



Zone 4 overview

Zone 4 includes the counties of:

- Brown, Wis.
- Calumet, Wis.
- Dodge, Wis. (northeast corner)
- Door, Wis.
- Fond du Lac, Wis. (eastern portion)
- Manitowoc, Wis.
- Marinette, Wis. (southern portion)
- Menominee, Mich. (southern portion)
- Menominee, Wis.
- Oconto, Wis.
- Outagamie, Wis.
- Kewaunee, Wis.
- Shawano, Wis. (eastern portion)
- Sheboygan, Wis.
- Winnebago, Wis. (eastern portion)

The physical boundaries of Zone 4 and transmission facilities located in Zone 4 are shown in Figure ZS-25.

Zone 4 land use is a mix of agricultural, forest and urban.

Major population centers in Zone 4 include Appleton, Oshkosh, Green Bay, Fond du Lac, Sheboygan, Marinette/Menominee and Manitowoc.

Zone 4 typically experiences peak electric demands during the summer months, though the northern portion of Zone 4 typically experiences nearly equal summer and winter peaks. Paper mills and foundries in the metropolitan areas are some of the largest electricity users in the zone.

Demographics

Historical and Projected Population

The population of the counties in Zone 4 grew at an annual rate of 0.5% from 2001 to 2010. The highest growth rate occurred in Calumet County (1.0%), while the largest increase in population over the period occurred in Brown County, which increased about 19,500 people.



Population in Zone 4 is projected to grow annually at 0.7% for the 2011 through 2020 period. Outagamie County is projected to realize the largest increase in population (17,800), while Calumet County the highest growth rate of 1.3%.

Historical and Projected Employment

During the same period, the annual employment growth rate was 0.2%. The highest growth rate occurred in Calumet County (0.7%). In addition, the largest increase in employment also occurred in Brown County, which increased about 5,500 employees.

Employment in Zone 4 is projected to grow at 0.9% annually for the 2011 to 2020 period. Brown County is projected to realize the largest increase in employment of over 16,500, while Calumet County is projected to have the highest growth rate (1.4%).

Employment			
Annual Growth Rate			
2001-2010		2011-2020	
Zone 4	0.2	Zone 4	0.9
Calumet, WI	0.7	Calumet, WI	1.4
Total Increase			
2001-2010		2011-2020	
Zone 4	10,677	Zone 4	62,653
Brown, WI	5,537	Brown, WI	16,495

Population			
Annual Growth Rate			
2001-2010		2011-2020	
Zone 4	0.5	Zone 4	0.7
Calumet, WI	1.0	Calumet, WI	1.3
Total Increase			
2001-2010		2011-2020	
Zone 4	48,794	Zone 4	67,765
Brown, WI	19,520	Outagamie, WI	17,832

Zone 4 Environment Considerations

Zone 4 includes lands in the Southeast Glacial Plains, Central and Northern Lake Michigan Coastal, and Northeast Sands ecological landscape regions.

The area drains towards Lake Michigan via the Milwaukee, Sheboygan, Manitowoc, Twin-Door-Kewaunee, Wolf and Lower Fox drainage basins. Lake Winnebago and the Fox

Valley are located in the central part of this zone. The eastern boundary of the zone is formed by the shorelines of Lake Michigan and Green Bay. The Niagara Escarpment runs through the center of the zone and out the Door County Peninsula.

Portions of the Kettle Moraine State Forest and the Horicon National Wildlife Refuge are found in the southern end of the zone. Navarino State Wildlife Area and a segment of the Wolf River, classified as a Federal Wild and Scenic River, are located in the northwest part of the zone. Several Indian reservations are also located in this zone.

Zone 4 electricity demand and generation

The coincident peak load forecasts for Zone 4 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). This table shows that load in Zone 4 is projected to grow at roughly 0.67 percent annually from 2012 through 2021. Comparing load with generation (at maximum output) within the zone indicates that Zone 4 has more generation than load during peak load periods. Actual operating experience indicates that during lighter load periods, Zone 4 is a net exporter of power.

Zone 4 transmission system issues

Key transmission facilities in Zone 4 include:

- Four 345-kV lines extending from the Kewaunee and Point Beach nuclear units,
- 138-kV network in the Fox River Valley/Green Bay area,
- Two 345-kV lines extending from the Edgewater Power Plant,
- Four 345-kV lines connecting the Gardner Park, Werner West, Morgan, and Plains Substations,
- Two 345-kV lines from North Appleton to Werner West and Fitzgerald, and
- Three 345-kV lines connecting South Fond du Lac Substation to the Columbia, Edgewater and Fitzgerald Substations.

Key system performance issues in Zone 4 include:

- Asset renewal concerns for the 138 and 69-kV facilities in the Green Bay area, north of Green Bay, southern Door County, areas north and west of Manitowoc and the Fox River Valley area,
- Heavily loaded 138-kV lines west of Green Bay and Appleton, and
- Heavily loaded 69-kV facilities in the Oshkosh area
- 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.



Zone 4 – 2012 study results

Refer to Table ZS-1 and Figure ZS-13

Summary of key findings

- The Oshkosh area 69-kV facilities continue to overload under single contingency conditions.
- Low voltages and heavily loaded 138/69-kV transformers exist in the northern portion of Door County.

As discussed in previous Assessments, the rebuild of the Sunset Point – Pearl Avenue 69-kV line will address the overload of the circuit under single-contingency conditions. To see the impact of this overload and to verify the overload is getting progressively worse over time, the rebuild project planned to reinforce this circuit was not included in the base case models analyzed for this assessment. Hence, the reason the overload appears in models past its anticipated in-service date. The current in-service date for this reinforcement project is April 2012. Once complete, the limitation will be addressed.

The completion of the Kewaunee switchyard reconfiguration along with the addition of a second 345/138-kV transformer in 2011 provides increased offsite power reliability for the nuclear power plant, helps facilitate switchyard maintenance on transmission facilities, provides the ability to deliver generation into our transmission network under transmission outages and brings more economical base load generation to the marketplace.

Similar to previous Assessments, the potential for low voltages under normal and single contingency conditions and the potential for overloads under single contingency conditions in northern Door County necessitates a combination of reinforcement projects be implemented. This area is unique because of the local area's peak load usually does not occur during ATC's typical system peak. The Sister Bay capacitor bank and the Canal – Dunn Road projects described below were included in all models evaluated for this assessment, thus the overloads and voltage issues noted in the summary of key findings above will not appear in any of the results.

To address the immediate needs of this area, two additional 1.2 MVAR distribution capacitor banks were installed at the Sister Bay Substation in 2008. The addition of these capacitor banks on the distribution system supports the voltages in the area under normal and single-contingency conditions until the longer term reinforcements noted below are in place.

