



## **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**

The population of the counties in Zone 5 grew at an annual rate of 0.5 percent from 1998 to 2008. The highest growth rate occurred in Washington County, while the largest increase in population occurred in Waukesha County, which increased by approximately 32,000 people over the period.

During the same period, the annual employment growth rate was 0.7 percent. The highest growth rate was in Kenosha County and the highest increase in employment occurred in Waukesha County.

## **Future Population and Employment Projections**

Population in Zone 5 is projected to grow at 0.6 percent annually for both the 2008 and 2013 and 2013 through 2018 periods. From 2008 to 2013, Waukesha County is projected to realize the largest increase in population, while Washington County is projected to have the highest growth rate.

Employment in Zone 5 is projected to grow at 1.3 percent annually between 2008 and 2013 and at 1.2 percent from 2013 through 2018. From 2008 to 2013, Waukesha County is



projected to realize the largest increase in employment and to have the highest growth rate.

	1998-2008	2008-2013	2013-2018	1998-2008	2008-2013	2013-2018
	Annual Growth Rate			Increase		
Employment						
Zone 5	0.71	1.30	1.21	83,309	81,802	81,304
Kenosha County	2.17					
Waukesha County		2.75	2.35	49,714	44,709	43,347
Population						
Zone 5	0.47	0.57	0.61	88,002	55,090	61,051
Washington County	1.35	1.87	1.76			
Waukesha County				32,235	30,025	31,217

**Zone 5 environmental considerations**

Zone 5 encompasses the southeastern portion of the state and is the most densely populated of the zones. 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 2009, 2013, 2018 and 2023 are shown in Table ZS-12. Existing generation, along with proposed generation based on projected in-service year, are also shown. The resultant capacity margins, with or without the proposed generation, are shown as well.

The table shows that load is projected to grow at roughly 1.8 percent annually from 2009 through 2018. Comparing load with generation (at maximum output) within the zone indicates that Zone 5 has less 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, and



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- a significant 138-kV network in the Milwaukee area, a portion of which is underground.

Key system performance issues in Zone 5 include:

- heavy flows on aging facilities,
- new generation projects are being planned that may influence the solutions to load-serving needs in the zone,
- heavy flows from the west (Zone 3) resulting in heavily loaded 138-kV facilities in the western portion of Zone 5,
- heavy market flows from the south, resulting in high 345- and 138-kV line loadings and the need to monitor potential multiple contingency conditions,
- sagging voltage profile in portions of Washington, Waukesha and Jefferson counties and
- stability of existing and proposed generation in the southeast portion of Zone 5.

In addition, the Wisconsin Department of Transportation is reconstructing the Marquette Interchange in downtown Milwaukee and portions of the interstate system near the Marquette Interchange. This project affects one ATC transmission line and a We Energies power plant connected to the 138-kV transmission system.

- A portion of Everett - 28<sup>th</sup> Street underground 138-kV circuit was relocated in 2004. No other ATC facilities were affected by the project.
- The 138-kV switchyard at the Valley Power Plant will require various equipment modifications and a more extensive maintenance program.
- The proposed rebuild of the Zoo interchange will necessitate some review of the existing 138-kV lines originating from the Bluemound Substation. This review could result in new projects within the next few years.



### **Zone 5 – 2009 study results**

Refer to Table ZS-1 and Figure ZS-17

#### *Summary of key findings*

- ❑ Many of the line loading and low voltage issues in Zone 5 occur as a result of opening substation bus tie breakers.
- ❑ New generation in the greater Milwaukee area will drive many system improvements in Zone 5 within the next decade.

Nine 138-kV buses in Waukesha and Washington Counties experience low bus voltages under NERC Category A or TPL-001-0 conditions (intact system) in 2009. The nine buses are Concord (93.5%), Bark River (94.2%), Cooney (92.8%), Cottonwood (93.1%), Germantown (93.6%), Hartford (94.9%), Merrill Hills (94.7%), Maple (94.1%), and Summit (92.9%). These low intact system bus voltages occurred because Concord and Germantown generation was modeled out of service in 2009 as a result of new generation at Oak Creek. A new 650-MW generator is scheduled to be placed in service prior to the summer of 2009. In addition, two-32.4 MVAR capacitor banks are scheduled to be placed in service at the Summit Substation by June of 2010 to improve area bus voltages. In the interim, dispatching Concord and/or Germantown generation will provide var support to improve area voltage.

Thermal and low voltage issues also are expected to occur elsewhere in Zone 5. Following are results of the contingency analysis (NERC Category B or TPL-002-0 conditions) performed on Zone 5.

An outage of the Jefferson–Crawfish River–Concord 138-kV line will cause the bus voltages at Concord (87.8%), Cooney (89.0%), and Summit (89.7%) to drop below 90%. Running Concord generation will alleviate this situation.

An outage of the Bark River–Cottonwood 138-kV line will cause bus voltages at Cooney (89.3%), Cottonwood (87.7%), and Summit (89.1%) to drop below 90%. Running Concord generation will alleviate this situation.

An outage of the Bark River–Sussex 138-kV line will cause bus voltages at Cooney (89.6%), Cottonwood (88.0%), Bark River (88.0%), Germantown (89.4%), and Summit (89.4%) to drop below 90%. Running Concord and Germantown generation alleviate this situation.

An outage of the Maple–Saukville 138-kV line will cause bus voltages at Cooney (90.0%), Cottonwood (89.2%), Bark River (89.6%), Germantown (84.1%), Maple (83.8%) and



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Summit (89.9%) to decrease drop below 90%. Running Germantown generation will alleviate this situation.

An outage of Hartford–St. Lawrence 138-kV line will cause low bus voltage at Hartford (86.8%). Running Concord generation will improve the bus voltage at Hartford.

Splitting the Pleasant Prairie 345-kV bus between bus sections 3 and 4 will cause Bain transformer #5 to exceed its summer emergency rating by 59%. Bus outages are low probability events. Relief can be provided by reducing the output of Pleasant Prairie generator #2 to about 350 MW.

An outage of the Bain–Kenosha 138-kV line will cause the Bain–Albers 138-kV line to load to 97.6% of its summer emergency rating. Increasing line conductor clearances will alleviate this situation by permitting operation above 167 degrees.

An outage of the Arcadian 345/138-kV transformer #1 causes Arcadian transformer #3 to load to 106.0% of its summer emergency rating and Arcadian transformers #2 to load to 96.0% of its summer emergency rating. Project development is underway to replace the Arcadian transformers #2 and #3 with a single 500 MVA transformer. The 345/138-kV windings of the existing transformers are rated at 239/239 MVA (SN/SE). The summer emergency rating of the new transformer will be 640 MVA.

Splitting the Oak Creek 230-kV bus between bus sections 6 and 7 will cause Oak Creek transformer T884 to load to 97.5% of its summer emergency rating. Bus outages are considered low probability events.

*Oak Creek generation:* We Energies received PSCW approval to build two 650-MW coal powered generators at the Oak Creek Power Plant. The units are scheduled to go into service in 2009 and 2010. The following projects are under construction as a result of this new generation.

#### 2009 - Oak Creek generation Phase 1

- build a new Oak Creek 345-kV switchyard to interconnect one new 650-MW generator
- reconductor a segment of the Oak Creek–Ramsey 138-kV line
- terminate the Ramsey–Harbor line into the Kansas/Norwich substations creating a Kansas–Harbor 138-kV line and a Norwich–Ramsey 138-kV line
- reconductor the Oak Creek–Allerton 138-kV line
- replace current transformers at the Racine 345-kV Substation
- replace two 345-kV circuit breakers at Pleasant Prairie Substation on the Racine and Zion lines with IPO breakers and upgrade relaying



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- expand Oak Creek 138-kV switchyard to connect the 345/138-kV, 500 MVA transformer

#### *2010 - Oak Creek generation Phase 2*

- expand 345-kV switchyard at Oak Creek Power Plant to interconnect a second new 650-MW generator
- reconductor the Oak Creek-Root River 138-kV line
- uprate terminal equipment and increase line clearances on the Oak Creek-Nicholson 138-kV line to permit operation at 230 degrees
- Increase line rating of the Kansas – Ramsey 138-kV line

In response to customer requests for new distribution interconnections, new 138-kV bus sections will be constructed at the Pleasant Valley, Shorewood and Brookdale Substations in 2009.





## **Zone 5 – 2013 study results**

Refer to [Table ZS-2](#) and [Figure ZS-18](#)

### *Summary of key findings*

- Additional var support is required in the greater Milwaukee area.
- Potential thermal violations indicate the need for facility upgrades in the Waukesha and Kenosha areas.
- Thermal, voltage, and load serving issues in Kenosha and Walworth might be resolved with a 138-kV line between Spring Valley and North Lake Geneva

Sixteen 138-kV buses in Waukesha and Washington County experience low bus voltage under NERC Category A or TPL-001-0 conditions (intact system) in 2013. The buses are Concord (90.6%), Allerton (94.7%), Bark River (91.8%), Edgewood (94.4%), Cooney (90.0%), Cottonwood (90.5%), Germantown (91.7%), Hartford (92.6%), Merrill Hills (92.7%), Mukwonago (93.8%), Maple (92.3%), St. Lawrence (94.0%), Summit (90.2%), Sussex (94.9%), Arthur Road (94.0%), and Glacier (94.5%). These low intact system bus voltages occurred because Concord and Germantown generation was modeled out of service in 2013 as a result of new generation at Oak Creek. The new generation is scheduled to be placed in service prior to the summer of 2010.

Two-32.4 MVAR capacitor banks are scheduled to be placed in service at Summit by June 2010 to improve area bus voltages. In the interim, dispatching Concord and/or Germantown will provide var support to improve area voltage.

Additional reactive sources are required in the greater Milwaukee area. In addition to the Summit capacitor banks, 225 MVAR of capacitance will be installed at the Bluemound Substation in 2010.

Following are the results of the 2013 contingency analysis (NERC Category B or TPL-002-0 conditions) performed on Zone 5.

An outage of either one of the Arcadian–Waukesha 138-kV lines (KK9962 and KK9942) results in the other Arcadian–Waukesha 138-kV line overloading by 14-15 percent. The limiting element is the line conductor with clearances set for operation at 200 degrees. The line conductor clearances will be increased in 2010 to permit higher flows under contingency conditions.

An outage of the Arcadian 345/138-kV transformer T1 causes the Arcadian 345/138-kV transformer T3 to overload by 10 percent. As a result, a provisional project to install 1-



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345/138-kV 500 MVA transformer to replace these two existing transformers is being considered in the 2011 timeframe.

### *Projects New in this Assessment*

The Albers-Bain 138-kV line loads to 96 percent of its summer emergency limit for an outage of the Bain-Kenosha 138-kV line. The limiting elements are bus jumpers at Bain Substation and the line conductor clearances. This line will be upgraded in 2010.

A project to install a second Shorewood-Humboldt underground cable in 2012 is under consideration to accommodate additional distribution load (2009) at the Shorewood Substation under contingency conditions. Under the Cornell-Shorewood 138-kV underground contingency, there is very little load bridging capability. A parallel Shorewood-Humboldt underground line will eliminate a potential load shedding situation.

A provisional project to uprate the Bain-Kenosha 138-kV line is being considered to resolve potential thermal overloads under single-contingency conditions in 2013.

Thermal, voltage, and load serving issues in Kenosha and Walworth County might be resolved by constructing a 138-kV line from Spring Valley to Twin Lakes, continuing on to South Lake Geneva. This would entail acquiring new right-of-way between Spring Valley and Twin Lakes. The remaining segment between Twin Lake and North Lake Geneva could make use of an existing right-of-way. Studies are underway to determine the course of action to alleviate the issues in the area. This project would also coordinate with a Zone 3 project, the North Lake Geneva-South Lake Geneva 138-kV line with a 2014 in-service date. Please refer to [Zone 3 – 2013 study results](#) for details about the North Lake Geneva-South Lake Geneva 138-kV line project.





## **Zone 5 – 2018 study results**

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

### *Summary of key findings*

- ❑ Heavy load growth in Waukesha, Washington, Dodge and Jefferson 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 to solve these problems.
- ❑ Voltage and thermal issues remain in Zone 5 under contingency conditions.
- ❑ Thermal, voltage, and load serving issues in Kenosha and Walworth might be resolved with a 138-kV line between Spring Valley and North Lake Geneva

Fifteen 138-kV buses in Waukesha and Washington County experience low bus voltage under NERC Category A or TPL-001-0 conditions (intact system) in 2018. The fifteen buses are Allerton (93.9%), Bark River (93.7%), Cooney (92.8%), Brookdale East (94.6%), Edgewood (94.5%), Chinook (94.4%), Cooney (93.8%), Cottonwood (92.9%), Germantown (94.4%), Hartford (94.7%), Merrill Hills (94.0%), Mukwonago (94.3%), Maple (94.6%), Summit (93.6%), and Country Aire (94.4%). In addition, another fourteen 138-kV buses have marginal bus voltages between 95-96%. It should be pointed out that provisional capacitor banks scheduled for Bluemound in 2010 as well as Mukwonago in 2014 were not modeled in service in the 2018 base case. In addition, only two Concord generators and one Germantown generator are online at time of peak. Modeling the Bluemound and Mukwonago capacitors in service as well as running additional generation at Concord and Germantown would improve the voltage in Waukesha and Washington counties.

Following are the results of the 2018 contingency analysis (NERC Category B or TPL-002-0 conditions) performed on zone 5.

The Oak Creek–Pennsylvania 138-kV line will load to 100.7% of its summer normal rating under intact system conditions. Under a number of contingencies, the line can exceed its summer emergency rating by up to 2.3%. The line conductor is the limiting element.

Splitting the Pleasant Prairie 345-kV bus between bus sections 3 and 4 will cause the Bain transformer #5 to exceed its summer emergency rating by 59.7%. Bus outages are low probability events. Relief can be provided by reducing the output of Pleasant Prairie generator #2 to about 350 MW.

The Bain 345/138-kV transformer #4 will exceed its summer emergency rating by 3.7% for an outage of Bain transformer #5. Reducing Pleasant Prairie generation will provide loading relief.



An outage of the Bain–Albers 138-kV line will result in the Bain–Kenosha 138-kV line loading to 98.7% of its summer emergency rating.

An outage of either one of the Arcadian–Waukesha 138-kV lines (KK9962 or KK9942) will result in the other Arcadian–Waukesha 138-kV line loading to 100% of its summer emergency rating. The limiting element is the line conductor with clearances set for operation at 200 degrees. The line conductor clearances will be increased in 2010 to permit higher flows under contingency conditions.

An outage of the Bark River–Cottonwood 138-kV line or Bark River–Sussex 138-kV line will cause bus voltages at Cottonwood to drop to 89.0%. Increasing the amount of Concord generation online will improve voltages in the area.

An outage of the Bark River–Sussex 138-kV line will cause bus voltages at Bark River to drop to 89.5%. Increasing the amount of Concord generation online will improve area bus voltages.

An outage of the Maple–Saukville 138-kV line will cause bus voltages at Germantown (89.3%), Maple (88.9%) and Country Aire (89.3%) to drop below 900=.0%. Dispatching Germantown generation will improve bus voltages.

An outage of the Bain–Kenosha 138-kV line will cause the Bain–Albers 138-kV line to load to 121.3% of its summer emergency rating. The line conductor clearance is the limiting element.

An outage of Oak Creek 345/138-kV transformer #1 will cause Oak Creek 345/138-kV transformer #2 to load to 99% of its summer emergency rating.

An outage of the Oak Creek–Pennsylvania 138-kV line will cause the Branch–Kansas 138-kV line (108.2%), Nicholson–Ramsey 138-kV line (96.3%), and Oak Creek–Ramsey 138-kV line (96.1%) to approach or exceed their summer emergency ratings. Increasing line conductor clearances on the Branch–Kansas 138-kV line will provide relief.

An outage of the Arcadian 345/138-kV transformer #1 causes the Arcadian transformer #3 to load to 120.1% of its summer emergency rating and Arcadian transformer #2 to load to 101.0% of its summer emergency rating.

Splitting the Burlington 138-kV bus will result in low 138-kV bus voltages at Tichigan (87.7%) and Burlington (88.6%).



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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 is being considered. The components of the project could include:

- ❑ 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.

In addition to improving the voltage profiles in Jefferson, Waukesha and Washington counties, reducing loadings on parallel 138-kV circuits and reducing system losses, the above reinforcements will 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.

Provisional projects to install 2-32 MVAR of capacitance at the Mukwonago Substation and upgrading the Oak Creek-Pennsylvania 138-kV line are being considered in the 2014 timeframe in order to address remaining voltage and thermal issues.



## **Zone 5 – 2023 study results**

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

### *Summary of key findings*

- ❑ Heavy load growth in Waukesha, Washington, Dodge and Jefferson 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.
- ❑ Voltage and thermal issues remain in Zone 5 under contingency conditions.

Eleven 138-kV buses in Waukesha and Washington County experience marginal bus voltage under NERC Category A or TPL-001-0 conditions (intact system) in 2023. The fifteen buses are Allerton (95.8%), Bark River (95.6%), Barton (95.8%), Cooney (95.5%), Cottonwood (95.2%), Hartford (95.1%), Merrill Hills (95.6%), St. Lawrence (95.6%), Summit (95.4%), Arthur Road (95.6%), and Glacier (95.5%).

Following are the results of the 2023 contingency analysis (NERC Category B or TPL-002-0 conditions) performed on Zone 5.

The Oak Creek–Pennsylvania 138-kV line will load to 106.3% of its summer normal rating under intact system conditions. Under a number of contingencies, the line can exceed its summer emergency rating by up to 7.8%.

Splitting the Concord 138-kV bus will result in low or marginal 138-kV bus voltage at Hartford (88.7%), St. Lawrence, Arthur Road (90.8%), and Cooney (90.3%).

An outage of the Saukville–Fredonia 138-kV line will cause the bus voltage at Fredonia to drop to 89.2%.

Splitting the Pleasant Prairie 345-kV bus between bus sections 3 and 4 will cause Bain transformer #5 to exceed its summer emergency rating by 59.7%. Bus outages are low probability events. Relief can be provided by reducing the output of Pleasant Prairie generator #2 to about 350 MW.

An outage of the Bain–Kenosha 138-kV line will cause the Albers–Kenosha 138-kV line to exceed its summer emergency rating by 4.0%.

An outage of the Oak Creek–Pennsylvania 138-kV line will cause the Branch–Kansas 138-kV line (119.9%), Nicholson – Ramsey 138-kV line (99.4%), and Oak Creek – Ramsey 138-kV line (99.2%) to approach or exceed their summer emergency ratings.



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Splitting the Burlington 138-kV bus will result in low 138-kV bus voltage at Tichigan (0.831) and Burlington (0.842).

An outage of the Arcadian 345/138-kV transformer #1 causes Arcadian transformer #3 to load to 118.9% of its summer emergency rating and Arcadian transformers #2 to load to 97.5% of its summer emergency rating.

In the previous 2018 results section, a potential Rockdale–Mill Road 345-kV line was discussed as a way improving bus voltages in Waukesha, Washington, and Jefferson Counties. Through 2018, the ATC planning models indicated there is generation available at Concord and Germantown that could provide support to the three county region. At some point between 2018 and 2023, all of the generation at Concord and Germantown will be dispatched. Dispatching generation at Concord and Germantown 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 to provide relief.

### ***Summary of Compliance with NERC Standards***

The mitigation plans, planned, proposed and provisional projects identified for Zone 5 in this Assessment will allow the ATC system in Zone 5 to meet NERC standards TPL-001, TPL-002, TPL-003 and TPL-004 in each of the four years 2009-2013, and for the 2014-2018 planning horizon.

**TABLE ZS-1  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2009 Summer Peak, 70% High Transfer and 90% East-to-West Bias Cases**

Planning Zone	Criteria Exceeded/Need	2009 Summer Peak Case		2009 High Transfer Case		2009 90% E-W Case		Facility Outage(s)	Project
		% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
1	Sigel and Lakehead Vesper 138-kV bus voltages	–	91 – 92%	–	–	–	–	Arpin-Sigel 138-kV line	Publicly announced load curtailments
1	Council Creek and Petenwell 138-kV bus voltage	–	90 – 95%	–	–	–	91%	Base Case Saratoga-Petenwell 138-kV line	Monroe County – Council Creek 161-kV line
1	Necedah, Whistling Wings, Dellwood, and Friendship 69-kV bus voltages	–	90 – 92%	–	–	–	91 – 92%	Petenwell 138/69-kV transformer Petenwell-Big Pond 69-kV line Big Pond-Necedah tap 69-kV line	Mckenna capacitor bank expansion
1	Wien – Stratford 115-kV line	99 – 105%		103.5%	–	–	–	Arpin 345/138-kV transformer Arpin 138/115-kV transformer Arpin-Galvin 115-kV line Galvin-Hume 115-kV line	Use recently validated circuit ratings
2	Delta – Mead 69-kV line	103-163 %	-	95-111%	-	103-161%	-	Base Case Chandler-Lakehead Tap 69-kV line Lakehead Tap-Masonville 69-kV line Masonville-Gladstone 69-kV line Gladstone-North Bluff 69-kV line North Bluff-Bay Tap 69-kV line Bay Tap-Mead 69-kV line	Dispatch local generation
2	Chandler – Delta 69-kV #1 line	109%	-	118%	-	109%	-	Chandler-Delta 69-kV #2 line	Dispatch local generation
2	Chandler – Delta 69-kV #2 line	103%	-	113%	-	103%	-	Chandler-Delta 69-kV #1 line	Dispatch local generation
2	Chandler 138/69-kV transformer	95-104%	-	101-102%	-	98-104%	-	Nordic-Mountain 69-kV line Mountain-Harris Tap 69-kV line Forsyth 138/69-kV transformer	Increased existing summer emergency rating from SELD
2	Chandler – Lakehead Tap 69-kV line Masonville – Lakehead Tap 69-kV line Masonville – Gladstone 69-kV line Gladstone – North Bluff 69-kV line North Bluff – Bay Tap 69-kV line Mead – Bay Tap 69-kV line	124-162%	-	98%-109%	-	121%-158%	-	Delta-Mead 69-kV line	Dispatch local generation
2	Pine River – Straits 69-kV line	104%-108%	-	-	-	103%-106%	-	Hiawatha-Lakehead 138-kV line Lakehead-Brevort 138-kV line Brevort-Straits 138-kV line	Dispatch of hydro and/or diesel generation
2	Straits– Evergreen 69-kV line Evergreen-Pine River 69-kV line	95%-105%	-	-	-	96%-104%	-	Hiawatha-Lakehead 138-kV line Lakehead-Brevort 138-kV line Brevort-Straits 138-kV line	Dispatch of hydro and/or diesel generation
2	Valley, Evergreen, Indian Lake, St. Ignace, Blaney Park, Curtis, Gould City, Straits, Engadine, Hiawatha 69-kV bus voltages	-	105.2%-105.8%	-	105.0%-105.6%	-	105.1% - 105.7%	Base Case	Operating guide
2	Engadine, Newberry Village, Lou Pac, Newberry, Newberry Hospital, Newberry Hospital Tap, Roberts, Hulbert, Eckerman, Raco 69 kV bus voltages	-	80.9%-91.4%	-	-	-	80.3%-91.3%	Hiawatha-Engadine 69-kV line Engadine-Newberry 69-kV line	9 Mile/Roberts 69-kV capacitor banks
2	Atlantic 138-kV bus voltage	-	88.9%	-	-	-	-	Atlantic-M-38 138-kV line outage	Operating guide
2	Iron Grove, Twin Lake 69-kV bus voltages	-	88.0%-88.9%	-	-	-	-	Twin Lake -Lakota Rd 138-kV line Twin Lake-Iron Grove 138-kV line	Operating guide
3	North Stoughton-Stoughton East – Stoughton 69-kV line	136.3% - 96.9%	–	–	–	119.4% - 103.2%	–	McCue-Harmony 69-kV line Harmony-Lamar 69-kV line Lamar-Fulton 69-kV line	Rebuild Stoughton Substation bus



