



## Zones & study results

### 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-21.

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.

### Zone 5 demographics

The population of the counties in Zone 5 grew at an annual rate of 0.3 percent from 1995 to 2005. The highest growth rate occurred in Washington County (1.4 percent), while the largest increase in population occurred in Waukesha County, which increased by about 41,400 people over the period.

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

### Zone 5 future population and employment projections

Population in Zone 5 grew at 0.4 percent annually between 2001 and 2006 and is projected to grow at 0.6 percent from 2006 through 2011. From 2001 to 2006, Waukesha County realized the largest increase in population, while Washington County had the highest growth rate.

Employment in Zone 5 grew at 0.5 percent annually between 2001 and 2006 and is projected to grow at 1.2 percent from 2006 through 2011. From 2001 to 2006, Waukesha County realized the largest increase in employment and had the highest growth rate.



## 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 2007, 2011 and 2015 are shown in Table ZS-11. 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 1.6 percent annually from 2007 through 2015. 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 and Racine 345/138-kV substations,
- ❑ the transmission lines emanating from the Pleasant Prairie and Oak Creek power plants and
- ❑ 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,
- ❑ 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.

## Zone 5 – 2007 study results

Refer to Table ZS-1 and Figure ZS-13

### *Summary of key findings*

- Many of the line loading and low voltage issues in Zone 5 are a result of opening substation bus tie breakers.

Two-27 MVAR capacitor banks were installed at the Burlington 138-kV Substation prior to June 2006.

Two of the facility overloads found in the 2007 analysis were caused by bus-tie circuit breaker operations.

- Splitting the Pleasant Prairie 345-kV bus between bus sections three and four results in Pleasant Prairie generator #2 being isolated on the Bain 345/138-kV transformer #5. The transformer exceeds its nameplate rating by 61 percent. The transformer has a long-term emergency rating of 382 MVA. The occurrence of this contingency will require Pleasant Prairie generator #2 to reduce its output significantly to avoid overloading and damaging the transformer. Bus and bus tie outages are considered low probability events.
- The Saukville-Pleasant Valley 138-kV line overloads by 23 percent when the Concord 138-kV bus is split between bus sections 4 and 5. While a bus outage is a low probability event, the Saukville-Pleasant Valley-Arthur Road-St. Lawrence 138-kV line will be rebuilt prior to the summer of 2008 in order to accommodate the second 600-MW block of generation at the Port Washington Power Plant. The condition of the St. Lawrence-Arthur Road-Pleasant Valley-Saukville 138-kV line warrants replacement of the structures as well as the conductor.
- The Concord-Cooney 138-kV line overloads by 1.6 percent when the Concord 138-kV bus is split between sections 4 and 5. A bus outage is a low probability event. The Concord-Cooney 138-kV line is expected to be uprated in 2007 from 287 MVA to 345 MVA.
- The Oak Creek 345/230-kV transformer T884 overloads by up to 8 percent for three different Oak Creek 230-kV bus outages. Reducing output of Oak Creek generator #8 will reduce the loading on T884. An outage of a bus is viewed as low probability event.



## Zone 5 – 2011 study results

Refer to [Table ZS-2](#) and [Figure ZS-14](#)

### *Summary of key findings*

- ❑ New generation in the greater Milwaukee area will drive many system improvements in Zone 5 within the next decade.
- ❑ Low 138-kV bus voltages occur in western Waukesha and Racine counties under contingency conditions.

### *Discussion of contingency analysis*

Many of the line loading and bus voltage issues found in the 2011 analysis are borderline and do not warrant solutions at this time. However, they will continue to be monitored in future studies.

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.

The 138-kV bus voltage at Tichigan Substation drops to 91 percent for a bus outage at Burlington Substation. A bus outage is a low probability event.

The 138-kV bus voltage at Cottonwood Substation drops to 91 percent for an outage of the Bark River – Cottonwood 138-kV line.

The 138-kV bus voltage at Cooney and Summit substations drops to 91 and 92 percent respectively for an outage of the Concord – Cooney 138-kV line.

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. Line conductor clearances can be increased to permit higher flows under contingency conditions.

An outage of the existing Oak Creek 345/138-kV transformer T88 results in the second Oak Creek 345/138-kV transformer loading up to 96 percent of its nameplate rating.

An outage of the Arcadian 345/138-kV transformer T1 causes the Arcadian 345/138-kV transformer T3 to overload by 10 percent. Generation redispatch at Concord and Germantown substations provides relief.



### *Major projects expected between 2007 and 2011*

Port Washington generation: A 600-MW block of combined-cycle generation was built at Port Washington Power Plant in 2005. A second 600-MW block of combined cycle generation will be installed and in service by 2008. The second phase of generation at Port Washington Power Plant requires the St. Lawrence-Arthur Road-Pleasant Valley-Saukville 138-kV line be uprated. Line condition and capacity will result in the line being rebuilt with T2 Hawk conductor.

Oak Creek generation: We Energies has received PSCW approval to build two 650-MW coal powered generators at Oak Creek Power Plant. The units are scheduled to go into service in 2009 and 2010.

### *Projects whose "Need date" precedes the "In-service" date:*

Bain 345-kV bus: Construction of a 345-kV bus at Bain Substation was listed as a 2007 provisional project, with a 2005 system need date in the 2005 10-Year Assessment Update. The main driver for this project appears to be a 345-kV bus outage at Pleasant Prairie Substation. Bus outages are considered low probability events. Further analysis is required to determine if justification other than a bus outage can be found.

Bluemound capacitor banks: Additional reactive sources are required in the greater Milwaukee area. A project to install capacitors at Bluemound Substation has appeared in recent 10-Year Assessments. The need year is listed as 2007. The project is listed as provisional. Vars are needed in various areas in the greater Milwaukee area. A comprehensive study needs to be performed to find the most effective locations for capacitor installations. Bluemound Substation is one of several locations under consideration. In addition, new generation in the 2009 and beyond time frame reduces the potential need to add reactive power resources.

### *Accelerated projects*

Racine current transformers – This project involves replacing 345-kV, 1200A current transformers (CTs) with CTs rated at 2000A. Past analysis found that the CTs would limit line flows in 2013. Recent studies found they would limit flow on the Racine – Oak Creek 345-kV line beginning in 2009. The CTs are scheduled to be replaced by the summer of 2009.

### *Deferred projects*

The following deferred projects were discussed in the 2005 10-Year Assessment Update.

- ❑ Rockdale – Mill Road 345-kV line
- ❑ Cornell – Rangeline 138-kV line
- ❑ Installation of a series reactor at Cornell Substation

The Rockdale-Concord–Bark River–Mill Road 345-kV project was to be built in stages. The entire project was scheduled to be completed and in service by 2011. With recent changes



in area loads, the availability of generation at Concord, and the impact of MISO Day 2, this project can be delayed until 2018 unless other issues appear. The analysis performed as part of the 2006 10-Year Assessment found this is still valid.

The Cornell – Rangeline 138-kV underground line was scheduled to be rebuilt by 2008 as part of the Port Washington phase 2 generation project. In recent years, there have been occasional large power flows through the Cornell/Center area. To provide relief, System Operators will open a circuit breaker at Cornell Substation on the Cornell - Fiebrantz – Center 138-kV line. With the system configured in this manner, the Cornell – Rangeline 138-kV line is not expected to overload with 1200 MW of generation online at Port Washington Power Plant in 2008. As a result, this project has been deferred until the 2014 timeframe unless other issues appear. The analysis performed as part of the 2006 10-Year Assessment did not find any reason to move this project up in time.

The installation of a reactor is being considered at Cornell Substation to control power flowing on the Cornell – Fiebrantz – Center 138-kV underground line. The reactor was originally scheduled to be installed in 2007. Further studies have indicated it can be delayed until June 1, 2008. The project remains a proposed project in the 2006 10-Year Assessment.

## **Zone 5 – 2015 study results**

Refer to [Table ZS-3](#) and [Figure ZS-15](#)

### *Summary of key findings*

- The addition of generation at Oak Creek Power Plant and the associated transmission strengthened the transmission system in the eastern portion of Zone 5.
- Voltage issues remain in western zone 5 under contingency conditions.

We Energies is proposing the installation of a third block of generation at Oak Creek Power Plant in 2013. The proposed third phase of generation has not been approved yet by the Public Service Commission of Wisconsin. However, the proposed Oak Creek generation met the criteria to be included in our 2015 planning model. Therefore, the 2015 analysis included all transmission requirements associated with the third phase of the Oak Creek generation project. Following is the list of system additions and modifications required for each of the three phases.

### 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



- reconductor the underground segment of the Ramsey-Harbor 138-kV line; this project has been revised to 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 two 345-kV circuit breakers at Pleasant Prairie Substation on the Racine and Zion lines with IPO breakers and upgrade relaying
- 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
- uprate Kansas-Ramsey 138-kV line
- 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

### 2013 - Oak Creek generation Phase 3

- Construct a second Pleasant Prairie – Zion 345-kV line on a separate right-of-way. This is new to this 10-Year Assessment and replaces the previous project which involved looping the Zion-Arcadian 345-kV line into Pleasant Prairie Substation.
- expand the Oak Creek 345-kV switchyard to interconnect the third 650-MW block of generation
- construct an Oak Creek-Hale-Granville 345-kV line using new right-of-way and/or converting/reconducting existing lines for use at 345 kV
- construct an Oak Creek-St. Martins 138-kV circuit
- restring the Bluemound-Butler 138-kV line on new 345-kV structures installed with the Hale-Granville line
- construct a Butler-Tamarack 138-kV line on new 345-kV structures installed with Hale-Granville line
- construct a 345/138-kV switchyard at Hale (Brookdale) Substation to accommodate two 345-kV lines and a 345/138-kV transformer

### *Discussion of contingency analysis*

A fault on the Granville 345-kV bus section 3 causes the Granville – Cedarsauk 345-kV line and Granville 345/138-kV transformer #3 to be removed from service. As a result, Granville transformer #1 loads to 96 percent of its summer emergency rating. Bus outages are considered low probability events. This contingency could also be the result of a fault on Granville transformer #3. In this case, the high side circuit switcher associated with transformer #3 would be opened and the Granville 345-kV bus would be reestablished. This would result in the loading on Granville transformer #1 being reduced.



# 10-Year Assessment

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

# 2006

**November 2006 10-Year Assessment**  
**[www.atc10yearplan.com](http://www.atc10yearplan.com)**

An outage of the Bain – Kenosha 138-kV line causes the Albers – Bain 138-kV line to load to 111 percent of its emergency rating. The limiting elements are bus jumpers at Bain Substation and the line conductor clearances.

Splitting the Oak Creek 230-kV bus between bus sections 7 and 8 results in Oak Creek 345/230-kV transformer T884 loading to its nameplate rating. Reducing the output of Oak Creek generator #8 will reduce the loading on the transformer.

Splitting the Burlington 138-kV bus results in the Tichigan 138-kV bus voltage dropping to 89 percent. Bus outages are low probability events.

An outage of the Whitewater – Walworth – Mukwonago 138-kV line causes the Edgewood – St. Martins 138-kV line to overload by 9 percent.

An outage of the Concord – Cooney 138-kV line causes the 138-kV bus voltage to drop below 91 percent at Cooney and Summit substations.

An outage of the Edgewood – St. Martins 138-kV line caused low bus voltages at Mukwonago (91 percent) and Edgewood (90 percent) substations.

An outage of either of the Arcadian – Waukesha 138-kV lines (KK9962 and KK9942) results in the other Arcadian – Waukesha 138-kV line overloading by 20 percent. The limiting element is the line conductor with clearances set for operation at 200 degrees.

An outage of the existing Oak Creek 345/138-kV transformer T88 results in the second Oak Creek 345/138-kV transformer loading up to 98 percent of its nameplate rating.

An outage of the Arcadian 345/138-kV transformer T1 causes Arcadian 345/138-kV transformer T3 to overload by 11 percent.

