0%	--	--	System Intact
3	Hubbard and Hustisford 138-kV buses	--	87.5% 88.2% 88.2%	--	87.1% 87.4% 87.4%	--	87.2% 86.5% 86.5%	--	--	--	87.2% 87.9% 87.9%	Rubicon – Hustisford 138-kV line Hustisford - Hubbard 138kV line Rubicon - Hustisford - Hubbard 138kV line
4	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
4	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	System Intact
4	Manrap – Custer 69-kV line	--	--	--	--	--	--	95.4%	--	--	--	Dewey – Lakefront 69-kV line
4	Lau Road – Elkhart Lake 138-kV line	--	--	--	--	--	--	--	--	95.6% 95.6% 95.6%	--	Sheboygan Energy Center – Grandville 345-kV line Point Beach – Sheboygan Energy Center 345-kV line Point Beach 345-kV bus tie 1 - 2
4	Elkhart Lake – Saukville 138-kV line	--	--	--	--	--	--	--	--	106.7% 106.7% 106.6% 103.4% 102.9% 101.9 – 95.0%	--	Point Beach 345-kV bus tie 1 - 2 Point Beach – Sheboygan Energy Center 345-kV line Sheboygan Energy Center – Grandville 345-kV line Cypress – Arcadian 345-kV line Edgewater – Cedarsauk 345-kV line Plus other less severe contingencies
4	Gravesville - Glenview 138-kV line	96.7% 96.7% 96.6% -- --	--	--	--	--	--	--	102.9% 102.9% 102.9% 96.0% 96.0%	--	--	Tecumseh Road 138/69 kV Transformer* Tecumseh Road 138/69 kV Transformer Tecumseh Road - Ford Drive tap 69-kV line Ford Drive tap - New Holstein 69-kV line Tecumseh Road - New Holstein 69-kV line*
4	Sunset Point – Pearl Avenue 69-kV line	107.9% 107.9%	--	--	--	97.0% 96.9%	--	113.6% 113.4%	--	--	--	Ellinwood – 12th Avenue 69-kV line Ellinwood 138/69-kV transformer*
5	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
5	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	System Intact
5	Bain 345/138-kV transformer #5	158.6% 111.4%	--	142.5% --	--	158.8% --	--	158.3% 106.4%	--	142.6% 127.1%	--	Split Pleasant Prairie 345-kV bus 34 Split Pleasant Prairie 345-kV bus 23
5	Oak Creek 345/230-kV transformer T895	104.2% 101.5%	--	--	--	104.4% --	--	104.3% 101.9%	--	--	--	Split Oak Creek 230-kV bus 78 Split Oak Creek 230-kV bus 67
5	Arcadian4 – Waukesha1 138-kV line	97.9%	--	114.1%	--	130.4%	--	98.5%	--	--	--	Arcadian6 – Waukesha3 138-kV line
5	Arcadian6 – Waukesha3 138-kV line	94.7% --	--	110.5% 100.4%	--	126.3% 112.7%	--	95.4% --	--	--	--	Arcadian4 – Waukesha1 138-kV line Split Waukesha 138-kV bus 12

Table ZS-2  
2016 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2016 Summer Peak Case		2016 70% Load Case		2016 90% Load Case		2016 105% Load Case		2016 65% High W-E Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
5	Arcadian 345/138-kV transformer #3	--	--	--	--	96.2% 99.6% 94.9%	--	--	--	--	--	Split Arcadian 345-kV bus 12 Arcadian 345-kV bus outage Arcadian 345/138-kV transformer #1
5	Bain – Kenosha 138-kV line	--	--	--	--	--	--	--	--	100.3%	--	Pleasant Prairie – Zion 345-kV line
5	Pleasant Prairie – Zion 345-kV line	--	--	--	--	--	--	--	--	96.8%	--	Zion – Arcadian 345-kV line <sup>27</sup>
5	Granville 345/138-kV transformer #1	--	--	--	--	108.2%	--	--	--	--	--	Split Granville 345-kV bus 23
5	Harbor – Kansas 138-kV line	--	--	110.4% 105.3% 102.5% 101.7%	--	100.0% -- -- --	--	--	--	--	--	Kansas – Norwich 138-kV line Dewey – Norwich 138-kV line Split Dewey 138-kV bus Dewey – Montana 138-kV line Plus Other Less Severe Outages
5	Albers – Kenosha 138-kV line	--	--	107.2%	--	105.6%	--	--	--	--	--	Albers – Bain 138-kV line
5	Edgewood – St. Martins 138-kV line	--	--	98.1%	--	--	--	--	--	--	--	Merrill Hills – Waukesha 138-kV line
5	Oak Creek – Ramsey 138-kV line Kansas – Ramsey 138-kV line Nicholson – Ramsey 138-kV line	--	--	--	--	101.0% 96.1% 95.1%	--	--	--	--	--	Oak Creek – Pennsylvania 138-kV line
5	Waukesha 138-kV bus 12	--	--	--	--	99.7%	--	--	--	--	--	Arcadian6 – Waukesha3 138-kV line
5	Kenosha – Lakeview 138-kV line	--	--	--	--	--	--	96.2%	--	126.9%	--	Pleasant Prairie – Zion 345-kV line
5	Lakeview – Zion 138-kV line	--	--	--	--	--	--	--	--	129.9%	--	Pleasant Prairie – Zion 345-kV line