**TABLE ZS-1 (continued)**  
**PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2009 Summer Peak, 70% High Transfer and 90% East-to-West Bias Cases**

Planning Zone	Criteria Exceeded/Need	2009 Summer Peak Case		2009 High Transfer Case		2009 90% E-W Case		Facility Outage(s)	Project
		% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
3	Verona-Sun Valley-Oregon 69-kV line	121.3%	–	–	–	105.9%	–	Stoughton-Aaker 69-kV line	Rebuild the Y-119 Verona to Oregon 69-kV line
3	McCue-Harmony-Lamar 69-kV line	111.6% - 95.2%	–	–	–	99.6% - 97.2%	–	Kegonsa 138/69-kV transformer Kegonsa-North Stoughton 69-kV line North-Stoughton-Stoughton E 69-kV line	Uprate Y-61 McCue-Lamar 69-kV line to achieve 300 deg F line ratings and install 2-12.45 Mvar 69-kV capacitor banks at Lamar Substation
3	Fitchburg-Syene 69-kV line	101.1%	–	–	–	–	–	Royster-Pflaum Tap 69-kV line	Loop 6947 Nine Springs-Pflaum 69-kV line into Femrite Substation
3	Stage Coach-Black Earth 69-kV line	98.3%	–	–	–	97.7%	–	Spring Green 138/69-kV transformer	Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating
3	Royster-Pflaum Tap 69-kV line	97.8%	–	–	–	–	–	Fitchburg-Syene 69-kV line	Loop 6947 Nine Springs-Pflaum 69-kV line into Femrite Substation
3	Enzyme Bio Systems-RC3 69-kV line	97.7%	–	–	–	98.1% - 95.5%	–	Colley Road – Dickinson 138-kV line	Operating guide
3	McCue-Harmony 69-kV line	95.2%	–	–	–	–	–	Brodhead Switching Station-Brodhead South 69-kV line	Uprate Y-61 McCue-Lamar 69-kV line to achieve 300 deg F line ratings and install 2-12.45 Mvar 69-kV capacitor banks at Lamar Substation
3	Concord, Rubicon, Hustisford, Hubbard and Butler Ridge 138-kV buses	–	93.4% - 94.7%	–	–	–	94.1% -94.8%	Base Case	Dispatch local generation
3	Harmony, Lamar, Fulton, Saunders Creek, Dana Corp, Sheepskin and Evansville 69-kV buses	–	83.6% - 91.8%	–	90.5% - 91.5%	–	86.8% - 91.5%	McCue-Harmony 69-kV line Harmony-Lamar 69-kV line Lamar-Fulton 69-kV line	Uprate Y-61 McCue-Lamar 69-kV line to achieve 300 deg F line ratings and install 2-12.45 Mvar 69-kV capacitor banks at Lamar Substation
3	Lakehead Cambridge Tap, Fort Atkinson, Jefferson, Crawfish, Concord ,Hubbard, Hustisford, Rubicon and Butler Ridge 138-kV buses	–	86.4% - 91.5%	–	–	–	88.3% - 91.8%	Rockdale to Lakehead Cambridge Tap 138-kV line Lakehead Cambridge Tap-Jefferson4 138-kV line Jefferson4-Jefferson 5 Bus outage Jefferson5-Crawfish 138-kV line Crawfish-Concord4 138-kV line Plus other less severe outages	Dispatch local generation

**TABLE ZS-1 (continued)**  
**PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2009 Summer Peak, 70% High Transfer and 90% East-to-West Bias Cases**

Planning Zone	Criteria Exceeded/Need	2009 Summer Peak Case		2009 High Transfer Case		2009 90% E-W Case		Facility Outage(s)	Project
		% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
3	Brodhead Muni 3, Brodhead Muni 2, Brodhead, Brodhead Muni 1, RCEC Orfordville, Orfordville, Bass Creek, Footville, RCEC Center, Evansville 69-kV bus voltages	–	88.2% - 91.7%	–	–	–	90.7% - 92%	Brodhead Switching Station-Brodhead Muni 3 69-kV line Brodhead Muni 2 – Brodhead Muni 3 69-kV line Brodhead Muni 2-Brodhead 69-kV line	Upgrade Sheepskin capacitor bank from 10.8 MVAR to 16.2 MVAR and Install 5.7 MVAR distribution capacitor bank at Union Townline 69-kV Substation
3	Aaker, Oregon and Brooklyn 69-kV buses	–	88.2% - 89.5%	–	–	–	–	Stoughton-Aaker 69-kV line	Rebuild the Y-119 Verona to Oregon 69-kV line
3	Spring Green, Arena, Mazomanie, Mazomanie Industrial, Lone Rock, Muscododa, Avoca, Blue River, Boscobel, Boscobel Muni 69-kV bus voltages	–	88.5% - 91.4%	–	–	–	90.5% - 91.7%	Spring Green 138/69-kV transformer	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation
3	Hubbard and Hustisford 138-kV buses	–	89.1% - 89.7%	–	88.5% -89.3%	–	–	Rubicon-Hustisford 138-kV line Hubbard-Hustisford 138-kV line	Adjust load tap changer at Hubbard
3	Dickinson, Global Renewable Energy, William Bay and Brick Church 138-kV buses	–	90.0% - 91.2%	–	89% - 91.5%	–	89.1% - 91.7%	Colley Road – Dickinson 138-kV line Dickinson-Global Renewable Energy 138-kV line Global Renewable Energy-Brick Church 138-kV line	Install a total of 6.3 MVAR distribution capacitor banks at Dickinson Substation and Install one temporary 12.45 MVAR 69-kV mobile capacitor bank at Brick Church Substation
3	Eden and Lancaster 138-kV buses	–	90.4% - 91.7%	–	–	–	–	Nelson Dewey-Lancaster 138-kV line Lancaster-Eden 138-kV line	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation
3	N Stoughton, Stoughton E, Stoughton and Aaker 69-kV buses	–	91.2% - 91.5%	–	–	–	–	N Stoughton-Kegonsa 69-kV line	Rebuild the Y-119 Verona to Oregon 69-kV line and Construct new Oak Ridge-Verona 138-kV line and install a 138/69-kV transformer at Verona with a 100 MVA summer normal rating
3	Muscododa and Avoca 69-kV buses	–	91.3% - 91.7%	–	–	–	91.9%	Spring Green-Lone Rock 69-kV line	Install 1-8.16 MVAR capacitor bank at Boscobel 69-kV Substation and upgrade existing 5.4 MVAR bank with an 8.16 MVAR bank
3	Paddock 345/138 kV transformer	–	–	107.7%	–	–	–	Base case	Dispatch local generation
3	Paddock-Townline 138-kV line	–	–	103.1%	–	–	–	Base case	Dispatch local generation
3	Paddock-Townline 138-kV line	–	–	123.3% - 113.8%	–	–	–	Paddock-NW Beloit 138-kV line NW Beloit-Blackhawk 138-kV line Blackhawk-Colley Road 138-kV line	Dispatch local generation
3	Paddock-NW Beloit-Blackhawk-Colley Road 138-kV line	–	–	116.8% - 105.5%	–	–	–	Paddock-Townline 138-kV line	Dispatch local generation

**TABLE ZS-1 (continued)**  
**PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2009 Summer Peak, 70% High Transfer and 90% East-to-West Bias Cases**

Planning Zone	Criteria Exceeded/Need	2009 Summer Peak Case		2009 High Transfer Case		2009 90% E-W Case		Facility Outage(s)	Project
		% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
3	Huiskamp-Mendota-Ruskin 69-kV line	–	–	106.5% - 98.9%	–	–	–	North Madison-Vienna 138-kV line Vienna-Yahara River 138-kV line Yahara River-American Center 138-kV line American Center-Sycamore 138-kV line	Dispatch local generation
3	N Stoughton-Stoughton E-Stoughton 69-kV line	–	–	113.9% - 104.4%	–	–	–	Paddock 345/138 kV transformer Paddock-Wempletown 345-kV lines	Dispatch local generation
3	North Monroe-Darlington 138-kV line	–	–	100.8%	–	–	–	Paddock 345/138 kV transformer Paddock-Wempletown 345-kV lines	Dispatch local generation
3	Brick Church 138-kV bus	–	–	–	94.9%	–	–	Base case	Dispatch local generation
3	Brick Church, Global Renewable Energy, North lake Geneva, William Bay, Elkhorn, Bristol, Sugar Creek and Bluff Creek 138-kV buses	–	–	–	90.8% - 91.8%	–	–	Burlington 138-kV Bus tie outage	Dispatch local generation
3	Potosi, Hillman, Lafayette wind, Darlington, Albany and North Monroe 138-kV buses	–	–	–	87.3% - 91.8%	–	–	Nelson Dewey-Potosi 138-kV line Potosi-Hillman 138-kV line Hillman-Lafayette Wind 138-kV line	Dispatch local generation
3	Entire Rock County and Walworth County 138-kV bus voltages	–	–	–	86.8% - 91%	–	–	Paddock 345/138 kV transformer Byron-Wempletown 345 kV line Paddock-Wempletown 345-kV line	Dispatch local generation
3	McCue-Harmony 69-kV line	96.5%	--	--	--	--	--	Columbia generator unit 1 or 2	Uprate Y-61 McCue-Lamar 69-kV line to achieve 300 deg F line ratings and install 2-12.45 Mvar 69 kV capacitor banks at Lamar Substation
4	West Marinette 138/69-kV transformer #1	96.6-95.1%	–	–	–	–	–	Wells St-Roosevelt 69-kV line Roosevelt 138/69-kV transformer	- Expand the Menominee 69-kV Substation and install 138-kV terminals. Loop the West Marinette-Bay De Noc 138-kV line into the Substation - Install 138/69-kV transformer at the expanded Menominee Substation
4	Sunset Point-Pearl Ave 69-kV line	104.8%	–	–	–	–	–	Ellinwood-Twelfth Ave 69-kV line	- Rebuild 2.37 miles of 69 kV from Sunset Point to Pearl Ave with 477 ACSR
4	Pioneer-Sobieski 69-kV line	99.6%	–	–	–	–	–	Pulliam-Suamico 69-kV line outage followed by Sobieski-Pioneer 69-kV line close	Rebuild/Convert Bayport-Suamico-Sobieski-Pioneer 69-kV line to 138 kV
4	Sobieski 69-kV bus	–	93.9%	–	–	–	94.8%	Base Case	Rebuild/Convert Bayport-Suamico-Sobieski-Pioneer 69-kV line to 138 kV

**TABLE ZS-1 (continued)**  
**PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2009 Summer Peak, 70% High Transfer and 90% East-to-West Bias Cases**

Planning Zone	Criteria Exceeded/Need	2009 Summer Peak Case		2009 High Transfer Case		2009 90% E-W Case		Facility Outage(s)	Project
		% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
4	Suamico 69-kV bus	-	91.6%	-	-	-	-	Pulliam-Suamico 69-kV line outage followed by Sobieski-Pioneer 69-kV line close	Rebuild/Convert Bayport-Suamico-Sobieski-Pioneer 69-kV line to 138 kV
4	Bluestone, Wesmark 69-kV buses	-	89.3-91.5%	-	-	-	-	Finger Rd-Bluestone 69-kV line outage	Construct a new 138-kV substation and loop Highway V-East Krok 138-kV line into the substation
5	Concord 138 kV bus Bark River 138 kV bus Cooney 138 kV bus Cottonwood 138 kV bus Germantown 138 kV bus Hartford 138 kV bus Merrill Hills 138 kV Maple 138 kV bus Summit 138kV bus	-	93.5 % 94.2 % 92.8 % 93.1 % 93.6 % 94.9 % 94.7 % 94.1 % 92.9 %	-	-	-	-	Intact System	Dispatch local generation
5	Concord, Cooney, Cottonwood, Summit, Bark River 138-kV bus voltages	-	90.6 – 91.8% 87.8 – 90.6 % 87.7 – 91.0 % 88.0 – 91.4 % 89.1 - 91.0 %	-	- - - -	-	91.8 -- 91.9% 89.5 -- 91.9% 88.9 – 90.4 % 89.5 – 90.7 % 91.1 – 91.7 %	Jefferson-Lakehead – Rockdale 138-kV line Jefferson-Crawfish River – Concord 138-kV line Bark River – Cottonwood 138-kV line Bark River – Sussex 138-kV line Maple – Saukville 138kV line Plus other less severe outages	Dispatch local generation
5	Germantown and Maple 138-kV bus voltages	-	88.7% 83.8 – 84.1% 89.4 – 90.4%	-	-	-	91.1 % 87.3 – 87.6 % 91.1 – 91.9%	Germantown – Maple 138kV line Maple - Saukville 138kV line Bark River – Sussex 138kV line	Dispatch local generation
5	Hartford 138-kV bus voltage	-	86.8%	-	-	-	88.6 %	Hartford – St. Lawrence 138kV line	Load shifting
5	Bain 345/138-kV transformer	159.0%	-	130.7%	-	159.1%	-	Pleasant Prairie bus split between buses 3 and 4	Dispatch local generation
5	Albers – Bain 138-kV line	97.6%	-	-	-	102.7%	-	Bain – Kenosha 138-kV line	Dispatch local generation
5	Oak Creek 345/230-kV transformer (T884)	97.5%	-	-	-	-	-	Oak Creek 230-kV bus split between buses 6 & 7	Dispatch local generation
5	Arcadian4 – Waukesha1 138-kV line	-	-	-	-	98.2%	-	Arcadian6 – Waukesha3 138-kV line	Dispatch local generation
5	Arcadian6 – Waukesha3 138-kV line	-	-	-	-	97.4%	-	Arcadian4 – Waukesha1 138-kV line	Dispatch local generation
5	Albers – Paris 138-kV line	-	-	100.7%	-	-	-	Paddock 345/138-kV transformer	Dispatch local generation
5	Harbor – Kansas 138-kV line	-	-	92.6% 93.2% 93.6% 94.6%	-	-	-	Montana – Dewey 138-kV line Dewey 138-kV bus tie outage Dewey – Norwich 138-kV line Kansas – Norwich 138-kV line	Dispatch local generation
5	Tichigan and Burlington 138-kV buses	-	-	-	89.3-89.6%	-	91.6%	Burlington 138-kV bus split	Load shift
5	Albers- Kenosha 138-kV line	-	-	111.3%	-	113.3%	-	Albers – Bain 138-kV line	Dispatch local generation
5	Root River – Oak Creek 138-kV line	-	-	-	-	101.2%	-	Albers – Paris 138-kV line	Dispatch local generation
5	Tichigan, Burlington and Air Liquide 138-kV buses	-	-	-	91.3-92.0%	-	-	Paddock 345/138-kV transformer	Load shift

**TABLE ZS-1 (continued)**  
**PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2009 Summer Peak, 70% High Transfer and 90% East-to-West Bias Cases**

Planning Zone	Criteria Exceeded/Need	2009 Summer Peak Case		2009 High Transfer Case		2009 90% E-W Case		Facility Outage(s)	Project
		% 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	- 106.0%	-	108.0% 94.1%	-	100.2% 106.4%	-	Arcadian 345-kV bus and Arcadian transformer #2 Arcadian transformer #1	Dispatch local generation (temporary) Arcadian transformer (provisional permanent solution)
5	Arcadian 345/138-kV transformer #2	96.0 %	--	--	--	97.5%	-	Arcadian transformer #1	Generation redispatch (temporary) Arcadian transformer (provisional permanent solution)

TABLE ZS-2

PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2013 Summer Peak, High Growth, 3000 MW Import and 90% East-to-West Bias Cases

Planning Zone	Criteria Exceeded/Need	2013 Summer Peak Case		2013 High Load Growth		2013-70% - 3000 MW Import Case		2013-90% - E-W Bias Case		Facility Outage(s)	Project
		% 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	Eagle River Muni 115-kV bus voltage	-	111.4%	-	110.1%	-	104.2%	-	113.6%	Eagle River Muni – Cranberry 115-kV line	Take Lakota Road capacitor out of service
1	Arrowhead 345-kV bus voltage	-	110.5%	-	110.6%	-	111.7%	-	110.8%	Arrowhead 345/230-kV Transformer Arrowhead 230-kV PST	Place Stone Lake inductor in-service
1	Stone Lake 345-kV bus voltage	-	-	-	-	-	-	-	105.8%	Base Case	Place Stone Lake inductor in-service
1	Rocky Run 345/115-kV transformer #3	-	-	95.6 – 95.9%	-	-	-	-	-	Rocky Run 345/115-kV transformer #2 Sigel – Arpin 115-kV line	No project required as yet (pending overload under high load growth scenario)
1	Wien – Stratford 115-kV line	104.4 – 105.7%	-	95.5 – 110.9%	-	105.1%	-	95.3 – 98.2%	-	Arpin 345/138-kV transformer Arpin 138/115-kV transformer Arpin-Galvin 115-kV line Glavin-Hume 115-kV line Hume-Wildwood 115-kV line	Use recently validated circuit ratings
1	Stratford - McMillan 115-kV line	-	-	99.5%	-	-	-	-	-	Galvin-Hume 115-kV line	Use recently validated circuit ratings
1	Sigel, Lakehead Vesper and Port Edwards 138-kV bus voltages	-	90.0 – 91.0%	-	89.6 – 90.7%	-	-	-	90.9 – 91.8%	Arpin-Sigel 138-kV line	Publicly announced load curtailments
1	Vulcan, Hollywood and Saratoga 138-kV bus voltages	-	91.0 – 91.6%	-	90.7 – 91.3%	-	-	-	91.8%	Arpin-Sigel 138-kV line	Publicly announced load curtailments
1	Petenwell 138/68 kV transformer	97.0%	-	98.0%	-	-	-	-	-	North Fond du Lac – Rosendale 69-kV line	No project needed yet
1	Castle Rock – Quincy 69-kV line	101.3 – 101.4%	-	101.2-101.3%	-	-	-	-	-	Petenwell 138/69-kV transformer Petenwell-Big Pond 69-kV line Big Pond-Necedah tap 69-kV line	Uprate Castle Rock-McKenna 69-kV circuit
1	McKenna – Quincy 69-kV line	95.8%	-	95.4%	-	-	-	-	-	Petenwell 138/69-kV transformer Petenwell-Big Pond 69-kV line Big Pond-Necedah tap 69-kV line	Uprate Castle Rock-McKenna 69-kV circuit
1	Council Creek and Petenwell 138-kV bus voltages	-	87.4 – 94.1%	-	87.0 – 93.8%	-	-	-	89.2 – 95.8%	Base Case Saratoga-Petenwell 138-kV line Arpin-Sigel 138-kV line Sigel-Lakehead Vesper 138-kV line Hillsboro 161/69-kV transformer	Monroe County – Council Creek 161-kV line
1	Petenwell, Necedah, Whistling Wings, Dellwood, Friendship, Houghton Rock and McKenna 69-kV bus voltages	-	85.6 – 92.0%	-	84.7 – 91.5%	-	91.8 – 91.9%	-	87.7 – 91.7%	Petenwell 138/69-kV transformer Petenwell-Big Pond 69-kV line Big Pond-Necedah tap 69-kV line Necedah tap-Whistling Wings tap 69-kV line	McKenna capacitor bank expansion
1	Metomen 138/69-kV transformer	-	-	95.2 – 102.6%	-	-	-	-	-	Metomen-Rosendale 69-kV line Rosendale-North Fond du Lac 69-kV line Winneconne-Sunset Point 69-kV line North Randolph-Markesan tap 69-kV line	Metomen transformer replacement
1	Coloma(ACEC), Lincoln Pumping Station, Brooks and Grand Marsh 69 kV bus voltages	-	92.0%	-	91.4 – 92.0%	-	-	-	-	Chafee Creek-Coloma tap 69-kV line Lincoln PS-Coloma tap 69-kV line	McKenna capacitor bank expansion
2	Delta – Mead 69-kV line	103%-164%	-	108-173%	-	95-112%	-	107-146%	-	Base Case Chandler-Lakehead Tap 69-kV line Lakehead Tap-Masonville 69-kV line Masonville-Gladstone 69-kV line Gladstone-North Bluff 69-kV line North Bluff-Bay Tap 69-kV line Bay Tap-Mead 69-kV line	Uprate Delta-Mead-North Bluff 69-kV line, or dispatch local generation
2	Chandler – Delta 69-kV #1 line	111%	-	120%	-	120%	-	-	-	Chandler-Delta 69-kV #2 line	Uprate Chandler-Delta 69-kV line #1, or dispatch local generation
2	Chandler – Delta 69-kV #2 line	105%	-	114%	-	114%	-	-	-	Chandler-Delta 69-kV #1 line	Uprate Chandler-Delta 69-kV line #2, or dispatch local generation
2	Chandler 138/69-kV transformer	95-104%	-	98-109%	-	95-104%	-	-	-	Nordic-Mountain 69 kV Mountain-Harris Tap 69-kV line Forsyth 138/69-kV transformer	Increased existing summer emergency rating from SELD
2	Chandler – Lakehead Tap 69-kV line Masonville – Lakehead Tap 69-kV line Masonville – Gladstone 69-kV line Gladstone – North Bluff 69-kV line North Bluff – Bay Tap 69-kV line Mead – Bay Tap 69-kV line	128-163%	-	133-173%	-	98-109%	-	110-144%	-	Delta-Mead 69-kV line	Uprate Chandler-Masonville, Masonville-Gladstone, Gladstone-North Bluff, Delta-Mead-North Bluff 69-kV lines; or dispatch local generation
2	Pine River-Straits 69-kV line	-	-	-	-	-	-	96%	-	Straits-Brevort 138-kV line	Dispatch of hydro and/or diesel generation
2	Forsyth 138/69-kV transformer	-	-	97%	-	-	-	-	-	Chandler 138/69-kV transformer	Uprate the Forsyth 138/69-kV transformer



TABLE ZS-2 (continued)

PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2013 Summer Peak, High Growth, 3000 MW Import and 90% East-to-West Bias Cases