The proposed long-term solutions for northern Door County include implementing reinforcements in two phases. The in-service dates for both phases were able to be



deferred to their current in-service dates as a result of installing the distribution capacitor banks at Sister Bay. The two phases consist of:

- Rebuild the existing Canal – Dunn Road 69-kV line as a new Canal – Dunn Road 138/69-kV double-circuit line and install a new 138/69-kV transformer at the Dunn Road Substation by June 2012, and
- Constructing a second Dunn Road – Egg Harbor 69-kV line by June 2021.

The proposed Canal – Dunn Road 138/69-kV double-circuit line and Dunn Road transformer will not only address the low voltages in the area under normal and single-contingency conditions, but also addresses the overloads of the 138/69-kV transformers at Canal and various 69-kV lines in the area under single-contingency conditions. The installation of the 138/69-kV transformer at the Dunn Road Substation introduces a third such transformer to this area and will provide geographic diversity from the existing transformation at the Canal Substation. ATC received approval in August 2010 for its CPCN application from the Public Service Commission of Wisconsin to construct the first phase of this project.

The second 69-kV line between Dunn Road and Egg Harbor Substations will provide a second source to the northern Door County area and facilitate maintenance outages of the existing Dunn Road – Egg Harbor 69-kV line. See Zone 4 – 2021 study results section for additional details.

No performance limits were exceeded for Category A conditions for all 2012 analysis.

Zone 4 – 2016 study results

Refer to Table ZS-2 and Figure ZS-14

Summary of key findings

- Zone 4 is an active study area for potential wind generation additions,
- Zone 4 is an active area for asset renewal type projects, and
- For the 2016 study model, the remainder of zone 4 is free of system limitations largely due to the reduced load forecast.

The Sunset Point – Pearl Avenue 69-kV line continues to overload and the magnitude of the overload continues to increase in the 2016 summer peak models. To see the impact of this overload and to verify the overload is getting progressively worse over time, the rebuild project planned to reinforce this circuit was not included in the base case models analyzed for this assessment. Hence, the reason the overload appears in models past its anticipated



in-service date. The current in-service date for this reinforcement project is April 2012. Once complete, the limitation will be addressed. See Zone 4 – 2012 study results section for additional details.

To improve reliability, ensure safety and comply with current code requirements, an Asset Management driven rebuild of the Dyckesville – Sawyer 69-kV circuit is proposed for 2016. ATC is currently performing a detailed study of structure integrity and conductor-to-ground clearances of this 69-kV circuit.

For a variety of reasons, we will be considering the installation of a second 345/138 kV transformer at the Fitzgerald Substation. Because this project is in the very early stages of project development, it is currently not listed in the project tables.

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”

- None

Zone 4 – 2021 study results

Refer to Table ZS-3 and Figure ZS-15

Summary of key findings

- Zone 4 is an active study area for potential wind generation additions,
- The updated load forecasts have resulted in the deferral of several projects identified in prior 10-Year Assessments,
- Additional reinforcements may be needed in the Manitowoc and eastern Calumet County areas, and
- Additional reinforcements may be needed in Northern Door County to facilitate maintenance outages and improve system intact as well as voltages under contingency conditions.



- The load forecasts have resulted in the deferral or absence of system performance issues identified in prior 10-Year Assessments.

The Sunset Point – Pearl Avenue 69-kV line continues to overload and the magnitude of the overload continues to increase in the 2021 summer peak models. The current in-service date for this reinforcement project is April 2012. Once complete, the limitation will be addressed. See Zone 4 – 2012 study results section for additional details.

A new limitation appeared in the 2021 analysis, the Glenview – Gravesville 69-kV circuit overloads for various contingencies. The ratings of this circuit were reduced in 2010 as a result of a Line Rating Study conducted by ATC. The result of this study was to develop a small Asset Renewal project to increase the conductor clearances to restore circuit ratings to an acceptable level. This project was completed in April 2011, thus the limitation can now be considered addressed.

There is an impending overload of the Manrap – Custer 69-kV circuit under single contingency conditions. A current project to address off-peak periods with certain generation patterns is currently proposed for a 2022 in-service date. This project may also address the Manrap – Custer loading issue. See Zone 4 – 2026 study results section for additional details of this project. Additional study of this impending overload will be needed to determine what mitigation measures are available or what potential reinforcements may be needed.

The proposed long-term solutions for northern Door County include implementing reinforcements in two phases. The first phase included implementing the Canal – Dunn Road 138 kV project with a planned in-service date of June 2012. The first phase is assumed complete in the base case model. The second phase includes adding a second 69-kV line between the Dunn Road and Egg Harbor substations. This is a provisional project pending the Best Value Planning process to determine how best to support maintenance outages, voltages and radial loads served by the Egg Harbor and Sister Bay substations.

Point Beach generation upgrades

NextEra has submitted requests to the MISO to increase the output of both of their generation units at the Point Beach Nuclear Plant (MISO queue positions G833, G834, J022 & J023). ATC completed the reliability assessment of the proposed changes in October 2009. This assessment is performed to ensure that the generators can be operated without stability limitations and the output of the generators can be delivered to the MISO market reliably. This assessment showed that the additional output from these generating units will result in overloads and system instability if the transmission system in this area is not reinforced.



The proposed reinforcements identified by the reliability assessment include the following transmission projects:

- Construct a new 345-kV switching station (tentatively named Birch River) near the northern intersection of the Point Beach – Sheboygan Energy Center 345-kV circuit and the Forest Junction – Howards Grove 138-kV circuit,
- Construct a new 345/138-kV substation (tentatively named Barnhart) near the intersection of the Edgewater – South Fond du Lac 345-kV circuit and the Howards Grove – Holland 138-kV circuit,
- Convert the existing double circuit line (345-kV and 138-kV) between Forest Junction and the new Birch River Switching Station and between the new Birch River and Barnhart substations to double circuit 345-kV lines, and
- To keep the existing Plymouth and Howards Grove substations networked, a new 138-kV line is proposed between the new Barnhart and Erdman substations, including looping into the Plymouth and Howards Grove substations.

The scope of work described above is subject to approval by the Public Service Commission of Wisconsin and ATC is currently targeting a CPCN application submittal date of October 2012 for this project.

The scheduled in-service dates for the generator changes are spring 2011 for unit 2 and fall 2011 for unit 1 with a projected in-service date for the new 345-kV facilities described above of June 2018. Based on the in-service date difference between the proposed generator changes and the proposed 345-kV transmission line and substations, additional studies were performed to determine if any feasible projects exist for delivery of all or a portion of the generator capacity prior to the in-service date of the 345-kV projects. The interim generator interconnection studies identified the following projects that will allow the generator to operate during this interim period under certain operating limitations and restrictions. These interim projects have all been completed and put in-service. Full generator operation, without restrictions, will not be allowed until all required 345-kV facilities are placed in service:

- Replacement of 345-kV terminal equipment at the North Appleton Substation,
- Replacement of system protection equipment on various 345-kV transmission lines at the Point Beach Substation,
- Improvements to the line conductor rating for two 345-kV transmission circuits, and
- Reconfiguration of the Kewaunee 345/138-kV Substation.(complete)

No performance limits were exceeded for Category A conditions for all 2021 analysis except the high voltage at the Kewaunee 138-kV bus in the 2021 minimum load model. The Kewaunee high voltage issue can be addressed by adjusting generation in the area.