Table ZS-3  
2021 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2021 Summer Peak Case		2021 Minimum Load Case		2021 70% Shoulder Case		2021 90% E-W Bias Case		2021 65% High W-E Bias Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
1	Base case loading criteria exceeded	TRUE	--	FALSE	--	FALSE	--	FALSE	--	TRUE	--	System Intact
1	Base case voltage criteria exceeded	--	FALSE	--	TRUE	--	FALSE	--	FALSE	--	FALSE	System Intact
1	Dartford, Ripon Industrial Park, Northwest Ripon and Ripon 69-kV buses	--	90.5 - 91.9% 90.6 - 91.9% 91.6%	--	--	--	--	--	--	--	--	Ripon - NW Ripon Tap 69-KV line Metomen - Ripon 69-KV line NW Ripon Tap - Dartford Tap 69-KV line
1	Winneconne, Omro and Omro Industrial Park 69-kV buses	--	90.8 - 91.4%	--	--	--	--	--	--	--	--	Winneconne - Sunset Point 69-kV line
1	Council Creek 161-kV bus	--	91.2%	--	--	--	--	--	--	--	--	Monroe County - La Crosse 161-kV line
1	Council Creek 138-kV bus	--	--	--	105.5%	--	--	--	--	--	--	System Intact
1	Metomen 138/69 KV transformer	95.6%	--	--	--	--	--	--	--	--	--	System Intact
1	Petenwell 138/69 KV transformer	101.7% 106.2% 104.1% 103.5% 101.4 - 103.3%	--	--	--	95.6 - 104.2%	--	--	--	119.2%	--	System Intact Castle Rock - Quincy ACEC 69-KV line Hilltop - Buckhorn Tap 69-KV line Castle Rock - McKenna 69-kV line <sup>14</sup> Plus other less severe contingencies
1	Castle Rock - ACEC Quincy 69-KV line	98.8% 98.8% 98.7%	--	--	--	--	--	--	--	--	--	Petenwell - Big Pond 69-KV line Petenwell 138/69-kV Transformer Necedah Tap - Big Pond 69-KV line
1	ACEC Badger West - Petenwell 138-kV line	--	--	--	--	96.9 - 135.9%	--	--	--	96.1 - 103.8%	--	Arpin - Eau Claire 345-kV line King - Eau Claire 345-kV line Arpin 345/138-kV transformer Arrowhead - Stone Lake 345-kV line Plus other less severe contingencies
1	ACEC Badger West - Saratoga 138-kV line	--	--	--	--	97.1 - 132.7%	--	--	--	100.5%	--	Arpin - Eau Claire 345-kV line King - Eau Claire 345-kV line Arpin 345/138-kV transformer Arrowhead - Stone Lake 345-kV line Plus other less severe contingencies
2	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
2	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	System Intact
2	Engadine, Newberry, Newberry Hospital, Roberts, LouPac, Newberry Village, Hulbert, Eckerman 69-kV buses	--	84.4-90.4% --	--	--	--	--	--	88.5-89.0% 89.5-89.8%	--	--	Hiawatha-Engadine 69-kV line Engadine-Newberry 69-kV line
3	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
3	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	System Intact
3	Darlington - North Monroe 138-kV line	--	--	--	--	--	--	--	--	118.8 - 98.8%	--	Paddock 345/138-kV transformer Darlington 138/69-kV transformer Darlington - DPC Gratiot 69-kV line Eden - Wyoming Valley 138-kV line Eden - Wyoming Valley - Spring Green 138-kV line plus other less severe contingencies
3	Eden - Mineral Point 69-kV line	--	--	--	--	--	--	--	--	111.3 - 98.5%	--	Darlington - Lafayette Wind 138-kV line
3	South Monroe - Browntown - Jennings Road - Wiote 69-kV line	--	--	--	--	--	--	--	--	110.8 - 101.2%	--	Darlington - North Monroe 138-kV line
3	Nelson Dewey 161/138-kV transformer	--	--	--	--	96.0%	--	--	--	--	--	System Intact
3	Nelson Dewey 161/138-kV transformer	--	--	--	--	103.1 - 99.4%	--	--	--	--	--	Nelson Dewey Unit 2 Pleasant Praire Unit 1 Pleasant Praire Unit 2 Edgewater Unit 5 plus other less severe contingencies
3	Royster - Sycamore 69-kV line	106.3%	--	--	--	--	--	96.3%	--	--	--	Femrite 138/69-kV transformer



Table ZS-3  
2021 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2021 Summer Peak Case		2021 Minimum Load Case		2021 70% Shoulder Case		2021 90% E-W Bias Case		2021 65% High W-E Bias Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	
3	Westport – Wanakee Muni#2 69-kV line	98.1%	--	--	--	--	--	--	--	--	--	West Middleton – Pheasant Branch 69-kV line
3	Verona 138-kV bus	--	87.9%	--	--	--	90.8%	--	88.8%	--	91.4%	Verona – Oak Ridge 138-kV line Verona 138/69-kV transformer
3	Huiskamp 138-kV bus	--	89.4%	--	114.8%	--	90.1%	--	90.4%	--	91.4%	Huiskamp – North Madison 138-kV line
3	Hubbard and Hustisford 138-kV bus	--	87.5% 88.1% 88.1%	--	87.5% 87.6% 87.6%	--	86.9% 87.3% 87.3%	--	88.1% 88.1% 88.1%	--	87.2% 87.2% 87.1%	Rubicon – Hustisford 138-kV line Hustisford – Hubbard 138-kV line Rubicon – Hustisford – Hubbard 138-kV line
3	Paddock – Townline 138kV line	--	--	--	--	102.8% 101.8% 101.1%	--	--	--	--	--	NW Neloit – Paddock 138-kV line Paddock – NW Beloit – Blackhawk 138-kV line NW Beloit – Blackhawk 138-kV line
3	NW Beloit – Paddock 138kV line	--	--	--	--	96.9%	--	--	--	--	--	Paddock – Townline 138-kV line
4	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
4	Base case voltage criteria exceeded	--	FALSE	--	TRUE	--	FALSE	--	FALSE	--	FALSE	System Intact
4	Manrap – Custer 69-kV line	99.3%	--	--	--	--	--	--	--	--	--	Dewey – Lakefront 69-kV line
4	Glenview – Gravesville 69-kV line	103.7% 103.7% 103.7% 97.0% 97.0%	--	--	--	--	--	--	--	--	--	Tecumseh Road 138/69 kV Transformer* Tecumseh Road 138/69 kV Transformer Tecumseh Road - Ford Drive tap 69-kV line Ford Drive tap - New Holstein 69-kV line Tecumseh Road - New Holstein 69-kV line*
4	Sunset Point – Pearl Avenue 69-kV line	110.5% 110.4%	--	--	--	--	--	98.9% 98.9%	--	--	--	Ellinwood 138/69-kV transformer* Ellinwood – 12th Avenue 69-kV line
4	Morgan – Falls 138-kV line	--	--	--	--	101.8%	--	--	--	--	--	Morgan – Plains 345-kV line
4	Elkhart Lake – Saukville 138-kV line	--	--	--	--	--	--	--	--	97.9%	--	Barnhart – Cedarsauk 345-kV line
4	Kewaunee 138-kV bus	--	--	--	103.6%	--	--	--	--	--	--	System Intact
5	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact
5	Base case voltage criteria exceeded	--	FALSE	--	TRUE	--	FALSE	--	FALSE	--	FALSE	System Intact
5	Oak Creek 345/230-kV transformer T895	104.3% 102.5%	--	--	--	--	--	104.4% 102.5%	--	102.7% 99.8%	--	Split Oak Creek 230-kV bus 78 Split Oak Creek 230-kV bus 67
5	Bain 345/138-kV transformer #5	158.4% 104.6%	--	--	--	--	--	--	--	--	--	Split Pleasant Prairie 345-kV bus 34 Split Pleasant Prairie 345-kV bus 23
5	Arcadian4 – Waukesha1 138-kV line	98.4%	--	--	--	110.2%	--	120.4%	--	--	--	Arcadian6 – Waukesha3 138-kV line
5	Arcadian6 – Waukesha3 138-kV line	95.3%	--	--	--	106.8% 95.8%	--	116.6% 102.0%	--	--	--	Arcadian4 – Waukesha1 138-kV line Split Waukesha 1-2 bus
5	Arcadian 345/138-kV transformer #3	--	--	--	--	--	--	95.9%	--	--	--	Arcadian 345/138-kV transformer #1
5	Pleasant Prairie – Zion 345-kV line	--	--	--	--	--	--	--	--	108.2% 101.1% 98.8%	--	Zion – Arcadian 345-kV line Zion - Arcadian 345-kV line <sup>14</sup> System Intact
5	Lakeview – Zion 138-kV line Arcadian – Zion 345-kV line Kenosha - Lakeview 138-kV line	96.8% -- 99.6%	--	--	--	--	--	--	--	144% 108.1% 141.9%	--	Pleasant Prairie – Zion 345-kV line
5	Bain – Kenosha 138-kV line	--	--	--	--	--	--	--	--	107.8%	--	Pleasant Prairie – Zion 345-kV line
5	Albers – Kenosha 138-kV line	--	--	--	--	100.4%	--	--	--	--	--	Albers – Bain 138-kV line
5	Maple and Germantown 138-kV buses	--	--	--	--	--	--	--	89.7-90.3%	--	--	Saukville – Maple 138-kV line