Planning Zone	Criteria Exceeded/Need	2013 Summer Peak Case		2013 High Load Growth		2013-70% - 3000 MW Import Case		2013-90% - E-W Bias Case		Facility Outage(s)	Project
		% 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		
2	Ontonagon-UPPSCO Tap 69-kV line Line, Ontonagon 138/69-kV transformer	-	-	-	-	-	-	97-100%	-	Mass-Rockland 69-kV line Rockland-Rockland Junction 2 69-kV line Rockland Junction 2-Victoria 69-kV line	Dispatch local generation
2	Indian Lake 138/69-kV transformers 1, 2	-	-	-	-	-	-	102%	-	Indian Lake 138/69-kV transformer 1, 2	Operating guide
2	Lakota Road 115-kV bus voltage Engadine, Straits, Hiawatha 69-kV bus voltages	-	105.0-105.2%	-	105.0%	-	-	-	-	Base Case	Operating guide
2	Lakota Road 115-kV bus voltage Indian Lake, Perkins, Atlantic 138-kV bus voltages, Munising, Alger 69-kV bus voltages	-	-	-	-	-	105.1-106.0%	-	-	Base Case	Operating guide
2	Lakota Road 115-kV bus voltage	-	-	-	-	-	-	-	105.1%	Base Case	Operating guide
2	Delta, West Side, Escanaba, Masonville, Mead, Gladstone, Bay View, North Bluff, Harris 69-kV bus voltages	-	91.7%-92.0%	-	90.4-92.0%	-	90.9-91.8%	-	-	Chandler 138/69-kV transformer	North Bluff 69-kV capacitor bank, or dispatch local generation
2	Atlantic 138-kV bus voltage	-	88.4%	-	86.8%	-	115.1%	-	-	Atlantic-M-38 138-kV line	M38 138-kV capacitor bank
2	Engadine, Newberry Village, Lou Pac, Newberry, Newberry Hospital, Newberry Hospital Tap, Roberts, Hulbert, Eckerman, Raco 69-kV bus voltages	-	-	-	-	Eastern U.P. Votlage Collapse	-	-	-	Hiawatha-Engadine 69-kV line Engadine-Newberry 69-kV line	9 Mile/Roberts 69-kV capacitor banks, and/or dispatch local generation
2	Engadine, Newberry Village, Lou Pac, Newberry, Newberry Hospital, Newberry Hospital Tap, Roberts, Hulbert, Eckerman, Raco 69-kV bus voltages	-	-	-	-	-	-	-	Eastern U.P. Votlage Collapse	Hiawatha-Engadine 69-kV line	9 Mile/Roberts 69-kV capacitor banks, and/or dispatch local generation
2	Engadine, Newberry Village, Lou Pac, Newberry, Newberry Hospital, Newberry Hospital Tap, Roberts, Hulbert, Eckerman, Raco 69-kV bus voltages	-	-	-	-	-	-	-	86.4-91.0%	Engadine-Newberry 69-kV line	9 Mile/Roberts 69-kV capacitor banks, and/or dispatch local generation
2	L'Anse 69-kV bus voltage	-	-	-	91.6%	-	-	-	-	M38 138/69-kV transformer	L'Anse 69-kV capacitor bank
3	North Stoughton-Stoughton East- Stoughton 69-kV line	131.9%-110.7%	-	143.3%-98.3%	-	-	-	115.7%-97.6%	-	McCue-Harmony 69-kV line Harmony-Lamar 69-kV line	Rebuild Stoughton Substation bus
3	Sheepskin-Dana Tap 69-kV line	110.2%-105%	-	120.5%-114.4%	-	-	-	-	-	McCue-Harmony 69-kV line Harmony-Lamar 69-kV line	Sheepskin Substation protection project
3	Enzyme Bio Systems-RC3 69-kV line	109.6%-96.1%	-	114.1%-96.6%	-	-	-	109.4%-95.7%	-	Colley Road-Dickinson 138-kV line Dickinson-Global Renewable Energy 138-kV line Brick Church 138/69-kV transformer Global Renewable Energy-Brick Church 138-kV line	Rebuild Y-32 Colley Road-Brick Church 69-kV line
3	Stoughton-Sheepskin 69-kV line	107.4%-102.8%	-	118.1%-112.6%	-	-	-	-	-	McCue-Harmony 69-kV line Harmony-Lamar 69-kV line	Install a 138/69-kV transformer at Bass Creek Substation and rebuild/reconductor X-12 Town Line Road-Bass Creek 138-kV line
3	North Lake Geneva-Lake Geneva 69-kV line	105.7%	-	111.1%-96.6%	-	-	-	-	-	Brick Church-Cobble Stone 69-kV line	Uprate Y-152 North Lake Geneva-Lake Geneva 69-kV line to achieve a 115 MVA summer emergency rating
3	Fitchburg-Syene 69-kV line	105.5%	-	110.9%	-	-	-	95.7%	-	Royster-Pflaum Tap 69-kV line	Loop 6947 Nine Springs-Pflaum 69-kV line into Femrite Substation
3	Academy-Columbus Muni 2 Tap 69-kV line and Columbus Muni 2 Tap- Columbus 69-kV line	103.2%-98%	-	105-100.8%	-	-	-	100.6%-97.1%	-	N Randolph-Fox Lake 138-kV line Fox Lake-N Beaver Dam 138-kV line	Construct a Horicon-East Beaver Dam 138-kV line
3	McCue-Harmony-Lamar 69-kV line	102.5%-96.8%	-	108%-95.2%	-	-	-	-	-	Kegonsa 138/69-kV transformer Kegonsa-N Stoughton 69-kV line	Uprate Y-61 McCue-Lamar 69-kV line to achieve 300 deg F line ratings and install 2-12.45 Mvar 69 kV capacitor banks at Lamar Substation
3	Royster-Pflaum Tap 69-kV line	102.4%	-	107.4%	-	-	-	-	-	Fitchburg-Syene 69-kV line	Loop 6947 Nine Springs-Pflaum 69-kV line into Femrite Substation
3	Colley Road-Marine 138-kV line	98.6%	-	101.3%-95.5%	-	-	-	-	-	Paddock-NW Beloit 138-kV line	Colley Road protection project in 2010
3	McCue-Milton Lawn 69-kV line	97.7%	-	102.6%	-	-	-	-	-	Janesville 138/69-kV transformer	Uprate terminal limitations at McCue for the Y-79 McCue-Milton Lawns 69-kV line
3	N Monroe-Idle Hour 69-kV line	97.6%-95.3%	-	102.1%-95.4%	-	-	-	-	-	Darlington-Gratiot 69-kV line Gratiot-Wiota 69-kV line	Install a 138/69-kV transformer at Bass Creek Substation and rebuild/reconductor X-12 Town Line Road-Bass Creek 138-kV line and Rebuild Y-33 Brodhead to South Monroe 69-kV line

TABLE ZS-2 (continued)

PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2013 Summer Peak, High Growth, 3000 MW Import and 90% East-to-West Bias Cases

Planning Zone	Criteria Exceeded/Need	2013 Summer Peak Case		2013 High Load Growth		2013-70% - 3000 MW Import Case		2013-90% - E-W Bias Case		Facility Outage(s)	Project
		% 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	Walworth-Schofield 69-kV line	97.1%	-	101.5%	-	-	-	-	-	N Lake Geneva-138/69-kV transformer	Uprate Y-41 Walworth- North Lake Geneva 69-kV to achieve a 69 MVA summer emergency rating
3	Gran Grae-Wauzeka-Boscobel 69-kV line	97.1%-96.8%	-	100.9%-96%	-	-	-	-	-	Spring Green 138/69-kV transformer Nelson Dewey-Lancaster 138-kV line Spring Green-Lone Rock 69-kV line	Uprate Y-40 Gran Grae-Boscobel 69-kV line to achieve a 99 MVA summer emergency rating
3	Rock Springs Tap – Artesian 138-kV line	96.7%-95.8%	-	98.2%-95.7%	-	-	-	-	-	Trienda-Lewiston 138-kV line East Dells-Lewiston 138-kV line	Construct a Lake Delton-Birchwood 138-kV line
3	Colley Road 138/69-kV transformer	96.4%	-	100.1%	-	-	-	-	-	Paddock 138/69-kV transformer	Install a 138/69-kV transformer at Bass Creek Substation and rebuild/reconductor X-12 Town Line Road-Bass Creek 138-kV line
3	Dane-Lodi Tap 69-kV line	95.7%	-	99.9%	-	-	-	-	-	Kirkwood-Island 69-kV line	Rebuild part of the Y-8 Dane-Dam Heights 69-kV line
3	Shaw-Shirland Ave 69-kV line	95.2%	-	98.8%	-	-	-	-	-	Colley Road 138/69-kV transformer	Rating increase after SELD validation
3	Jefferson, Lake Mills, Fort Atkinson, Crawfish, Concord, Rubicon, Hustisford, Hubbard and Butler Ridge 138-kV buses	-	91.4%-95.8%	-	90.8%-95.1%	-	-	-	93.1%-95.9%	Base Case	Install 4-49 MVAR 138-kV capacitor banks at Concord Substation
3	Brick Church 138-kV bus	-	95.6%	-	-	-	-	-	-	Base Case	Install 2-24.5 Mvar 138-kV capacitor banks and 1-18 Mvar 69-kV capacitor bank at Brick Church substation
3	Harmony, Lamar, Fulton, Saunders Creek, Dana Corp, Sheepskin and Evansville 69-kV buses	-	78.7%-91.8%	-	75.3%-92%	-	88.8%-91.8%	-	83.9%-91.9%	McCue-Harmony 69-kV line Harmony-Lamar 69-kV line Lamar-Fulton 69-kV line	Uprate Y-61 McCue-Lamar 69-kV line to achieve 300 deg F line ratings and install 2-12.45 Mvar 69-kV capacitor banks at Lamar Substation and Install a 138/69-kV transformer at Bass Creek Substation and rebuild/reconductor X-12 Town Line Road-Bass Creek 138-kV line
3	Lakehead Cambridge Tap, Fort Atkinson, Jefferson, Crawfish, Concord ,Hubbard, Hustisford, Rubicon and Butler Ridge 138-kV buses	-	83.6%-91.3%	-	87.1%-91.9%	-	91.4%-91.8%	-	86.4%-91.8%	Rockdale to Lakehead Cambridge Tap 138-kV line Lakehead Cambridge Tap-Jefferson4 138-kV line Jefferson4-Jefferson 5 Bus outage Jefferson5-Crawfish 138-kV line Crawfish-Concord4 138-kV line Plus other less severe outages	Install 4-49 MVAR 138-kV capacitor banks at Concord Substation
3	Spring Green, Arena, Mazomanie, Mazomanie Industrial, Lone Rock, Muscodia, Avoca, Blue River, Boscobel, Boscobel Muni 69-kV bus voltages	-	85.9%-91.4%	-	84.5%-91.8%	-	-	-	89.1%-91.8%	Spring Green 138/69-kV transformer	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating
3	Brodhead Muni 3, Brodhead Muni 2, Brodhead, Brodhead Muni 1, RCEC Orfordville, Orfordville, Bass Creek, Footville, RCEC Center, Evansville 69-kV bus voltages	-	86%-92%	-	84.2%-91.3%	-	-	-	89.2%-91.5%	Brodhead Switching Sta-Brodhead Muni 3 69-kV line Brodhead Muni 2 -Brodhead Muni 3 69-kV line Brodhead Muni 2-Brodhead 69-kV line	Install a 138/69-kV transformer at Bass Creek Substation and rebuild/reconductor X-12 Town Line Road-Bass Creek 138-kV line
3	Dickinson, Global Renewable Energy, William Bay and Brick Church 138-kV buses	-	87.1%-91.5%	-	86.1%-91.8%	-	87.1%-91.7%	-	86.6%-91.9%	Colley Road – Dickinson 138-kV line Dickinson-Global Renewable Energy 138-kV line Global Renewable Energy-Brick Church 138-kV line	Install 2-24.5 Mvar 138-kV capacitor bank and 1-18 Mvar 69-kV capacitor bank at Brick Church Substation
3	Hubbard and Hustisford 138-kV buses	-	88.5%-89.1%	-	88.1%-88.8%	-	88.3%-88.6%	-	88.3%-88.8%	Rubicon-Hustisford 138-kV line Hubbard-Hustisford 138-kV line	Construct a Horicon-East Beaver Dam 138-kV line
3	Evansville 69-kV bus	-	90.6%	-	89.5%-91.9%	-	-	-	-	Evansville-Sheepskin 69-kV line	Install a 138/69-kV transformer at Bass Creek Substation and rebuild/reconductor X-12 Town Line Road-Bass Creek 138-kV line
3	Lake Geneva and Twin Lake 69-kV buses	-	91.9%-92%	-	89.6%-90.6%	-	-	-	-	N Lake Geneva-Lake Geneva 69-kV line	Construct new 138-kV line from North Lake Geneva to South Lake Geneva Substation and construct new 138-kV bus and install a 138/69-kV 100 MVA transformer at South Lake Geneva Substation
3	Eden, Wyoming Valley and Lancaster 138-kV buses	-	89.7%-91.6%	-	89%-91.8%	-	-	-	91.2%-91.9%	Nelson Dewey-Lancaster 138-kV line Lancaster-Eden 138-kV line	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating

TABLE ZS-2 (continued)

PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2013 Summer Peak, High Growth, 3000 MW Import and 90% East-to-West Bias Cases

Planning Zone	Criteria Exceeded/Need	2013 Summer Peak Case		2013 High Load Growth		2013-70% - 3000 MW Import Case		2013-90% - E-W Bias Case		Facility Outage(s)	Project
		% 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	Lone Rock, Muscoda, Avoca, Blue River, Boscobel, Boscobel Muni 69-kV bus voltages	-	89.7%-91.9%	-	88.7%-91%	-	-	-	91.9%	Lone Rock-Spring Green 69-kV line	Install 1-8.16 MVAR capacitor bank at Boscobel 69-kV Substation and upgrade existing 5.4 MVAR bank with an 8.16 MVAR bank
3	Cobblestone and Zenda 69-kV buses	-	90.5%-91.7%	-	90.2%-91.6%	-	-	-	-	Brick Church-Cobblestone 69-kV line	North Lake Geneva-South Lake Geneva 138-kV line project in 2014. The need year is determined by Cobblestone voltage problem.
3	Idle Hour, Monroe and S Monroe 69-kV buses	-	91.6%-92%	-	90.3%-90.7%	-	-	-	-	N Monroe-Idle Hour 69-kV line	Rebuild Y-33 Brodhead to South Monroe 69-kV line
3	Avoca, Muscoda 69-kV buses	-	91.9%	-	90.2-91.4%	-	-	-	-	Lone Rock-Avoca 69-kV line	Install 1-8.16 MVAR capacitor bank at Boscobel 69-kV Substation and upgrade existing 5.4 MVAR bank with an 8.16 MVAR bank
3	Troy 138-kV bus	-	92%	-	91.2%-91.9%	-	-	-	-	Kirkwood-Troy 138-kV line Troy-Spring Green 138-kV line	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating
3	Burke and Reiner 69-kV buses	-	-	-	90.9%-91.6%	--	92%	-	-	Reiner Road 138/69-kV transformer	Install 2-16.33 Mvar 69-kV capacitor banks at Sun Prairie
3	West Middleton-Black Hawk 69-kV line	-	-	-	-	101.6%	-	-	-	Base Case	Dispatch local generation
3	Nelson Dewey 161/138-kV transformer	-	-	-	-	115.3%	-	-	-	Base Case	2 <sup>nd</sup> Nelson Dewey 161/138 kV transformer
3	Paddock 345/138-kV transformer	-	-	-	-	97.1%	-	-	-	Base Case	Dispatch local generation
3	Benton-Miner 69-kV line	-	-	-	-	109%	-	-	-	Nelson Dewey 161/138-kV transformer	2 <sup>nd</sup> Nelson Dewey 161/138 kV transformer
3	Paddock-NW Beloit-Blackhawk 138-kV line	-	-	-	-	100.7%-98%	-	-	-	Paddock-Townline 138-kV line	Dispatch local generation
3	North Stoughton-Stoughton East-Stoughton 69-kV line	-	-	-	-	118.5%-107.4%	-	-	-	Paddock 345/138 kV transformer and Paddock-Wempletown 345-kV lines	Dispatch local generation
3	West Middleton-Black Hawk 69-kV line	-	-	-	-	108.4%-95%	-	-	-	North Madison-Vienna 138-kV line Vienna-Yahara 138-kV line Yahara-American Center 138-kV line Kegonsa-McFarland 138-kV line McFarland-Femrite 138-kV line Plus other less severe outages	Dispatch local generation
3	Nelson Dewey 161/138-kV transformer	-	-	-	-	100.6%-96.5%	-	-	-	Paddock 345/138-kV transformer Paddock-Wempletown 345-kV line Rockdale-Wempletown 345-kV line Byron-Wempletown 345-kV line	2 <sup>nd</sup> Nelson Dewey 161/138-kV transformer
3	North Monroe-Darlington 138-kV line	-	-	-	-	103.7%	-	-	-	Paddock 345/138 kV transformer	Dispatch local generation
3	Paddock-Townline 138-kV line	-	-	-	-	105.2%-96.1%	-	-	-	Paddock-NW Beloit 138-kV line NW Beloit-Blackhawk 138-kV line Blackhawk-Colley Road 138-kV line	Dispatch local generation
3	Entire Rock County and Walworth County 138-kV bus voltages	-	-	-	-	-	92.5%-96%	-	-	Base Case	Dispatch local generation
3	Fitchburg, Oakridge 138-kV buses	-	-	-	95.5%	-	95.8%-95.9%	-	-	Base Case	Dispatch local generation
3	Concord 138-kV buses	-	-	-	-	-	95.4%	-	-	Base Case	Install 4-49 MVAR 138-kV capacitor banks at Concord Substation
3	Entire Rock County and Walworth County 138-kV bus voltages	-	-	-	-	-	82.7%-92%	-	-	Paddock 345/138 kV transformer Paddock-Wempletown 345-kV line Rockdale-Wempletown 345-kV line Byron-Wempletown 345-kV line	Dispatch local generation
3	Entire Rock County and Walworth County 138-kV bus voltages	-	-	-	-	-	87.7%-92%	-	-	Burlington 138-kV bus 1-2 outage Burlington-Air Liquide 138-kV line Air Liquide-Paris 138-kV line	Dispatch local generation
3	Williams Bay 138-kV bus	-	-	-	-	-	90.7%	-	-	Elkhorn-Williams Bay 138-kV line	Dispatch local generation
3	La Prairie, Bradford, West Darien, SW Delavan and North Shore 138-kV buses	-	-	-	91.7%-91.9%	-	91.8%	-	-	Rock River-La Prairie 138-kV line La Prairie-Bradford 138-kV line Bradford-West Darien 138-kV line	Dispatch local generation
3	Sugar Creek 138-kV bus	-	-	-	-	-	91.9%	-	-	Burlington-N Lake Geneva Tap 138-kV line	Dispatch local generation
3	Brick Church, Williams Bay, Elkhorn and North Lake Geneva 138-kV buses	-	-	-	-	-	90.8%-91.8%	-	-	North Lake Geneva Tap-North Lake Geneva 138-kV line	Dispatch local generation
3	North Lake Geneva Tap 138-kV bus voltage	-	-	-	-	-	-	-	92%	Burlington 138-kV bus 1-2 outage	Dispatch local generation
3	Whitewater 138-kV bus	-	-	-	-	-	-	-	91.7%	Whitewater 138-kV bus 4-5 outage Whitewater-Lakehead Tap 138-kV line	Dispatch local generation
3	Whitewater, Lakehead, University and Bluff Creek 138-kV buses	-	-	-	-	-	-	-	90.7%-91.9%	Sunrise-Lakehead Tap 138-kV line	Dispatch local generation

TABLE ZS-2 (continued)

PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2013 Summer Peak, High Growth, 3000 MW Import and 90% East-to-West Bias Cases

Planning Zone	Criteria Exceeded/Need	2013 Summer Peak Case		2013 High Load Growth		2013-70% - 3000 MW Import Case		2013-90% - E-W Bias Case		Facility Outage(s)	Project
		% 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	Spring Green and Wyoming Valley 138-kV buses	-	-	-	95.9%	-	-	-	-	Base Case	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating
3	Cobblestone- Zenda 69-kV line	-	-	95.5%	-	-	-	-	-	North Lake Geneva-Lake Geneva 69-kV line	Construct new 138-kV line from North Lake Geneva to South Lake Geneva Substation and construct new 138-kV bus and install a 138/69-kV 100 MVA transformer at South Lake Geneva Substation
3	Spring Green 138/69-kV transformer	-	-	99.5%-97.4%	-	-	-	-	-	Gran Grae-Wauzeka 69-kV line Wauzeka-Boscobel 69-kV line	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating
3	Stage Coach-Black Earth 69-kV line	-	-	97%	-	-	-	-	-	Spring Green 138/69-kV transformer	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating
3	Nine Springs-Syene 69-kV line	-	-	97%	-	-	-	-	-	Royster-Pflaum 69-kV line	Loop 6947 Nine Springs-Pflaum 69-kV line into Femrite Substation
3	South Fond Du Lac-Waupun 69-kV line	-	-	103.6%-102.5%	-	-	-	-	-	North Randolph-Fox Lake 138-kV line Fox Lake-N Beaver Dam 138-kV line	Construct a Horicon-East Beaver Dam 138-kV line
3	Bluff Creek and Sugar Creek 138-kV buses	-	-	91.3%-91.7%	-	-	-	-	-	University-Bluff Creek 138-kV line	Dispatch local generation
3	Brodhead Muni 3, Brodhead Muni 2, Brodhead, Brodhead Muni 1, RCEC Orfordville, Orfordville, Bass Creek, Footville, RCEC Center, Evansville 69-kV bus voltages	-	-	91.1%-92%	-	-	-	-	-	Paddock-Newark 69-kV line	Install a 138/69-kV transformer at Bass Creek Substation and rebuild/reconductor X-12 Town Line Road-Bass Creek 138-kV line
3	Rockdale-Lakehead Cambridge 138-kV line	95.2%	--	--	--	--	--	--	--	Oak Creek generation unit 1 or 2	Construct new 138-kV line from North Lake Geneva to South Lake Geneva Substation and construct new 138-kV bus and install a 138/69-kV 100 MVA transformer at South Lake Geneva Substation Construct Spring Valley-Twin Lakes-South Lake Geneva 138-kV line
4	Pulliam-Suamico 69-kV line	100.8%	-	105.6%	-	-	-	-	-	Base case	Rebuild/Convert Bayport-Suamico-Sobieski-Pioneer 69-kV line to 138 kV
4	West Marinette 138/69-kV transformer #1	97.8-96.3%	-	100-101.9%	-	-	-	-	-	Wells St-Roosevelt 69-kV line Roosevelt 138/69-kV transformer	Expand the Menominee 69-kV Substation and install 138 kV terminals. Loop the West Marinette-Bay De Noc 138-kV line into the Substation Install 138/69-kV transformer at the expanded Menominee Substation
4	Pioneer-Sobieski 69-kV line	110.3%	-	116.5%	-	-	-	99.4%	-	Pulliam-Suamico 69-kV line followed by Sobieski-Pioneer 69-kV line close	Rebuild/Convert Bayport-Suamico-Sobieski-Pioneer 69-kV line to 138 kV
4	Sunset Point-Pearl Ave 69-kV line	104.4%	-	109.5%	-	-	-	-	-	Ellinwood-Twelfth Avenue 69-kV line	Rebuild 2.37 miles of 69 kV from Sunset Point to Pearl Ave with 477 ACSR
4	Melissa-Tayco 138-kV line	103.8%	-	-	-	-	-	-	-	Butte Des Morts 138-kV bus tie 1-2 outage	Uprate the Melissa-Tayco to 229 MVA (300F)
4	North Appleton-Fox River 345-kV line	-	-	-	-	-	-	95.6%	-	North Appleton-Kewaunee 345-kV line	Uprate North Appleton-Fox River 345-kV line
4	Sobieski, Suamico 69-kV bus voltages	-	94.2-92.2%	-	94.3-92.2%	-	-	-	95.7-93.9%	Base case	Rebuild/Convert Bayport-Suamico-Sobieski-Pioneer 69-kV line to 138 kV
4	Sobieski 69-kV bus voltage	-	91.8%	-	-	-	-	-	-	Morgan-Highway 22 345-kV line	Rebuild/Convert Bayport-Suamico-Sobieski-Pioneer 69-kV line to 138 kV
4	Bluestone, Wesmark 69-kV bus voltages	-	90.1-87.6%	-	86.4-88.9%	-	-	-	90.3%	Finger Rd-Bluestone 69-kV line	Construct a new 138-kV substation and loop Highway V-East Krok 138-kV line into the substation
4	East Krok, Beardsley St 69-kV bus voltages	-	91.9-91.5%	-	90.8-91.2%	-	-	-	-	East Krok 138/69-kV transformer	No provisional project Additional study is being conducted.
4	Hickory, Forward Energy Center, Butternut 4, and Butternut 5 138-kV bus voltages	-	91.9%	-	91%	-	-	-	-	Hickory-South Fond du Lac 138-kV line	Install 28.8 MVAR capacitor bank at Butternut 138-kV Substation
4	Holland 138-kV bus voltage	-	91.8%	-	91.4%	-	-	-	-	Charter Steel Industry-Holland 138-kV line	No provisional project. Additional study is being conducted.
4	Suamico 69-kV bus	-	90.7%	-	89.8%	-	-	-	91.5	Pulliam-Suamico 69-kV line followed by Sobieski-Pioneer 69-kV line close	Rebuild/Convert Bayport-Suamico-Sobieski-Pioneer 69-kV line to 138 kV