An outage of the Merrill Hills – Waukesha 138-kV line causes low 138-kV bus voltage at Merrill Hills (91 percent) Substation.

An outage of the Bark River – Cottonwood 138-kV line causes low voltages at Cooney (89 percent), Cottonwood (87 percent), and Summit (89 percent) substations.

An outage of the Bark River – Sussex 138-kV line causes low voltage at Bark River, Cooney, Cottonwood and Summit (89-90 percent) substations.

An outage of the Maple – Saukville 138-kV line causes low voltage at Germantown (90 percent), and Maple (90 percent) substations.





# 10-Year Assessment

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

# 2006

**November 2006 10-Year Assessment**  
**[www.atc10yearplan.com](http://www.atc10yearplan.com)**

The installation of 138-kV capacitors in the Cottonwood/Summit area would improve the voltage profile in the area. The Rockdale – Mill Road 345-kV line is a project tentatively scheduled for construction in 2018. That project includes 345/138-kV transformers at Concord, Bark River, and Mill Road substations. The line and associated transformers will also improve the bus voltages in western zones as well as in the eastern portion of zone 3.

**TABLE ZS-1  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2007 Peak and Hot Summer Case**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause	% of Facility Rating Hot Summer Case	% of Nominal Bus Voltage Hot Summer Case
1	Antigo, Aurora Street and Summit Lake 115-kV bus voltages		89 – 92%	Gardner Park-Blackbrook-Antigo 115-kV line outage		88 – 92%
1	Weston-Sherman Street 115-kV line	102%		Weston-Morrison 115-kV line outage	105%	
1	Weston-Morrison 115-kV line	104%		Weston-Sherman Street 115-kV line outage	107%	
1	Morrison-Sherman Street 115-kV line	112%		Weston-Sherman Street 115-kV line outage	115%	
1	Sigel, Lakehead Vesper & Port Edwards 138-kV bus voltages		87 – 91%	Arpin-Sigel 138-kV line outage Sigel-Lakehead Vesper 138-kV line outage Lkhd Vesper-Port Edwards 138-kV line outage		85 – 90%
1	Port Edwards, Hollywood, & Saratoga 138-kV bus voltages		88 – 92%	Arpin-Sigel 138-kV line outage Sigel-Lakehead Vesper 138-kV line outage Lkhd Vesper-Port Edwards 138-kV line outage		86 – 92%
1	Castle Rock – Quincy 69-kV line	95 - 102%		Various line outages	95 – 107%	
1	Council Creek 69-kV bus tie	97 – 100%		King-Eau Claire-Arpin 345-kV line outage Eau Claire-Arpin 345-kV line outage Hillsboro-Hillsboro tap 69-kV line outage	98 – 102%	
1	Council Creek and Petenwell 138-kV bus voltage		90 – 96%	Base Case Arpin-Sigel 138-kV line outage Sigel-Lakehead Vesper 138-kV line outage		91%
1	Necedah, Whistling Wings, Dellwood, Friendship, Houghton Rock 69-kV bus voltages		89 – 91%	Petenwell 138/69-kV transformer Petenwell-Big Pond 69-kV line outage Big Pond-Necedah tap 69-kV line outage		88 – 92%
1	Wautoma, Sand Lake and Roeder 138-kV bus voltages		88 – 95%	Base Case Various line outages		86 – 92%
1	Metomen 138/69-kV transformer	97 – 102%		North Fond Du Lac-Rosendale 69-kV line outage Rosendale-Metomen 69-kV line outage	96 – 107%	
1	Metomen-Ripon 69-kV line	98%		Winneconne-Sunset Point 69-kV line outage	97 – 104%	
1	NW Ripon - Ripon 69-kV line	96%		Winneconne-Sunset Point 69-kV line outage	102%	
1	Metomen-Rosendale 69-kV line	96%		Metomen 138/69-kV transformer outage	102%	
1	North Fond du Lac-Rosendale 69-kV line	105%		Metomen 138/69-kV transformer outage	112%	
1	Berlin area 69-kV bus voltages		88 – 92%	Various line outages		85 – 92%
1	Deer Trail-Polar Tap 69-kV line	98%		Gardner Pk-Blackbrook-Antigo 115 kV outage	96 – 102%	
1	Portage – Lakehead Portage 69-kV line	95 – 101%		Various line outages	95 – 107%	
1	Roslin, Endeavor and Lakehead Portage 69-kV bus voltages		84 – 91%	Portage-Lakehead Portage 69-kV line outage		84 – 92%
1	Coloma (ACEC) 69-kV bus voltage		91%	Chaifee Creek-Coloma tap 69-kV line outage		90%
1	Roslin – Lakehead Portage 69-kV line	-		Various line outages	98 – 100%	
1	Mckenna – Quincy 69-kV line	-		Winnebago-Quincy 69-kV line outage	98%	
1	Bunker Hill – Blackbrook 115-kV line	-		Gardner Park-Blackbrook 115-kV line outage	95%	
1	Wild Rose and Wild Rose (ACEC) 69-kV bus voltages		-	Harrison 138/69-kV transformer outage		91 – 92%
1	Hancock, Hancock (ACEC), Plainfield, Plainfield (ACEC), Coloma 69-kV bus voltages		-	Sand Lake 138/69-kV transformer outage		89 – 90%
1	Wisconsin Dells #2, Lyndon Station 69-kV bus voltages		-	Kilbourn-Wisc Dells #2 69-kV line outage		91 – 92%
1	Winnebago, Glen 69-kV bus voltages		-	Kilbourn-Winnebago 69-kV line outage		91 – 92%
2	Atlantic-Elevation Tap #1 69-kV	113%		Atlantic-Elevation Tap #1 69-kV line outage	119%	
2	Sawyer, Gwinn 69-kV bus voltages		89-91%	Forsyth-Gwinn 69-kV line outage		88-90%
2	Bruce Crossing, Watersmeet 69-kV bus voltages		90-91%	Mass-Bruce Crossing 69-kV line outage		88-89%
2	L'Anse, Baraga, M-38 69-kV bus voltages		89-91%	M-38 138/69-kV transformer outage		89-91%
2	Munising 69-kV bus voltage		91%	Munising 138/69-kV transformer, Munising-Forsyth 138-kV line outage		91%

**TABLE ZS-1  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2007 Peak and Hot Summer Case (continued)**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause	% of Facility Rating Hot Summer Case	% of Nominal Bus Voltage Hot Summer Case
2	L'Anse and Baraga 69-kV bus voltages, M-38 and Atlantic 138-kV bus voltages		90-91%	M38-Perch Lake 138-kV line outage		
2	Hiawatha, Lakehead, Brevort 138-kV bus voltages		90%	Hiawatha-Lakehead 138-kV line outage, Lakehead-Brevort 138-kV line outage, Brevort-Straits 138-kV line outage		89%
2	Engadine, Newberry Village, Newberry Hospital, Louisiana Pacific and Roberts 69-kV bus voltages		89-91%	Engadine-Hiawatha 69-kV line outage		87-88%
2	St. Ignace and Straits 69-kV bus voltages		91%	Straits 138-69-kV transformer		89-90%
3	Rock River 138/69-kV transformer	109%		Colley Road-Brick Church 138-kV line outage Op Guide, Colley Road-Brick Church 138-kV line outage, Black Hawk-Colt Industries 69-kV line outage.	111%	
3	Rock River-Turtle 69-kV line	128%		Colley Road-Brick Church 138-kV line outage Op Guide, Colley Road-Brick Church 138-kV line outage	131%	
3	Colley Road-Brick Church 69-kV line	111%		Colley Road-Brick Church 138-kV line outage	115%	
3	Paddock-Shirland Ave 69-kV line	104%		Colley Road 138/69-kV transformer outage	108%	
3	Colley Road-Park Ave Tap 69-kV line	110%		Paddock 138/69-kV transformer outage	116%	
3	Colley Road 138/69-kV transformer	96%		Paddock 138/69-kV transformer outage	100%	
3	North Lake Geneva-Lake Geneva 69-kV line	109%		Brick Church-Cobblestone 69-kV line outage	114%	
3	Brick Church-Cobblestone 69-kV line	114%		North Lake Geneva-Lake Geneva 69-kV line outage	119%	
3	Janesville-Parkview 69-kV line	113%		McCue 138/69-kV transformer outage	120%	
3	Royster-Pflaum 69-kV line	104%		Fitchburg-Syene 69-kV line outage	109%	
3	Blount-Ruskin 69-kV line	106%		Second Blount-Ruskin 69-kV line outage	119%	
3	Fitchburg-Syene 69-kV line	111%		Royster-Pflaum Tap 69-kV line outage	117%	
3	Stage Coach-Black Earth 69-kV line	102%		Spring Green 138/69-kV transformer outage	109%	
3	Verona-Oregon 69-kV line	121%		Stoughton-Aaker Road 69-kV line outage, Stoughton-Sheepskin 69-kV line outage	131%	
3	North Monroe-Monticello 69-kV line	95%		Stoughton-Aaker Road 69-kV line outage	99%	
3	Brodhead-Blacksmith 69-kV line	111%		North Monroe 138/69-kV transformer outage, Town line Road-Albany 138-kV line outage, Albany-North Monroe 138-kV line outage	116%	
3	Hillman-Belmont 69-kV line	97%		Nelson Dewey-Lancaster 138-kV line outage	97%	
3	Hillman 138/69-kV transformer	115%		Various DPC 69-kV line outages	121%	
3	Darlington-Rock Branch 69-kV line	97%		Nelson Dewey-Lancaster 138-kV line outage	98%	
3	Kilbourn 47 MVA 138/69-kV transformer	144%		Kilbourn 93 MVA 138/69-kV transformer outage	152%	
3	Portage-Columbia 69-kV line	113%		Portage 138/69-kV transformer outage	118%	
3	Columbia 138/69-kV transformer	105%		Portage 138/69-kV transformer outage, North Madison 138/69-kV transformer outage	109%	
3	Portage-Trienda 138-kV line	98%		Second Portage-Trienda 138-kV line outage	104%	
3	Columbia 345/138-kV transformer #2	98%		Columbia 345/138-kV transformer #1 and #3 outage	103%	
3	Academy-Columbus 69-kV line	110%		North Randolph-Fox Lake 138-kV line outage, Fox Lake-North Beaver Dam 138-kV line outage,	117%	
3	Concord-Cooney 138-kV line	102%		Concord 138-kV bus 4-5 outage	111%	
3	Cobblestone-Zenda Tap 69-kV line			North Lake Geneva-Lake Geneva 69-kV line outage	98%	
3	North Monroe-Monticello 69-kV line			Stoughton-Sheepskin 69-kV line outage	95%	
3	Black Hawk 138/69-kV transformer			Rock River 138/69-kV transformer outage	96%	