Table ZS-4  
2026 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2026 Summer Peak Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	
1	Base case loading criteria exceeded	TRUE	--	System Intact
1	Base case voltage criteria exceeded	--	TRUE	System Intact
1	Silver Lake, ACEC Spring Lake, Redgranite, Fountain Valley, River Run, Berlin and Fox River 69-kV buses	--	90.0 - 91.7% 91.0 - 91.2% 91.2 - 91.4% 91.8 - 91.9%	Wautoma – Silver Lake Tap 69-kV line Ripon - Northwest Ripon Tap 69-kV line Metomen – Ripon 69-kV line Silver Lake – ACEC Spring Lake 69-kV line
1	Dartford, Ripon Industrial Park, Northwest Ripon and Ripon 69-kV buses	--	96.4% 88.3 - 89.8% 88.5 - 89.9% 90.4 - 91.8%	System Intact Ripon - Northwest Ripon Tap 69-KV line Metomen – Ripon 69-kV line Northwest Ripon Tap - Dartford Tap 69-KV line
1	Winneconne, Omro and Omro Industrial Park 69-kV buses	--	89.4 - 90.0%	Winneconne – Sunset Point 69-kV line
1	Castle Rock – ACEC Quincy 69-kV line	101.1%	--	Necedah Tap – Big Pond 69-kV line Petenwell – Big Pond 69-kV line Petenwell 138/69-kV transformer
1	Metomen 138/69 KV transformer	100.5% 101.4% 100.0%	--	System Intact North Fond du Lac 138/69-kV transformer North Fond du Lac – Rosendale Tap 69-kV line
1	Petenwell 138/69-kV transformer	106.2% 110.2% 107.9% 107.5% 107.3% 98.6 - 106.2%	--	System Intact Castle Rock – Quincy ACEC 69-kV line McKenna – Quincy ACEC 69-kV line Hilltop – Buckhorn Tap 69-kV line Castle Rock - McKenna 69-kV line <sup>25</sup> Plus other less severe contingencies
1	Wautoma - ACEC Wautoma Tap 69-kV line	96.9%	--	Harrison North - Harrison 69-kV line
2	Base case loading criteria exceeded	FALSE	--	System Intact
2	Base case voltage criteria exceeded	--	FALSE	System Intact
2	Hulbert, Eckermann, Lou-Pac, Newberry Village, Roberts, Talantino 69-kV buses	--	83.5 - 89.4% 88.1 - 91.5% 86.4 - 90.8% 86.7 - 91.2%	Engadine – Newberry 69-kV line Newberry – Newberry Hospital 69-kV line Newberry Hospital – Roberts 69-kV line Hiawatha – Roberts 69-kV line 6911 <sup>24</sup>
3	Base case loading criteria exceeded	FALSE	--	System Intact
3	Base case voltage criteria exceeded	--	FALSE	System Intact
3	Timberlane Tap – West Middleton 69-kV line	95.6%	--	Spring Green 138/69-kV transformer
3	West Middleton – Pheasant Branch 69-kV line	107.8 – 96.5%	--	Waunakee Switching – Waunakee Municipal 2 69-kV line Westport – Waunakee Municipal 2 69-kV line West Middleton 138/69-kV transformer
3	West Middleton 138/69-kV transformer	--	--	West Middleton 138/69-kV transformer
3	Westport – Waunakee Muni2 69-kV line	114.7%	--	West Middleton – Pheasant Branch 69-kV line
3	Waunakee Industrial Park – Huiskamp 69-kV line	95.7%	--	West Middleton – Pheasant Branch 69-kV line
3	Royster – Sycamore 69-kV line	115.0%	--	Femrite 138/69-kV transformer
3	Huiskamp 138-kV bus	--	88.7%	Huiskamp – North Madison 138-kV line
3	Verona 138-kV bus	--	86.0%	Verona – Oak Ridge 138-kV line
3	Hubbard and Hustisford 138-kV bus	--	87.0% 87.7% 87.7%	Rubicon – Hustisford 138-kV line Hustisford – Hubbard 138-kV line Rubicon – Hustisford – Hubbard 138-kV line
3	Alto 69-kV bus	--	96.8%	System Intact
4	Base case loading criteria exceeded	FALSE	--	System Intact
4	Base case voltage criteria exceeded	--	FALSE	System Intact
4	Manrap – Custer 69-kV line	106.2%	--	Dewey – Lakefront 69-kV line