TABLE ZS-2 (continued)

PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2013 Summer Peak, High Growth, 3000 MW Import and 90% East-to-West Bias Cases

Planning Zone	Criteria Exceeded/Need	2013 Summer Peak Case		2013 High Load Growth		2013-70% - 3000 MW Import Case		2013-90% - E-W Bias Case		Facility Outage(s)	Project
		% 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		
4	Edgewater-Washington Ave 69-kV line	-	-	95.6%		-	-	-	-	Edgewater-Nicolet 69-kV line	No provisional project. Additional study is being conducted.
4	City Limits-Combined Locks Tap 138-kV line	-	-	98.1%		-	-	-	-	North Appleton-Apple Hills 138-kV line	No provisional project. Additional study is being conducted.
4	Barnett 69-kV bus voltage	-	-	-	91.8%	-	-	-	-	East Krok 138/69-kV transformer	No provisional project. Additional study is being conducted.
4	Auburn 138-kV bus voltage	-	-	-	91.7%	-	-	-	-	Hickory-South Fond du Lac 138-kV line	Install 28.8 MVAR capacitor bank at Butternut 138-kV Substation
4	Forward Energy Center, Butternut 4, and Butternut 5 138-kV bus voltages	-	-	-	91.6%	-	-	-	-	Hickory-Forward Energy Center 138-kV line	Install 28.8 MVAR capacitor bank at Butternut 138-kV Substation
4	Butternut 4, Butternut 5 138-kV bus voltages	-	-	-	91.8%	-	-	-	-	Butternut 5-Forward Energy Center 138-kV line	Install 28.8 MVAR capacitor bank at Butternut 138-kV Substation
4	Holland 138-kV bus voltage	-	-	-	91.9%	-	-	-	-	Charter Steel Industry 138-kV bus plus Charter Steel-Cedarsauk 138-kV line	No provisional project. Additional study is being conducted.
5	Concord 138-kV bus voltage Allerton 138-kV bus voltage Bark River 138-kV bus voltage Brookdale (East) 138-kV bus voltage Edgewood 138-kV bus voltage  Cooney 138-kV bus voltage Cottonwood 138-kV bus voltage Germantown 138-kV bus voltage Hartford 138-kV bus voltage Merrill Hills 138-kV bus voltage  Mukwonago 138-kV bus voltage Maple 138-kV bus voltage Pleasant Valley 138-kV bus voltage St. Lawrence 138-kV bus voltage Summit 138-kV bus voltage  Sussex 138-kV bus voltage Arthur Road 138-kV bus voltage Glacier 138-kV bus voltage  Albers – Paris 138-kV line	--	90.6% 94.7% 91.8% > 96.0% 94.4%  90.0% 90.5% 91.7% 92.6% 92.7%  93.8% 92.3% > 95.0% 94.0% 90.2%  94.9% 94.0% 94.5%		89.9% 93.9% 91.9% 94.6% 93.7%  89.4% 90.3% 93.6% 92.0% 92.1%  93.2% 93.9% 94.6% 93.5% 89.7%  94.6% 93.5% 94.2%				94.1% --- 94.9% --- ---  93.4% 93.9% 94.7% --- 94.9%  --- --- --- --- 93.5%  --- --- ---	Intact System  (No Concord or Germantown generation is on line in the summer peak model. One Germantown unit is on line in the high load growth model. Voltages are based on 90% machine Q. Contingencies based on 95% Q)  * Two 32 MVar capacitors were placed in service at Summit prior to 2013 summer peak contingency analysis and high load growth contingency analysis. Intact system voltages are prior to capacitor installation.	Dispatch local generation
5	Concord, Cooney, Cottonwood, Summit, Bark River 138-kV bus voltages	--	86.6 – 89.8% 87.2 – 89.7% 86.8 – 89.6% 87.4 – 89.4% 88.7 – 89.9% --	--	85.6 – 89.4% 84.7 – 87.9% 87.5 – 89.2% 86.1 – 89.5% % 87.2 – 88.6% --	--	--	--	89.8 % -- -- -- -- --	Jefferson-Crawfish River - Concord 138-kV line Bark River – Cottonwood 138-kV line Bark River – Sussex 138-kV line Hartford – St. Lawrence 138-kV line Cooney – Summit 138-kV line Plus other less severe outages	Summit, Mukwonago caps & Dispatch local generation
5	Germantown and Maple 138-kV bus voltages	--	88.1 – 89.2% 87.3% 82.2 – 82.5%	--	-- 88.8 – 89.2% %	--	--	--	-- 87.6 87.9%	Bark River – Sussex 138-kV line Germantown – Maple 138-kV line Maple – Saukville 138-kV line	Dispatch local generation
5	Hartford 138-kV bus voltage	--	83.9% 89.3%	--	82.3 % 88.3 %	--	--	--	89.1 % --	Hartford – St. Lawrence 138-kV line Pleasant Valley – Saukville 138-kV line	Load shifting
5	St. Lawrence, Arthur Road 138-kV bus voltage	--	--	--	89.1%	--	--	--	--	Pleasant Valley – Saukville 138-kV line	No Project Yet Load shifting
5	Pleasant Valley 138-kV bus voltage	--	89.4%	--	--	--	--	--	--	Pleasant Valley – Saukville 138-kV line	Load Shifting
5	Bain 345/138-kV transformer T5	159.9% 99.6% 100.4%	--	160.3% 98.8% 103.9%	--	139.2% -- --	--	159.1% -- 97.0%	--	Pleasant Prairie bus split between 3 and 4 Pleasant Prairie bus split between 2 and 3 Pleasant Prairie - Bain transformer T4	Dispatch local generation
5	Bain 345/138-kV transformer T4	99.6%	--	103.1%	--	--	--	96.2%	--	Pleasant Prairie - Bain transformer T5	Dispatch local generation
5	Albers – Bain 138-kV line	118.2%	--	121.6%	--	101.8%	--	117.5%	--	Bain – Kenosha 138-kV line	Uprate Albers – Bain 138-kV line Dispatch local generation
5	Edgewood – St. Martins 138-kV line	--	--	--	--	98.7% 103.6 % 107.3% 106.0% 101.2%	--	--- --- --- 96.5% ---	--	Split Burlington 138-kV bus Burlington – Air Liquide – Paris Paddock 345/138-kV transformer Merrill Hills – Waukesha 138-kV line Wempletown – Paddock 345-kV line	No project yet Dispatch local generation
5	Bain – Kenosha 138-kV line	95.6%	--	98.8	--	--	--	--	--	Albers – Bain 138-kV line	No project yet – Dispatch local generation

TABLE ZS-2 (continued)

PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2013 Summer Peak, High Growth, 3000 MW Import and 90% East-to-West Bias Cases

Planning Zone	Criteria Exceeded/Need	2013 Summer Peak Case		2013 High Load Growth		2013-70% - 3000 MW Import Case		2013-90% - E-W Bias Case		Facility Outage(s)	Project
		% 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	Arcadian6 – Waukesha3 138-kV line	100.0%	--	101.7%	--	95.4%	--	107.7%	--	Arcadian4 – Waukesha1 138-kV line	Uprate Arcadian – Waukesha 138-kV line Dispatch local generation
5	Arcadian4 – Waukesha1 138-kV line	100.8%	--	102.5%	--	96.1%	--	108.5%	--	Arcadian6 – Waukesha3 138kV line	Uprate Arcadian – Waukesha 138-kV line Dispatch local generation
5	Maple – Saukville 138-kV line	100.3%	--	--	--	--	--	--	--	Bark River – Sussex 138-kV line	Dispatch local generation
5	Oak Creek – Pennsylvania 138-kV line	95.3 %	--	98.1% 99.4% 98.7% 97.3% 99.2%	--	--	--	95.1% 95.9% 95.4% --	--	Kansas – Ramsey 138-kV line Oak Creek – Nicholson 138-kV line Nicholson – Ramsey 138-kV line Norwich – Ramsey 138-kV line Oak Creek – Ramsey 138-kV line Plus other less severe outages	No Project yet Load Shifting
5	Oak Creek 345/138-kV transformer #2	--	--	97.4%	--	--	--	96.7%	--	Oak Creek 345/138-kV transformer #1	No project yet – Dispatch local generation
5	Branch – Kansas 138-kV line	--	--	97.8%	--	--	--	--	--	Oak Creek – Pennsylvania 138-kV line	No project yet - Load shifting
5	Nicholson – Ramsey 138-kV line	--	--	--	--	--	--	97.9%	--	Oak Creek – Pennsylvania 138-kV line	No project yet - Load shifting
5	Oak Creek – Ramsey 138-kV line	--	--	--	--	--	--	97.1%	--	Oak Creek – Pennsylvania 138-kV line	No project yet - Load Shifting
5	Bark River – Sussex 138-kV line	98.8%	--	--	--	--	--	--	--	Maple – Saukville 138-kV line	No project yet – Dispatch local generation
5	Harbor – Kansas 138-kV line	--	--	--	--	102.1% 98.7% 102.9% 103.2% 100.1%	--	--	--	Montana – Dewey 138-kV line Valley – Montana 138-kV line Split Dewey 138-kV bus Dewey – Norwich 138-kV line Kansas – Norwich 138-kV line Plus less severe outages	No project yet – Dispatch local generation
5	Tichigan , Burlington1 138-kV bus voltages	--	--	--	--	--	86.1-86.6%	--	89.3-90.0%	Split Burlington 138-kV bus	No project yet - Load Shifting
5	Paris – Albers 138-kV line	--	--	--	--	99.7%	--	--	--	Paddock 345/138-kV transformer	No project yet – Dispatch local generation
5	Tichigan, Burlington, Walworth, Air Liquide 138-kV buses	--	--	--	--	--	88.2-89.1%	--	--	Paddock 345/138-kV transformer	No project yet - Load shift
5	Albers-Kenosha 138-kV line	--	--	--	--	120.2%	--	--	109.0%	Albers – Bain 138-kV line	No project yet – Dispatch local generation
5	Granville 345/138-kV transformer #1	--	--	--	--	--	--	100.0% 98.5%	--	Granville-Cedarsauk 345-kV line Granville 345/138-kV T2 Granville 345-kV bus split between 2 and 3	No project yet – Dispatch local generation
5	Arcadian 345/138-kV transformer #2	94.9%	--	--	--	99.7%	--	98.2%	--	Arcadian 345/138-kV transformer #1	No project yet - Replace Arcadian transformer
5	Arcadian 345/138-kV transformer #3	111.8% --	--	101.0% 102.0%	--	117.4% --	--	113.2% 105.5% 101.3%	--	Arcadian 345/138-kV transformer #1 Arcadian 345-kV bus split between 1 and 2 Arcadian xfmr #2 and 345-kV bus outage	Replace Arcadian transformer



**TABLE ZS-3  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2018 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2018 Summer Peak Case		Facility Outage(s)	Project
		% of Facility Rating	% of Nominal bus voltage		
1	Stone Lake 345-kV bus voltage		105.2%	Base Case	Place Stone Lake Inductor in-service
1	Rocky Run 345/115-kV transformer #3	95.8 – 97.4%		Rocky Run 345/115-kV transformer #2 Sigel – Arpin 115-kV line	No project needed yet
1	Wien – Stratford 115-kV line	108.2%		Glavin-Hume 115-kV line	Use recent valid circuit ratings
1	Stratford - McMillan 115-kV line	99.7%		Base Case	Use recent valid circuit ratings
1	Sigel, Lakehead Vesper, Vulcan and Port Edwards 138-kV bus voltages		86.6 – 91.0%	Arpin-Sigel 138-kV line Sigel-Lakehead Vesper 138-kV line	Publicly announced load curtailments
1	Port Edwards, Hollywood and Saratoga 138-kV bus voltages and Saratoga 115-kV bus voltage		88.0 – 91.9%	Arpin-Sigel 138-kV line Sigel-Lakehead Vesper 138-kV line	Publicly announced load curtailments
1	Castle Rock – Quincy 69-kV line	99.6%		Big Pond-Necedah tap 69-kV line	Uprate Castle Rock-Mckenna 69 kV circuit
1	Council Creek and Petenwell 138-kV bus voltages	–	89.2 – 95.0%	Base Case Arpin-Sigel 138-kV line	Monroe County – Council Creek 161 kV line
1	Petenwell, Necedah, Whistling Wings, Dellwood, Friendship, Houghton Rock and Mckenna 69-kV bus voltages	–	84.3 – 91.8%	Big Pond-Necedah Tap 69-kV line Necedah tap-Whistling Wings Tap 69-kV line Whistling Wings Tap-Dellwood 69-kV line	Mckenna capacitor bank expansion and conversion of Necedah substation to 138 kV
1	Metomen 138/69-kV transformer	96.5 – 112.5%		Metomen-Rosendale 69-kV line Rosendale-North Fond du Lac 69-kV line Winneconne-Sunset Point 69-kV line North Randolph-Markesan Tap 69-kV line Plus other less severe outages	Metomen transformer replacement
1	Lakehead Portage, Endeavor and Roslin 69-kV bus voltages		91.4 – 92.0%	Portage-Lakehead Portage 69-kV line	No project needed yet
1	Ripon, Ripon Industrial Park, NW Ripon, Dartford, SW Ripon 69-kV bus voltages		90.7 – 91.0%	Metomen-Ripon 69-kV line	No project needed yet
1	Winneconne, Omro and Omro Industrial 69-kV bus voltages		88.2 – 89.2%	Winneconne-Sunset Point 69-kV line	Ripon capacitor bank expansion, Metomen transformer replacement and Wautoma 2 <sup>nd</sup> transformer
1	Silver Lake Fountain Valley, Spring Lake, Red Granite and River Run 69-kV bus voltages		89.2 – 91.9%	Wautoma-Silver Lake 69-kV line Silver Lake-Spring Lake 69-kV line	Ripon capacitor bank expansion and Metomen transformer replacement
1	Sand Lake 138-kV bus voltage		90.7%	Arpin-Sigel 138-kV line	No project needed yet
2	Delta – Mead 69-kV line	100-161%	-	Base Case Chandler-Lakehead Tap 69-kV line Lakehead Tap-Masonville 69-kV line Masonville-Gladstone 69-kV line Gladstone-North Bluff 69-kV line North Bluff-Bay Tap 69-kV line Bay Tap-Mead 69-kV line	Uprate Delta-Mead-North Bluff 69 kV line, or dispatch local generation

**TABLE ZS-3  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2018 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2018 Summer Peak Case		Facility Outage(s)	Project
		% of Facility Rating	% of Nominal bus voltage		
2	Chandler – Delta 69-kV #1 line	114%	-	Chandler-Delta 69-kV #2 line	Uprate Chandler-Delta 69 kV line #1, or dispatch local generation
2	Chandler – Delta 69-kV #2 line	108%	-	Chandler-Delta 69-kV #1 line	Uprate Chandler-Delta 69 kV line #2, or dispatch local generation
2	Chandler 138/69-kV transformer	97-107%	-	Nordic-Mountain 69-kV line Mountain-Harris Tap 69-kV line Forsyth 138/69-kV transformer	Increased existing SE rating from SELD
2	Chandler – Lakehead Tap 69-kV line Masonville – Lakehead Tap 69-kV line Masonville – Gladstone 69-kV line Gladstone – North Bluff 69-kV line North Bluff – Bay Tap 69-kV line Mead – Bay Tap 69-kV line	123-162%	-	Delta-Mead 69-kV line	Uprate Chandler-Masonville, Masonville-Gladstone, Gladstone-North Bluff, Delta-Mead-North Bluff 69 kV lines; or dispatch local generation
2	Forsyth 138/69-kV transformer	102%	-	Chandler 138/69-kV transformer	Uprate the Forsyth 138/69 kV transformer
2	Atlantic-Henry St. Tap 69-kV line	97%	-	Base Case	
2	Atlantic-M38 69-kV line	101%	-	Atlantic-M38 138-kV line Atlantic 138/69-kV transformer	Uprate Atlantic-M38 69 kV line
2	Atlantic 138/69-kV transformer	100%	-	M38 138/69-kV transformer	Uprate Atlantic 138/69 kV transformer
2	Delta, West Side, Escanaba, Masonville, Mead, Gladstone, Bay View, North Bluff, Harris 69-kV bus voltages	-	90.4-92.0%	Chandler 138/69-kV transformer	North Bluff 69 kV capacitor bank, or dispatch local generation
2	Atlantic, Elevation St., Henry St., MTU, Osceola, Portage, Keweenaw 69 kV bus voltages	-	82.0-91.1%	Atlantic-M38 138-kV line Atlantic 138/69-kV transformer	M38/Osceola capacitor banks, or dispatch local generation
2	L'Anse, Baraga 69 kV-bus voltages	-	90.7-91.3%	M38 138/69-kV transformer	L'Anse capacitor bank
2	Winona, Atlantic, M38 138-kV bus voltages M38, L'Anse, Baraga 69-kV bus voltages	-	89.0-92.0%	M38-Perch Lake 138-kV line	M38/Osceola capacitor banks, or dispatch local generation
3	Fitchburg-Syene-Nine Springs 69-kV line	119.4%-102%		Royster-Pflaum Tap 69-kV line Pflaum-Pflaum Tap 69-kV line	Loop 6947 Nine Springs-Pflaum 69-kV line into Femrite Substation
3	Enzyme Bio Systems-RC3-Clinton-Sharon 69-kV line	118%-96.3%		Colley Road-Dickinson 138-kV line Dickinson-Global Renewable Energy 138-kV line Brick Church 138/69-kV transformer Global Renewable Energy-Brick Church 138-kV line	Rebuild Y-32 Colley Road-Brick Church 69-kV line
3	Royster-Pflaum Tap-Pflaum 69-kV line	115.9%-99.2%		Fitchburg-Syene 69-kV line Nine Springs-Syene 69-kV line	Loop 6947 Nine Springs-Pflaum 69-kV line into Femrite Substation
3	North Stoughton-Stoughton E – Stoughton 69-kV line	114.7%-112.2%		McCue-Harmony 69-kV line Harmony-Lamar 69-kV line	Rebuild Stoughton Substation bus
3	Sheepskin-Dana Tap 69-kV line	113.8%-109%		McCue-Harmony 69-kV line Harmony-Lamar 69-kV line	Sheepskin substation protection project in 2010

**TABLE ZS-3  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2018 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2018 Summer Peak Case		Facility Outage(s)	Project
		% of Facility Rating	% of Nominal bus voltage		
3	Stage Coach-Black Earth-Mazomanie 69-kV line	113.2%-102.1%		Spring Green 138/69-kV transformer	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating
3	Dane-Lodi Tap 69-kV line	110.1%-96.4%		Kirkwood-Island 69-kV line Island-Moore St 69-kV line Moore St-Baraboo 69-kV line	Rebuild part of the Y-8 Dane-Dam Heights 69-kV line
3	South Lake Geneva-Lake Geneva 69-kV line	109.7%		Brick Church-Cobble Stone 69-kV line	Construct new 138-kV line from North Lake Geneva to South Lake Geneva substation and Construct new 138-kV bus and install a 138/69-kV 100 MVA transformer at South Lake Geneva Substation
3	West Middleton-Timberland 69-kV line	107.7%		Spring Green 138/69-kV transformer	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating
3	Academy-Columbus Muni 2 Tap 69-kV line and Columbus Muni 2 Tap- Columbus 69-kV line	107.5%-97.6%		North Randolph-Fox Lake 138-kV line Fox Lake-N Beaver Dam 138-kV line	Construct a Horicon-East Beaver Dam 138-kV line
3	South Fond Du Lac-Waupun 69-kV line	107.4%-102.2%		North Randolph-Fox Lake 138-kV line Fox Lake-N Beaver Dam 138-kV line	Hubbard-North Beaver Dam project in 2014.
3	Colley Road 138/69-kV transformer	106.8%-96.4%		Paddock 138/69-kV transformer Paddock-Shirland Ave 69-kV line Shaw-Shirland 69-kV line	Install a 138/69-kV transformer at Bass Creek Substation and rebuild/reconductor X-12 Town Line Road-Bass Creek 138-kV line and Rebuild Y-33 Brodhead to South Monroe 69-kV line
3	Shaw-Shirland 69-kV line	106.6%		Colley Road 138/69-kV transformer	Rating increase after SELD validation
3	Cobblestone-Zenda Tap 69-kV line	106.5%		North Lake Geneva-Lake Geneva 69-kV line	Construct new 138-kV line from North Lake Geneva to South Lake Geneva substation and Construct new 138-kV bus and install a 138/69-kV 100 MVA transformer at South Lake Geneva Substation
3	N Monroe-Idle Hour 69-kV line	106.2%-98.7%		Darlington-Gratiot 69-kV line Gratiot-Wiota 69-kV line Wiota-Jennings Rd 69-kV line Darlington 138/69-kV transformer Paddock-Newark 69-kV line	Install a 138/69-kV transformer at Bass Creek Substation and rebuild/reconductor X-12 Town Line Road-Bass Creek 138-kV line and Rebuild Y-33 Brodhead to South Monroe 69-kV line

**TABLE ZS-3  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2018 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2018 Summer Peak Case		Facility Outage(s)	Project
		% of Facility Rating	% of Nominal bus voltage		
3	Gran Grae-Wauzeka-Boscobel 69-kV line	105.4%-97.6%		Spring Green 138/69-kV transformer Nelson Dewey-Lancaster 138-kV line Lancaster-Eden 138-kV line Eden-Wyoming Valley 138-kV line Spring Green-Lone Rock 69-kV line	Uprate Y-40 Gran Grae-Boscobel 69-kV line to achieve a 99 MVA summer emergency rating
3	Kirkwood-Rock Springs Tap – Artesian 138-kV line	103.2%-97.9%		Trienda-Lewiston 138-kV line East Dells-Kilbourn 138-kV line East Dells-Lewiston 138-kV line	Construct a Lake Delton-Birchwood 138-kV line
3	Spring Green 138/69-kV transformer	102.3%-101%		Gran Grae-Wauzeka 69-kV line Wauzeka-Boscobel 69-kV line	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating
3	Hillman 138/69-kV transformer	99.4%-96.9%		DPC Galena-Pilot 69-kV line Pilot-Terr TP 69-kV line	Replace the existing 46 MVA Hillman 138/69-kV transformer with a 100 MVA transformer
3	Paddock-Shirland Ave 69-kV line	98.6%		Colley Road 138/69-kV transformer	No project so far
3	McCue-Milton Lawn 69-kV line	96.7%		Janesville 138/69-kV transformer	Uprate terminal limitations at McCue for the Y-79 McCue-Milton Lawns 69-kV line
3	Eden 138/69-kV transformer	96.4%		Eden-Wyoming Valley 138-kV line	No project so far
3	McCue-Harmony 69-kV line	96.4%-95.6%		Kegonsa 138/69-kV transformer Kegonsa-N Stoughton 69-kV line	Uprate Y-61 McCue-Lamar 69-kV line to achieve 300 deg F line ratings and install 2-12.45 Mvar 69 kV capacitor banks at Lamar Substation
3	West Middleton 138/69 kV transformer	96.4%		West Middleton 138/69-kV transformer	Construct West Middleton-Blount 138-kV line
3	Colley Road-Dickinson 138-kV line	96%-95.1%		Rock River-La Prairie 138-kV line La Prairie-Bradford 138-kV line Bradford-West Darien 138-kV line	Colley Road protection project in 2010
3	Eden, Spring Green, Wyoming Valley and Troy 138-kV buses		92.9%-94.2%	Base Case	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating and Install 2-16.33 MVAR 69-kV capacitor banks at Eden Substation
3	Oakridge, Hawk, Pleasant View, McFarland, Sprecher, Kegonsa, Colloday Point, Reiner Road, Cross County, Fitchburg, Sycamore, Femrite and Blount 138-kV buses		93.7%-95.7%	Base Case	Install 2-16.33 MVAR 69-kV capacitor banks and 2-24.5 MVAR capacitor banks at Femrite substation
3	Hustisford, Hubbard, Concord, Rockvale, Fort Atkinson, Crawfish and Rubicon 138-kV buses		94.5%-95.8%	Base Case	Install 4-49 MVAR 138-kV capacitor banks at Concord Substation