TABLE ZS-1

## PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2007 Peak and Hot Summer Case (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause	% of Facility Rating Hot Summer Case	% of Nominal Bus Voltage Hot Summer Case
3	Janesville 138/69-kV transformer			McCue 138/69-kV transformer outage	96%	
3	McCue-Harmony 69-kV line			Sheepskin-Sheepskin Peak Unit 69-kV line outage, Paddock-Newark 69-kV line outage, Brodhead Switching Station-Brodhead Muni 3 69-kV line outage	98%	
3	Columbia 138/69-kV transformer			DeForest-North Madison 69-kV line outage	96%	
3	Pheasant Branch-Westport 69-kV line			West Middleton-Pheasant Branch 69-kV line outage	98%	
3	Town Line-Albany 138-kV line			Nelson Dewey-Potosi 138-kV line outage, Potosi-Hillman 138-kV line outage	97%	
3	Portage-Columbia 138-kV line			Second Portage-Columbia 138-kV line outage	95%	
3	Both of the Blount-Ruskin 69-kV lines			North Madison 138/69-kV transformer outage, North Madison-Dane 69-kV line outage	98%	
3	Concord-Cooney 138-kV line			Concord-Rubicon 138-kV line outage	97%	
3	Syene-Nine Springs 69-kV line			Royster-Pflaum Tap 69-kV line outage	99%	
3	Koch Oil Tap-South Fond Du Lac 69-kV line			North Randolph-Fox Lake 138-kV line outage	98%	
3	Lake Geneva, South Lake Geneva, Twin Lake, Katzenberg 69-kV bus voltages		88-90%	North Lake Geneva-Lake Geneva 69-kV line outage		88-91%
3	Brodhead Muni 3, Brodhead Muni 2, Brodhead, Brodhead Muni 1, RCEC Orfordville 69-kV bus voltages			Brodhead Switching Station-Brodhead Muni 3 69-kV line outage, Brodhead Muni 3-Brodhead Muni 2 69-kV line outage		92%
3	Evansville, RCEC center 69-kV bus voltages		90-92%	Evansville-Sheepskin 69-kV line outage		89-91%
3	North Monroe, Idle Hour, Monroe, Monroe Tap, South Monroe, Monticello, Monticello Tap, New Glarus, Belleville, Blacksmith, Browntown, Verona, Oregon, Green Wind 69-kV bus voltages		85-92%	North Monroe 138/69-kV transformer, North Monroe-Idle Hour 69-kV line outage, Idle Hour-Monroe 69-kV line outage		83-90%
3	Monticello, Monticello Tap, New Glarus, Belleville, Verona, Oregon, Brooklyn 69-kV bus voltages		83-91%	North Monroe-Monticello Tap 69-kV line outage, Monticello Tap-New Glarus 69-kV line outage, New Glarus-Belleville 69-kV line outage		81-90%
3	Pine River, Richland Center, Richland, Lone Rock 69-kV bus voltages		91-92%	Pine River-Richland 69-kV line outage, Lone Rock 69 Rock-Richland 69-kV line outage, Lone Rock 69 kV phase shifter outage		90-91%
3	Spring Green 69-kV bus voltage		92%	Spring Green 138/69-kV transformer outage		91%
3	Brooklyn, Oregon, Aaker Road, Verona, Belleville 69-kV bus voltages		83-90%	Stoughton-Aaker Road 69-kV line outage		80-90%
3	Brooklyn, Oregon 69-kV bus voltages		90%	Oregon-Aaker Road 69-kV line outage		88%
3	North Beaver Dam, Beaver Dam East 138-kV bus voltages		93%	Base case, various line outages		92%
3	North Beaver Dam, Beaver Dam East, Fox Lake, Cambridge, Cambridge Tap, London, Boxelder, Lakehead Waterloo, Stony Brook 138-kV bus voltages		89-91%	Boxelder to London 138-kV line outage, Rockdale to Cambridge Tap 138-kV line outage, Cambridge Tap to London 138-kV line outage		88-89%
3	Pflaum, Pflaum Tap, AGA Gas 69-kV bus voltages		91%	Royster-Pflaum Tap 69-kV line outage		90%
3	Concord 5 138-kV bus voltage		92%	Concord 138-kV bus 4-5 outage		89%
3	Dickinson, Brick Church, Williams Bay, Eikhorn 138-kV bus voltages		90-92%	Colley Road-Brick Church 138-kV line outage		89-91%
3	North Lake Geneva 138-kV bus voltage		92%	North Lake Geneva-North Lake Geneva Tap 138-kV line outage		91%
3	Lewiston, Kilbourn, Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan 138-kV bus voltages		90-92%	Trienda-Lewiston 138-kV line outage		88-90%
3	Kilbourn, Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan 138-kV bus voltages		90-92%	Lewiston-Kilbourn 138-kV line outage		88-90%

**TABLE ZS-1  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2007 Peak and Hot Summer Case (continued)**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause	% of Facility Rating Hot Summer Case	% of Nominal Bus Voltage Hot Summer Case
3	North Beaver Dam, Beaver Dam East, Fox Lake 138-kV bus voltages		80%	North Randolph-Fox Lake 138-kV line outage, Fox Lake-North Beaver Dam 138-kV line outage		78%
3	Avoca, Muscoda, Lone Rock, Arena, Mazomanie, Mazomanie Industrial 69-kV bus voltages			Spring Green 138/69-kV transformer outage		92%
3	Burke 69-kV bus voltage			Reiner Road-Burke Tap 69-kV line outage, Reiner Road 138/69-kV transformer outage		91%
3	North Lake Geneva Tap, North Lake Geneva 138-kV bus voltages			Burlington 138-kV bus 1-2 outage		92%
3	Albany 138-kV bus voltage			Town Line-Albany 138-kV line outage		92%
3	Hustiford, Spring Brook, Mayville, Oakfield, Horicon Industrial Park 69-kV bus voltages			Oakfield-South Fond Du Lac 69-kV line outage		91-92%
3	Fox Lake 138-kV bus voltage			Base case		94%
3	Footville, Bass Creek 69-kV bus voltages			Evansville-Sheepskin 69-kV line outage		91-92%
3	Nine Springs 69-kV bus voltage			Royster-Pflaum Tap 69-kV line outage		92%
3	Third Street, Center Street, Alto 69-kV bus voltages			North Randolph-Fox Lake 138-kV line outage		91-92%
4	Pioneer-Sandstone 69-kV line	95.3%		Crivitz-High Falls 69-kV line outage	100%	
4	High Falls-Crivitz 69-kV line	<95%		Pioneer-Sandstone 69-kV line outage	95%	
4	Goodman 69-kV bus		92.6%	Base Case		93%
4	Mountain 69-kV bus		91%	Crivitz-High Falls 69-kV line outage		89%
4	Thunder, High Falls, Caldron Falls 69-kV buses		>92%	Crivitz-High Falls 69-kV line outage		91-92%
4	Woodenshoe, Mears Corners 138-kV buses		>92%	Crivitz-High Falls 69-kV line outage		91%
4	Ellington-Hintz 138-kV line	107.6%		Neevin-Woodenshoe 138-kV line outage	115%	
4	Hintz-Werner 138-kV line	105.9%		North Appleton-Werner West 345-kV line outage	113%	
4	Werner-Werner West 138-kV line	<95%		North Appleton-Werner West 345-kV line outage	99%	
5	Bain 345/138-kV transformer #5	161%		North Appleton-Werner West 345-kV line outage	164%	
5	Oak Creek 345/230-kV transformer T884	101-108%		Splitting Pleasant Prairie 345-kV bus sections 3 & 4	106-111%	
5	Pleasant Valley – Saukville 138-kV line	123%		Various Oak Creek 230-kV bus outages	98-133%	
5	Pleasant Valley – Arthur Road 138-kV line			Various outages	98%	
5	Cooney – Concord 138-kV line	102%		Splitting Concord 345-kV bus sections 3 & 4	107%	
5	St. Martins – Raymond 138-kV line			Pleasant Prairie – Racine 345-kV line	98%	
5	Germantown – Maple 138-kV line			Bark River - Germantown	101%	

**TABLE ZS-2  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2011 Peak, Hot Summer and Shoulder Cases**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause	% of Facility Rating Hot Summer Case	% of Nominal Bus Voltage Hot Summer Case	% of Facility Rating Shoulder Case	% of Nominal Bus Voltage Shoulder Case
1	Antigo, Aurora Street, Summit Lake, Venus, Three Lakes, Cranberry, St. Germain, Clear Lake, Highway 8, Hodag, Easton, Tomahawk and Pine 115-kV bus voltages		82 – 92%	Maine-Pine 115-kV line outage Blackbrook-Antigo 115-kV line outage Antigo-Aurora Street 115-kV line outage Gardner Park-Blackbrook-Antigo 115 kV outage Gardner Park-Blackbrook 115-kV line outage		80 – 92%		--
1	Bunker Hill – Blackbrook 115-kV line	108%		Maine-Pine 115-kV line outage	113%		--	
1	Gardner Park – Blackbrook 115-kV line	97 – 108%		Maine-Pine 115-kV line outage Maine-Hilltop 115-kV line outage	99 – 113%		--	
1	Kelly – Bunker Hill 115-kV line	95%		Maine-Pine 115-kV line outage	105%		--	
1	Highway 8 – Clear Lake 115-kV line	--		Three Lakes-Venus 115-kV line outage	98%		--	
1	Sigel, Lakehead Vesper and Port Edwards 138-kV bus voltages		89 – 90%	Arpin-Sigel 138-kV line outage		89 – 90%		91 – 92%
1	Port Edwards, Hollywood, and Saratoga 138-kV bus voltages		90 – 91%	Arpin-Sigel 138-kV line outage		90 – 91%		91 – 92%
1	Castle Rock – Quincy 69-kV line	98%		Petenwell 138/69-kV transformer outages Petenwell-Big Pond 69-kV line outage Necedah tap-Big Pond 69-kV line outage Hillsboro-Hillsboro tap 69-kV line outage	101%		96 – 107%	
1	Council Creek 69-kV bus tie	--		Base Case	96%		95 – 113%	--
1	Council Creek and Petenwell 138-kV bus voltage		90 – 95%	Arpin-Sigel 138-kV line outage Sigel-Lakehead Vesper 138-kV line outage Council Creek-Petenwell 138-kV line outage Petenwell-Saratoga 138-kV line outage		90 – 95%		--
1	Necedah, Whistling Wings, Dellwood, Friendship, Houghton Rock 69-kV bus voltages		89 – 92%	Petenwell 138/69-kV transformer Petenwell-Big Pond 69-kV line outage Big Pond-Necedah tap 69-kV line outage Necedah tap-Whistling Wings tap 69 kV outage		87 – 92%		91 – 92%
1	Hilltop, Lyndon Station, Wisconsin Dells 69-kV bus voltages		90 – 92%	Kilbourn-Wisc. Dells 69-kV line outage		89 – 91%		--
1	Wautoma, Sand Lake and Roeder 138-kV bus voltages		91 – 96%	Base Case		90 – 95%		--
1	Sand Lake 138/69-kV transformer	95 – 101%		Sigel-Arpin 138-kV line outage Wautoma 138/69-kV transformer outage Winnebago-Kilbourn 69-kV line outage Trienda-Lewiston 138-kV line outage E. Dells-Lewiston 138-kV line outage	95 – 107%		--	
1	Hancock, Hancock (ACEC), Plainfield and Plainfield (ACEC) 69-kV bus voltages		91 – 92%	Sand Lake 138/69-kV transformer outage		89 – 92%		--
1	Metomen 138/69-kV transformer	95 – 111%		Base Case	95 – 117%		--	
1	Metomen – Ripon 69-kV line	96 – 103%		Various line outages			--	
1	NW Ripon – Ripon 69-kV line	102%		Winneconne-Sunset Point 69-kV line outage	97 – 112%		--	
1	Winneconne – Sunset Point 69-kV line	95%		Omro-Winneconne 69-kV line outage Markesan tap-North Randolph 69-kV line outage			--	
1	Omro – Winneconne 69-kV line	--		Winneconne-Sunset Point 69-kV line outage NW Ripon - Ripon 69-kV line outage NW Ripon - Ripon 69-kV line outage	98 – 109% 102% 98%		--	
1	Berlin area 69-kV bus voltages		88 – 92%	Various line outages		85 – 92%		--
1	Roslin, Endeavor and Lakehead Portage 69-kV bus voltages		87 – 92%	Portage-Lakehead Portage 69-kV line outage Endeavor tap-Lkhd Portage 69-kV line outage Antigo-Blackbrook 115-kV line outage Whitcomb 115/69-kV transformer	97 – 112% 96%		--	--
1	Whitcomb 115/69-kV transformer	99%					--	
1	Caroline 115/69-kV transformer	--					--	
1	Deer Trail – Polar tap 69-kV line	98 – 105%		Gardner Park-Blackbrook-Antigo 115 kV outage Gardner Park-Blackbrook 115-kV line outage Blackbrook-Antigo 115-kV line outage	99 – 113%		--	