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”

- New Dunn Road – Egg Harbor 69-kV line: Past 10-Year Assessments have found reliability issues in northern Door County. These issues did not appear in the 2011 10-Year Assessment. This proposed project was retained for now until it can be determined in future 10-Year Assessments that these issues truly no longer exist.

Zone 4 – 2026 study results

Refer to Table ZS-4 and Figure ZS-17

Summary of key findings

- Zone 4 is an active study area for potential wind generation additions,
- Additional reinforcements may be needed in the Kewaunee, Manitowoc and eastern Calumet County areas due to potential increases in generation, and
- The load forecasts have resulted in the deferral or absence of system performance issues identified in prior 10-Year Assessments.

A project for replacing the two existing Glenview 138/69-kV transformers in past Assessments has been delayed from 2020 and is now scheduled for 2025. It would address the potential overload of the transformers under single contingency conditions. The transformer overloads are primarily due to the potential for higher load demand of a local industrial customer. This project may be able to be deferred several additional years by transferring load from the Glenview 69-kV bus to the 138-kV buses, depending upon the customer's load cycle.

A provisional project to address the potential overload of the two existing Sunset Point 138/69-kV transformers has a current in-service date of 2024. The prior in-service date was driven by potential economic benefits to replacing the transformers, but updated economic benefits screening has shown that the project cost is now likely to exceed the projects economic benefits.

The Manrap – Custer 69-kV circuit continues to overload and the magnitude of the overload continues to increase in the 2026 summer peak models. A provisional project for a new Shoto – Custer 138-kV line could help address this overload as well as the potential heavy flows on the Shoto – Mirro – Northeast – Revere 69-kV line or the Shoto 138/69-kV transformer. These loading issues occur under single contingency conditions during non-peak periods with certain generation patterns. The project includes constructing a new Shoto – Custer 138-kV line and installing a new 138/69-kV transformer at Custer Substation. This project is currently scheduled for a 2022 in-service date based upon updated load and generation assumptions utilized in the studies. The in-service date as well as the scope of the project may need to be adjusted once a more detailed study is completed.

A new limitation to the 2026 analysis is the Glenview – Gravesville 69-kV circuit overloads for various contingencies. The ratings of this circuit were reduced in 2010 as a result of a Line Rating Study conducted by ATC. The result of this study was to develop a small Asset Renewal project to increase the conductor clearances to restore circuit ratings to an acceptable level. This project was completed in April 2011, thus the limitation can now be considered addressed.

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

Prior assessments have shown the need for potential transmission reinforcements in the Sheboygan, Kewaunee, and Green Bay areas. Although system needs in the 2026 timeframe have diminished with the load forecasts used in the 2011 10-Year Assessment, it is desirable to keep the discussion below in mind in case the system needs re-emerge in the next Assessment. The reinforcements listed below are based upon preliminary analysis to address system issues under single-contingency conditions. Further adjustments will be made to reflect system needs as well as in-service dates in future 10-Year Assessments.

Potential future reinforcements are:

- Upgrading the Edgewater – Washington Ave. 69-kV line may be needed in the timeframe just beyond 2026 to address line overloads under single-contingency conditions,
- Additional transmission reinforcements such as adding a second 138/69-kV transformer at the East Krok Substation may be needed in the timeframe beyond the current planning horizon to boost voltages along the East Krok – Beardsley Street – Barnett 69-kV line under single-contingency conditions, and
- Depending on the load forecasted in downtown Green Bay, additional transmission reinforcements such as rebuilding the older sections of the existing Oak Street –



10-Year Assessment

An annual report summarizing proposed additions and expansions to ensure electric system reliability.

2011

September 2011 10-Year Assessment
www.atc10yearplan.com

Ashland 69-kV line may be needed in the timeframe beyond the current planning horizon to address line overloads under single-contingency conditions.

- Increasing the rating of the Kewaunee – East Krok 138-kV line may be needed to address line overloads under certain transmission outages and generation patterns,

Assessment of Steady State Compliance with NERC Standards

The mitigation plans comprised of planned, proposed and provisional projects identified for Zone 4 in this Assessment will allow the ATC system in Zone 4 to meet the steady state portions of NERC standards TPL-001 and TPL-002 in each of the five years 2011-2015, and for the 2016-2020 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 ⁵
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 ³
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 ¹ 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 ⁵
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 ⁵
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 ²⁷ 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 ²⁶
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 ²³
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 – Granville 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 ²⁷
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 ¹⁴ 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 ¹⁴ 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 ²⁵ 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 ²⁴
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
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