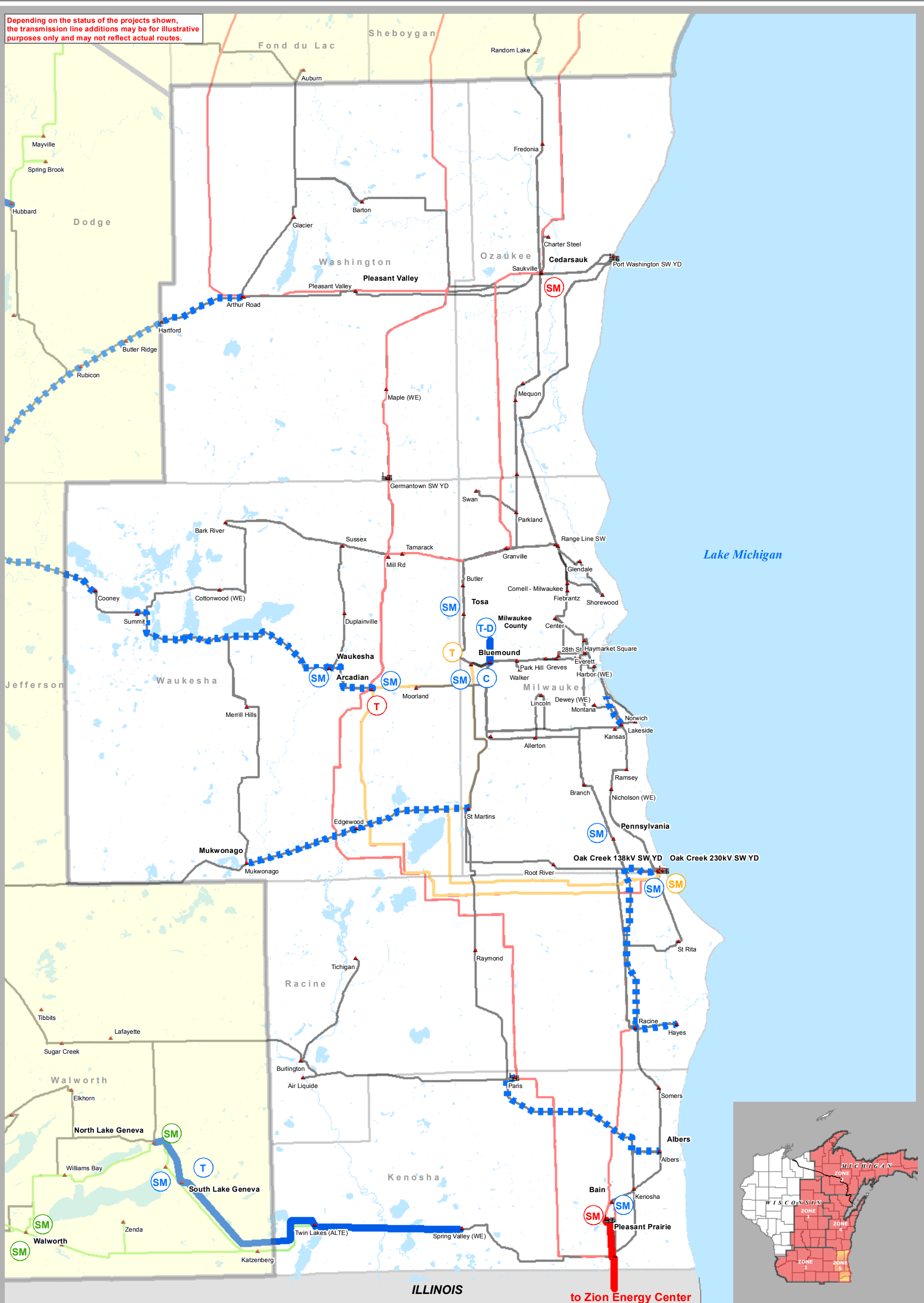
Table ZS-4  
2026 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2026 Summer Peak Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	
4	Glenview – Gravesville 69-kV line	101.5% 101.5% 101.5%	--	Tecumseh Road 138/69-kV transformer <sup>24</sup> Tecumseh Road 138/69-kV transformer Tecumseh Road – Ford Drive 69-kV
4	Sunset Point – Pearl Avenue 69-kV line	113.2% 112.9%	--	Ellinwood – 12th Avenue 69-kV line Ellinwood 138/69-kV transformer <sup>20</sup>
5	Base Case Loading Criteria Exceeded	FALSE	--	System Intact
5	Base Case Voltage Criteria Exceeded	--	FALSE	System Intact
5	Bluemound 230-kV buses #1, #2 and #3	--	95.8%	System Intact
5	Brookdale East, Allerton 138-kV buses	--	95.5 - 95.9%	System Intact
5	Bain 345/138-kV transformer #5	158.9% 99.5%	--	Split Pleasant Prairie 345-kV bus 34 Split Pleasant Prairie 345-kV bus 23
5	Oak Creek 345/230-kV transformer T895	102.4% 104.7%	--	Split Oak Creek 230-kV bus 67 Split Oak Creek 230-kV bus 78
5	Kenosha – Lakeview 138-kV line	103.0%	--	Pleasant Prairie – Zion 345-kV line
5	Lakeview – Zion 138-kV line	99.3%	--	Pleasant Prairie – Zion 345-kV line
5	Pennsylvania 138-kV bus	--	91.6%	Oak Creek – Pennsylvania 138-kV line
5	Arcadian – Waukesha 138-kV line	--	96.8%	Arcadian – Waukesha 138-kV line

*Table ZS-12  
Zone 5 Load and Generation*

Zone 5	2012	2016	2021	2026
Peak Forecast (megawatts)	4553.1	4784.4	5093.1	5408.9
Average Peak Load Growth	N/A	1.25%	1.26%	1.21%
Existing Generation Capacity (megawatts)	5535	5535	5535	5535
Existing Capacity Less Load (megawatts)	981.9	750.6	441.9	126.1
Existing Generation Capacity plus Modeled Generating Capacity Additions (megawatts)	5535	5535	5535	5535
Modeled Capacity Less Load (megawatts)	981.9	750.6	441.9	126.1

Depending on the status of the projects shown, the transmission line additions may be for illustrative purposes only and may not reflect actual routes.



## 2011 10-Year Assessment Projects PLANNING ZONE 5

Currently, ATC owns or operates transmission facilities in Wisconsin, Illinois, Minnesota, and the Upper Peninsula of Michigan. Facilities include:

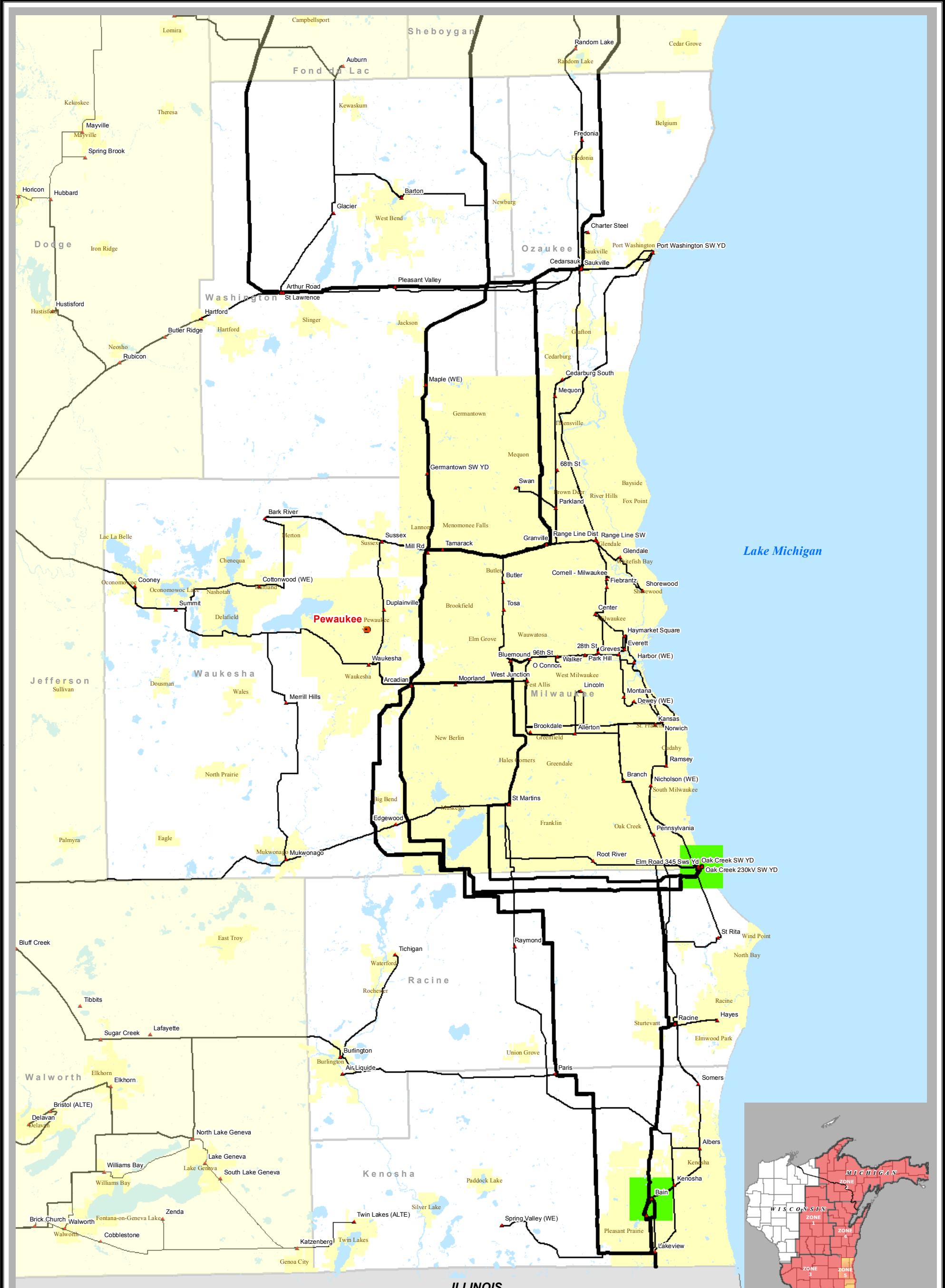
- \* Approximately 9440 miles of transmission lines
- \* 96 wholly owned substations
- \* 419 jointly owned substations
- \* ATC offices in Madison, Cottage Grove, Pewaukee, DePere, and Kingsford, MI

- New 69kV Transmission Line
- New 115, 138 or 161 kV Transmission Line
- New 345 kV Transmission Line
- - - Rebuilt 69 kV Transmission Line
- - - Rebuilt 115, 138 or 161 kV Transmission Line
- - - Rebuilt 345 kV Transmission Line
- Transmission Line Voltage Conversion

- (SS) New Substation
- SM Substation Modifications
- (T-D) T-D Interconnection
- (C) Capacitor Bank
- (T) Transformer

- Existing Transmission Facilities**
- ▲ ATC Substation, Switchyard or Terminal
  - ⚡ Generation
  - ▲ Non-ATC Substation, Switchyard or Terminal
  - Non-ATC Transmission Line
- ATC Transmission Lines**
- 69 kV
  - 115 kV
  - 138 kV
  - 161 kV
  - 230 kV
  - 345 kV

The information presented in this map document is advisory and is intended for reference purposes only. American Transmission Company owned and operated facility locations are approximate.



Performance Criteria Exceed and Other Constraints (2011-2012)  
**PLANNING ZONE 5**

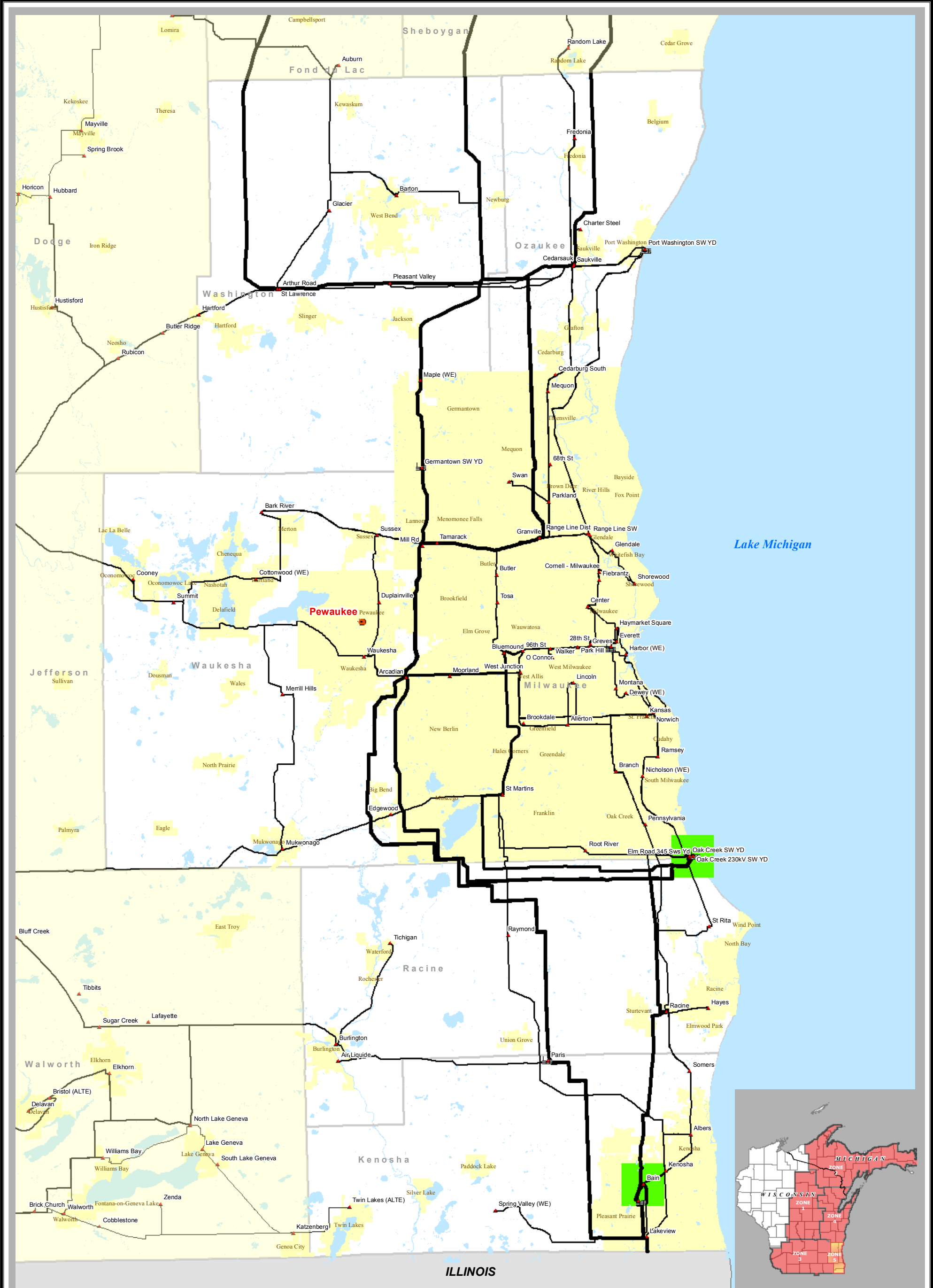
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- \* 419 jointly owned substations
- \* ATC offices in Madison, Cottage Grove, Pewaukee, DePere, and Kingsford, MI