**TABLE ZS-3  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2018 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2018 Summer Peak Case		Facility Outage(s)	Project
		% of Facility Rating	% of Nominal bus voltage		
3	Boscobel, Muscoda and Blue River 69-kV buses		95.3%-95.6%	Base case	Install 1-8.16 MVAR capacitor bank at Boscobel 69-kV Substation and upgrade existing 5.4 MVAR bank with an 8.16 MVAR bank, Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating and Install 2-16.33 MVAR 69-kV capacitor banks at Eden Substation
3	Lodi and Okee 69-kV buses		95.4%-95.9%	Base case	Install 2-16.33 Mvar 69-kV capacitor banks at Dam Heights
3	Gaston Road, Cottage Grove and Bird Street 69-kV buses		95.7%-96%	Base case	Install 2-16.33 Mvar 69-kV capacitor banks at Sun Prairie
3	Spring Green, Arena, Mazomanie, Mazomanie Industrial, Lone Rock, Muscoda, Avoca, Blue River, Boscobel, Boscobel Muni 69-kV bus voltages		78.9%-90.1%	Spring Green 138/69-kV transformer	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating
3	Harmony, Lamar, Fulton, Saunders Creek, Dana Corp, Sheepskin and Evansville 69-kV buses		84.4%-91.7%	McCue-Harmony 69-kV line Harmony-Lamar 69-kV line Lamar-Fulton 69-kV line	Uprate Y-61 McCue-Lamar 69-kV line to achieve 300 deg F line ratings and install 2-12.45 Mvar 69 kV capacitor banks at Lamar Substation and construct double-circuit line between McCue and Lamar substations
3	Wauzeka, Spring Green, Lone Rock, Muscoda, Avoca, Blue River, Boscobel, Boscobel Muni 69-kV bus voltages, Spring Green and Wyoming Valley 138-kV bus voltages		85.9%-91.6%	Gran Grae-Wauzeka 69-kV line Wauzeka-Boscobel 69-kV line	Install 1-8.16 MVAR capacitor bank at Boscobel 69-kV Substation and upgrade existing 5.4 MVAR bank with an 8.16 MVAR bank ,
3	Lone Rock, Muscoda, Avoca, Blue River, Boscobel, Boscobel Muni 69-kV bus voltages		85.9%-88.5%	Lone Rock-Spring Green 69-kV line	Install 1-8.16 MVAR capacitor bank at Boscobel 69-kV Substation and upgrade existing 5.4 MVAR bank with an 8.16 MVAR bank, Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating
3	Hubbard and Hustisford 138-kV bus voltages		86.1%-86.8%	Rubicon-Hustisford 138-kV line Hubbard-Hustisford 138-kV line	Construct a Horicon-East Beaver Dam 138-kV line

**TABLE ZS-3  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2018 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2018 Summer Peak Case		Facility Outage(s)	Project
		% of Facility Rating	% of Nominal bus voltage		
3	Eden, Wyoming Valley, Spring Green, Troy and Lancaster 138-kV bus voltages, Muscoda, Avoca, Blue River, Boscobel, Boscobel Muni 69-kV bus voltages		86.2%-91.9%	Nelson Dewey-Lancaster 138-kV line Lancaster-Wyoming Valley 138-kV line Lancaster-Eden 138-kV line	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating and Install 2-16.33 MVAR 69-kV capacitor banks at Eden Substation
3	Dickinson, Global Renewable Energy, William Bay and Brick Church 138-kV buses		86.9%-91.6%	Colley Road – Dickinson 138-kV line Dickinson-Global Renewable Energy 138-kV line Global Renewable Energy-Brick Church 138-kV line	Install 2-24.5 Mvar 138-kV capacitor bank and 1-18 Mvar 69-kV capacitor bank at Brick Church substation
3	Idle Hour, Monroe, Black Smith, New Glarus, Monticello, Brown town and S Monroe 69-kV buses		87.4%-91.3%	North Monroe-Idle Hour 69-kV line North Monroe 138/69-kV transformer outage	Rebuild Y-33 Brodhead to South Monroe 69-kV line and Install a 138/69-kV transformer at Bass Creek Substation and rebuild/reconductor X-12 Town Line Road-Bass Creek 138-kV line
3	Concord ,Hubbard, Hustisford, Rubicon, Rockvale and Butler Ridge 138-kV bus voltages		87.7%-91.8%	Concord4-5 138-kV bus outage Hartford-St Lawrence 138-kV line	Install 4-49 MVAR 138-kV capacitor banks at Concord Substation
3	Avoca, Muscoda, Blue River, Boscobel, Boscobel Muni 69-kV bus voltages		87.8%-91.6%	Lone Rock-Avoca 69-kV line Avoca-Muscoda 69-kV line	Install 1-8.16 MVAR capacitor bank at Boscobel 69-kV Substation and upgrade existing 5.4 MVAR bank with an 8.16 MVAR bank
3	Brodhead Muni 3, Brodhead Muni 2, Brodhead, Brodhead Muni 1, RCEC Orfordville, Orfordville, Bass Creek, Footville, RCEC Center, Evansville 69-kV bus voltages		87.8%-91.9%	Brodhead Switching Station- Brodhead Muni 3 69-kV line Brodhead Muni 2 -Brodhead Muni 3 69-kV line Brodhead Muni 2-Brodhead 69-kV line	Install a 138/69-kV transformer at Bass Creek Substation and rebuild/reconductor X-12 Town Line Road-Bass Creek 138-kV line
3	Eden, Wyoming Valley, Spring Green, Troy, City view, Lake Delton and Lancaster 138-kV bus voltages,		88.2%-91.8%	Trienda-Lewiston 138-kV line Lake Delton-City View 138-kV line City View-Kirkwood 138-kV line Trienda-Lake Delton 138-kV line plus other less severe outages	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating and Install 2-16.33 MVAR 69-kV capacitor banks at Eden Substation
3	Cobblestone, Lake Shore, Twin Lakes, Richmond and Zenda 69-kV buses		88.4%-91.6%	Brick Church-Cobblestone 69-kV line	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating

**TABLE ZS-3  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2018 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2018 Summer Peak Case		Facility Outage(s)	Project
		% of Facility Rating	% of Nominal bus voltage		
3	Lake Geneva, S Lake Geneva, Richmond, Katzenberg and Twin Lake 69-kV buses		88.4%-89.3%	North Lake Geneva-Lake Geneva 69-kV line	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating
3	Burke, Sun Prairie, Token Creek, South, Colorado, Bird St, Gaston RD and Reiner 69-kV buses		88.6%-91.9%	Reiner Road 138/69-kV transformer outage, Burke-Colorado 69-kV line and Reiner Road-Burke 69-kV line	Install 2-16.33 Mvar 69-kV capacitor banks at Sun Prairie
3	Evansville, Footville, Center and Bass Creek 69-kV bus voltages		88.7%-91.1%	Evansville-Sheepskin 69-kV line	Install a 138/69-kV transformer at Bass Creek Substation and rebuild/reconductor X-12 Town Line Road-Bass Creek 138-kV line
3	Arena, Mazomanie and Black Earth 69-kV bus voltages		88.7%-91.9%	Spring Green-Arena 69-kV line	Install 2-12.25 MVAR 69-kV capacitor banks at Mazomanie Substation
3	Eden, Wyoming Valley, Spring Green, Troy and Lancaster 138-kV bus voltages,		89%-91.8%	Spring Green-Troy 138-kV line Troy-Kirkwood 138-kV line	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating and Install 2-16.33 MVAR 69-kV capacitor banks at Eden Substation
3	Island, Moore St, Baraboo, Dam Heights, Tower St , Eagle View and Prairie Du Sac 69-kV bus voltages		89.3%-91.3%	Island-Kirkwood 69-kV line	Install 2-16.33 Mvar 69-kV capacitor banks at Dam Heights
3	Rockvale 138-kV bus voltage		90%	Concord-Rockvale 138-kV line	Install 4-49 MVAR 138-kV capacitor banks at Concord Substation
3	Potosi, Hillman, Darlington and Lafayette Wind 138-kV bus voltages		90.1%-90.9%	Nelson Dewey-Potosi 138-kV line Potosi-Hillman 138-kV line	Install 2-16.33 Mvar 69-kV cap banks at North Monroe
3	Albany and N Monroe 138-kV bus voltages		90.5%-90.6%	Townline-Albany 138-kV line	Install 2-16.33 Mvar 69-kV cap banks at North Monroe
3	Lone Rock, Muscoda, Avoca, Blue River, Boscobel, Boscobel Muni 69-kV bus voltages		90.7%-91.9%%	Spring Green-Wyoming Valley 138-kV line	Install 1-8.16 MVAR capacitor bank at Boscobel 69-kV Substation and upgrade existing 5.4 MVAR bank with an 8.16 MVAR bank, Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating

**TABLE ZS-3  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2018 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2018 Summer Peak Case		Facility Outage(s)	Project
		% of Facility Rating	% of Nominal bus voltage		
3	Oakridge, Cross County, Fitchburg 138-kV buses		91.4%-91.9%	Rockdale-West Middleton 345-kV line West Middleton 345/138-kV transformer outage Pleasant View-West Middleton 138-kV line	Install 2-16.33 MVAR 69-kV capacitor banks and 2-24.5 MVAR capacitor banks at Femrite Substation
3	Fox Lake, N Beaver Dam and E Beaver Dam 138-kV bus voltages		90.2%-90.3%	North Randolph-Fox Lake 138-kV line	Construct a Horicon-East Beaver Dam 138-kV line
3	Bluff Creek and Sugar Creek 138-kV bus voltage		91%-91.3%	University-Bluff Creek 138-kV line	No project so far
3	Sun Valley 69-kV bus voltage		91.8%	Sun Valley-Verona 69-kV line	Uprate Y-61 McCue-Lamar 69-kV line to achieve 300 deg F line ratings and install 2-12.45 Mvar 69 kV capacitor banks at Lamar Substation, Install a 138/69-kV transformer at Bass Creek Substation and rebuild/reconductor X-12 Town Line Road-Bass Creek 138-kV line
3	La Prairie, Bradford, West Darien, SW Delavan and North Shore 138-kV buses		91.5%-91.9%	Rock River-La Prairie 138-kV line La Prairie-Bradford 138-kV line Bradford-West Darien 138-kV line	Install 2-24.5 Mvar 138-kV capacitor bank and 1-18 Mvar 69-kV capacitor bank at Brick Church Substation
3	Black Earth 69-kV bus voltage		92%	Stage Coach-Black Earth 69-kV line	Install 2-12.25 MVAR 69-kV capacitor banks at Mazomanie Substation
3	Cottage Grove and Gaston RD 69-kV bus voltage		90.5%-91.2%	Kegonsa-Cottage Grove 69-kV line	Install 2-16.33 Mvar 69-kV capacitor banks at Sun Prairie
3	McFarland, Femrite and Sprecher 138-kV bus voltages		90.8%-91.9%	Kegonsa-McFarland 138-kV line McFarland-Femrite 138-kV line	Install 2-16.33 MVAR 69-kV capacitor banks and 2-24.5 MVAR capacitor banks at Femrite Substation
3	Deforest, Burke, Sun Prairie, Token Creek, South, Colorado, Bird St, Gaston RD and Reiner 69-kV buses		91.2%-92%	Deforest-North Madison 69-kV line	Install 2-16.33 Mvar 69-kV capacitor banks at Sun Prairie
3	Lodi, Okee 69-kV bus voltages		90.6%-92%	Dane-Lodi Tap 69-kV line	Install 2-16.33 Mvar 69-kV capacitor banks at Dam Heights
3	Eagle View 69-kV bus voltage		92%	Eagle View-Dam Heights 69-kV line	No project so far
3	Randolph, Didion and Cambria 69-kV bus voltages		90.9%-91.8%	North Randolph-Randolph Tap 69-kV line Didion-Randolph Tap 69-kV line	Install 2-16.33 Mvar 69-kV cap banks at Rio
3	Boscobel 69-kV bus voltage		91.3%	Gran Grae 138/69-kV transformer	Install 1-8.16 MVAR capacitor bank at Boscobel 69-kV Substation and upgrade existing 5.4 MVAR bank with an 8.16 MVAR bank
3	Yahara, Vienna and American Center 138-kV bus voltages		91.3%-91.6%	North Madison-Yahara 138-kV line	No project so far
3	Miner and Shullsburg 69-kV bus voltages		91.8%-91.9%	DPC Galena-Pilot 69-kV line	No project so far



**TABLE ZS-3  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2018 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2018 Summer Peak Case		Facility Outage(s)	Project
		% of Facility Rating	% of Nominal bus voltage		
3	Fort Atkinson 138-kV bus voltage		91.6%-91.8%	Jefferson-Lakehead Cambridge 138-kV line Rockdale- Lakehead Cambridge 138-kV line	Install 4-49 MVAR 138-kV capacitor banks at Concord Substation
3	Horicon and Horicon Industry 69-kV bus voltage		91.2%-91.5%	Hubbard-Horicon 69-kV line	Construct a Horicon-East Beaver Dam 138-kV line
3	LCI and Pflaum 69-kV bus voltage		91.4%	Royster-Pflaum 69-kV line	Loop 6947 Nine Springs-Pflaum 69-kV line into Femrite Substation
3	N Lake Geneva Tap 138-kV bus voltage		91.9%	Burlington 138-kV bus 1-2	No project so far
3	Spring Green and Wyoming Valley 138-kV bus voltages		90.9%-91%	Columbia generation Unit 1 or Unit 2	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation and Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating and Install 2-16.33 MVAR 69-kV capacitor banks at Eden Substation
3	Wauzeka-Boscobel 69-kV line	99.2%		Columbia generation Unit 1 or Unit 2	Y-40 rebuild
3	North Monroe 138/69 kV transformer	95.3%		Columbia generation Unit 1 or Unit 2	Construct Verona-North Monroe 138-kV line
3	McCue-Harmony-Lamar 69-kV line	100.1%-97.2%		Sheepskin generation Unit 1	Uprate Y-61 McCue-Lamar 69-kV line to achieve 300 deg F line ratings and install 2-12.45 Mvar 69 kV capacitor banks at Lamar Substation
3	West Middleton-Black Hawk 69-kV line	95.7%		West Campus generation ST	Construct West Middleton-Blount 138-kV line
3	Nelson Dewey-Gran Grae 161-kV line	96.1%		DPC Genoa generation Unit 3	No project so far
4	Pulliam-Suamico 69-kV line	117%	-	Base case	Rebuild/Convert Bayport-Suamico-Sobieski-Pioneer 69-kV line to 138 kV
4	West Marinette 138/69-kV transformer #1	99.8-98%	-	Wells St-Roosevelt 69-kV line outage Roosevelt 138/69-kV transformer outage	- Expand the Menominee 69-kV Substation and install 138 kV terminals. Loop the West Marinette-Bay De Noc 138-kV line into the Substation - Install 138/69-kV transformer at the expanded Menominee Substation
4	Pioneer-Sobieski 69-kV line	128%	-	Pulliam-Suamico 69-kV line outage followed by Sobieski-Pioneer 69-kV line close	Rebuild/Convert Bayport-Suamico-Sobieski-Pioneer 69-kV line to 138 kV
4	Sunset Point-Pearl Ave 69-kV line	106.1%	-	Ellinwood-Twelfth Avenue 69-kV line outage	Rebuild 2.37 miles of 69 kV from Sunset Point to Pearl Ave with 477 ACSR

**TABLE ZS-3  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2018 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2018 Summer Peak Case		Facility Outage(s)	Project
		% of Facility Rating	% of Nominal bus voltage		
4	Canal 138/69-kV transformer #1	95.1%	-	Canal 138/69-kV transformer #2 outage	- Construct Canal-Dunn Road 138-kV line - Install 60 MVA 138/69-kV transformer at Dunn Road
4	Glenview 138/69-kV transformer #1	96.1%	-	Glenview 138/69-kV transformer #2 outage	Replace two existing 138/69-kV transformers at Glenview Substation with 100 MVA transformers
4	Glenview 138/69-kV transformer #2	95.6%	-	Glenview 138/69-kV transformer #1 outage	Replace two existing 138/69-kV transformers at Glenview Substation with 100 MVA transformers
4	Finger Rd-Bluestone 69-kV line	96.5-113%	-	Wesmark-Kellnersville 69-kV line outage Kellnersville-Manrap 69-kV line outage Mishicot-Shoto 138-kV line outage Lakefront G9 outage	Construct a new 138-kV substation and loop Highway V-East Krok 138-kV line into the substation
4	Northeast-Mirro 69-kV line	95.9%	-	Lakefront G9 outage	Construct Shoto to Custer 138-kV line
4	City Limits 138-kV bus tie 1-2 City Limits-Combined Locks Tap 138-kV line	100.8-107.5%	-	North Appleton-Apple Hills 138-kV line outage	No provisional project. Additional study is being conducted.
4	Sobieski, Suamico 69-kV bus voltages	-	91-87.5%	Base case Pulliam G5 or G7 outage	Rebuild/Convert Bayport-Suamico-Sobieski-Pioneer 69-kV line to 138 kV
4	Bluestone, Wesmark 69-kV bus voltages	-	Diverged	Finger Rd-Bluestone 69-kV line outage	Construct a new 138-kV substation and loop Highway V-East Krok 138-kV line into the substation
4	East Krok, Beardsley St, Barnett, Booster 69-kV bus voltages	-	90.3-91.5%	East Krok 138/69-kV transformer outage	No provisional project. Additional study is being conducted.
4	Hickory, Forward Energy Center, Butternut 4, Butternut 5 138-kV bus voltages	-	91.3-91.5%	Hickory-South Fond du Lac 138-kV line outage	Install 28.8 MVAR capacitor bank at Butternut 138-kV Substation
4	Holland, Plymouth #4 138-kV bus voltage	-	90.1-91.8%	Charter Steel Industry-Holland 138-kV line outage	No provisional project. Additional study is being conducted.
4	Suamico, Sobieski 69-kV bus voltages	-	88.5-91.2%	Pulliam-Suamico 69-kV line outage followed by Sobieski-Pioneer 69-kV line close	Rebuild/Convert Bayport-Suamico-Sobieski-Pioneer 69-kV line to 138 kV
4	Holland 138-kV bus voltages	-	90.6%	Charter Steel 138-kV bus plus Charter Steel-Cedarsauk 138-kV line outage	No provisional project. Additional study is being conducted.

**TABLE ZS-3  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2018 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2018 Summer Peak Case		Facility Outage(s)	Project
		% of Facility Rating	% of Nominal bus voltage		
5	Bluemound 230-kV bus Concord 138-kV bus Walworth 138-kV bus Allerton 138-kV bus Bark River 138-kV bus  Barton 138-kV bus Brookdale E 138-kV bus Brookdale W 138-kV bus Edgewood 138-kV bus Chinook 138-kV bus  Cooney 138-kV bus Cottonwood 138-kV bus Germantown 138-kV bus Hartford 138-kV bus Merrill Hills 138-kV bus  Mukwonago 138-kV bus Maple 138-kV bus Pleasant Valley 138-kV bus Duplainville 138-kV bus St. Lawrence 138-kV bus  St. Martins 138-kV bus Summit 138-kV bus Sussex 138-kV bus 28 <sup>th</sup> St 138-kV bus Tamarack 138-kV bus  Arthur Road 138-kV bus Westridge 138-kV bus Country Aire 138-kV bus Glacier 138-kV bus	--	95.3% 95.6% 95.8% 93.8% 93.7%  95.9% 94.6% 95.4% 94.4% 94.3%  93.7% 92.9% 94.3% 94.7% 94.0%  94.2% 94.5% 95.8% 95.9% 95.3%  95.8% 93.6% 95.5% 95.8% 95.7%  95.3% 95.0% 94.3% 95.4%	Intact system	Generation redispatch
5	Oak Creek – Pennsylvania 138-kV line	100.7 % 101.0% 102.3% 101.6% 102.1%	--	Intact system Kansas – Ramsey 138-kV line Nicholson – Oak Creek 138-kV line Nicholson – Ramsey 138-kV line Oak Creek – Ramsey 138-kV line Plus other less severe outages	Load shift
5	Cottonwood 138-kV bus voltage	--	88.9% 89.5%	Bark River – Cottonwood 138-kV line Bark River – Sussex 138-kV line	Generation redispatch
5	Bark River 138-kV bus voltage	--	89.5%	Bark River – Sussex 138-kV line	Generation redispatch
5	Germantown, Country Aire, Maple 138-kV buses	--	88.9 – 89.3%	Maple – Saukville 138-kV line	Generation redispatch
5	Bain 345/138-kV transformer T5	95.1% 159.7% 104.5%	--	Pleasant Prairie bus split between 2 and 3 Pleasant Prairie bus split between 3 and 4 Bain transformer #1	Generation redispatch

**TABLE ZS-3  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2018 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2018 Summer Peak Case		Facility Outage(s)	Project
		% of Facility Rating	% of Nominal bus voltage		
5	Bain 345/138-kV transformer T4	103.7%	--	Bain transformer T5	Generation redispatch
5	Albers – Bain 138-kV line	121.3%	--	Bain – Kenosha 138-kV line	Generation redispatch
5	Bain – Kenosha 138-kV line	98.7%	--	Albers – Bain 138-kV line	Generation redispatch
5	Arcadian6 – Waukesha3 138-kV line	99.3%	--	Arcadian4 – Waukesha1 138-kV line	Generation redispatch
5	Oak Creek 345/138-kV transformer #2	99.0%	--	Oak Creek 345/138-kV transformer #1	Generation redispatch
5	Branch – Kansas 138-kV line	108.2%	--	Oak Creek – Pennsylvania 138-kV line	Load shift
5	Nicholson – Ramsey 138-kV line	96.3%	--	Oak Creek – Pennsylvania 138-kV line	Load shift
5	Oak Creek – Ramsey 138-kV line	96.1%	--	Oak Creek – Pennsylvania 138-kV line	Load shift
5	Arcadian4 – Waukesha1 138-kV line	100.1%	--	Arcadian6 – Waukesha1 138-kV line	Generation redispatch
5	Tichigan , Burlington1 138-kV bus voltages	--	87.7-88.6%	Split Burlington 138-kV bus	Load shift
5	Arcadian 345/138-kV transformer #2	101.0%		Arcadian 345/138-kV transformer #1	Generation redispatch (temporary) Arcadian transformer (provisional permanent solution)
5	Arcadian 345/138-kV transformer #3	120.1%		Arcadian 345/138-kV transformer #1	Generation redispatch (temporary) Arcadian transformer (provisional permanent solution)