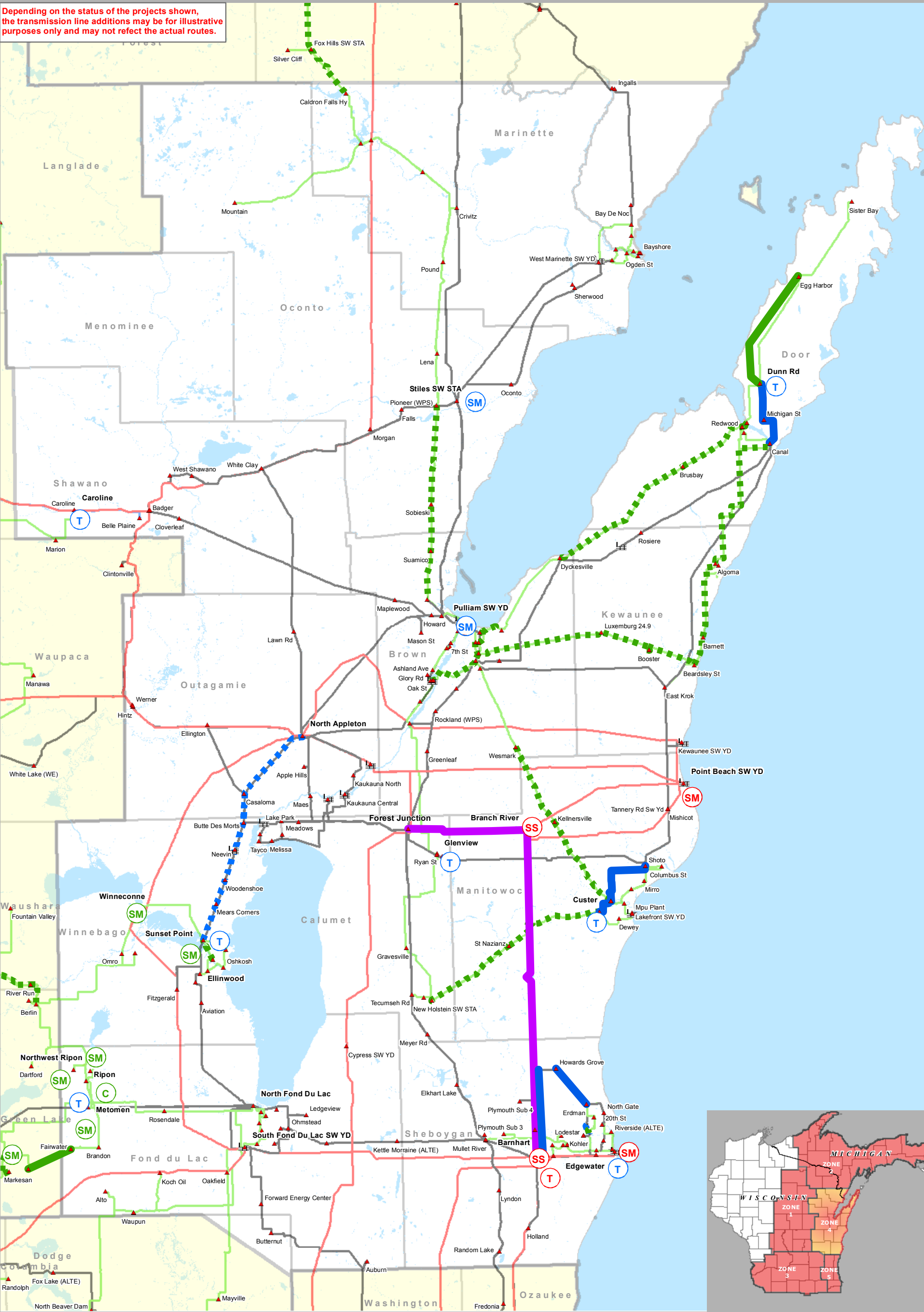
Planning Zone	Criteria Exceeded/Need	2026 Summer Peak Case		Facility Outage(s)
		% of Facility Rating	% of Nominal Bus Voltage	
4	Glenview – Gravesville 69-kV line	101.5% 101.5% 101.5%	--	Tecumseh Road 138/69-kV transformer ²⁴ Tecumseh Road 138/69-kV transformer Tecumseh Road – Ford Drive 69-kV
4	Sunset Point – Pearl Avenue 69-kV line	113.2% 112.9%	--	Ellinwood – 12th Avenue 69-kV line Ellinwood 138/69-kV transformer ²⁰
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-11
Zone 4 Load and Generation

Zone 4	2012	2016	2021	2026
Peak Forecast (megawatts)	3226.9	3296.6	3427.1	3548.3
Average Peak Load Growth	N/A	0.54%	0.78%	0.70%
Existing Generation Capacity (megawatts)	5310.6	5310.6	5310.6	5310.6
Existing Capacity Less Load (megawatts)	2083.7	2014	1883.5	1762.3
Existing Generation Capacity plus Modeled Generating Capacity Additions (megawatts)	5645.7	5994.2	5994.2	5994.2
Modeled Capacity Less Load (megawatts)	2418.8	2697.6	2567.1	2445.9

Figure PR-4

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



2011 10-Year Assessment Projects
PLANNING ZONE 4

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

- Generation
- ▲ ATC Substation, Switchyard or Terminal
- ▲ Non-ATC Substation, Switchyard or Terminal
- Non-ATC Transmission Line
- 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.