**TABLE ZS-2  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2011 Peak, Hot Summer and Shoulder Cases (continued)**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause	% of Facility Rating Hot Summer Case	% of Nominal Bus Voltage Hot Summer Case	% of Facility Rating Shoulder Case	% of Nominal Bus Voltage Shoulder Case
1	Brooks Corners – Deer Trail 69-kV line	--		Gardner Park-Blackbrook-Antigo 115 kV outage Gardner Park-Blackbrook 115-kV line outage Blackbrook-Antigo 115-kV line outage	95 –97%		--	
1	Coloma (ACEC), Lincoln Pumping Station, Brooks (ACEC) and Grand Marsh 69-kV bus voltages		90 – 92%	Chaffee Creek-Coloma tap 69-kV line outage		89 – 91%		90 – 91%
1	White Lake 138-kV bus voltage		91%	Werner West-White Lake 138-kV line outage		91%		--
1	Plover – Coyne 115-kV line	--		Rocky Run-Coyne 115 kV line outage	--		97%	
2	Indian Lake 138-kV bus voltage		95%	Intact System		94%		
2	Atlantic-Elevation Tap #1 69-kV	115%		Atlantic-Elevation Tap #1 69-kV line outage	122%			
2	Sawyer, Gwinn, Chatham, Forest Lake 69-kV bus voltages		--	Forsyth-Gwinn 69-kV line outage		84-91%		
2	Sawyer, Gwinn 69-kV bus voltages		87-88%	Forsyth-Gwinn 69-kV line outage		--		
2	Bruce Crossing, Watersmeet, Land O' Lakes, Conover, and Twin Lakes 69-kV bus voltages		--	Mass-Bruce Crossing 69-kV line outage		84-89%		
2	Bruce Crossing, Watersmeet, Land O Lakes, Conover 69-kV bus voltages		87-91%	Mass-Bruce Crossing 69-kV line outage		--		
2	L'Anse, Baraga, M-38 69-kV bus voltages		89-91%	M-38 138/69-kV transformer outage		88-90%		
2	Munising and Alger 69-kV bus voltages		91%	Munising 138/69-kV transformer, Munising-Forsyth 138-kV line outage		90-91%		
2	L'Anse 69-kV bus voltage and Atlantic 138-kV bus voltage		91%	M38-Perch Lake 138-kV line outage		--		
2	L'Anse and Baraga 69-kV bus voltages, and M38 and Atlantic 138-kV bus voltages		--	M38-Perch Lake 138-kV line outage		89-91%		
2	Hiawatha, Lakehead and Brevort 138-kV bus voltages		90%	Hiawatha-Lakehead 138-kV line outage, Lakehead-Brevort 138-kV line outage, Brevort-Straits 138-kV line outage		--		
2	Hiawatha, Lakehead, Brevort, and Indian Lake 138-kV bus voltages		--	Hiawatha-Lakehead 138-kV line outage, Lakehead-Brevort 138-kV line outage, Brevort-Straits 138-kV line outage		89-91%		
2	Engadine, Newberry Village, Newberry Hospital, Louisiana Pacific, Roberts, Hulbert, and Eckerman 69-kV bus voltages		--	Engadine-Hiawatha 69-kV line outage, Engadine-Newberry 69-kV line outage		85-90%		
2	Engadine, Newberry Village, Newberry Hospital, Louisiana Pacific, Roberts, Hulbert 69-kV bus voltages		88-91%	Engadine-Hiawatha 69-kV line outage, Engadine-Newberry 69-kV line outage		--		
2	St. Ignace, Straits, Evergreen, Michigan Limestone, Talentino, and Rockview 69-kV bus voltages		--	Straits 138-69-kV transformer		88-90%		
2	St. Ignace, Straits, Evergreen, Michigan Limestone 69-kV bus voltages		90-91%	Straits 138-69-kV transformer		--		
2	Keweenaw, Osceola, MTU, Henry St. 69-kV bus voltages			Atlantic 138/69-kV transformer outage, Atlantic-M38 138-kV line outage		89-91%		
2	Indian Lake 138-kV bus voltage			Plains-Arnold 138-kV line outage		91%		
3	Brodhead-Blacksmith 69-kV line	106%		North Monroe 138/69-kV transformer outage, Town line Road-Albany 138-kV line outage, Albany-North Monroe 138-kV line outage, North Monroe-Idle Hour 69-kV line outage	111.5%			
3	Brick Church-Cobblestone-Zenda Tap 69-kV line	139%		North Lake Geneva-Lake Geneva 69-kV line outage, Lake Geneva-South Lake Geneva 69-kV line outage	150%		98%	
3	Brick Church-North Lake Geneva 69-kV line	114%		North Lake Geneva 138/69-kV transformer outage	122%			
3	Hillman 138/69-kV transformer	126%		Various DPC 69-kV line outages	136%		98%	
3	Hillman-Beimont 69-kV line	96%		Nelson Dewey-Lancaster 138-kV line outage, Lancaster-Eden 138-kV line outage	107%		117%	
3	Darlington-Darlington North-Rock Branch 69-kV line	102%		Nelson Dewey-Lancaster 138-kV line outage, Lancaster-Eden 138-kV line outage	109%			
3	Colley Road-Park Ave Tap 69-kV line	103%		Paddock 138/69-kV transformer outage	102%			

**TABLE ZS-2  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2011 Peak, Hot Summer and Shoulder Cases (continued)**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause	% of Facility Rating Hot Summer Case	% of Nominal Bus Voltage Hot Summer Case	Rating Shoulder Case	% of Nominal Bus Voltage Shoulder Case
3	Paddock 138/69-kV transformer			Rockdale-Wempletown 345-kV line outage			106%	
3	Ruskin 1 and 2 bus tie			North Madison-Vienna 138-kV line outage, Vienna-Yahara River 138-kV line outage, American Center – Yahara River 138-kV line outage, American Center-Sycamore 138-kV line outage			110%	
3	Bio Enzyme Systems-RCEC Clinton-Clinton 69-kV line	98%		Brick Church 138/69-kV transformer outage	103%			
3	North Lake Geneva-Lake Geneva 69-kV line	110%		Brick Church-Cobblestone 69-kV line outage	117%			
3	Janesville-Parkview 69-kV line	122%		McCue 138/69-kV transformer outage	126%		109%	
3	Janesville 138/69-kV transformer	97%		McCue 138/69-kV transformer outage	102%			
3	McCue-Milton Lawns 69-kV line	100%		Janesville 138/69-kV transformer outage	106%			
3	Black Earth-Cross Plains-Stagecoach-Timberlane 69-kV line	135%		Spring Green 138/69-kV transformer outage	145%			
3	Portage-Columbia 69-kV line	113%		Portage 138/69-kV transformer outage	116%		102%	
3	Columbia 138/69-kV transformer	109%		Portage 138/69-kV transformer outage, Deforest-North Madison 69-kV line outage	112%			
3	Kilbourn 47 MVA 138/69-kV transformer	133%		Kilbourn 93 MVA 138/69-kV transformer outage	132%		107%	
3	Huiskamp-Ruskin 69-kV line	115%		North Madison-Vienna 138-kV line outage, Vienna-Yahara River 138-kV line outage, American Center-Sycamore 138-kV line outage, Martinsville-North Madison 138-kV line outage, Martinsville-West Middleton 138-kV line outage	117%		129%	
3	Royster-Pflaum 69-kV line	98%		Fitchburg-Syene 69-kV line outage	103%			
3	Ruskin 69-kV 1-2 bus tie	107-98%		North Madison-Vienna 138-kV line outage, Vienna-Yahara River 138-kV line outage, American Center – Yahara River 138-kV line outage	118-105%			
3	Portage-Trienda 138-kV line	113%		Second Portage-Trienda 138-kV line outage	115%			
3	Portage-Columbia 138-kV line	96%		Second Portage-Columbia 138-kV line outage	99%			
3	Columbia 345/138-kV transformer #2	103%		Columbia 345/138-kV transformer #1 and #3 outage	106%			
3	Fitchburg-Syene 69-kV line	107%		Royster-Pflaum Tap 69-kV line outage	111%			
3	Brick Church-Cobblestone-Zenda Tap 69-kV line			North Lake Geneva 138/69-kV transformer outage	96%			
3	Zenda Tap-Katzenberg 69-kV line			North Lake Geneva-Lake Geneva 69-kV line outage	101%			
3	Janesville-Parkview 69-kV line			Russell 138/69-kV transformer outage	96%			
3	West Middleton-Timberlane 69-kV line			Spring Green 138/69-kV transformer outage	96%			
3	Rock Springs Tap-Artesian 138-kV line			Trienda-Lewiston 138-kV line outage	96%			
3	Academy-Columbus 69-kV line			North Randolph-Fox Lake 138-kV line outage	95%			
3	Koch Oil Tap-South Fond Du Lac 69-kV line			North Randolph-Fox Lake 138-kV line outage	98%			
3	Nine Springs-Syene 69-kV line			Royster- Pflaum Tap 69-kV line outage	97%			
3	Portage-Trienda 138-kV line			Second Portage-Trienda 138-kV line outage	96%			
3	Waunakee Switching Station-Waunakee #2 69-kV line			Martinsville-North Madison 138-kV line outage	96%			
3	Pheasant Branch-West Port 69-kV line			Martinsville-North Madison 138-kV line outage	102%			
3	Martinsville-North Madison 138-kV line			Martinsville-West Middleton 138-kV line outage				
3	Kegonsa-Christiana 138-kV line			Second Kegonsa-Christiana 138-kV line outage	101%			
3	Idle Hour, Monroe, Monroe Tap, South Monroe, Blacksmith 69-kV bus voltages	89-92%		North Monroe-Idle Hour 69-kV line outage		87-91%		
3	Idle Hour, Monroe, Monroe Tap, South Monroe, North Monroe, Monticello, Monticello Tap, New Glarus 69-kV bus voltages	91-92%		North Monroe 138/69-kV transformer		88-92%		
3	Brodhead Muni 3, Brodhead Muni 2, Brodhead, Brodhead Muni 1, RCEC Orfordville, Orfordville, Bass Creek, Footville, RCEC Center 69-kV bus voltages	90-92%		Brodhead Switching Station-Brodhead Muni 3 69-kV line outage		88-92%		90-92%
3	Brodhead Muni 2, Brodhead, Brodhead Muni 1 69-kV bus voltages			Brodhead Muni 2 -Brodhead Muni 3 69-kV line outage		92%		92%