- High or Low Bus Voltage
- Overloaded Facility

- Existing Transmission Facilities**
- ATC Office Location
  - ▲ ATC Substation, Switchyard or Terminal
  - ⚡ Generation
  - ATC Transmission Line (width = voltage)

The information presented in this map document is advisory and is intended for reference purposes only. American Transmission Company owned and operated facility locations are approximate.



Performance Criteria Exceed and Other Constraints (2013-2016)  
**PLANNING ZONE 5**

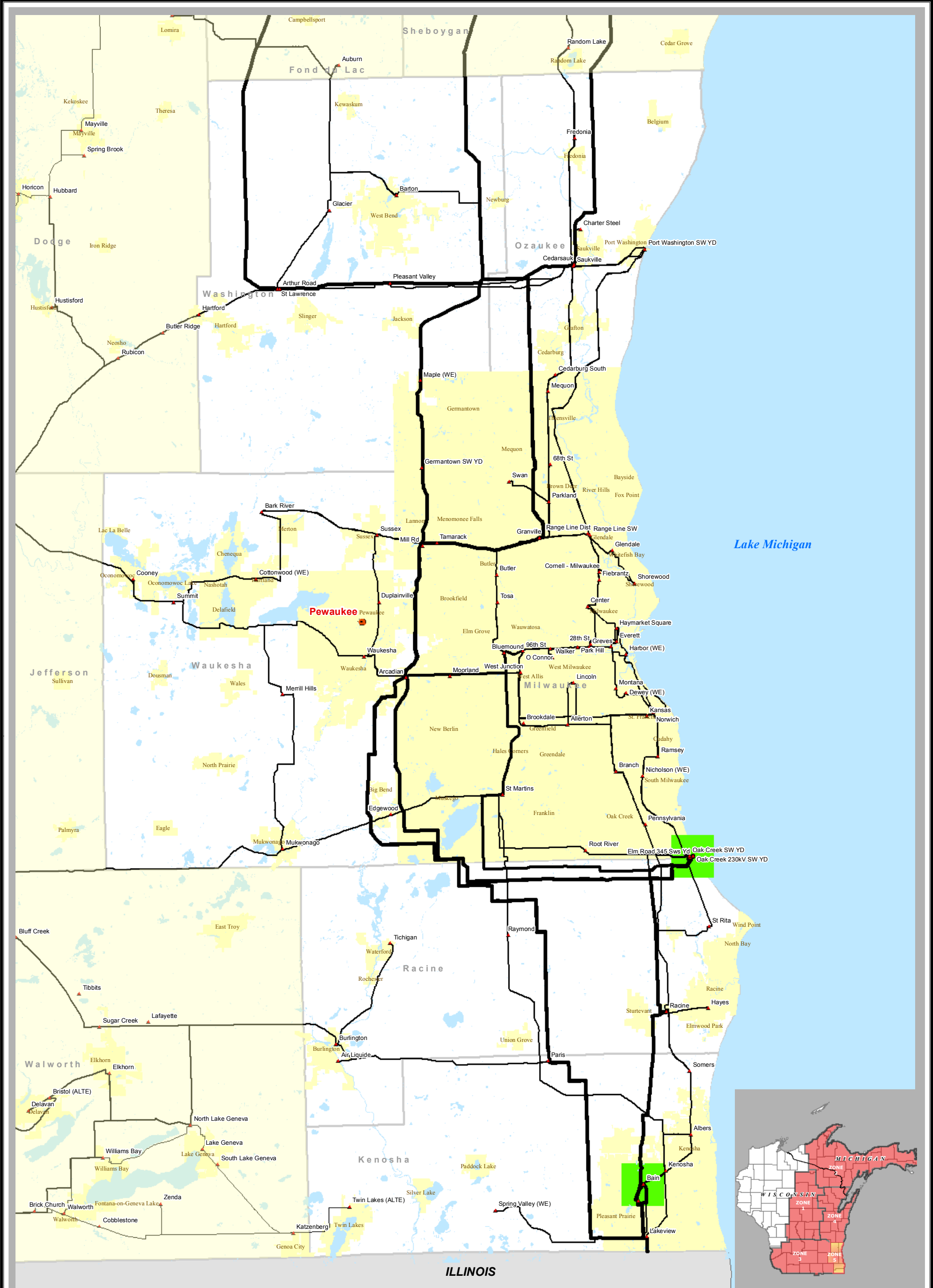
Currently, ATC owns or operates transmission facilities in Wisconsin, Illinois, Minnesota, and the Upper Peninsula of Michigan. Facilities include:

- \* Approximately 9440 miles of transmission lines
- \* 96 wholly owned substations
- \* 419 jointly owned substations
- \* ATC offices in Madison, Cottage Grove, Pewaukee, DePere, and Kingsford, MI

- High or Low Bus Voltage
- Overloaded Facility

- Existing Transmission Facilities**
- ATC Office Location
  - ▲ ATC Substation, Switchyard or Terminal
  - ⚡ Generation
  - ATC Transmission Line (width = voltage)

The information presented in this map document is advisory and is intended for reference purposes only. American Transmission Company owned and operated facility locations are approximate.