Figure ZS-13

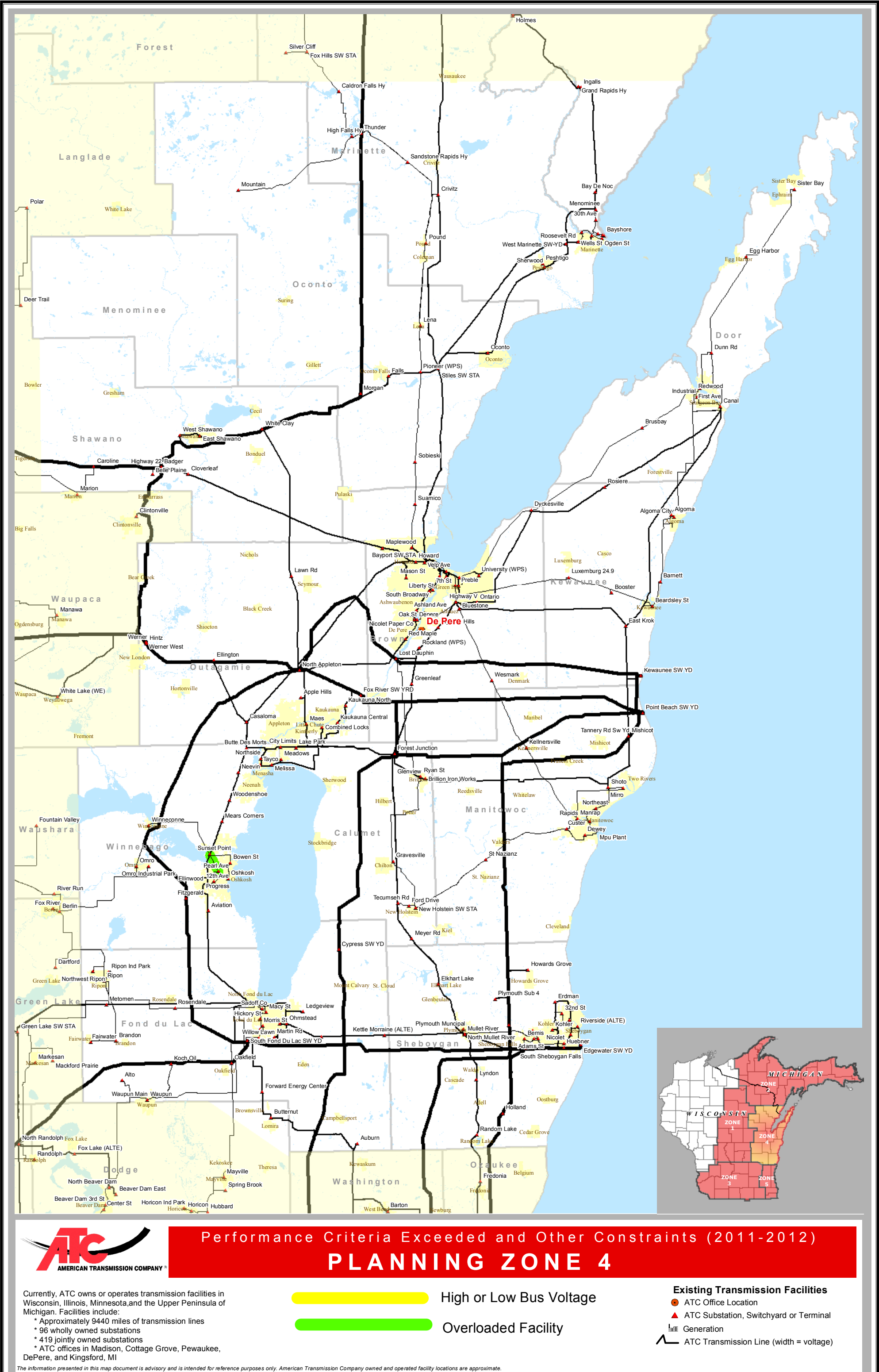


Figure ZS-14

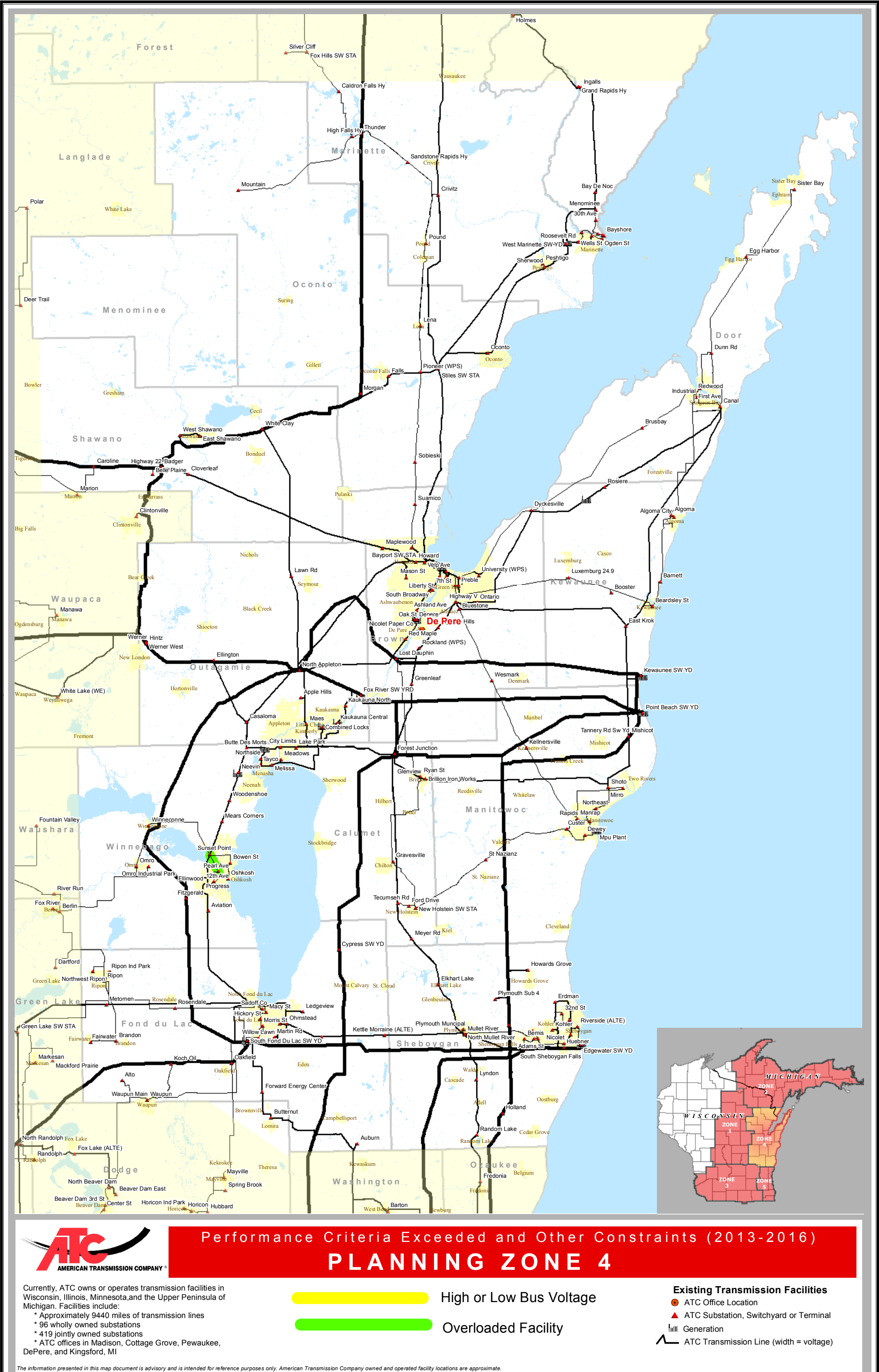