**TABLE ZS-2  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2011 Peak, Hot Summer and Shoulder Cases (continued)**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause	% of Facility Rating Hot Summer Case	% of Nominal Bus Voltage Hot Summer Case	% of Facility Rating Shoulder Case	% of Nominal Bus Voltage Shoulder Case
3	Orfordville, Bass Creek, Footville, RCEC Center, Evansville 69-kV bus voltages		88-92%	Evansville-Sheepskin 69-kV line outage		87-92%		
3	Lake Geneva, South Lake Geneva, Twin Lake, Richmond, Katzenberg 69-kV bus voltages		84-86%	North Lake Geneva-Lake Geneva 69-kV line outage		81-91%		90-92%
3	South Lake Geneva, Twin Lake, Richmond, Katzenberg 69-kV bus voltages		90-91%	Lake-Geneva-South Lake Geneva 69-kV line outage		89-90%		
3	Harmony, Lamar, Fulton, Saunders Creek 69-kV bus voltages		92%	McCue-Harmony 69-kV line outage		89-92%		89-92%
3	Harmony, Lamar, Fulton, Saunders Creek, Dana Cooperation, RCEC Edgerton, Sheepskin 69-kV bus voltages			McCue-Harmony 69-kV line outage				
3	Lamar, Fulton 69-kV bus voltages			Harmony-Lamar 69-kV line outage		90-91%		
3	Lamar, Fulton, Saunders Creek, Dana Cooperation, Sheepskin, 69-kV bus voltages			Harmony-Lamar 69-kV line outage				89-92%
3	Pine River, Richland Center, Richland, Lone Rock 69-kV bus voltages		90%	Pine River-Richland 69-kV line outage, Lone Rock-Richland 69-kV line outage, Lone Rock 69 kV phase shifter outage		89-90%		
3	Avoca, Muscoda, Lone Rock, Blue River 69-kV bus voltages		91-92%	Lone Rock-Spring Green 69-kV line outage		89-91%		
3	Arena 69-kV bus voltage		92%	Spring Green-Arena 69-kV line outage				
3	Spring Green, Avoca, Muscoda, Lone Rock, Arena, Mazomanie, Mazomanie Industrial, Blue River, Pine River, Richland Center 69-kV bus voltages		88-92%	Spring Green 138/69-kV transformer outage		88-92%		
3	Spring Green, Arena 69-kV bus voltages			Spring Green 138/69-kV transformer outage				92%
3	McFarland, Femrite 138-kV bus voltages		91%	McFarland-Kegonsa 138-kV line outage		91%		
3	Femrite 138-kV bus voltage		92%	McFarland-Femrite 138-kV line outage		92%		
3	Burke, Colorado 69-kV bus voltages		87-91%	Reiner-Burke Tap 69-kV line outage		86-90%		
3	Burke, Colorado, Reiner 69-kV bus voltages		87-91%	Reiner 138/ 69-kV transformer outage		86-90%		92%
3	Burke 69-kV bus voltage			Reiner-Burke Tap 69-kV line outage, Reiner 138/ 69-kV transformer outage				
3	Hubbard 138-kV bus voltage		90%	Hustiford-Hubbard 138-kV line outage		90%		89%
3	Hustiford, Hubbard 138-kV bus voltages		90%	Hustiford-Rubicon 138-kV line outage		90%		89%
3	Pflaum, Pflaum Tap , AGA Gas, Nine Springs 69-kV bus voltages		90-91%	Royster-Pflaum Tap 69-kV line outage		90-91%		
3	Pflaum, Pflaum Tap , AGA Gas 69-kV bus voltages			Royster-Pflaum Tap 69-kV line outage				92%
3	Pflaum 69-kV bus voltage		92%	Pflaum-Pflaum Tap 69-kV line outage		92%		
3	Kilbourn, Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan, Artesian, Rock Springs 138-kV bus voltages, Artesian, Loganville, Reedsburg 69-kV bus voltages		86-90%	East Dells-Lewiston 138-kV line outage		85-91%		
3	Kilbourn, Loch Mirror, Birchwood, Dell Creek 138-kV bus voltages			East Dells-Lewiston 138-kV line outage				91-92%
3	Kilbourn, Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan, Artesian, Rock Springs 138-kV bus voltages, Loganville, Reedsburg 69-kV bus voltages		86-90%	East Dells-Kilbourn 138-kV line outage		85-92%		
3	Kilbourn, Loch Mirror, Birchwood 138-kV bus voltages			East Dells-Kilbourn 138-kV line outage				
3	Lancaster, Eden, Wyoming Valley, Spring Green, Troy 138-kV bus voltages		90-92%	East Dells-Lewiston 138-kV line outage		88-92%		91-92%
3	Eden, Wyoming Valley 138-kV bus voltages		92%	Lancaster-Eden 138-kV line outage		91-92%		
3	Lake Delton, City View, Kirkwood, Spring Green Troy, Zobel, Nishan, Artesian, Rock Springs 138-kV bus voltages, Artesian, Reedsburg 69-kV bus voltages		90-92%	Lake Delton-Trienda 138-kV line outage		89-92%		
3	Lewiston, East Dells, Kilbourn, Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan, Artesian, Rock Springs 138-kV bus voltages, Artesian, Loganville, Reedsburg 69-kV bus voltages		90-92%	Lewiston-Trienda 138-kV line outage		84-91%		

**TABLE ZS-2  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2011 Peak, Hot Summer and Shoulder Cases (continued)**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause	% of Facility Rating Hot Summer Case	% of Nominal Bus Voltage Hot Summer Case	% of Facility Rating Shoulder Case	% of Nominal Bus Voltage Shoulder Case
3	Lewiston, East Dells, Kilbourn, Loch Mirror, Birchwood, Dell Creek 138-kV bus voltages			Lewiston-Trienda 138-kV line outage				91-92%
3	Richland Center, Pine River 69-kV bus voltages		91-92%	DPC Dayton-T RC 69-kV line outage		89-90%		
3	Richland Center, Pine River, Gays Mills 69-kV bus voltages		90-91%	DPC Seneca-Bell Center 161-kV line outage		89-90%		
3	Verona 138-kV bus voltage		85%	Verona-Oak Ridge 138-kV line outage		84%		87%
3	Cobblestone, Zenda 69-kV bus voltage		92%	Cobblestone-Brick Church 69-kV line outage		90-92%		
3	City View, Kirkwood, Rock Springs, Artesian 138-kV bus voltages		92%	City View- Lake Delton 138-kV line outage		91-92%		
3	Monroe, South Monroe 69-kV bus voltages			Monroe Tap-South Monroe 69-kV line outage		91%		
3	South Lake Geneva, Twin Lake, Richmond, Katzenberg 69-kV bus voltages			North Lake Geneva 138/69-kV transformer outage		91-92%		
3	Richland Center, Pine River 69-kV bus voltage			Richland Center-T RC 69-kV line outage		90-91%		
3	South, Sun Prairie, Bird St.69-kV bus voltages			Reiner-Burke Tap 69-kV line outage		92%		
3	South, Sun Prairie, Bird St.69-kV bus voltages			Reiner 138/ 69-kV transformer outage		92%		
3	Artesian, Nishan, Zobel 138-kV bus voltages, Artesian, Reedsburg 69-kV bus voltages			Rock Springs Tap-Artesian 138-kV line outage		92%		
3	Rock Springs, Dell Creek, Artesian, Nishan, Zobel 138-kV bus voltages, Artesian, Reedsburg 69-kV bus voltages			Rock Springs Tap-Kirkwood 138-kV line outage		91-92%		
3	Loch Mirror, Birchwood 138-kV bus voltages			Kilbourn-Loch Mirror 138-kV line outage		92%		
3	Concord 138-kV bus 4 and 5 voltages			Jefferson-Crawfish River 138-kV line outage		91%		
3	Concord, Hubbard, Hustiford 138-kV bus voltages			Concord bus 4 and 5 outage		91-92%		
3	Concord 138-kV bus 4 and 5 voltages			Concord bus G and 5 outage		91%		
3	Wyoming Valley, Spring Green, Troy 138-kV bus voltages			Eden-Wyoming Valley 138-kV line outage		92%		
3	Dickinson 138-kV bus voltage			Colley Road-Dickinson 138-kV line outage		91%		
3	Spring Green 138-kV bus voltage			Spring Green-Wyoming Valley 138-kV line outage		92%		
3	North Beaver Dam, Beaver Dam East, Fox Lake 138-kV bus voltages			North Randolph-Fox Lake 138-kV line outage		91%		
3	Kirkwood, Rock Springs, Artesian, Nishan, Zobel 138-kV bus voltages			City View-Kirkwood 138-kV line outage		91-92%		
4	West Marinette 138/69-kV transformer #1	95-111%		Wells St-Roosevelt Rd 69-kV line outage, Roosevelt Rd 138/69-kV transformer outage, West Marinette 138/69-kV transformer #2 outage	98-116%			
4	West Marinette 138/69-kV transformer #2	97-100 %		Wells St-Roosevelt Rd 69-kV line outage, Roosevelt Rd 138/69-kV transformer outage	102-104%			
4	Sunset Point-Pearl Ave 69-kV line	97%		Ellinwood-12th Ave 69-kV line outage	102%			
4	Henry St-Danz Ave 69-kV line	<95%		Pulliam-Van Buren 69-kV line outage	97%			
4	Sunset Point 138/69-kV transformer #1	<95%		Sunset Point 138/69-kV transformer #2 outage	99%			
4	Mirro-North East 69-kV line	<95%		Shoto-Mantrap 69-kV line outage			98%	
4	Glenview 138/69-kV transformer #1	<95%		Glenview 138/69-kV transformer #2 outage			97%	
4	Glenview 138/69-kV transformer #2	<95%		Glenview 138/69-kV transformer #1 outage			96%	
4	Quarry Run, Woodenshoe, Mears Corners 138-kV bus voltages		91%	Neevin-Quarry Run 138-kV line outage, Quarry Run-Woodenshoe 138-kV line outage		90-92%		
4	Sunset Point 138-kV bus voltage		>92%	Neevin-Quarry Run 138-kV line outage		92%		
4	East Krok 69-kV bus voltage		>92%	East Krok 138/69-kV transformer outage		92%		
4	Hickory, Butternut, Forward Energy Center 138-kV bus voltages		>92%	Hickory-South Fond du Lac 138-kV line outage		92%		
5	Germanytown 138-kV bus		-----	Base Case		92%		
5	Country Aire 138-kV bus		-----	Base Case		91%		
5	Bain 345/138-kV transformer #5	156%		Splitting Pleasant Prairie 345-kV bus sections 3 and 4	157%		158%	
5	Albers – Bain	98%		Bain – Kenosha 138-kV line	105%			
5	Oak Creek – Pennsylvania 138-kV line	100 – 108%		Various Contingencies	113%		95 – 100%	

**TABLE ZS-2  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2011 Peak, Hot Summer and Shoulder Cases (continued)**

Planning Zone	Criteria Exceeded/Need	% of Facility		Cause	% of Nominal Bus		% of Facility		% of Nominal Bus Voltage Hot Summer Case	Rating Shoulder Case	% of Facility	% of Nominal Bus Voltage Shoulder Case
		Rating Peak Case	Bus Voltage Peak Case		Rating Hot Summer Case	Rating Shoulder Case						
5	Arcadian4 – Waukesha 1 138-kV line	114%		Arcadian6 – Waukesha 3			125%			117%		
5	Arcadian 345/138-kV transformer #3	110%		Arcadian 345/138-kV transformer #1 outage			118%			103%		
5	Oak Creek 345/138-kV transformer #1	96%		Oak Creek 345/138-kV transformer #2 outage			100%					
5	Nicholson – Ramsey 138-kV line	95%		Oak Creek – Pennsylvania 138-kV line outage			98%			96%		
5	Oak Creek – Ramsey 138-kV line	94%		Oak Creek – Pennsylvania 138-kV line outage			97%			95%		
5	Arcadian6 – Waukesha3 138-kV line	115%		Arcadian4 – Waukesha 1 138-kV line outage			126%			118%		
5	Bluemound – Brookdale W 138-kV line			Bluemound – 96th St.2 138-kV line outage			104%					
5	Bark River – Sussex 138-kV line			Maple – Saukville 138-kV line outage			104%					
5	Maple – Saukville 138-kV line			Bark River – Sussex 138-kV line outage			104%					
5	Bluemound5 – Butler 138-kV line			Various Contingencies						107 -109%		
5	Bluemound6 – Butler 138-kV line			Various Contingencies						99 – 101%		
5	Harbor – Kansas 183-kV line			Various Contingencies						97 – 99%		
5	Albers – Kenosha 138-kV line			Albers – Bain 138-kV line outage						102%		
5	Granville – Rangeline 138-kV line			Cornell – Granville 138-kV line outage						102%		