Performance Criteria Exceed and Other Constraints (2017-2021)  
**PLANNING ZONE 5**

Currently, ATC owns or operates transmission facilities in Wisconsin, Illinois, Minnesota, and the Upper Peninsula of Michigan. Facilities include:

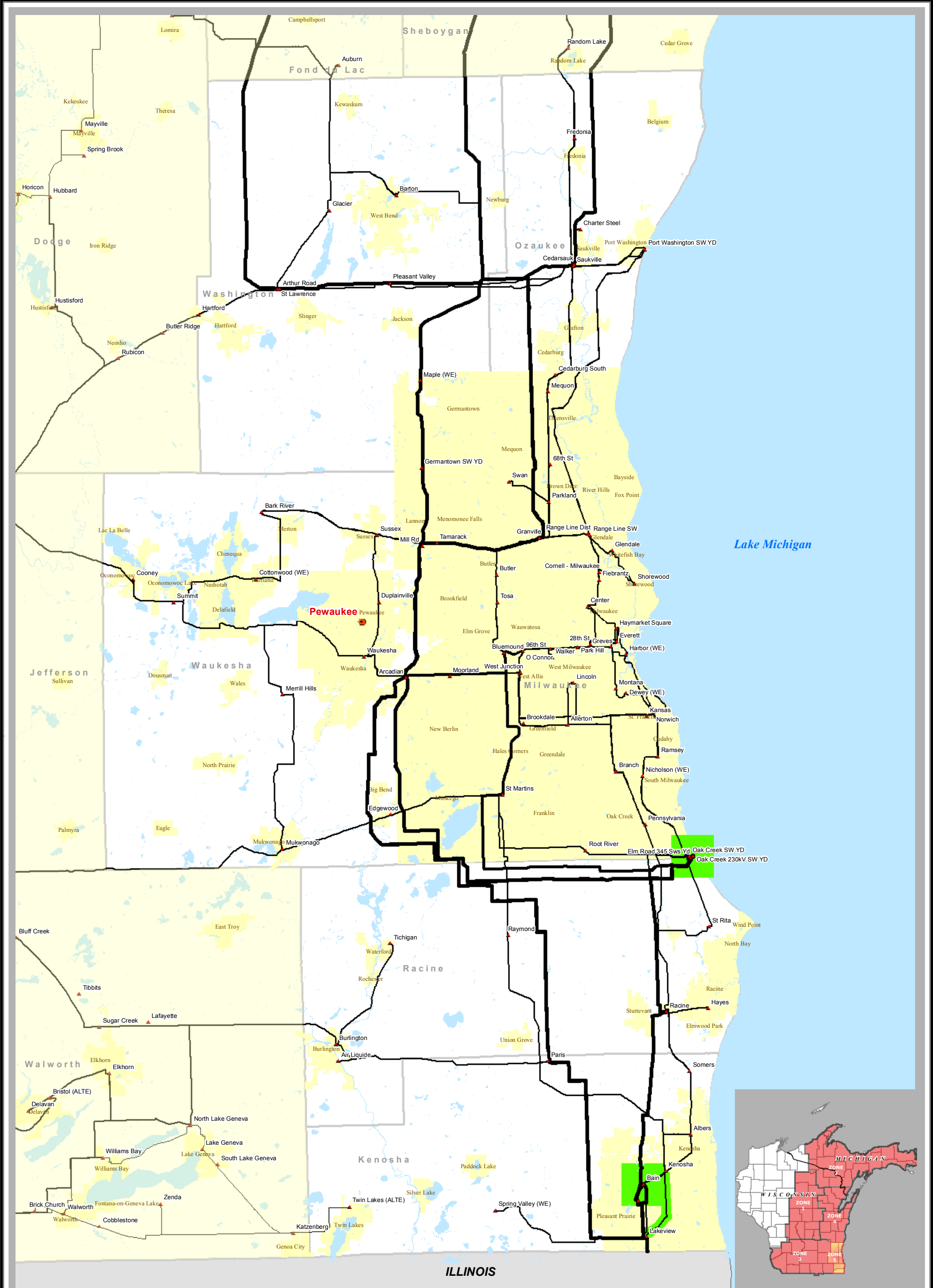
- \* Approximately 9440 miles of transmission lines
- \* 96 wholly owned substations
- \* 419 jointly owned substations
- \* ATC offices in Madison, Cottage Grove, Pewaukee, DePere, and Kingsford, MI

- High or Low Bus Voltage
- Overloaded Facility

- Existing Transmission Facilities**
- ATC Office Location
  - ▲ ATC Substation, Switchyard or Terminal
  - ⚡ Generation
  - ATC Transmission Line (width = voltage)

The information presented in this map document is advisory and is intended for reference purposes only. American Transmission Company owned and operated facility locations are approximate.





Performance Criteria Exceed and Other Constraints (2022-2026)  
**PLANNING ZONE 5**

Currently, ATC owns or operates transmission facilities in Wisconsin, Illinois, Minnesota, and the Upper Peninsula of Michigan. Facilities include:

- \* Approximately 9440 miles of transmission lines
- \* 96 wholly owned substations
- \* 419 jointly owned substations
- \* ATC offices in Madison, Cottage Grove, Pewaukee, DePere, and Kingsford, MI