**TABLE ZS-4  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2023 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2023 Summer Peak Case		Facility Outage(s)
		% of Facility Rating	% of Nominal bus voltage	
1	Rocky Run 345/115-kV transformer #3	96.5 – 104.2%	--	Arpin – Sigel 138-kV line Rocky Run 345/115-kV transformer #2 Rocky Run 345/115-kV transformer #1 Arpin 345/138-kV transformer
1	Plover – Coyne 115-kV line	96.3%	--	Arpin-Sigel 138-kV line Hume Wildwood 115-kV line Arpin 345/138-kV transformer
1	Wien – Stratford 115-kV line	99.5 – 116.6%	--	Glavin-Hume 115-kV line Hume Wildwood 115-kV line Arpin 345/138-kV transformer
1	Stratford - McMillan 115-kV line	108.0%	--	Glavin-Hume 115-kV line
1	Sigel, Lakehead Vesper, Vulcan and Port Edwards 138-kV bus voltages	--	95.5% 84.3 – 91.5%	Base Case Arpin-Sigel 138-kV line Sigel-Lakehead Vesper 138-kV line Lakehead Vesper-Port Edwards 138-kV line
1	Port Edwards, Hollywood and Saratoga 138-kV bus voltages	--	95.5% 85.8 – 91.8%	Base Case Arpin-Sigel 138-kV line Sigel-Lakehead Vesper 138-kV line Lakehead Vesper-Port Edwards 138-kV line
1	Saratoga and Baker 115-kV bus voltage	--	95.8% 89.2 – 92.0%	Base Case Arpin-Sigel 138-kV line Sigel-Lakehead Vesper 138-kV line Baker-Coyne 115-kV line
1	Castle Rock – Quincy 69-kV line	95.2 – 108.4%	--	Big Pond-Necedah tap 69-kV line Necedah tap-Whistling Wings tap 69-kV line
1	Mckenna – Quincy 69-kV line	101.2%	--	Big Pond-Necedah tap 69-kV line
1	Chaffee Creek – Coloma 69-kV line	101.2%	--	Big Pond-Necedah tap 69-kV line
1	Council Creek and Petenwell 138-kV bus voltages	--	93.9 – 94.1% 87.7 – 92.0%	Base Case Arpin-Sigel 138-kV line Saratoga – Petenwell 138-kV line Sigel - Lakehead Vesper 138-kV line Hillsboro 161/69-kV transformer Plus other less severe outages
1	Tomah Industrial Park and Cardinal Glass 69-kV bus voltages	--	91.9%	Hillsboro 161/69-kV transformer
1	Necedah, Whistling Wings, Dellwood, Friendship, Houghton Rock and Mckenna 69-kV bus voltages	--	80.8 – 91.9%	Big Pond-Necedah tap 69-kV line Necedah tap-Whistling Wings tap 69-kV line Whistling Wings tap-Dellwood 69-kV line
1	Metomen 138/69-kV transformer	100.6 – 121.8%	--	Metomen-Rosendale 69-kV line Rosendale-North Fond du Lac 69-kV line Winneconne-Sunset Point 69-kV line North Randolph-Markesan tap 69-kV line Plus other less severe outages
1	Metomen – Ripon 69-kV line	97.4%	--	Winneconne-Sunset Point 69-kV line
1	NW Ripon – Ripon 69-kV line	97.1%	--	Winneconne-Sunset Point 69-kV line
1	Winneconne – Sunset Point 69-kV line	95.2 – 95.5%	--	NW Ripon – Ripon 69-kV line Metomen – Ripon 69-kV line
1	Wautoma 138/69-kV transformer	102.0%	--	Base Case
1	Harrison 138/69-kV transformer	97.0%	--	Base Case
1	Lakehead Portage, Endeavor, Roslin and Montello 69-kV bus voltages	--	88.2 – 91.7%	Portage-Lakehead Portage 69-kV line Lakehead Portage-Endeavor tap 69-kV line

**TABLE ZS-4  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2023 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2023 Summer Peak Case		Facility Outage(s)
		% of Facility Rating	% of Nominal bus voltage	
1	Ripon, Ripon Industrial Park, NW Ripon, Dartford and SW Ripon 69-kV bus voltages	--	88.1 – 91.7%	Metomen-Ripon 69-kV line NW Ripon-Ripon 69-kV line Winneconne-Sunset Point 69-kV line Silver Lake-Wautoma 69-kV line Silver Lake-Spring Lake 69-kV line
1	Winneconne, Omro and Omro Industrial 69-kV bus voltages	--	83.5 – 91.8%	Winneconne-Sunset Point 69-kV line Omro-Winneconne 69-kV line Silver Lake-Wautoma 69-kV line
1	Silver Lake, Fountain Valley, Spring Lake, Red Granite and River Run 69-kV bus voltages	--	85.7 – 92.0%	Wautoma-Silver Lake 69-kV line Silver Lake-Spring Lake 69-kV line Spring Lake-Red Granite 69-kV line Fountain Valley-Red Granite 69-kV line Plus other less severe outages
1	Quincy (ACEC), Lincoln Pumping Station, Brooks (ACEC) and Grand Marsh 69-kV bus voltages	--	90.1 – 91.9%	Big Pond-Necedah tap 69-kV line
1	Fairwater 69-kV bus voltage	--	91.9%	Metomen 138/69-kV transformer
1	Sand Lake and Wautoma 138-kV bus voltage	--	95.0 – 95.3% 88.5 – 91.2%	Base Case Arpin-Sigel 138-kV line Sigel-Lakehead Vesper 138-kV line
1	Roeder and Green Lake 138-kV bus voltage	--	95.2 – 96.0%	Base Case
1	Metomen 138-kV bus voltage	--	94.7% 90.8%	Base Case Rosendale-North Fond du Lac 69-kV line
1	Hillsboro, Dorset Corners, Wonewoc, and Union Center 69-kV bus voltages	--	91.1 – 91.5%	Hillsboro 161/69-kV transformer
2	Delta – Mead 69-kV line	100-161%	-	Base Case Chandler-Lakehead Tap 69-kV line Lakehead Tap-Masonville 69-kV line Masonville-Gladstone 69-kV line Gladstone-North Bluff 69-kV line North Bluff-Bay Tap 69-kV line Bay Tap-Mead 69-kV line
2	Chandler – Delta 69 kV #1 line	116%	-	Chandler-Delta 69 kV #2 line
2	Chandler – Delta 69 kV #2 line	111%	-	Chandler-Delta 69 kV #1 line
2	Chandler 138/69-kV transformer	96-109%	-	Nordic-Mountain 69-kV line Mountain-Harris Tap 69-kV line Forsyth 138/69-kV transformer
2	Chandler – Lakehead Tap 69-kV line Masonville – Lakehead Tap 69-kV line Masonville – Gladstone 69-kV line Gladstone – North Bluff 69-kV line North Bluff – Bay Tap 69-kV line Mead – Bay Tap 69-kV line	126-165%	-	Delta-Mead 69-kV line
2	Forsyth 138/69-kV transformer	105%	-	Chandler 138/69-kV transformer
2	Atlantic-Henry St. Tap 69-kV line	99%	-	Base Case
2	Atlantic-M38 69-kV line	107%	-	Atlantic-M38 138-kV line Atlantic 138/69-kV transformer
2	Atlantic 138/69-kV transformer	106%	-	M38 138/69-kV transformer
2	Indian Lake 138/69-kV transformer 1, 2	97%	-	Indian Lake 138/69-kV transformer 1, 2
2	Valley, Indian Lake, Glen Jenks, Manistique, Blaney Park, Curtis, Gould City, Straits, Engadine, Hiawatha 69-kV bus voltages	-	105.1-105.8%	Base Case

**TABLE ZS-4  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2023 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2023 Summer Peak Case		Facility Outage(s)
		% of Facility Rating	% of Nominal bus voltage	
2	Delta, West Side, Escanaba, Masonville, Mead, Gladstone, Bay View, North Bluff, Harris 69-kV bus voltages	-	86.0-88.1 %	Chandler 138/69-kV transformer
2	Atlantic, Elevation St., Henry St., MTU, Osceola, Portage, Keweenaw 69 kV bus voltages	-	77.8-86.3%	Atlantic 138/69-kV transformer
3	North Monroe 138/69-kV transformer	106%	--	Base Case
3	Colley Road 138/69-kV transformer	99%	--	Base Case
3	Paddock 138/69-kV transformer	98.1%	--	Base Case
3	Wauzeka-Boscobel 69-kV line	96.8%	--	Base Case
3	Concord 4-Concord generation bus	99.4%	--	Base Case
3	North Stoughton-Stoughton East-Stoughton 69-kV line	142.4%-98.8%	--	McCue-Harmony 69-kV line Harmony-Lamar 69-kV line Fulton-Lamar 69-kV line Oak Ridge-Verona 138-kV line Verona 138/69-kV transformer
3	Sheepskin-Dana Tap 69-kV line	132%-126.1%	--	McCue-Harmony 69-kV line Harmony-Lamar 69-kV line
3	Fitchburg-Syene-Ninesprings 69-kV line	129%-110.4%	--	Royster-Pflaum Tap 69-kV line Pflaum-Pflaum Tap 69-kV line
3	Stage Coach-Black Earth-Mazomanie 69-kV line	126%-96.7%	--	Spring Green 138/69-kV transformer
3	Dane-Lodi Tap 69-kV line	126%-97.2%	--	Kirkwood-Island 69-kV line Island-Moore St 69-kV line Moore St-Baraboo 69-kV line Trienda-Lake Delton 138-kV line Lake Delton-City View 138-kV line City View-Kirkwood 138-kV line
3	Cobblestone-Zenda Tap 69-kV line	124.5%-96.6%	--	North Lake Geneva-Lake Geneva 69-kV line Lake Geneva-S Lake Geneva 69-kV line
3	Royster-Pflaum Tap-Pflaum 69-kV line	124.1%-104.2%	--	Fitchburg-Syene 69-kV line Nine Springs-Syene 69-kV line
3	Lake Geneva-S Lake Geneva-Katzenberg 69-kV line	123.1%-105.6%	--	Brick Church-Cobble Stone 69-kV line
3	West Middleton-Timberland-Stage Coach 69-kV line	119.1%-96%	--	Spring Green 138/69-kV transformer Nelson Dewey-Lancaster 138-kV line Lancaster-Eden 138-kV line
3	Colley Road 138/69-kV transformer	117.1%-96.2%	--	Paddock 138/69-kV transformer Paddock-Shirland Ave 69-kV line Shaw-Shirland 69-kV line Brick Church 138/69-kV transformer Colley Road-Dickinson 138-kV line
3	Enzyme Bio Systems-RC3-Clinton-Sharon 69-kV line	114.7%-97%	--	Colley Road-Dickinson 138-kV line Dickinson-Global Renewable Energy 138-kV line Brick Church 138/69-kV transformer Global Renewable Energy-Brick Church 138-kV line
3	North Monroe-Idle Hour 69-kV line	114.2%-95.7%	--	Darlington-Gratiot 69-kV line Gratiot-Wiota 69-kV line Wiota-Jennings Road 69-kV line Darlington 138/69-kV transformer Paddock-Newark 69-kV line Whistling Wind-Black Smith 69-kV line
3	South Fond Du Lac-Koch Oil-Waupun 69-kV line	114.1%-107.8%	--	North Randolph-Fox Lake 138-kV line Fox Lake-North Beaver Dam 138-kV line

**TABLE ZS-4  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2023 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2023 Summer Peak Case		Facility Outage(s)
		% of Facility Rating	% of Nominal bus voltage	
3	Kirkwood-Rock Springs Tap – Artesian 138-kV line	113.5%-106.8%	--	Trienda-Lewiston 138-kV line East Dells-Kilbourn 138-kV line East Dells-Lewiston 138-kV line
3	Gran Grae-Wauzeka-Boscobel-Blue River 69-kV line	113%-96.1%	--	Spring Green 138/69-kV transformer Nelson Dewey-Lancaster 138-kV line Lancaster-Eden 138-kV line Eden-Wyoming Valley 138-kV line Spring Green-Lone Rock 69-kV line King-Eau Claire-Arpin 345-kV line
3	East Rockton-Shaw-Shirland 69-kV line	112.7%-103.2%	--	Colley Road 138/69-kV transformer Paddock 138/69-kV transformer
3	McCue-Harmony-Lamar 69-kV line	112%-95.6%	--	Kegonsa 138/69-kV transformer Kegonsa-North Stoughton 69-kV line North Stoughton-Stoughton 69-kV line Brodhead Switching-Brodhead South 69-kV line Sheepskin generation outage
3	Academy-Columbus Muni 2 Tap 69-kV line and Columbus Muni 2 Tap- Columbus 69-kV line	111.9%-100.4%	--	North Randolph-Fox Lake 138-kV line Fox Lake-North Beaver Dam 138-kV line
3	Brick Church-Cobblestone 69-kV line	107.9%	--	North Lake Geneva-Lake Geneva 69-kV line
3	McCue-Milton Lawn 69-kV line	107.1%	--	Janesville 138/69-kV transformer
3	Stoughton-Aaker Road 69-kV line	106.9%	--	Oak Ridge-Verona 138-kV line Verona 138/69-kV transformer
3	Hillman 138/69-kV transformer	106.3%-97.6%	--	DPC Galena-Pilot 69-kV line Pilot-Terr Tap 69-kV line
3	North Monroe 138/69-kV transformer	104.6%-95.4%	--	Darlington 138/69-kV transformer Darlington-Gratiot 69-kV line Gratiot-Wiota 69-kV line Wiota-Jennings Road 69-kV line Darlington 138/69-kV transformer Paddock-Newark 69-kV line
3	Paddock-Shirland Ave 69-kV line	104.5%	--	Colley Road 138/69-kV transformer
3	Spring Green 138/69-kV transformer	104.1%-97.3%	--	Gran Grae-Wauzeka 69-kV line Wauzeka-Boscobel 69-kV line Black Earth-Stage Coach 69-kV line
3	Eden 138/69-kV transformer	103.9%-96.1%	--	Eden-Wyoming Valley 138-kV line Spring Green-Wyoming Valley 138-kV line Nelson Dewey-Potosi 138-kV line Potosi-Hillman 138-kV line
3	Hubbard-Horicon 69-kV line	103.9%-99.6%	--	North Randolph-Fox Lake 138-kV line Fox Lake-N Beaver Dam 138-kV line
3	Brownstown-South Monroe 69-kV line	103.7%	--	North Monroe 138/69-kV transformer North Monroe-Idle Hour 69-kV line
3	Zenda-Katzenberg 69-kV line	102.6%	--	North Lake Geneva-Lake Geneva 69-kV line
3	North Lake Geneva-Lake Geneva 69-kV line	101.9%	--	Brick Church-Cobble Stone 69-kV line
3	Concord 4-Concord Generation Bus	101.8%-99.4%	--	Saukville-Pleasant Valley 138-kV line Rockdale-Lake Cambridge 138-kV line Lake Cambridge-Jefferson 138-kV line
3	Portage-Columbia 138-kV line	100.7%	--	Second Portage-Columbia 138-kV line
3	Paddock 138/69-kV transformer	100.4%	--	Colley Road 138/69-kV transformer
3	Bloomington-La Pointe 69-kV line	100.1%	--	Gran Grae 161/69-kV transformer
3	Colley Road-Park Ave 69-kV line	98.6%	--	Paddock 138/69-kV transformer
3	Center Street-South Beaver Dam 69-kV line	98.6%	--	North Randolph-Fox Lake 138-kV line



**TABLE ZS-4  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2023 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2023 Summer Peak Case		Facility Outage(s)
		% of Facility Rating	% of Nominal bus voltage	
3	Academy 138/69-kV transformer	95.7%	--	North Randolph-Fox Lake 138-kV line
3	West Middleton 138/69-kV transformer	97.1%	--	West Middleton 138/69-kV transformer
3	West Middleton-West Town 69-kV line	95.3%	--	West Middleton-Pleasant View 138-kV line
3	Whistling Wind-Black Smith 69-kV line	98.6%	--	North Monroe-Idle Hour 69-kV line
3	Gratiot-Wiota 69-kV line	97%-95.9%	--	North Monroe 138/69-kV transformer North Monroe-Idle Hour 69-kV line
3	Brick Church 138/69-kV transformer	98.5%	--	North Lake Geneva 138/69-kV transformer
3	Wauaukee Switching-Wauaukee Muni 2 69-kV line	96.7%	--	West Middleton-Pheasant Branch 69-kV line
3	Huiskamp-Wauaukee Industrial 69-kV line	99.5%	--	North Madison 138/69-kV transformer
3	Femrite-Royster 69-kV line	96.1%	--	Fitchburg-Syene 69-kV line
3	Portage-Trienda 138-kV line	98.3%	--	Second Portage-Trienda 138-kV line
3	West Middleton-Pleasant View 138-kV line	95.4%	--	Kegonsa-Christiana 138-kV line
3	Columbia T22 345/138-kV transformer	96.1%	--	Columbia T21 and T23 345/138-kV transformer
3	Columbia T21 and T23 345/138-kV transformer	95.4%	--	Columbia T22 345/138-kV transformer
3	Eden, Spring Green, Wyoming Valley, Lancaster and Troy 138-kV buses	--	90.7%-95.7%	Base Case
3	Oakridge, Hawk, Pleasant View, McFarland, Sprecher, Kegonsa, Colloday Point, Reiner Road, Cross County, Fitchburg, Sycamore, Femrite and Blount 138-kV buses	--	92.8%-95.4%	Base Case
3	Boscobel, Muscoda, Avoca and Blue River 69-kV buses	--	93.1%-94.1%	Base Case
3	East Beaver Dam, North Beaver Dam, Fox Lake, North Randolph, Fountain Prairie, Friesland and Academy 138-kV buses	--	94.6%-94.7%	Base Case
3	Okee and Lodi 69-kV buses	--	94.6%-95.2%	Base Case
3	Kirkwood, Lake Delton, City View, Rock Springs, Artesian and Nishan 138-kV buses and Reedsburg, Artesian 69-kV buses	--	94.8%-95.9%	Base Case
3	Mazomanie, Black Earth and Arena 69-kV buses	--	94.9%-95.6%	Base Case
3	Hustisford, Hubbard, Butler Ridge, Concord, Rockvale, Fort Atkinson, Crawfish, Lake Mills, Stoney Brook, Boxelder, Jefferson and Rubicon 138-kV buses	--	95.1%-95.9%	Base Case
3	Gaston Road and Cottage Grove 69-kV buses	--	95.7%	Base Case
3	Spring Green, Arena, Mazomanie, Mazomanie Industrial, Lone Rock, Muscoda, Avoca, Blue River, Boscobel, Boscobel Muni 69-kV bus voltages	--	75.9%-90.8%	Spring Green 138/69-kV transformer
3	Harmony, Lamar, Fulton, Saunders Creek, Dana Corp, Sheepskin Footville, RCEC Center, Bass Creek, Orfordville and Evansville 69-kV buses	--	80%-91.8%	McCue-Harmony 69-kV line Harmony-Lamar 69-kV line Lamar-Fulton 69-kV line
3	Wauzeka, Spring Green, Lone Rock, Muscoda, Avoca, Blue River, Boscobel, Boscobel Muni ,69-kV bus voltages, Spring Green, Eden and Wyoming Valley 138-kV bus voltages	--	79.5%-91.4%	Gran Grae-Wauzeka 69-kV line Wauzeka-Boscobel 69-kV line
3	Lone Rock, Muscoda, Avoca, Blue River, Boscobel, Boscobel Muni , Pine River, Brewer and Richland Center 69-kV bus voltages	--	82.9%-91.2%	Lone Rock-Spring Green 69-kV line
3	Hubbard, Hustisford, North Beaver Dam and Beaver Dam East 138-kV bus voltages	--	85%-85.8%	Rubicon-Hustisford 138-kV line Hubbard-Hustisford 138-kV line
3	Eden, Wyoming Valley, Spring Green, Troy and Lancaster 138-kV bus voltages, Muscoda, Avoca, Blue River, Boscobel, Boscobel Muni 69-kV bus voltages	--	83.8%-92%	Nelson Dewey-Lancaster 138-kV line Eden-Wyoming Valley 138-kV line Lancaster-Eden 138-kV line

**TABLE ZS-4  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2023 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2023 Summer Peak Case		Facility Outage(s)
		% of Facility Rating	% of Nominal bus voltage	
3	Dickinson, Global Renewable Energy, William Bay N Lake Geneva, Como, Elkhorn and Brick Church 138-kV buses	--	87%-91.8%	Colley Road – Dickinson 138-kV line Dickinson-Global Renewable Energy 138-kV line Global Renewable Energy-Brick Church 138-kV line
3	Idle Hour, Monroe, Black Smith, New Glarus, Monticello, Brown town, Monticello, New Glarus, Whistling Wind and S Monroe 69-kV buses	--	83.7%-92%	North Monroe-Idle Hour 69-kV line North Monroe 138/69-kV transformer Monroe-Idle Hour 69-kV line
3	Concord, Hubbard, Hustisford, Rubicon, Rockvale, Crawfish, Jefferson, Fort Atkinson and Butler Ridge 138-kV bus voltages	--	85.6%-91.9%	Concord4-5 138-kV bus Hartford-St. Lawrence 138-kV line
3	Avoca, Muscoda, Blue River, Boscobel, Boscobel Muni 69-kV bus voltages	--	88.2%-91.3%	Lone Rock-Avoca 69-kV line Avoca-Muscoda 69-kV line
3	Brodhead Muni 3, Brodhead Muni 2, Brodhead, Brodhead Muni 1, RCEC Orfordville, Orfordville, Bass Creek, Footville, RCEC Center, Evansville 69-kV bus voltages	--	84.8%-91.9%	Brodhead Switching Station-Brodhead Muni 3 69-kV line Brodhead Muni 2 -Brodhead Muni 3 69-kV line Brodhead Muni 2-Brodhead 69-kV line
3	Cobblestone, Lake Shore, Twin Lakes, Richmond and Zenda 69-kV buses	--	86.5%-91.1%	Brick Church-Cobblestone 69-kV line
3	Lake Geneva, South Lake Geneva, Richmond, Katzenberg and Twin Lake 69-kV buses	--	83.1%-92%	North Lake Geneva-Lake Geneva 69-kV line Lake Geneva-South Lake Geneva 69-kV line South Lake Geneva-Katzenberg 69-kV line
3	Burke, Sun Prairie, Token Creek, South, Colorado, Bird St, Gaston Road and Reiner 69-kV buses	--	88.1%-91.9%	Reiner Road 138/69-kV transformer Burke-Colorado 69-kV line Reiner Road-Burke 69-kV line
3	Evansville, Footville, Center and Bass Creek 69-kV bus voltages	--	87.2%-91.4%	Evansville-Sheepskin 69-kV line
3	Arena, Mazomanie and Black Earth 69-kV bus voltages	--	88.2%-91.7%	Spring Green-Arena 69-kV line
3	Eden, Wyoming Valley, Spring Green, Troy and Lancaster 138-kV bus voltages,	--	85.9%-90.1%	Spring Green-Troy 138-kV line Troy-Kirkwood 138-kV line
3	Island, Moore St, Baraboo, Dam Heights, Tower St, Eagle View, Lodi, Okee and Prairie Du Sac 69-kV bus voltages	--	86.2%-92%	Island-Kirkwood 69-kV line Island-Moore St 69-kV line
3	Rockvale 138-kV bus voltage	--	92%	Concord-Rockvale 138-kV line
3	Potosi, Hillman, Darlington, North Monroe and Lafayette Wind 138-kV bus voltages	--	87%-91.6%	Nelson Dewey-Potosi 138-kV line Potosi-Hillman 138-kV line Hillman-Lafayette Wind 138-kV line Lafayette Wind-Darlington 138-kV line
3	Albany, North Monroe, Darlington, Lafayette Wind 138-kV bus voltages	--	86.5%-91.6%	Townline-Albany 138-kV line Albany-North Monroe 138-kV line
3	Lone Rock, Muscoda, Avoca, Blue River, Boscobel, Boscobel Muni 69-kV bus voltages, Troy 138-kV bus voltage	--	88.4%-91.8%	Spring Green-Wyoming Valley 138-kV line
3	Pleasant View, Hawk, West Middleton, NE Cross Plains, Oakridge, Cross County, Fitchburg 138-kV buses	--	89.4%-91.9%	Rockdale-West Middleton 345-kV line West Middleton 345/138-kV transformer West Middleton 138/69-kV transformer Pleasant View-West Middleton 138-kV line
3	North Beaver Dam and East Beaver Dam 138-kV bus voltages, Koch Oil 69-kV bus voltage	--	91.5%-92%	South Fond Du Lac-Koch Oil 69-kV line Koch Oil-Waupun 69-kV line
3	Bluff Creek and Sugar Creek 138-kV bus voltage	--	91.6%-91.9%	University-Bluff Creek 138-kV line
3	Cottage Grove 69-kV bus voltage	--	91.4%	Kegonsa-Cottage Grove 69-kV line
3	McFarland, Femrite and Sprecher 138-kV bus voltages	--	90.3%-91.1%	Kegonsa-McFarland 138-kV line McFarland-Femrite 138-kV line
3	Lodi, Okee 69-kV bus voltages	--	88.8%-91.7%	Dane-Lodi Tap 69-kV line Lodi-Okee Tap 69-kV line