**TABLE ZS-3  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2015 Peak Summer Case**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause
1	Antigo, Aurora Street, Cranberry and St. Germain 115-kV bus voltages		89 – 92%	Gardner Park-Blackbrook-Antigo-Aurora St. 115-kV outage Gardner Park-Blackbrook-Antigo 115-kV line outage Blackbrook-Antigo 115-kV line outage Eagle River-Cranberry 115-kV line outage
1	Bunker Hill – Blackbrook 115-kV line	103%		Gardner Park-Blackbrook 115-kV line outage
1	Gardner Park – Blackbrook 115-kV line	97%		Maine-Pine 115-kV line outage
1	Sigel, Young Road, Lakehead Vesper and Port Edwards 138-kV bus voltages		88 – 91%	Arpin-Sigel 138-kV line outage Young Road-Sigel 138-kV line outage Young Road-Lakehead Vesper 138-kV line outage Port Edwards-Lakehead Vesper 138-kV line outage
1	Port Edwards, Vulcan, Hollywood and Saratoga 138-kV bus voltages		89 – 92%	Arpin-Sigel 138-kV line outage Young Road-Sigel 138-kV line outage Young Road-Lakehead Vesper 138-kV line outage Port Edwards-Lakehead Vesper 138-kV line outage
1	Castle Rock – Quincy 69-kV line	96 - 112%		Petenwell 138/69-kV transformer outages Petenwell-Big Pond 69-kV line outage Necedah Tap-Big Pond 69-kV line outage Various other line outages
1	McKenna – Quincy 69-kV line	100%		Petenwell 138/69-kV transformer outages Petenwell-Big Pond 69-kV line outage Necedah tap-Big Pond 69-kV line outage
1	Council Creek 69-kV bus tie (ATC-DPC)	95 – 121%		Hillsboro-Hillsboro tap 69-kV line outage King-Eau Claire-Arpin 345-kV line outage Eau Claire-Arpin 345-kV line outage Various other line outages
1	Council Creek and Petenwell 138-kV bus voltage		90 – 95%	Base Case Arpin-Sigel 138-kV line outage Young Road-Sigel 138-kV line outage Council Creek-Petenwell 138-kV line outage
1	Necedah, Whistling Wings, Dellwood, Friendship, Houghton Rock 69-kV bus voltages		85 – 92%	Petenwell 138/69-kV transformer Petenwell-Big Pond 69-kV line outage Big Pond-Necedah tap 69-kV line outage Various other 69-kV line outages
1	Hilltop, Mauston, West Mauston, Lyndon Station, Wisconsin Dells 69-kV bus voltages		88 – 92%	Kilbourn-Wisc. Dells 69-kV line outage E. Dells-Lewiston 138-kV line outage Trienda-Lewiston 138-kV line outage
1	Wautoma and Sand Lake 138-kV bus voltages		90 – 96%	Base Case Arpin-Sigel 138-kV line outage Young Road-Sigel 138-kV line outage Young Road-Lakehead Vesper 138-kV line outage
1	Sand Lake 138/69-kV transformer	95 – 109%		Wautoma 138/69-kV transformer outage Trienda-Lewiston 138-kV line outage E. Dells-Lewiston 138-kV line outage Various other line outages
1	Hancock, Hancock (ACEC), Plainfield and Plainfield (ACEC) 69-kV bus voltages		88 – 92%	Sand Lake 138/69-kV transformer outage Sand Lake-Plainfield Tap 69-kV line outage

**TABLE ZS-3  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2015 Peak Summer Case (continued)**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause
1	Metomen 138/69-kV transformer	95 – 119%		Base Case North Fond du Lac-Rosendale 69-kV line outage Metomen-Rosendale 69-kV line outage Various other line outages
1	Metomen – Ripon 69-kV line	96 – 103%		Winneconne-Sunset Point 69-kV line outage Omro-Winneconne 69-kV line outage Markesan tap-North Randolph 69-kV line outage Wautoma-Silver Lake 69-kV line outage
1	NW Ripon – Ripon 69-kV line	96 – 106%		Winneconne-Sunset Point 69-kV line outage Omro-Winneconne 69-kV line outage
1	Winneconne – Sunset Point 69-kV line	95 – 103%		NW Ripon – Ripon 69-kV line outage Metomen-Ripon 69-kV line outage
1	Omro – Winneconne 69-kV line	98%		NW Ripon – Ripon 69-kV line outage NW Ripon – Ripon 69-kV line outage
1	Berlin area 69-kV bus voltages		85 – 92%	Metomen-Ripon 69-kV line outage Winneconne-Sunset Point 69-kV line outage Wautoma-Silver Lake 69-kV line outage Various other line outages
1	Montello, Roslin, Endeavor and Lakehead Portage 69-kV bus voltages		89 – 92%	Portage-Lakehead Portage 69-kV line outage Endeavor Tap-Lakehead Portage 69-kV line outage Gardner Park-Blackbrook-Antigo 115-kV line outage Antigo-Blackbrook 115-kV line outage Werner West-White Lake 138-kV line outage
1	Whitcomb 115/69-kV transformer	95 – 98%		Whitcomb 115/69-kV transformer
1	Caroline 115/69-kV transformer	95%		Whitcomb 115/69-kV transformer
1	Coloma (ACEC), Lincoln Pumping Station, Brooks (ACEC) and Grand Marsh 69-kV bus voltages		88 – 92%	Chaffee Creek-Coloma tap 69-kV line outage Lincoln Pumping Station-Coloma Tap 69-kV line outage Sand Lake 138/69-kV transformer outage Petenwell 138/69-kV transformer outage
1	White Lake, Waupaca, Harrison and Hartman Creek 138-kV bus voltages		90 – 92%	Werner West-White Lake 138-kV line outage
1	Hillsboro, Woneoc and Union Center 69 kV bus voltages		90 – 91%	Hillsboro-Hillsboro tap 69-kV line outage
2	Indian Lake 138-kV bus voltage		95%	Base Case
2	St. Ignace, Straits, Evergreen, Michigan Limestone, and Talentino 69-kV bus voltages		90-91%	Straits 138/69-kV transformer
2	Engadine, Newberry Village, Newberry Hospital and Louisiana Pacific bus voltages		91%	Engadine-Hiawatha 69-kV line outage
3	McCue 138/69-kV transformer	101%		Base Case
3	North Monroe 138/69-kV transformer	104%		Base Case
3	Kirkwood-Skillet Creek 69-kV line	110%		Base Case
3	Brodhead-Blacksmith 69-kV line	134-95%		North Monroe 138/69-kV transformer outage, Town Line Road-Albany 138-kV line outage, Albany-North Monroe 138-kV line outage, North Monroe-Idle Hour 69-kV line outage, Brodhead-Brodhead Muni 3 69-kV line outage, North Monroe – Idle Hour 69-kV line outage Pilot NB-Galena 69-kV line outage Wempletown-Rockdale 345-kV line outage
3	Hillman-Elmo 69-kV line	99%		
3	North Monroe-Monticello Tap 69-kV line	95%		
3	North Monroe 138/69-kV transformer	97-95%		Darlington 138/69-kV transformer outage, Paddock-Newark 69-kV line outage
3	Janesville-Park View 69-kV line	99%		McCue 138/69-kV transformer outage
3	Janesville 138/69-kV transformer	104%		McCue 138/69-kV transformer outage
3	Milton-Lawns-McCue 69-kV line	110%		Janesville 138/69-kV transformer outage

**TABLE ZS-3  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2015 Peak Summer Case (continued)**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause
3	Dana Corporation Tap – Sheepskin 69-kV line	103%		McCue-Harmony 69-kV line outage
3	Black Earth - Cross Plain - Stage Coach - Timberlane - West Middleton 69-kV line	115%		Spring Green 138/69-kV transformer outage
3	North Stoughton-Stoughton Muni 69-kV line	100-95%		McCue-Harmony 69-kV line outage, Harmony-Lamar 69-kV line outage
3	Stoughton-Aaker 69-kV line	95%		Verona 138/69-kV transformer outage, Verona-Oak Ridge 138-kV line outage
3	Kegonsa – Cottage Grove 69-kV line	99%		Deforest-North Madison 69-kV line outage
3	Deforest-Arlington Tap 69-kV line	102%		Deforest-North Madison 69-kV line outage
3	Arlington Tap – Poynette 69-kV line	115%		Deforest-North Madison 69-kV line outage
3	Waunakee Industrial Park – Huiskamp 69-kV line	96%		North Madison 138/69-kV transformer outage
3	Rock Springs Tap – Artesian 138-kV line	113-108%		Trienda-Lewiston 138-kV line outage, East Delis-Lewiston 138-kV line outage, East Delis-Lewiston 138-kV line outage
3	Academy-Columbus Muni 2 Tap 69-kV line	100%		North Randolph-Fox Lake 138-kV line outage
3	Columbus Muni 2 Tap- Columbus 69-kV line	96%		North Randolph-Fox Lake 138-kV line outage
3	Waupun – Koch Oil Tap 69-kV line	97%		North Randolph-Fox Lake 138-kV line outage
3	Koch Oil Tap – South Fond Du Lac 69-kV line	101-96%		North Randolph-Fox Lake 138-kV line outage, Fox Lake-North Beaver Dam 138-kV line outage
3	47 MVA Kilbourn 138/69-kV transformer	120%		93 MVA Kilbourn 138/69-kV transformer outage
3	Huiskamp-Ruskin 69-kV line	132-108%		North Madison-Vienna 138-kV line outage, Vienna-Yahara River 138-kV line outage, Yahara River-American Center 138-kV line outage, American Center-Sycamore 138-kV line outage
3	East Delis-Kilbourn 138-kV line	96%		Lake Delton-Trienda 138-kV line outage
3	East Delis-Lewiston 138-kV line	98%		Lake Delton-Trienda 138-kV line outage
3	X-19 Portage-Trienda 138-kV line	126%		X-67 Portage-Trienda 138-kV line
3	X-67 Portage-Trienda 138-kV line	105%		X-19 Portage-Trienda 138-kV line
3	Portage-Columbia 138-kV line	105%		Second Portage-Columbia 138-kV line outage
3	Trienda-Lewiston 138-kV line	99-95%		Lake Delton-Trienda 138-kV line outage, Rock Springs Tap-Kirkwood 138-kV line outage
3	Columbia 345/138 transformer T21	99%		Columbia 345/138 transformer T22 outage
3	Columbia 345/138 transformer T23	99%		Columbia 345/138 transformer T22 outage
3	Ruskin 69-kV bus tie	104-98%		North Madison-Vienna 138-kV line outage, Vienna-Yahara 138-kV line outage
3	Idle Hour, Monroe, Monroe Tap, South Monroe, Blacksmith, Browntown, Green Wind, Jennings Road, Wiota 69-kV bus voltages		85-92%	North Monroe-Idle Hour 69-kV line outage
3	Idle Hour, Monroe, Monroe Tap, South Monroe, North Monroe, Monticello, Monticello Tap, New Glarus, Belleville, Montrose, Brooklyn, Sun Valley, Oregon, Verona 69-kV bus voltages		85-92%	North Monroe 138/69-kV transformer
3	Monticello, Monticello Tap, New Glarus, Belleville, Montrose, Brooklyn, Sun Valley, Oregon, Verona, Jennings South Monroe, Blacksmith, Browntown, Green Wind, Aakar Road, Wiota 69-kV bus voltages, Verona 138-kV bus voltage		87-92%	North Monroe-Monticello Tap 69-kV line outage
3	South Monroe, Monroe, Blacksmith, Browntown 69-kV bus voltages		88-91%	Idle Hour-Monroe Tap 69-kV line outage
3	New Glarus, Belleville, Montrose, Brooklyn, Sun Valley, Oregon 69-kV bus voltages, Verona 138-kV bus voltage		88-91%	Monticello Tap-New Glarus 69-kV line outage
3	Brodhead Muni 3, Brodhead Muni 2, Brodhead, Brodhead Muni 1, RCEC Orfordville, Orfordville, Bass Creek, Footville, RCEC Center, Evansville 69-kV bus voltages		88-91%	Brodhead Switching Station-Brodhead Muni 3 69-kV line outage