Figure ZS-15

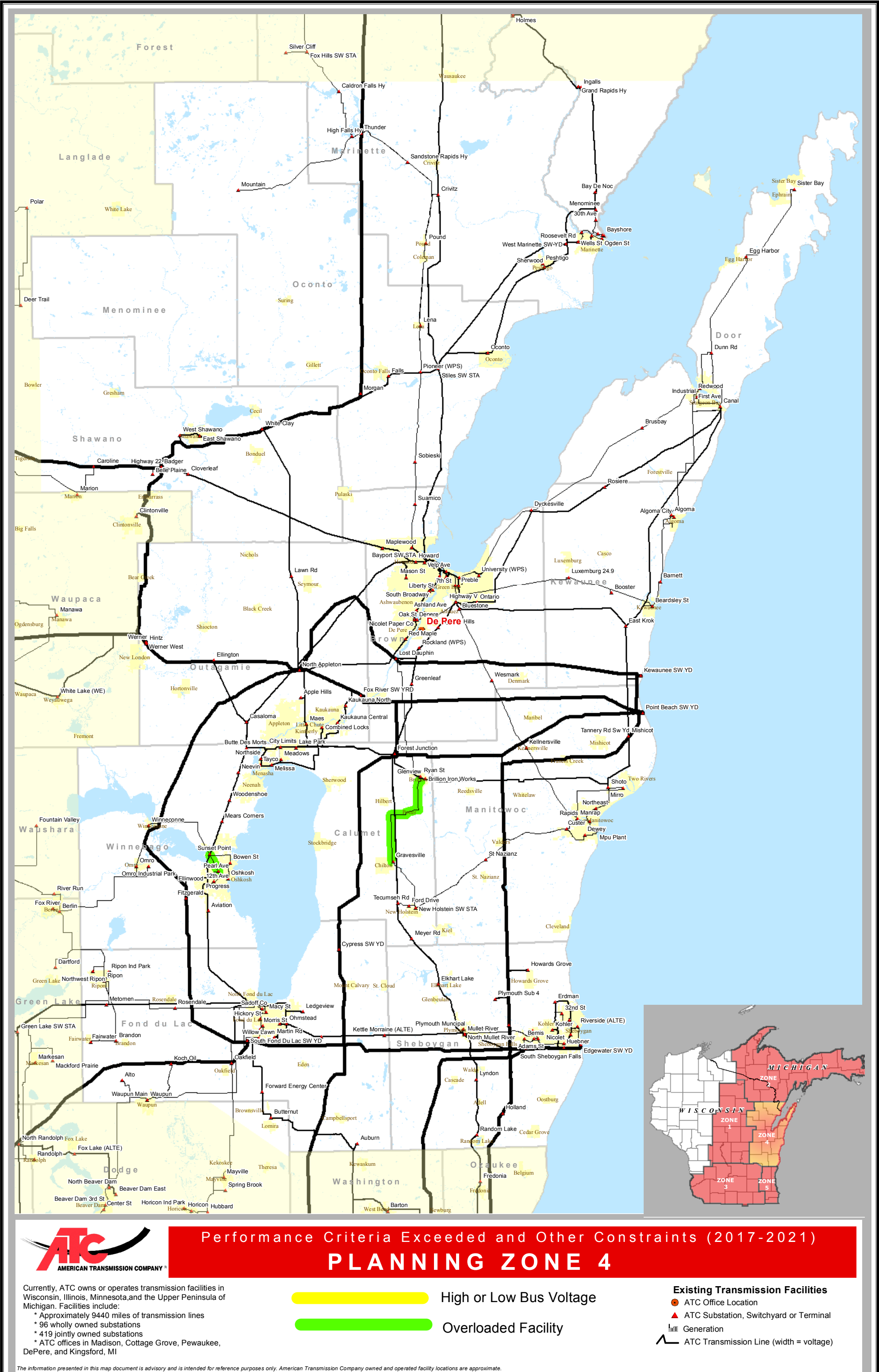
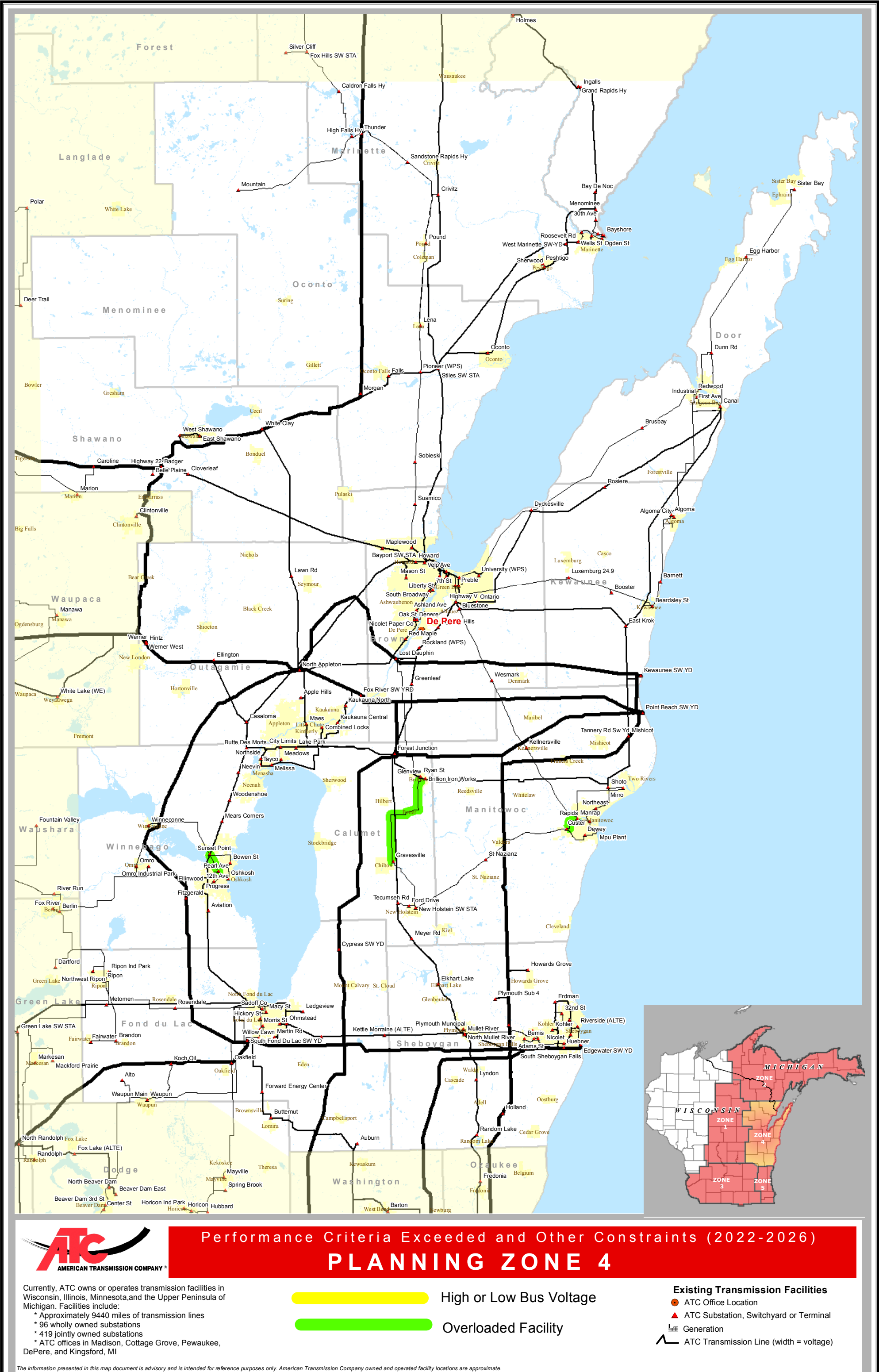