**TABLE ZS-4  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2023 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2023 Summer Peak Case		Facility Outage(s)
		% of Facility Rating	% of Nominal bus voltage	
3	Eagle View 69-kV bus voltage	--	91%	Eagle View-Dam Heights 69-kV line
3	Randolph, Didion and Cambria 69-kV bus voltages	--	89.4%-91.7%	North Randolph-Randolph Tap 69-kV line Didion- Randolph Tap 69-kV line
3	Boscobel, Blue River, Wauzeka, Gran Grae, La Pointe, Muscoda, Avoca 69-kV bus voltage	--	88.3%-91.9%	Gran Grae 138/69-kV transformer
3	Yahara, Vienna, Reiner Road, Sprecher, Femrite and American Center 138-kV bus voltages	--	91.2%-92%	North Madison-Yahara 138-kV line Vienna-Yahara 138-kV line
3	Horicon, Juneau and Horicon Industry 69-kV bus voltages, North Beaver Dam, Fox Lake and Beaver Dam East 138-kV bus voltages	--	89%-91.8%	Hubbard-Horicon Industrial 69-kV line Horicon-Horicon Industrial 69-kV line
3	LCI, Ninesprings and Pflaum 69-kV bus voltage	--	89.6-91.6%	Royster-Pflaum 69-kV line
3	Lewiston, East Dells, Kilbourn, Loch Mirror, Birchwood, Zobel, Nishan, Artesian, Rock Springs, Kirkwood, City View, Kirkwood, Lake Delton and Troy 138-kV bus voltages, Reedsburg and Artesian 69-kV bus voltages	--	87.4%-91.8%	City View-Kirkwood 138-kV line Kirkwood-Lake Delton 138-kV line Trienda-Lewiston 138-kV line Lewiston-East Dells 138-kV line East Dells-Kilbourn 138-kV line Trienda-Lake Delton 138-kV line Loch Mirror-Kilbourn 138-kV line Loch Mirror-Birchwood 138-kV line
3	Academy 138-kV bus voltage	--	91.9%	Boxelder-Academy 138-kV line
3	Aaker Road 69-kV bus voltage	--	91.1%	Stoughton-Aaker Road 69-kV line
3	Timberline, Stage Coach, Cross Plains, Black Earth, Spring Green, Arena, Mazomanie, Mazomanie Industrial, Lone Rock, Muscoda, Avoca, Blue River, Boscobel, Boscobel Muni 69-kV bus voltages	--	88.8%-92%	West Middleton-Timberline 69-kV line Black Earth-Mazomanie 69-kV line Stage Coach-Black Earth 69-kV line
3	West Darien, Southwest Delavan and North Shore 138-kV bus voltages	--	91.6%-91.8%	Bradford-West Darien 138-kV line
3	La Prairie, Bradford, West Darien, SW Delavan and N Shore 138-kV bus voltages	--	91.6%-91.7%	Rock River-La Prairie 138-kV line
3	Newark, Brodhead Switching, Brodhead South, Brodhead, Brodhead North, Orfordville, Bass Creek, Spring Grove and Footville 69-kV bus voltages	--	90.6%-92%	Paddock-Newark 69-kV line Newark-Brodhead Switching Station 69-kV line
3	Lone Rock, Muscoda, Avoca, Blue River, Pine River, Richland Center, Brewer and Seneca 69-kV bus voltages	--	89.9%-91.6%	Seneca-Bell Center 161-kV line
3	Lone Rock, Muscoda, Avoca, Pine River, Richland Center, Brewer 69-kV bus voltages	--	90.7%-91.9%	Hillsboro 161/69-kV transformer
3	Lone Rock, Muscoda, Avoca, Pine River, Richland Center, Brewer and Boscobel 69-kV bus voltages	--	89.3%-91.7%	Richland Center-T RC 69-kV line T RC-Dayton 69-kV line
3	Miner, Shullsburg 69-kV bus voltages	--	90.5%-92%	DPC Galena-Pilot 69-kV line Pilot-Terr Tap 69-kV line
3	Verona, Sun Valley, Montrose 69-kV bus voltages	--	90.3%-91.1%	Oak Ridge-Verona 138-kV line Verona 138/69-kV transformer
3	North Lake Geneva, Sugar Creek, Williams Bay, Como, Elkhorn and Brick Church 138-kV bus voltages	--	88.4%-92%	Burlington 138-kV Bus 1-2 outage Paris-Air Liquide 138-kV line Burlington-Air Liquide 138-kV line
3	Fox Lake, Beaver Dam East and North Beaver Dam 138-kV bus voltages	--	88.3%-89.7%	North Randolph-Fox Lake 138-kV line Fox Lake-North Beaver Dam 138-kV line
3	Reiner Road 138-kV bus voltage	--	91.7%	Reiner Road-Sycamore 138-kV line
3	Hamilton, North Beaver Dam and Beaver Dam East 138-kV bus voltages	--	91.8-91.9%	Portage-Hamilton 138-kV line
3	Cambridge, London 138-kV bus voltages	--	91.8%-92%	Rockdale-Cambridge Tap 138-kV line
3	N Monroe 138/69-kV transformer	108.6%	--	Columbia generator 1 or 2 outage

**TABLE ZS-4  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2023 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2023 Summer Peak Case		Facility Outage(s)
		% of Facility Rating	% of Nominal bus voltage	
3	McCue-Harmony-Lamar 69-kV line	98.9%-95.8%	--	Columbia generator 1 or 2 outage
3	Wauzeka-Boscobel 69-kV line	107.1%	--	Columbia generator 1 or 2 outage
3	Troy, Eden, Kirkwood, City View, Lake Delton 138-kV bus voltages, Muscodia, Blue River, Boscobel, Avoca an Reedsburg 69-kV bus voltages	--	88.9%-91.8%	Columbia generator 1 or 2 outage
3	Nelson Dewey 161/138-kV transformer	102.1%-100.7%	--	Nelson Dewey generator 1 or 2 outage
3	McCue-Harmony-Lamar 69-kV line	111.8%-108.6%	--	Sheepskin generation outage
3	McCue 138/69-kV transformer	97.6%	--	Sheepskin generation outage
3	North Stoughton-Stoughton 69-kV line	105.5%	--	Sheepskin generation outage
3	Nelson Dewey-Gran Grae 161-kV line	98.3%	--	DPC Genoa generation outage
4	Pulliam-Suamico 69-kV line	134%	--	Base case
4	Edgewater 138/69-kV transformer #1 Edgewater 138/69-kV transformer #2	100-101%	--	Base case
4	Edgewater 138/69-kV transformer #1	96.4%	--	Edgewater 138/69-kV transformer #2
4	Edgewater-Washington St 69-kV line	104.4%	--	Edgewater-Nicolet 69-kV line
4	Pulliam-James St 138-kV line	96.2%	--	Green Bay South West-De Pere 138-kV line
4	Pioneer-Sobieski 69-kV line Pioneer 138/69-kV transformer	128-96.6%	--	Pulliam-Suamico 69-kV line followed by Sobieski-Pioneer 69-kV line close
4	Canal 138/69-kV transformer #1	99%	--	Canal 138/69-kV transformer #2
4	Canal 138/69-kV transformer #2	98.6%	--	Canal 138/69-kV transformer #1
4	Glenview 138/69-kV transformer #1	115.1%	--	Glenview 138/69-kV transformer #2
4	Glenview 138/69-kV transformer #2	114.6%	--	Glenview 138/69-kV transformer #1
4	Finger Road-Bluestone 69-kV line	96.3-126.2%	--	Wesmark-Kellnersville 69-kV line Kellnersville-Manrap 69-kV line Mishicot-Shoto 138-kV line
4	City Limits 138-kV bus tie 1-2 City Limit-Butte Des Morts 138-kV line City Limits-Combined Locks Tap 138-kV line	100-118.9%	--	North Appleton-Apple Hills 138-kV line
4	Manrap-Custer 69-kV line	95.4%	--	Revere-Lakefront 69-kV line
4	Sunset Point 138/69-kV transformer #1	100.3%	--	Sunset Point 138/69-kV transformer #2
4	Oak St-Ashland Ave 69-kV line	103.1%	--	Pulliam-South Broadway Tap 69-kV line
4	East Krok 138/69-kV transformer	96.9%	--	Canal-East Krok 138-kV line
4	Sobieski, Suamico 69-kV bus voltages	--	87.2-89.6%	Base case
4	Ashland 69-kV bus voltage	--	95.6%	Base case
4	Bluestone, Wesmark 69-kV bus voltages	--	Diverged	Finger Road-Bluestone 69-kV line
4	East Krok, Beardsley St, Barnett, Booster, Luxemburg 69-kV bus voltages	--	89.2-91.1%	East Krok 138/69-kV transformer
4	Combined Lock Taps, Maes, Apple Hills 138-kV bus voltages	--	90.7-91.9%	North Appleton-Apple Hills 138-kV line
4	Hickory, Forward Energy Center, Butternut 4, Butternut 5 138-kV bus voltages	--	91%	Hickory-South Fond du Lac 138-kV line
4	Forward Energy Center, Butternut 4, Butternut 5 138-kV bus voltages	--	91.8%	Hickory-Forward Energy Center 138-kV line
4	Butternut 4, Butternut 5 138-kV bus voltages	--	91.9%	Butternut-Forward Energy Center 138-kV line
4	Holland, Plymouth #4, Howards Grove, Meeme 138-kV bus voltages	--	87.1-91.6%	Charter Steel Industry-Holland 138-kV line Charter Steel Industry 138-kV bus plus Charter Steel-Cedarsauk 138-kV line
4	Lyndon 138-kV bus voltage	--	90.8%	Cedarsauk-Fredonia 138-kV line
4	Suamico, Sobieski 69-kV bus voltages	--	87-90.2%	Pulliam-Suamico 69-kV line followed by Sobieski-Pioneer 69-kV line close

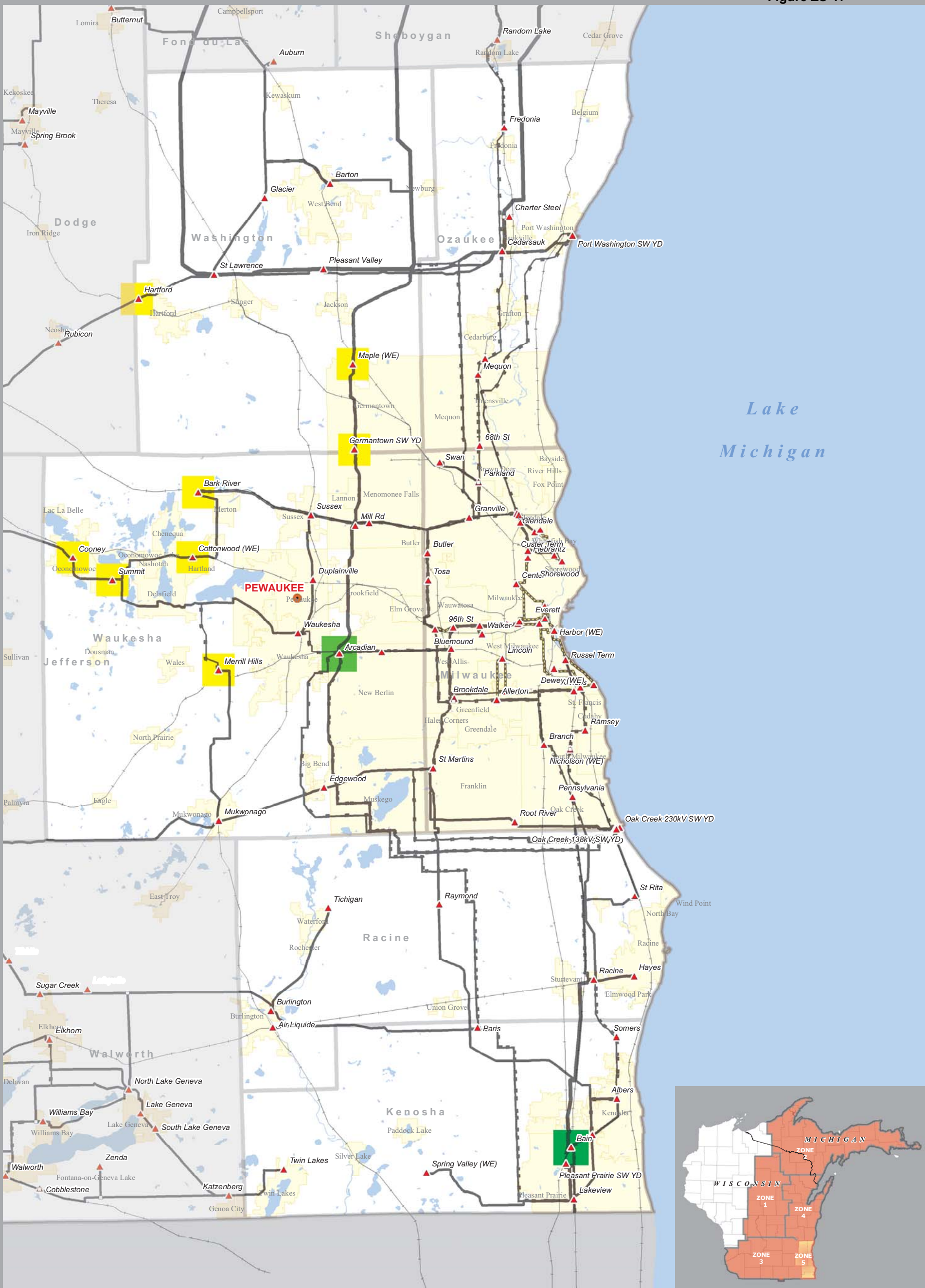
**TABLE ZS-4  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2023 Summer Peak Case**

Planning Zone	Criteria Exceeded/Need	2023 Summer Peak Case		Facility Outage(s)
		% of Facility Rating	% of Nominal bus voltage	
5	Allerton 138-kV bus voltage Bark River 138-kV bus voltage Barton 138-kV bus voltage Cooney 138-kV bus voltage  Cottonwood 138-kV bus voltage Hartford 138-kV bus voltage Merrill Hills 138-kV bus voltage St. Lawrence 138-kV bus voltage  Summit 138-kV bus voltage Arthur Road 138-kV bus voltage Glacier 138-kV bus voltage	--	95.8% 95.5% 95.8% 95.4%  95.2% 95.1% 95.6% 95.6%  95.4% 95.5% 95.5%	Intact System
5	Oak Creek – Pennsylvania 138-kV line	106.3% 107.8% 107.6% 107.0% 106.4%	--	Intact System Nicholson – Oak Creek 138-kV line Oak Creek – Ramsey 138-kV line Nicholson – Ramsey 138-kV line Kansas – Ramsey 138-kV line Plus other less severe outages
5	Hartford 138-kV bus voltage	--	88.7%	Concord 138-kV bus split between 4 and 5
5	St. Lawrence and Arthur Road 138-kV buses	--	90.8%	Concord 138-kV bus split between 4 and 5
5	Glacier 138-kV bus voltage	--	91.8%	Concord 138-kV bus split between 4 and 5
5	Cooney, Cottonwood, Hartford, Summit 138-kV buses	--	90.2-91.9%	Concord 138-kV bus split between G and 4
5	Brookdale W – Kansas 138-kV line	95.5%	--	Bluemound – Brookdale W 138-kV line
5	Fredonia 138-kV bus voltage	--	89.2%	Cedarsauk – Fredonia 138-kV line
5	Swan 138-kV bus voltage	--	91.5%	Granville – Swan Tap 138-kV line
5	Bain 345/138-kV transformer T5	159.7%	--	Pleasant Prairie bus split between 3 and 4
5	Albers – Kenosha 138-kV line	104.0%	--	Bain – Kenosha 138-kV line
5	Pleasant Valley 138-kV bus	--	91.1%	Pleasant Valley – Saukville 138-kV line
5	Branch – Kansas 138-kV line	119.9%	--	Oak Creek – Pennsylvania 138-kV line
5	Nicholson – Ramsey 138-kV line	99.4%	--	Oak Creek – Pennsylvania 138-kV line
5	Oak Creek – Ramsey 138-kV line	99.2%	--	Oak Creek – Pennsylvania 138-kV line
5	Tichigan , Burlington1 138-kV bus voltages	--	83.1-84.2% 88.1–89.1%	Split Burlington 138-kV bus Burlington – Air Liquide – Paris 138-kV line
5	Arcadian 345/138-kV transformer #2	97.5 %		Arcadian 345/138-kV transformer #1
5	Arcadian 345/138-kV transformer #3	118.9%		Arcadian 345/138-kV transformer #1

*Table ZS-12*  
*Zone 5 – Peak Load and Generation*

Zone 5	2009	2013	2018	2023
Peak Forecast (megawatts)	4709.4	5075.1	5550.9	6069
Average Peak Load Growth	N/A	1.89%	1.81%	1.80%
Existing Generation Capacity (megawatts)	4468	4468	4468	4468
Existing Capacity Less Load	-241.4	-607.1	-1082.9	-1601
Existing Generation Capacity plus Modeled Generating Capacity Additions (megawatts)	5118	5768	5768	5768
Modeled Capacity Less Load (megawatts)	408.6	692.9	217.1	-301

Figure ZS-17



Performance Criteria Limits Exceeded and Other Constraints 2008-2009

**PLANNING ZONE 5**

Currently, ATC owns or operates transmission facilities in 50 Wisconsin counties and in 15 Michigan counties. Facilities include:  
 \* Approximately 8900 miles of transmission lines  
 \* 98 wholly owned substations  
 \* 358 jointly owned substations  
 \* Offices in Madison (2), Cottage Grove, Pewaukee, De Pere, Wausau and Kingsford, MI

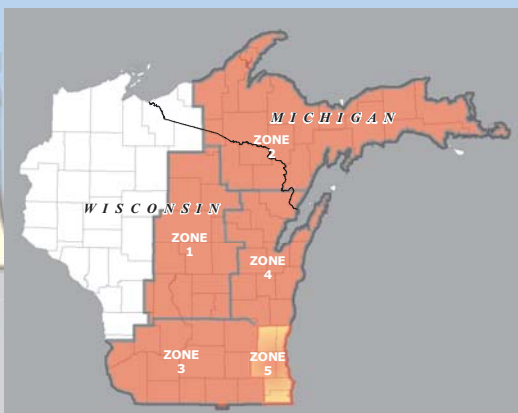
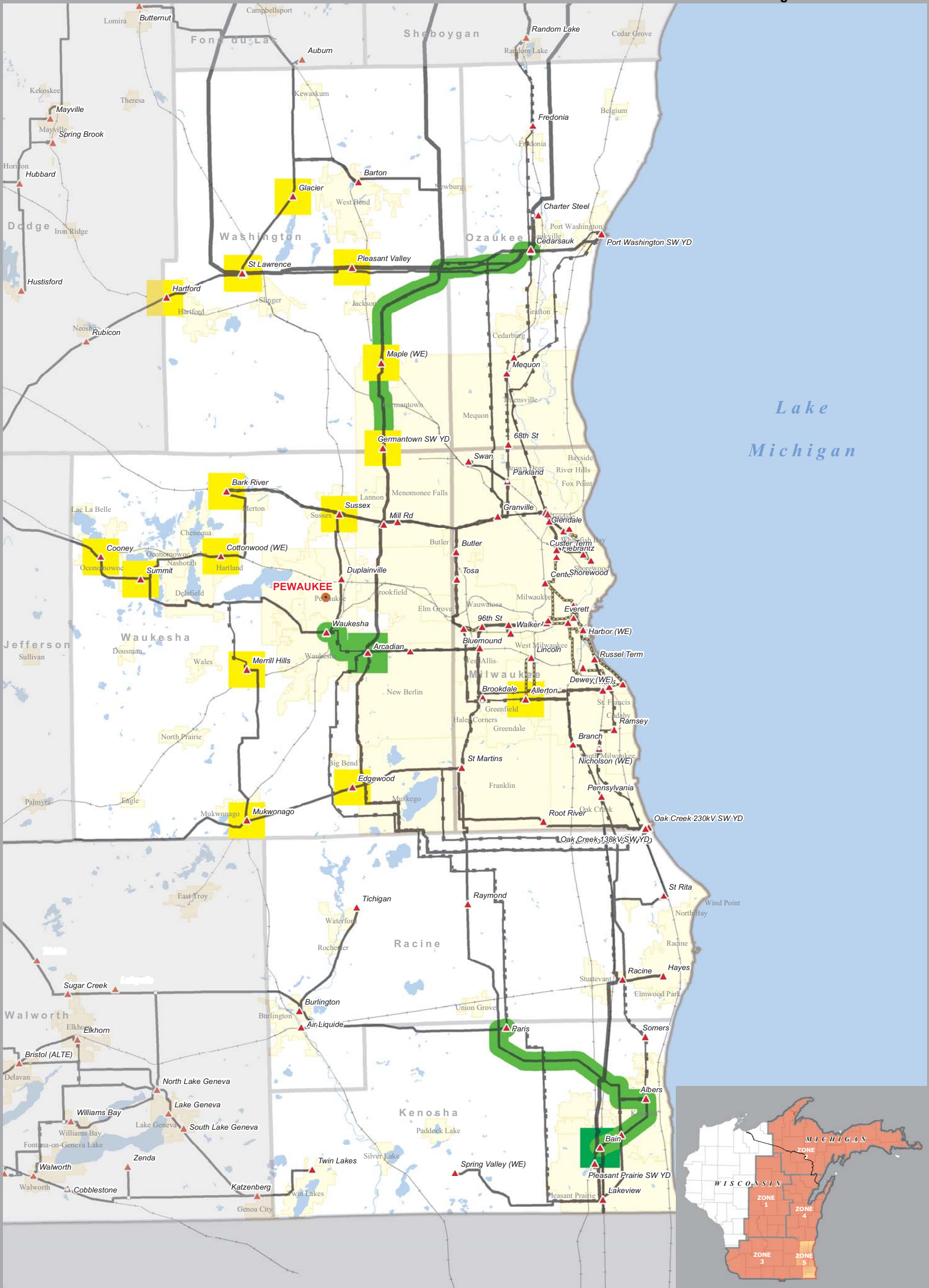
- Low Voltages
- Overloaded Facility
- New Generation/Stability
- Transmission Needed for Load Growth
- Transmission Service Limiter

**Transmission Related Facilities**

- Substation, Switchyard or Terminal
- Proposed/Design/Construction
- ATC Office Location
- Generation
- Other Facility

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 Limits Exceeded and Other Constraints 2010-2013**  
**PLANNING ZONE 5**