- High or Low Bus Voltage
- Overloaded Facility

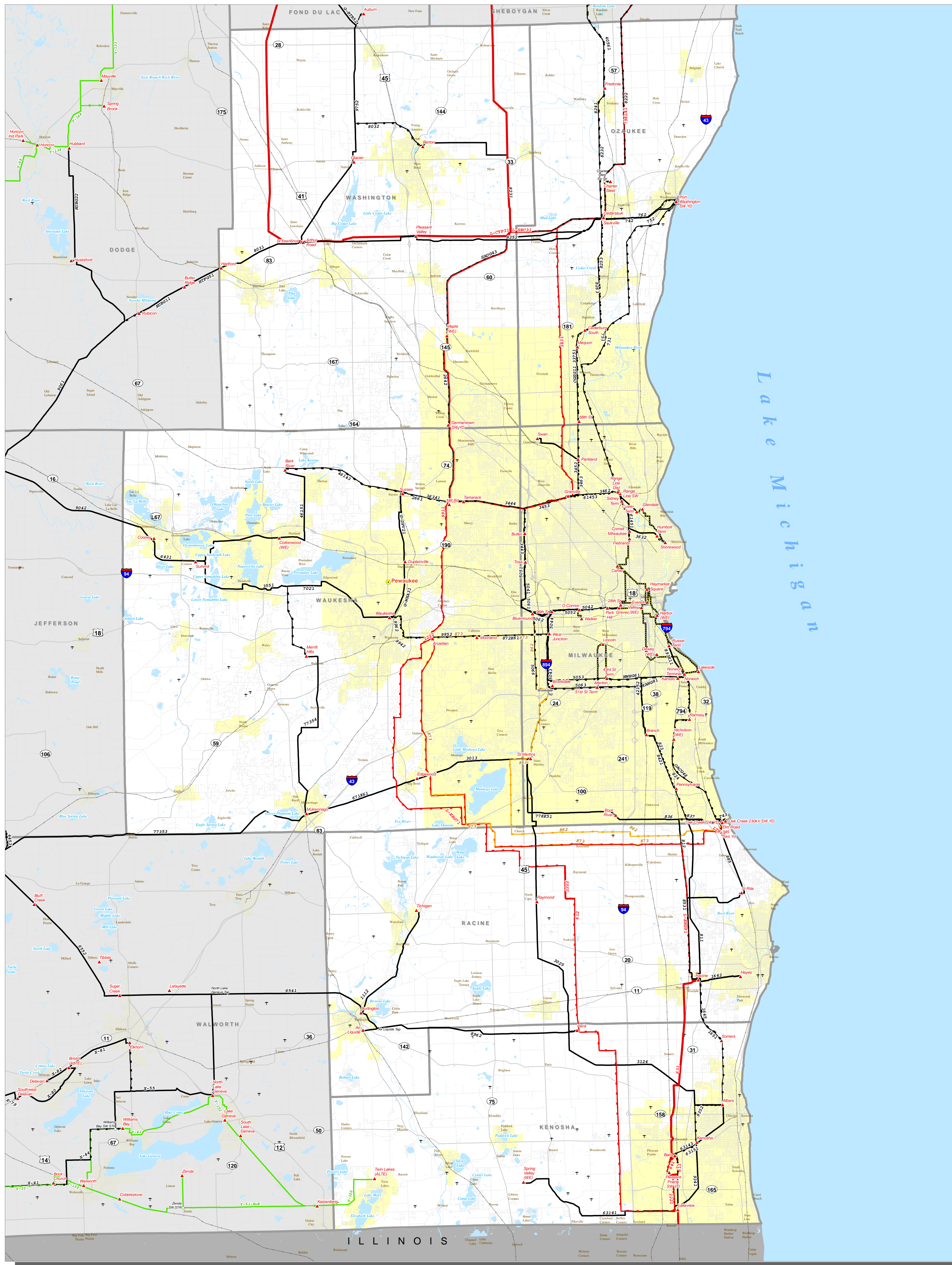
- Existing Transmission Facilities**
- ATC Office Location
  - ▲ ATC Substation, Switchyard or Terminal
  - ⚡ Generation
  - ATC Transmission Line (width = voltage)

The information presented in this map document is advisory and is intended for reference purposes only. American Transmission Company owned and operated facility locations are approximate.

Transmission Network and Substations

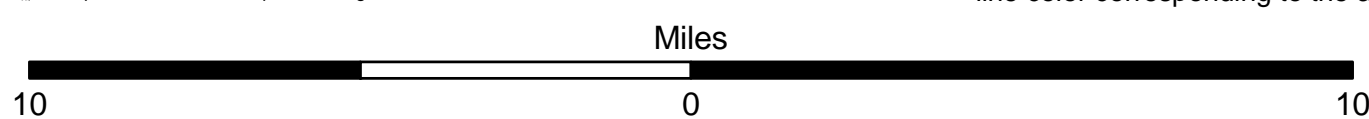


PLANNING ZONE 5

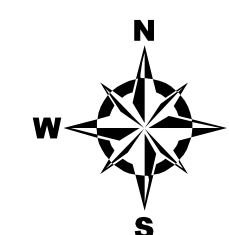
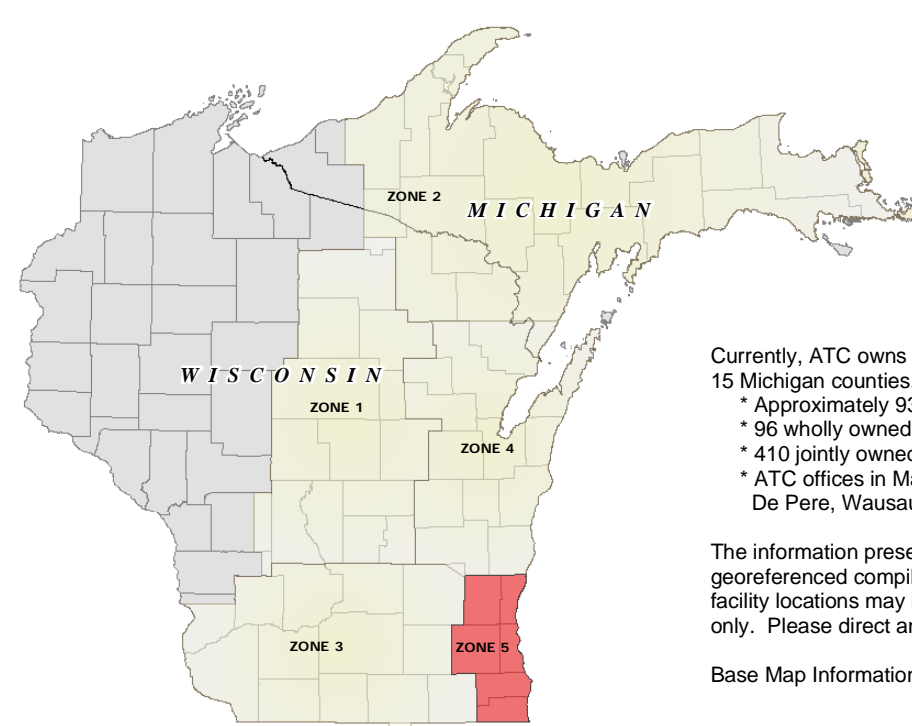


Electric Transmission and Related Facilities

- ▲ Substation or Switchyard
- Tap or Switching Structure
- Generation
- ATC Office Location
- ✈ Airport, Airfield or Helicopter Landing Site
- 69 kV
- 115 kV
- 138 kV
- 230 kV
- 345 kV
- 69 kV Double Circuit
- 115 kV Double Circuit
- 138 kV Double Circuit
- 230 kV Double Circuit
- 345 kV Double Circuit
- 69 kV Underground
- 138 kV Underground
- Mixed voltage multiple circuit lines drawn with each line color corresponding to the appropriate voltage.



Revised February 2011



Currently, ATC owns or operates transmission facilities in 50 Wisconsin counties and in 15 Michigan counties. Facilities include:  
 \* Approximately 9350 miles of transmission lines  
 \* 96 wholly owned substations  
 \* 410 jointly owned substations  
 \* ATC offices in Madison, Cottage Grove, Pewaukee, De Pere, Wausau and Kingsford, WI

The information presented in this map document represent the most current and accurate georeferenced compilation of ATC owned and operated transmission facilities available - some facility locations may be approximate. This map is advisory and intended for reference purposes only. Please direct any revisions or corrections to ATC Asset Applications and GIS Group.

Base Map Information: ATC, PSCW, MIDNR, WDNR