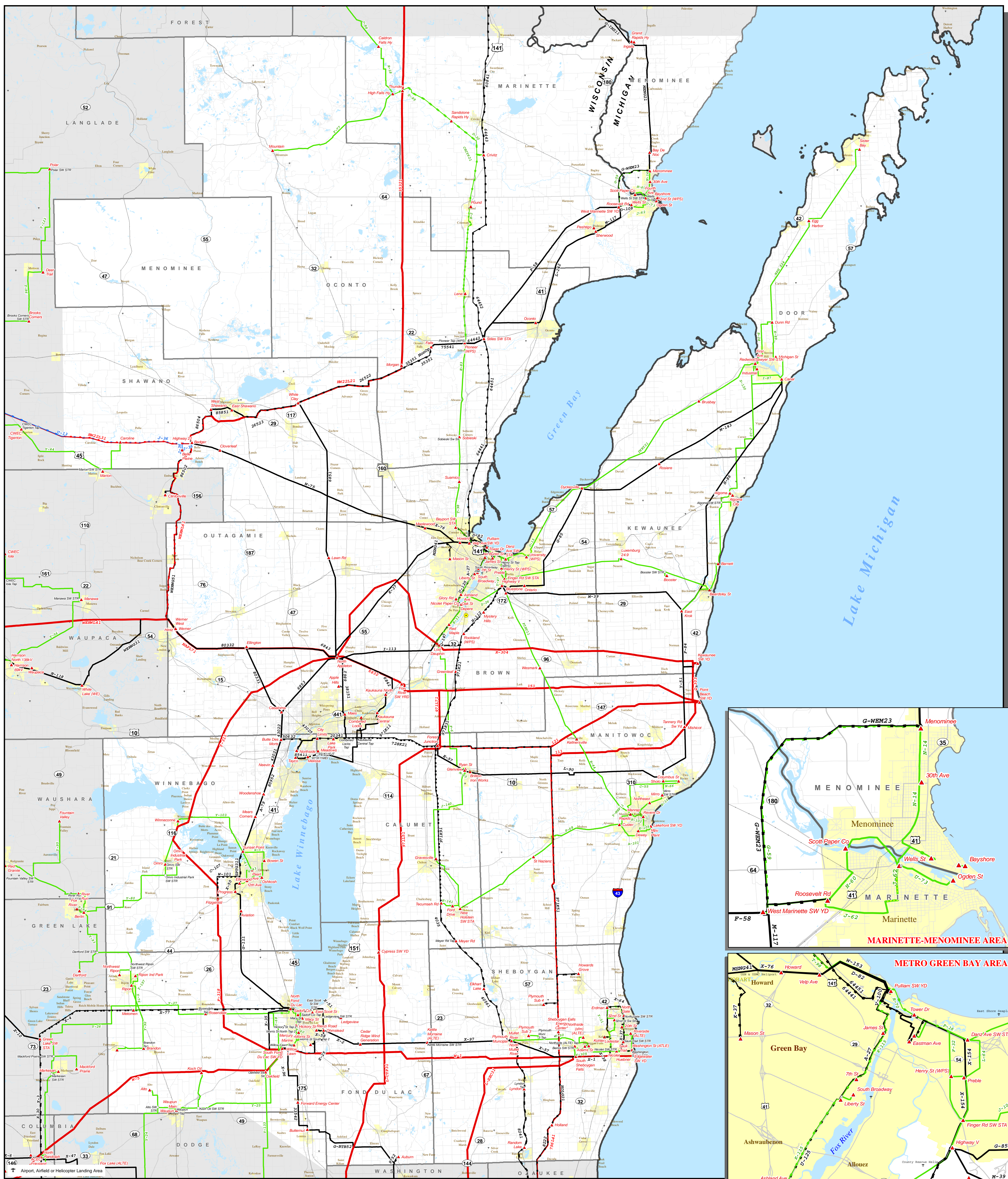
Figure ZS-16



Transmission Network and Substations



PLANNING ZONE 4



Electric Transmission and Related Facilities

Transmission Facilities

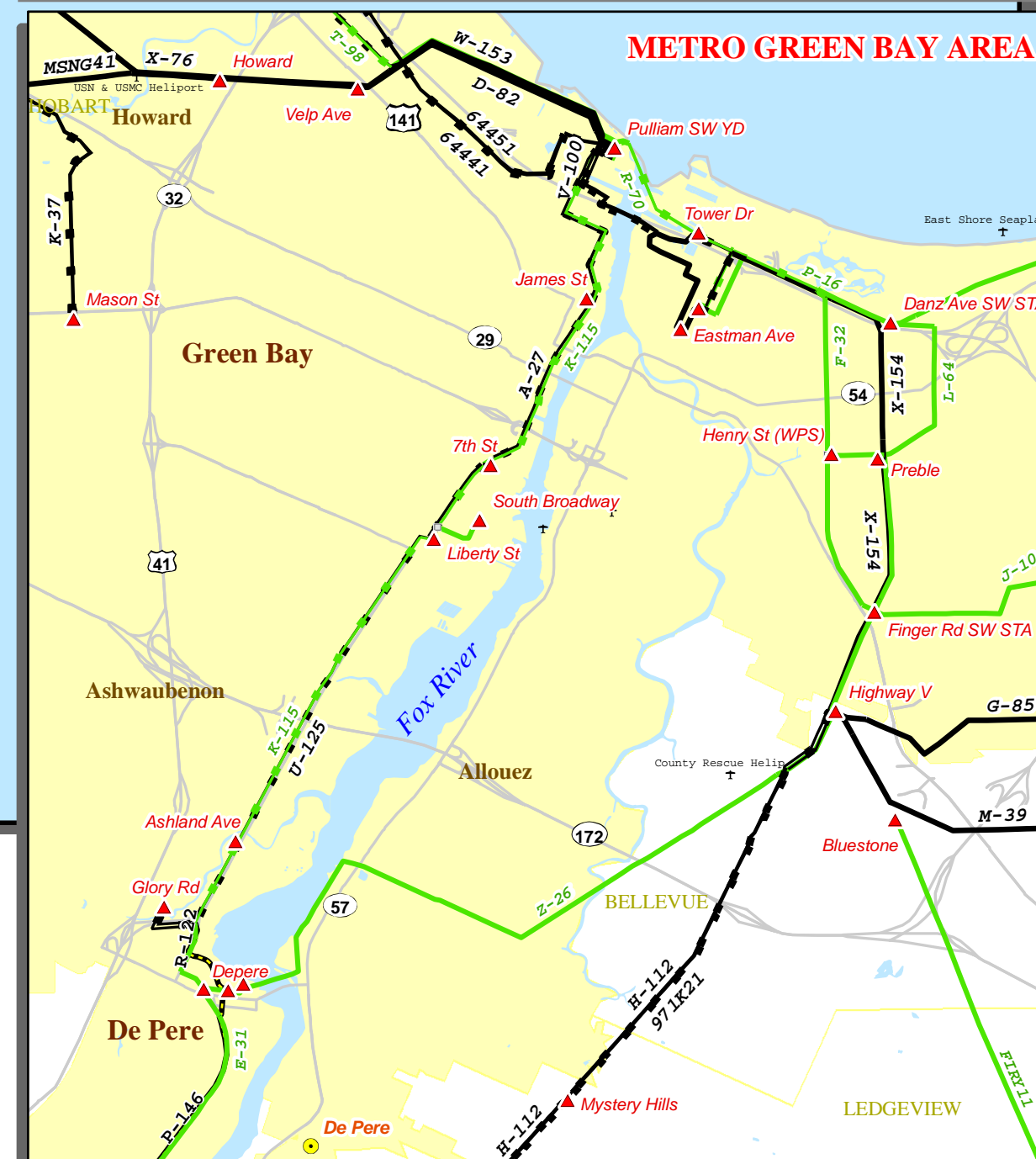
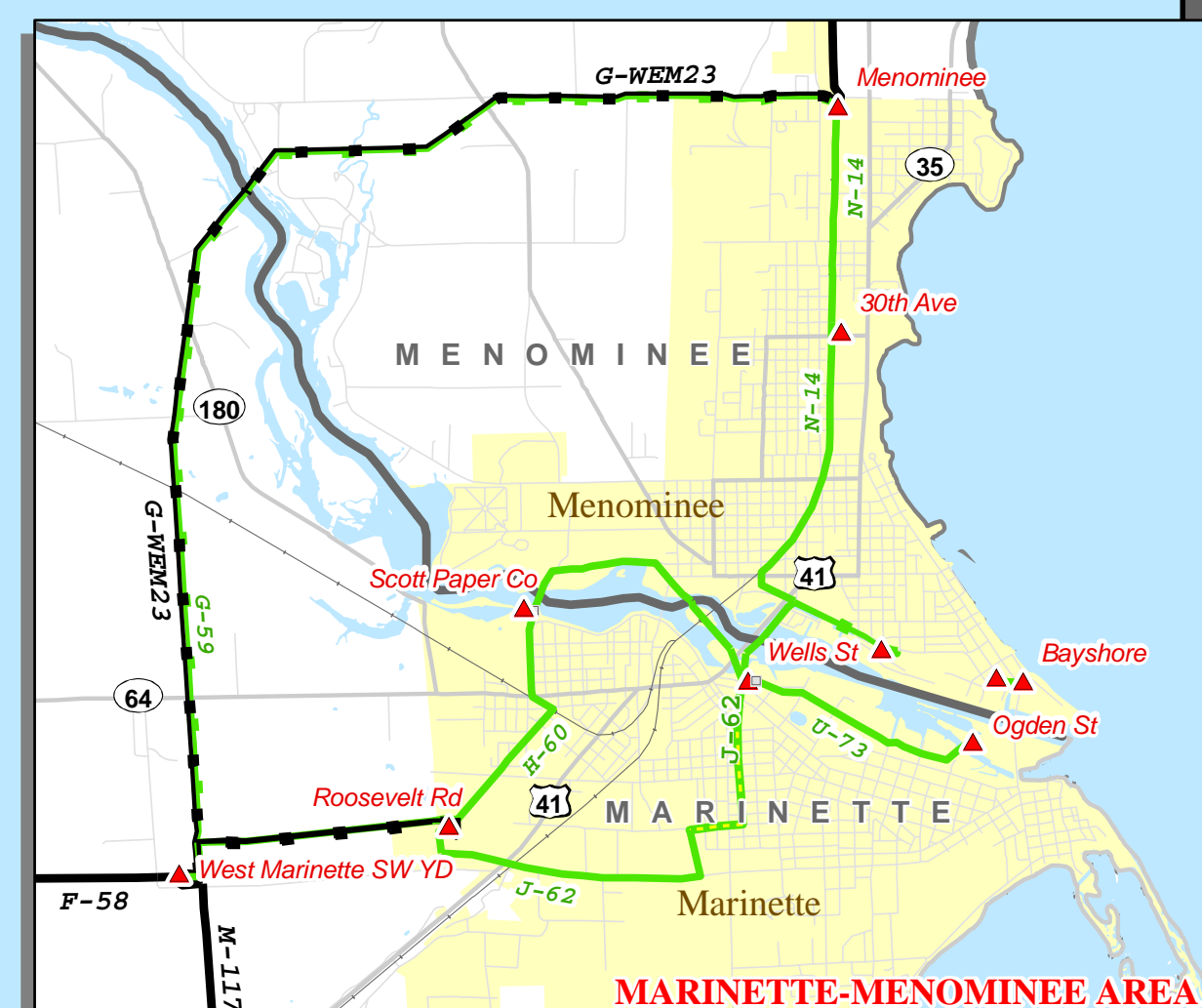
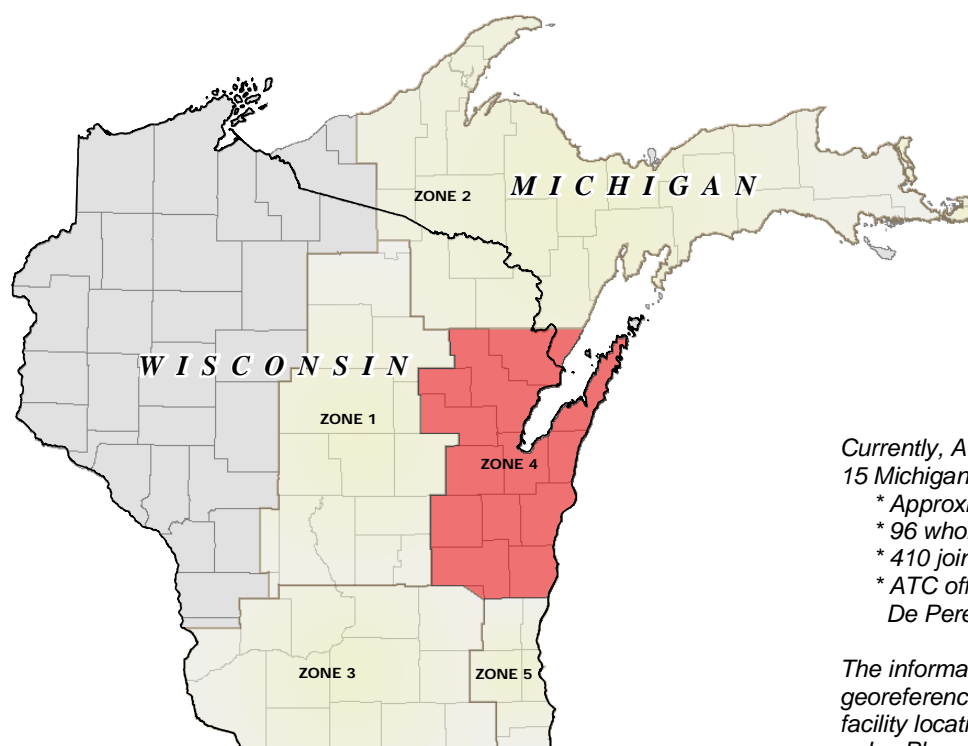
- Substation or SW YD
- Tap or Switching Structure
- ATC Office
- Generation

Transmission Line Voltage and Type

- < 50 kV
- 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 double circuit lines drawn with each line color corresponding to the appropriate voltage.

10 0 10 20 Miles



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, MDNR, WDNR