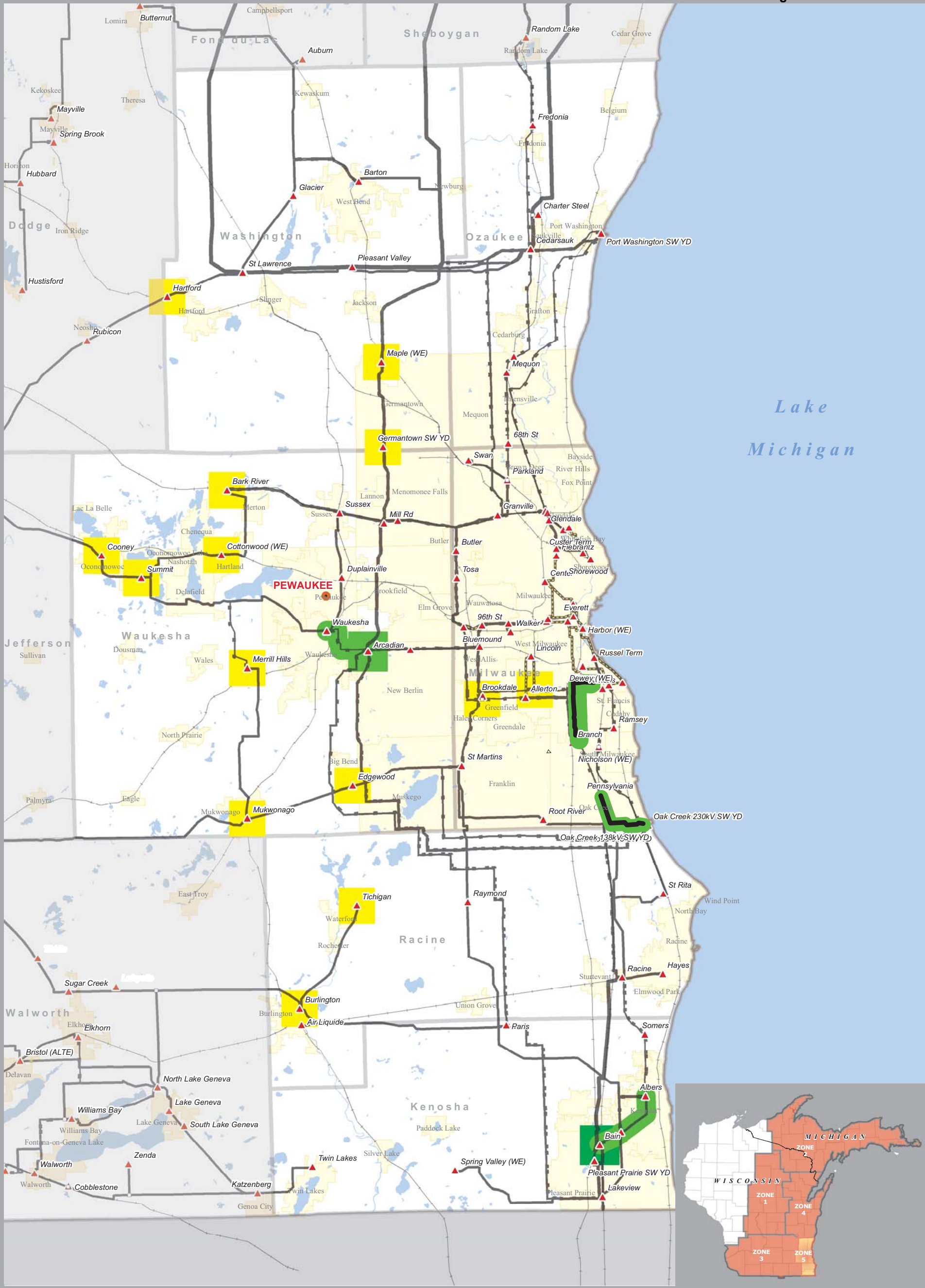
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 \* Offices in Madison (2), Cottage Grove, Pewaukee, De Pere, Wausau and Kingsford, MI

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: yellow; border: 1px solid black; margin-right: 5px;"></span> Low Voltages</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: green; border: 1px solid black; margin-right: 5px;"></span> Overloaded Facility</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: blue; border: 1px solid black; margin-right: 5px;"></span> New Generation/Stability</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: orange; border: 1px solid black; margin-right: 5px;"></span> Transmission Needed for Load Growth</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: pink; border: 1px solid black; margin-right: 5px;"></span> Transmission Service Limiter</li> </ul> | <p><b>Transmission Related Facilities</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 0; height: 0; border-left: 5px solid transparent; border-right: 5px solid transparent; border-bottom: 8px solid black; margin-right: 5px;"></span> Substation, Switchyard or Terminal</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: yellow; border: 1px solid black; margin-right: 5px;"></span> Proposed/Design/Construction</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: orange; border: 1px solid black; margin-right: 5px;"></span> ATC Office Location</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: blue; border: 1px solid black; margin-right: 5px;"></span> Generation</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: black; border: 1px solid black; margin-right: 5px;"></span> Other Facility</li> </ul> |
|---|--|

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-19



Performance Criteria Limits Exceeded and Other Constraints 2014-2018  
**PLANNING ZONE 5**

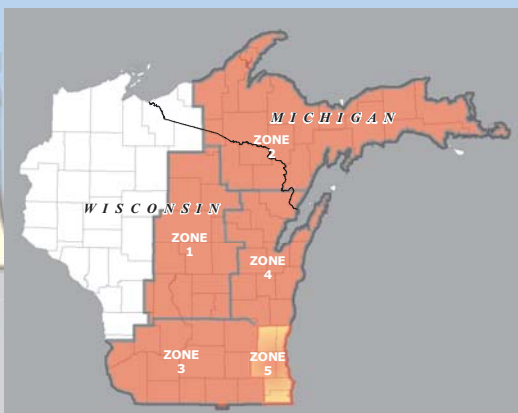
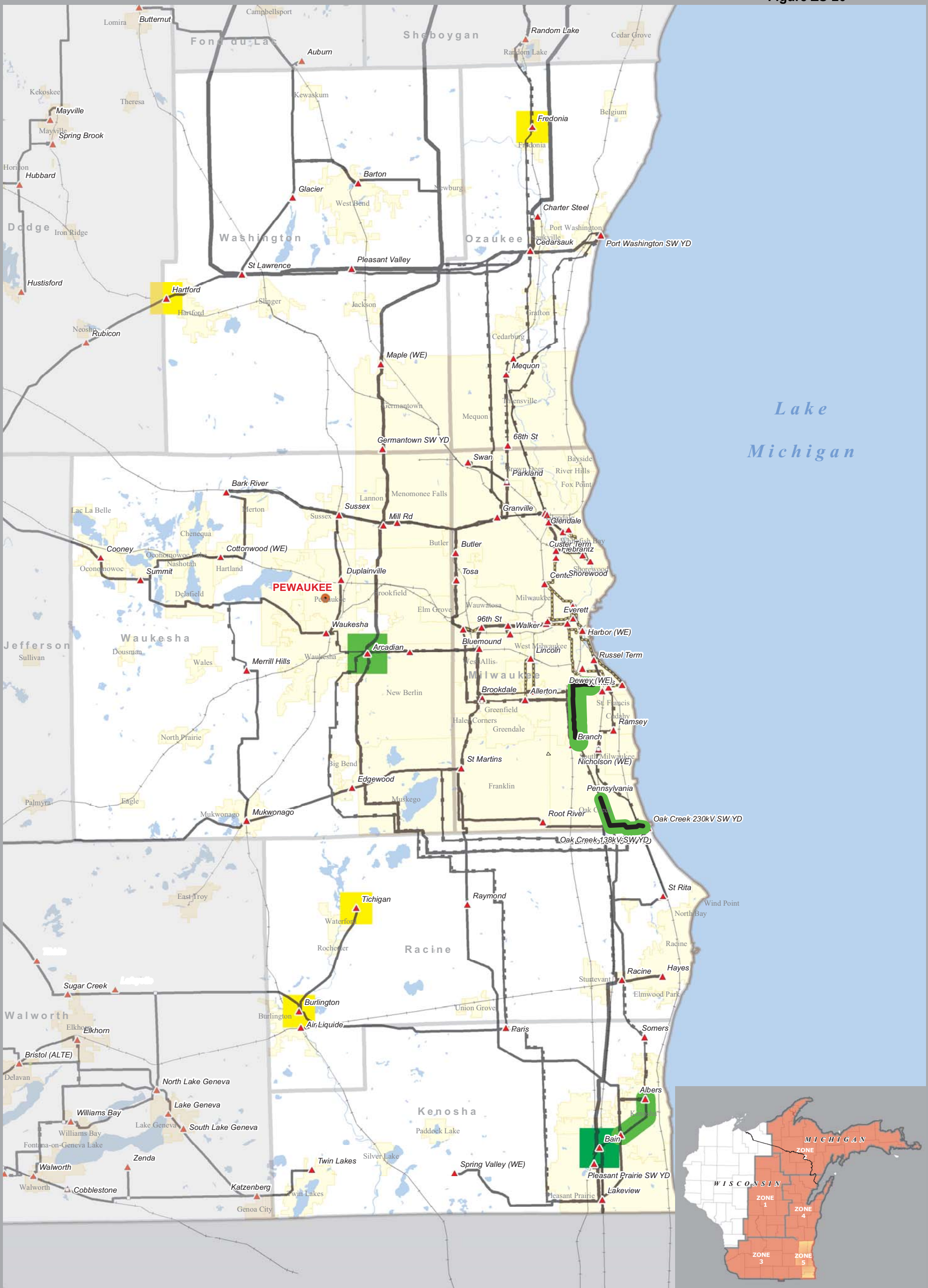
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 \* Approximately 8900 miles of transmission lines  
 \* 98 wholly owned substations  
 \* 358 jointly owned substations  
 \* Offices in Madison (2), Cottage Grove, Pewaukee, De Pere, Wausau and Kingsford, MI

- |  |  |   |  |   |
|--|--|---|--|---|
| <span style="display:inline-block; width:15px; height:15px; background-color:yellow; border:1px solid black;"></span> Low Voltages           | <span style="display:inline-block; width:15px; height:15px; background-color:green; border:1px solid black;"></span> Overloaded Facility         | <span style="display:inline-block; width:15px; height:15px; background-color:orange; border:1px solid black;"></span> Transmission Needed for Load Growth | <span style="display:inline-block; width:15px; height:15px; background-color:yellow; border:1px solid black;"></span> Proposed/Design/Construction | <span style="display:inline-block; width:15px; height:15px; background-color:orange; border:1px solid black;"></span> ATC Office Location |
| <span style="display:inline-block; width:15px; height:15px; background-color:blue; border:1px solid black;"></span> New Generation/Stability | <span style="display:inline-block; width:15px; height:15px; background-color:blue; border:1px solid black;"></span> Transmission Service Limiter | <span style="display:inline-block; width:15px; height:15px; background-color:orange; border:1px solid black;"></span> Substation, Switchyard or Terminal  | <span style="display:inline-block; width:15px; height:15px; background-color:orange; border:1px solid black;"></span> Generation                   | <span style="display:inline-block; width:15px; height:15px; background-color:orange; border:1px solid black;"></span> Other Facility      |

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-20

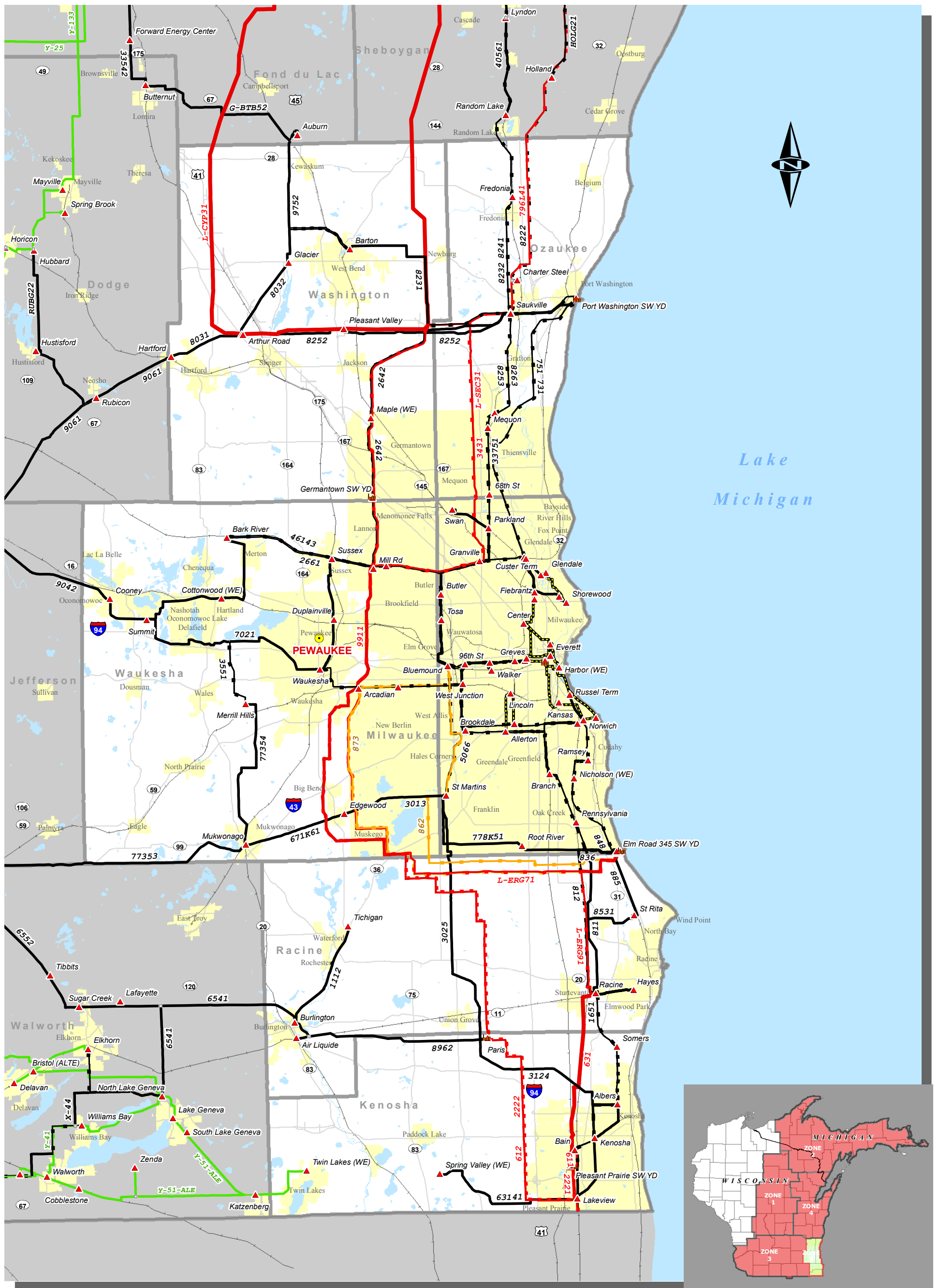


Performance Criteria Limits Exceeded and Other Constraints 2019-2023  
**PLANNING ZONE 5**

Currently, ATC owns or operates transmission facilities in 50 Wisconsin counties and in 15 Michigan counties. Facilities include:  
 \* Approximately 8900 miles of transmission lines  
 \* 98 wholly owned substations  
 \* 358 jointly owned substations  
 \* Offices in Madison (2), Cottage Grove, Pewaukee, De Pere, Wausau and Kingsford, MI

- |                                     |                                    |                              |                     |
|-------------------------------------|------------------------------------|------------------------------|---------------------|
| Low Voltages                        | Substation, Switchyard or Terminal | Proposed/Design/Construction | ATC Office Location |
| Overloaded Facility                 | New Generation/Stability           | Generation                   | Other Facility      |
| Transmission Needed for Load Growth | Transmission Service Limiter       |                              |                     |

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.



Electric Transmission Network and Substations  
**PLANNING ZONE 5**



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, MI

Transmission Line Voltage		
69 kV	69 kV Double Circuit	69 kV Underground
115 kV	115 kV Double Circuit	138 kV Underground
138 kV	138 kV Double Circuit	Non-ATC Line
230 kV	230 kV Double Circuit	
345 kV	345 kV Double Circuit	

Transmission Related Facilities	
▲ Substation or Switchyard	● ATC Office Location
■ Tap or Switching Structure	■ Generation

The information presented in this map document represent the most current and accurate georeferenced compilation of ATC owned and operated transmission facilities. Please direct any revisions or corrections to ATC Real Estate/GIS Services.

Base Map Information: ATC, PSCW, MIDNR, WDNR



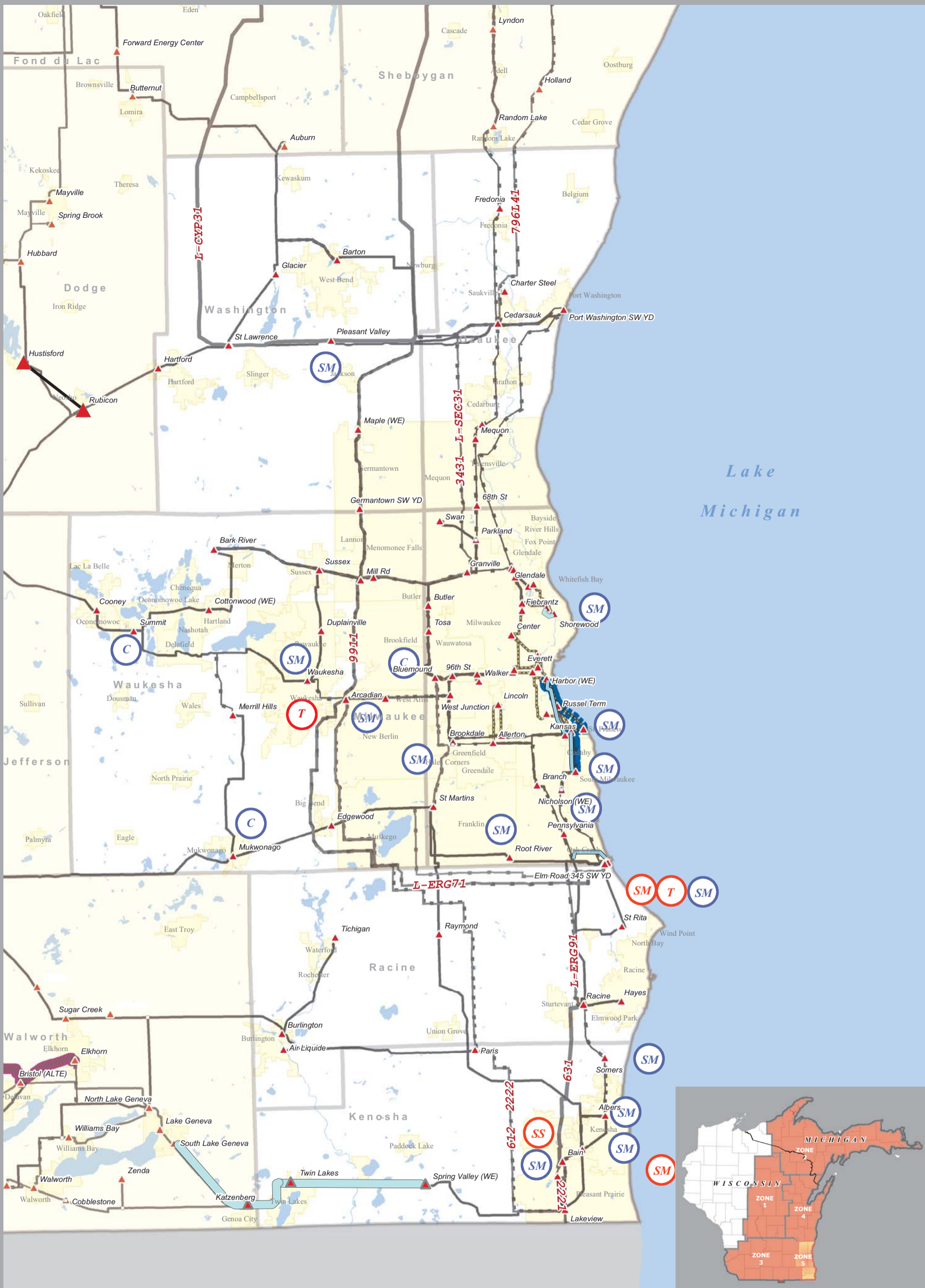
Table PR-18  
Zone 5 Transmission System Additions

<b>System Additions</b>	<b>System Need Year</b>	<b>Projected In-Service Year</b>	<b>Planning Zone</b>	<b>Need Category</b>	<b>Planned, Proposed or Provisional</b>
Replace relaying on 230-kV circuits at Oak Creek	2009	2009	5	new generation	Planned
Replace two 345-kV circuit breakers at Pleasant Prairie Substation on the Racine and Zion lines with IPO breakers and upgrade relaying	2009	2009	5	new generation	Planned
Reconductor Oak Creek-Allerton 138-kV line	2009	2009	5	new generation	Planned
Install second 500 MVA 345/138-kV transformer at Oak Creek Substation	2009	2009	5	new generation	Planned
Loop Ramsey5-Harbor 138-kV line into Norwich and Kansas to form a new line from Ramsey-Norwich and Harbor-Kansas 138-kV lines	2009	2009	5	new generation	Planned
Replace CTs at Racine 345-kV Substation	2009	2009	5	new generation	Planned
Reconductor Oak Creek-Ramsey 138-kV line	2009	2009	5	new generation	Planned
Construct a 138-kV bus at Pleasant Valley Substation to permit second distribution transformer interconnection	2009	2009	5	T-D interconnection	Proposed
Construct a 138-kV bus at Hale Substation to permit third Brookdale distribution transformer interconnection	2009	2009	5	T-D interconnection	Proposed
Expand Oak Creek 345-kV switchyard to interconnect one new generator	2009	2009	5	new generation	Planned
Construct 138-kV bus section at Shorewood	2009	2009	5	T-D interconnection	Provisional
Install 2-32 MVAR capacitor banks at Summit 138-kV Substation	2009	2010	5	reliability	Proposed
Uprate Arcadian-Waukesha 138-kV lines KK9942/KK9962	2010	2010	5	reliability	Proposed
Expand 345-kV switchyard at Oak Creek to interconnect one new generator	2010	2010	5	new generation	Planned
Uprate Oak Creek-Root River 138-kV line	2010	2010	5	new generation	Planned
Uprate Oak Creek-Nicholson 138-kV line	2010	2010	5	new generation	Planned
Install 200 MVAR capacitor bank at Bluemound Substation	2010	2010	5	reliability	Proposed
Upgrade Bain-Albers 138-kV line	2010	2010	5	reliability	Provisional
Replace two existing 345/138-kV transformers at Arcadian Substation with 1-500 MVA transformer	2010	2011	5	reliability	Provisional

Table PR-18 (continued)  
Zone 5 Transmission System Additions

System Additions	System Need Year	Projected In-Service Year	Planning Zone	Need Category	Planned, Proposed or Provisional
A second distribution transformer at Somers Substation requires a rebuild of the Racine-Somers-Albers 138-kV line; extend Albers 138-kV bus to permit connecting the Racine-Somers-Albers radial line to the Albers 138-kV bus	2011	2011	5	T-D interconnection	Provisional
Construct second Shorewood-Humboldt 138-kV underground cable	2012	2012	5	reliability	Proposed
Upgrade Bain-Kenosha 138-kV line	2013	2013	5	reliability	Provisional
Construct a 345-kV bus at Bain Substation	2008	2014	5	reliability	Provisional
Install 2-32 Mvar capacitor banks at Mukwonago 138-kV Substation	2014	2014	5	reliability	Provisional
Upgrade Oak Creek-Pennsylvania 138-kV line	2014	2014	5	reliability	Provisional
Construct Spring Valley-Twin Lakes-South Lake Geneva 138-kV line	2018	2018	3 & 5	T-D interconnection, reliability	Provisional
Reconductor Ramsey-Harbor 138-kV line	TBD	TBD	5	reliability	Provisional

Figure PR-5



- SS** New Substation
- SM** Substation Modifications
- T** Transformer
- C** Capacitor Bank
- T-D** New T-D Interconnection
- R** Series Reactor

**Transmission System Additions (May be Planned, Proposed or Provisional)**  
**PLANNING ZONE 5**

- 345 kV Transmission Line
- ▬▬▬▬ 115 or 138 kV Transmission Line
- ▬▬▬▬ Rebuilt 115 or 138 kV Transmission Line
- ▬▬▬▬ Transmission Line Voltage Conversion

**Transmission Related Facilities**

- ▲ Substation, Switchyard or Terminal
- Proposed/Design/Construction
- ATC Office Location
- Generation
- Other Facility