**TABLE ZS-3  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2015 Peak Summer Case (continued)**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause
3	Brodhead Muni 2, Brodhead, Brodhead Muni 1, RCEC Orfordville, Orfordville, Bass Creek, Footville, RCEC Center 69-kV bus voltages		90-91%	Brodhead Muni 2 -Brodhead Muni 3 69-kV line outage
3	Orfordville, Bass Creek, Footville, RCEC Center, Evansville 69-kV bus voltages		87-92%	Evansville-Sheepskin 69-kV line outage
3	Brodhead Switching Station, Brodhead Muni 3, Brodhead Muni 2, Brodhead, Brodhead Muni 1 69-kV bus voltages		92%	Paddock-Newark 69-kV line
3	Bradford, West Darien, SW Delavan, North Shore, Delavan, Bristol, Elkhorn, Como, Williams Bay, North Lake Geneva, White River, South Lake Geneva, Brick Church 138-kV bus voltages		90-92%	RCEC La Prairie-RCEC Bradford 138-kV line outage
3	La Prairie, Bradford, West Darien, SW Delavan, North Shore, Delavan, Bristol, Elkhorn, Como, Williams Bay, North Lake Geneva, White River, South Lake Geneva, Brick Church 138-kV bus voltages		90-92%	Rock River-RCEC La Prairie 138-kV line outage
3	Twin Lakes, Richmond, Katzenberg 69-kV bus voltages		90%	Katzenberg-South Lake Geneva 69-kV line outage
3	West Darien, SW Delavan, North Shore, Delavan, Bristol, Elkhorn, Como, Williams Bay, North Lake Geneva, White River, South Lake Geneva, Brick Church 138-kV bus voltages		90-92%	West Darien-West Darien Tap 138-kV line outage
3	West Darien Tap, West Darien, SW Delavan, North Shore, Delavan, Bristol, Elkhorn, Como, Williams Bay, North Lake Geneva, White River, South Lake Geneva, Brick Church 138-kV bus voltages		90-92%	RCEC Bradford-West Darien Tap 138-kV line outage
3	SW Delavan, North Shore, Delavan, Bristol, Elkhorn, Como, Williams Bay, North Lake Geneva, White River 138-kV bus voltages		91-92%	West Darien-SW Delavan 138-kV line outage
3	Harmony, Lamar, Fulton, Saunders Creek, Evansville, Dana Corporation, RCEC Center 69-kV bus voltages		85-92%	McCue-Harmony 69-kV line outage
3	Lamar, Fulton, Saunders Creek, Evansville 69-kV bus voltages		88-92%	Harmony-Lamar 69-kV line outage
3	Avoca, Avoca Tap, Muscoda 69-kV bus voltages		91-92%	Avoca Tap-Lone Rock 69-kV line outage
3	Pine River, Richland Center, Richland, Lone Rock 69-kV bus voltages		91-92%	Lone Rock 69-kV Phase Shifter outage, Lone Rock-Richland Center 69-kV line outage
3	Pine River, Richland Center, Richland, Lone Rock, Muscoda, Avoca, Blue River, Boscobel, Boscobel Muni 69-kV bus voltages		88-90%	Lone Rock-Spring Green 69-kV line outage
3	Arena, Mazomanie, Mazomanie Industrial, Black Earth 69-kV bus voltages		90-91%	Spring Green-Arena 69-kV line outage
3	Spring Green, Avoca, Muscoda, Lone Rock, Arena, Mazomanie, Mazomanie Industrial, Blue River, Pine River, Richland Center, Black Earth, Boscobel, Boscobel Muni 69-kV bus voltages		84-92%	Spring Green 138/69-kV transformer outage
3	Mazomanie, Mazomanie Industrial, Black Earth 69-kV bus voltages		91-92%	Arena-Mazomanie 69-kV line outage
3	Black Earth, Mazomanie, Mazomanie Industrial 69-kV bus voltages		92%	Black Earth-Cross Plains 69-kV line outage
3	Cross Plains, Black Earth, Mazomanie, Mazomanie Industrial 69-kV bus voltages		89-90%	Stage Coach-Cross Plains 69-kV line outage
3	Timberlane, Cross Plains, Stage Coach, Black Earth, Mazomanie, Mazomanie Industrial, Mount Horeb, Forward 69-kV bus voltages		88-92%	Timberlane-West Middleton 69-kV line outage
3	Asker Rd, Sun Valley, Oregon, Brooklyn 69-kV bus voltages		90-92%	Stoughton-Aakar 69-kV line outage
3	Cottage Grove, Gaston Road 69-kV bus voltages		90%	Kegonsa-Cottage Grove 69-kV line outage, Kegonsa 138/69-kV transformer outage
3	McFarland, Femrite, Sprecher, Reiner Road 138-kV bus voltages		88-91%	McFarland-Kegonsa 138-kV line outage
3	Femrite, Sprecher, Reiner Road 138-kV bus voltages		89-91%	McFarland-Femrite 138-kV line outage

**TABLE ZS-3  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2015 Peak Summer Case (continued)**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause
3	Burke, Burke Tap, Colorado, Sun Prairie, South, Bird St., Business Park, Gaston Rd, Token Creek 69-kV bus voltages		85-91%	Reiner Road-Burke Tap 69-kV line outage
3	Reiner Rd, Burke, Burke Tap, Colorado, Sun Prairie, South, Bird St., Business Park, Gaston Rd, Token Creek, Cottage Grove, Hampden Tap, Hampden 69-kV bus voltages		82-92%	Reiner 138/69-kV transformer outage
3	Colorado 69-kV bus voltage		92%	Colorado-Burke Tap 69-kV line outage
3	Token Creek 69-kV bus voltage		92%	Deforest-Token Creek 69-kV line outage
3	Deforest, Sun Prairie, South, Bird St., Gaston Rd, Token Creek, Hampden Tap, Hampden 69-kV bus voltages		90-91%	Deforest-North Madison 69-kV line outage
3	Hubbard 138-kV bus voltage		89%	Hustiford-Hubbard 138-kV line outage
3	Hustiford, Hubbard 138-kV bus voltages		88%	Hustiford-Rubicon 138-kV line outage
3	Birchwood, Dell Creek, Zobel, Nishan 138-kV bus voltages		91-92%	Loch Mirror-Birchwood 138-kV line outage
3	Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan, Artesian, Rock Springs, Spring Green, Troy, Wyoming Valley, Kirkwood 138-kV bus voltages, Artesian, Loganville, Reedsburg 69-kV bus voltages		87-92%	Loch Mirror-Kilbourn 138-kV line outage
3	East Dells, Kilbourn, Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan, Artesian, Rock Springs, Spring Green, Troy, Wyoming Valley, Kirkwood, City View, Lake Delton, Eden 138-kV bus voltages, Artesian, Loganville, Reedsburg, Finnegan, Platte, Kilbourn 69-kV bus voltages		83-92%	East Dells-Lewiston 138-kV line outage
3	Kilbourn, Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan, Artesian, Rock Springs, Spring Green, Troy, Wyoming Valley, Kirkwood, City View, Lake Delton 138-kV bus voltages, Artesian, Loganville, Reedsburg, Finnegan, Platte, Kilbourn 69-kV bus voltages		83-92%	East Dells-Kilbourn 138-kV line outage
3	Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan, Artesian, Rock Springs, Spring Green, Troy, Wyoming Valley, Kirkwood, City View, Lake Delton, Eden 138-kV bus voltages, Artesian, Loganville, Reedsburg 69-kV bus voltages		88-91%	Lake Delton-Trienda 138-kV line outage
3	East Dells, Kilbourn, Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan, Artesian, Rock Springs, Spring Green, Troy, Wyoming Valley, Kirkwood, City View, Lake Delton, Eden 138-kV bus voltages, Artesian, Loganville, Reedsburg, Finnegan, Platte, Kilbourn 69-kV bus voltages		82-92%	Trienda-Lewiston 138-kV line outage
3	Dell Creek, Zobel, Nishan, Artesian, Rock Springs, Spring Green, Troy, Wyoming Valley, Kirkwood, City View, Eden 138-kV bus voltages		90-92%	City View-Lake Delton 138-kV line outage
3	Spring Green, Troy, Wyoming Valley, Kirkwood 138-kV bus voltages		91-92%	City View-Kirkwood 138-kV line outage
3	Sugar Creek 138-kV bus voltage		92%	Sugar Creek-University 138-kV line
3	Fort Atkinson 138-kV bus voltage		91%	Jefferson 4-5 138-kV bus tie outage
3	Crawfish, Rockvale 138-kV bus voltages		91-92%	Jefferson-Crawfish River 138-kV line outage
3	Concord, Hubbard, Hustiford, Rubicon 138-kV bus voltages		90-92%	Concord 4-5 138-kV bus tie outage
3	Rockvale 138-kV bus voltage		90%	Rockvale-Concord 138-kV line outage
3	North Shore, Delavan, Bristol, Elkhorn, Como 138-kV bus voltages		91-92%	SW Delavan-North Shore 138-kV line outage
3	Lancaster, Eden, Wyoming Valley, Spring Green, Troy 138-kV bus voltages, Avoca, Blue River, Muscoda 69-kV bus voltages		88-92%	Nelson Dewey-Lancaster 138-kV line outage
3	Potosi, Hillman, Lafayette Wind, Darlington 138-kV bus voltages		90%	Nelson Dewey-Potosi 138-kV line outage
3	Hillman, Lafayette Wind, Darlington 138-kV bus voltages		90%	Potosi-Hillman 138-kV line outage
3	Darlington 138-kV bus voltage		92%	Darlington-Lafayette Wind 138-kV line outage



**TABLE ZS-3  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2015 Peak Summer Case (continued)**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause
3	Eden, Wyoming Valley, Spring Green, Troy 138-kV bus voltages, Wyoming Valley, Spring Green, Troy 138-kV bus voltages, Avoca, Muscoda 69-kV bus voltages		90-91%	Eden-Lancaster 138-kV line outage
3	North Monroe, Darlington 138-kV bus voltages		91-92%	Eden-Wyoming Valley 138-kV line outage
3	North Monroe, Darlington, Lafayette Wind 138-kV bus voltages		90-92%	North Monroe-Albany 138-kV line outage
3	Dickinson, Brick Church, Williams Bay 138-kV bus voltages		88-92%	Town line Road-Albany 138-kV line outage
3	Brick Church, Williams Bay 138-kV bus voltages		89-91%	Colley Road-Dickinson 138-kV line outage
3	Spring Green, Troy 138-kV bus voltages		91-92%	Dickinson-Brick Church 138-kV line outage
3	Fort Atkinson 138-kV bus voltage		91-92%	Spring Green-Wyoming Valley 138-kV line outage
3	Reiner Road, Sprecher 138-kV bus voltages		92%	Rockdale-Lakehead Cambridge 138-kV line
3	Fox Lake, Beaver Dam East bus voltages		91-92%	Reiner Rd-Sycamore 138-kV line outage
3	Rockvale 138-kV bus voltage		91-92%	North Randolph-Fox Lake 138-kV line outage
3	LCI, Pflaum, Femrite, Nine Springs, Syene 69-kV bus voltages		91-92%	Bark River-Cottonwood 138-kV line outage, Bark River-Sussex 138-kV line outage
3	Brisbois, Grangrae, Boscobel, Boscobel Muni, Wauzeka, Hillside, Lapointe 69-kV bus voltages		90-92%	Femrite 138/69-kV transformer outage
3	Miner 69-kV bus voltage		91-92%	Grangrae 138/69-kV transformer outage
3	Miner, Shullsburg 69-kV bus voltages		92%	DPC Terr TP – Pilot NB 69-kV line outage
3	Muscoda, Blue River, Brisbois 69-kV bus voltages		91%	DPC Pilot NB-Galena 69-kV line outage
3	Vienna, Yahara River, American Center, Reiner Rd, Sprecher, Femrite, Sycamore, Blount 138-kV bus voltages		91-92%	Seneca-Genoa 161-kV line outage
3	Yahara River, American Center, Reiner Road, Sprecher, Femrite, Sycamore 138-kV bus voltages		91-92%	North Madison-Vienna 138-kV line outage
3	Reiner Rd, Sprecher, Femrite, Sycamore 138-kV bus voltages		91-92%	Yahara River-Vienna 138-kV line outage
3	Verona, Sun Valley, Brooklyn, Oregon, Montrose, Belleville, Aaker, Stoughton, Stoughton Muni, Mount Horeb, New Glarus, Forward, Monticello 69-kV bus voltages		86-91%	Yahara River-American Center 138-kV line outage
3	Verona, Sun Valley, Brooklyn, Oregon, Montrose, Belleville, Aaker, Stoughton, Stoughton Muni, Mount Horeb, New Glarus, Forward, Monticello 69-kV bus voltages		87-91%	Verona-Oakridge 138-kV line outage
3	Sun Valley, Oregon, Brooklyn 69-kV bus voltages		88-90%	Verona 138/69-kV transformer outage
3	Cobble Stone, Lake Shore, Zenda Tap, Zenda, Katzenberg, Richmond, Twin Lakes 69-kV bus voltages		88-92%	Sun Valley-Verona 69-kV line outage
4	Pulliam-Van Buren 69-kV line	97%		Cobble Stone-Brick Church 69-kV line outage
4	Henry-Danz Avenue 69-kV line	105%		Pulliam-Danz Avenue 69-kV line outage
4	Pulliam-Danz Avenue 69-kV line	102%		Pulliam-Van Buren 69-kV line outage
4	Sunset Point-Pearl Avenue 69-kV line	104%		Pulliam-Van Buren 69-kV line outage
4	Sunset Point 138/69-kV transformer #1	101%		Ellinwood-Twelth Avenue 69-kV line outage
4	Sister Bay 69-kV bus voltage		95%	Sunset Point 138/69-kV transformer #2 outage
4	Bluestone, Wesmark 69-kV bus voltages		86-88%	Base Case
4	Booster, Barnett, Beardsley St, East Krok 69-kV bus voltages		90-91%	Finger Road-Bluestone 69-kV line outage
4	Quarry Run, Woodenshoe, Mears Corners, Sunset Point 138-kV bus voltages		89-91%	East Krok 138/69-kV transformer outage
4	Hickory, Butternut, Forward Energy Center 138-kV bus voltages		92%	Neevin-Quarry Run 138-kV line outage, Quarry Run-Woodenshoe 138-kV line outage
5	Oak Creek 345/230-kV transformer	100%		Hickory-South Fond du Lac 138-kV line outage
5	Granville 345/138-kV transformer	95%		Splitting Oak Creek 230-kV bus 78
5	Tichigan and Burlington 138-kV bus voltages		89-90%	Splitting Granville 345-kV bus 23
5	Edgewood – St. Martins 138-kV line	102%		Splitting Burlington 138-kV bus
5	Albers – Bain 345-kV line	110%		Walworth – Mukwonago 138-kV bus outage
				Bain – Kenosha 138-kV line outage

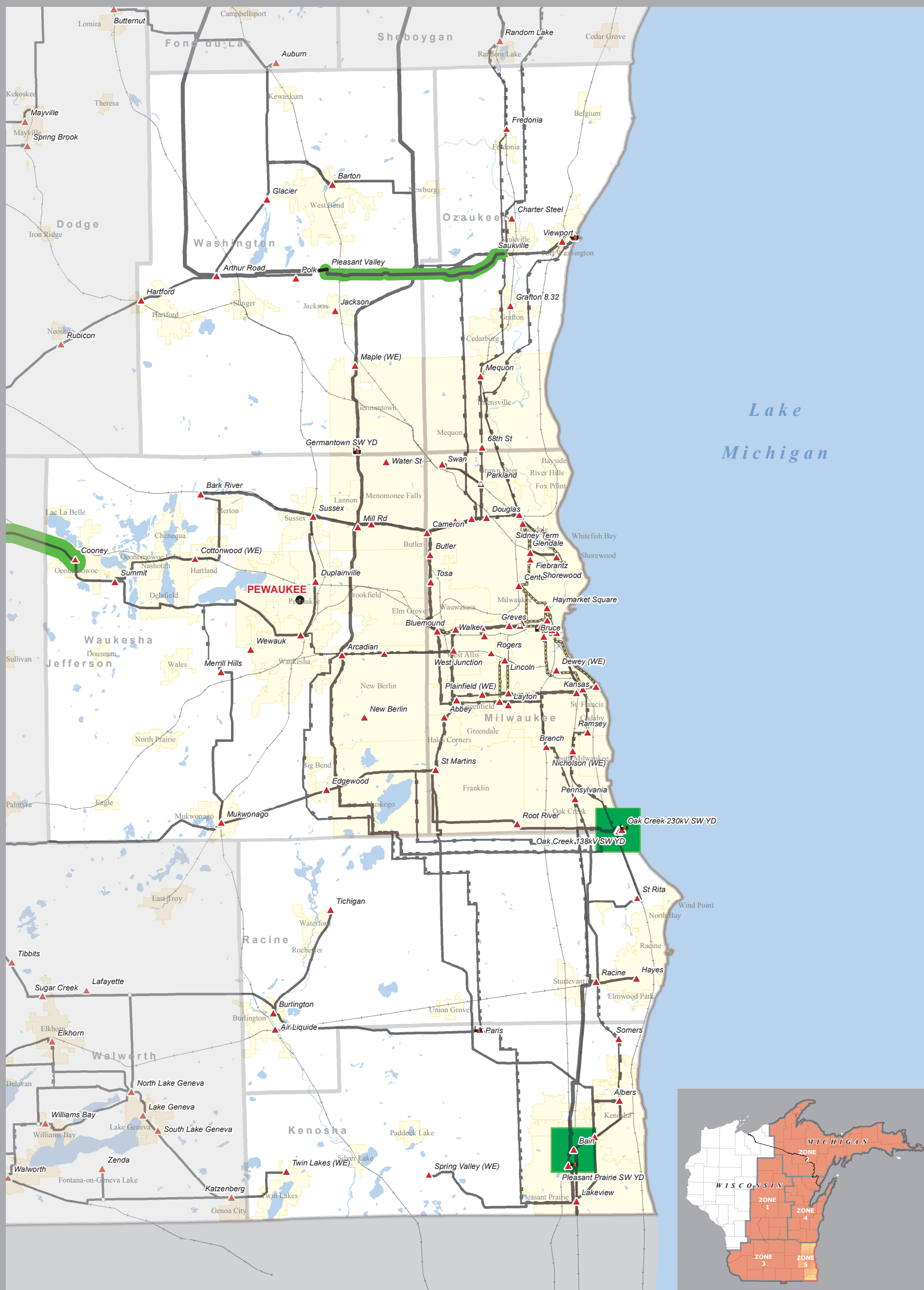
**TABLE ZS-3  
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2015 Peak Summer Case (continued)**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause
5	Oak Creek – Pennsylvania 138-kV line	95 – 103%		Various Contingencies
5	Arcadian4 – Waukesha1 138-kV line	103 – 117%		Various Contingencies
5	Arcadian 345/138-kV transformer #3	111%		Arcadian 345/138-kV transformer #1 outage
5	Fredonia 138-kV bus voltage		91%	Cedarsauk – Fredonia 138-kV line outage
5	Bark River and Cottonwood 138-kV bus voltages		91-92%	Various Contingencies
5	Oak Creek 345/138-kV transformer	97%		Oak Creek 345/138-kV transformer outage
5	Arcadian6 – Waukesha3 138-kV line	118%		Arcadian4 – Waukesha1 138-kV line outage
5	Germantown, Maple 138-kV bus voltages		91-92%	Maple – Saukville 138-kV line outage

*Table ZS-11  
Forecast of Peak Load and Generation in Zone 5*

	2007	2011	2015
Peak Forecast (megawatts)	4743.4	5074.3	5387.5
Average Peak Load Growth	N/A	1.70%	1.51%
Existing Generation Capacity (megawatts)	3944	3944	3944
Existing Capacity Less Load	-799.4	-1130.3	-1443.5
Existing Generation Capacity plus Modeled Generating Capacity Additions (megawatts)	3944	5784	6434
Modeled Capacity Less Load (megawatts)	-799.4	709.7	1046.5

*Modeled generating capacity additions in the table above reflect those proposed capacity additions that were included in the 2006 Assessment analyses models, as listed in the **Projects** section.*



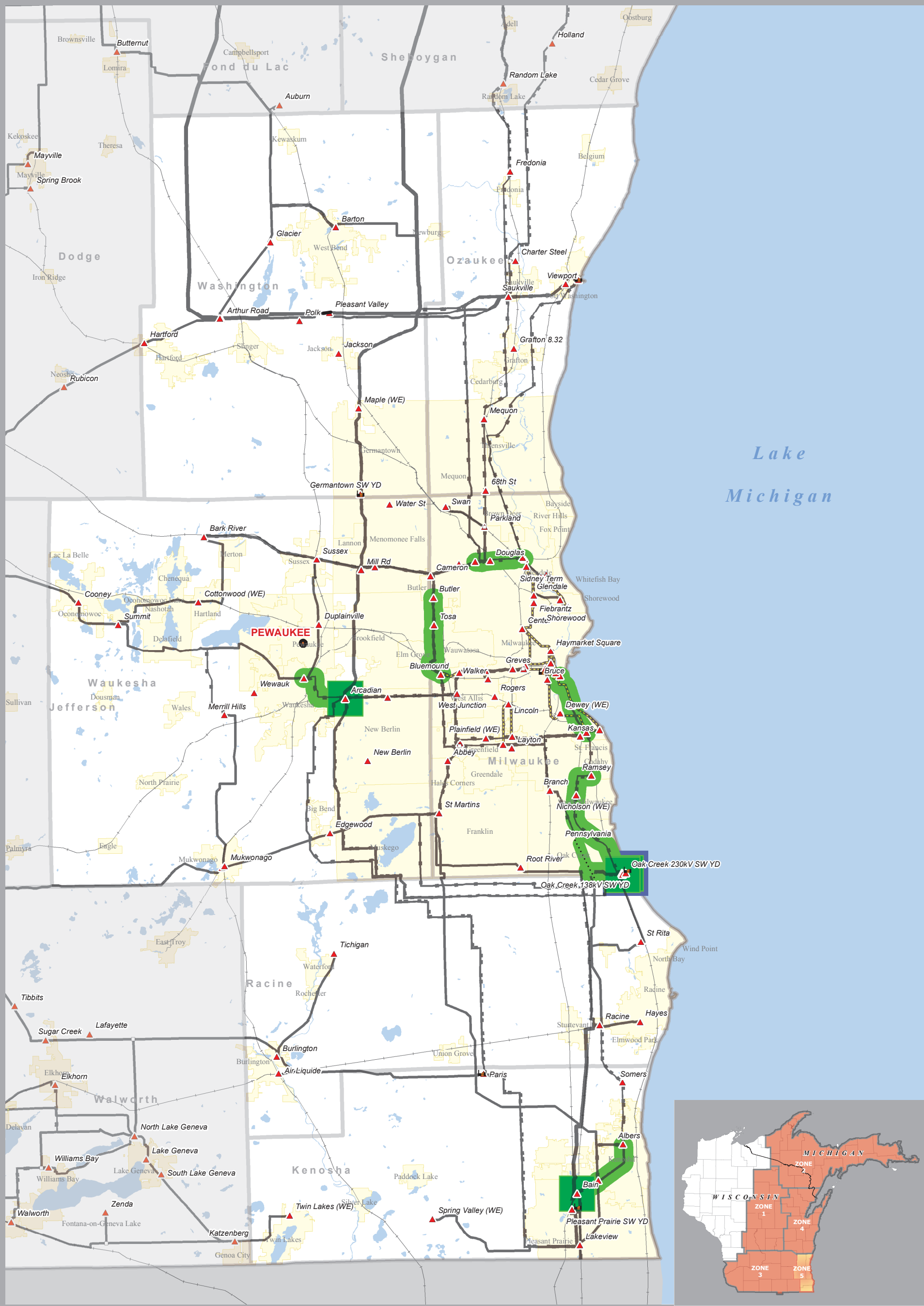
Performance Criteria Limits Exceeded and Other Constraints 2006-2007  
**PLANNING ZONE 5**

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 2008-2011**  
**PLANNING ZONE 5**

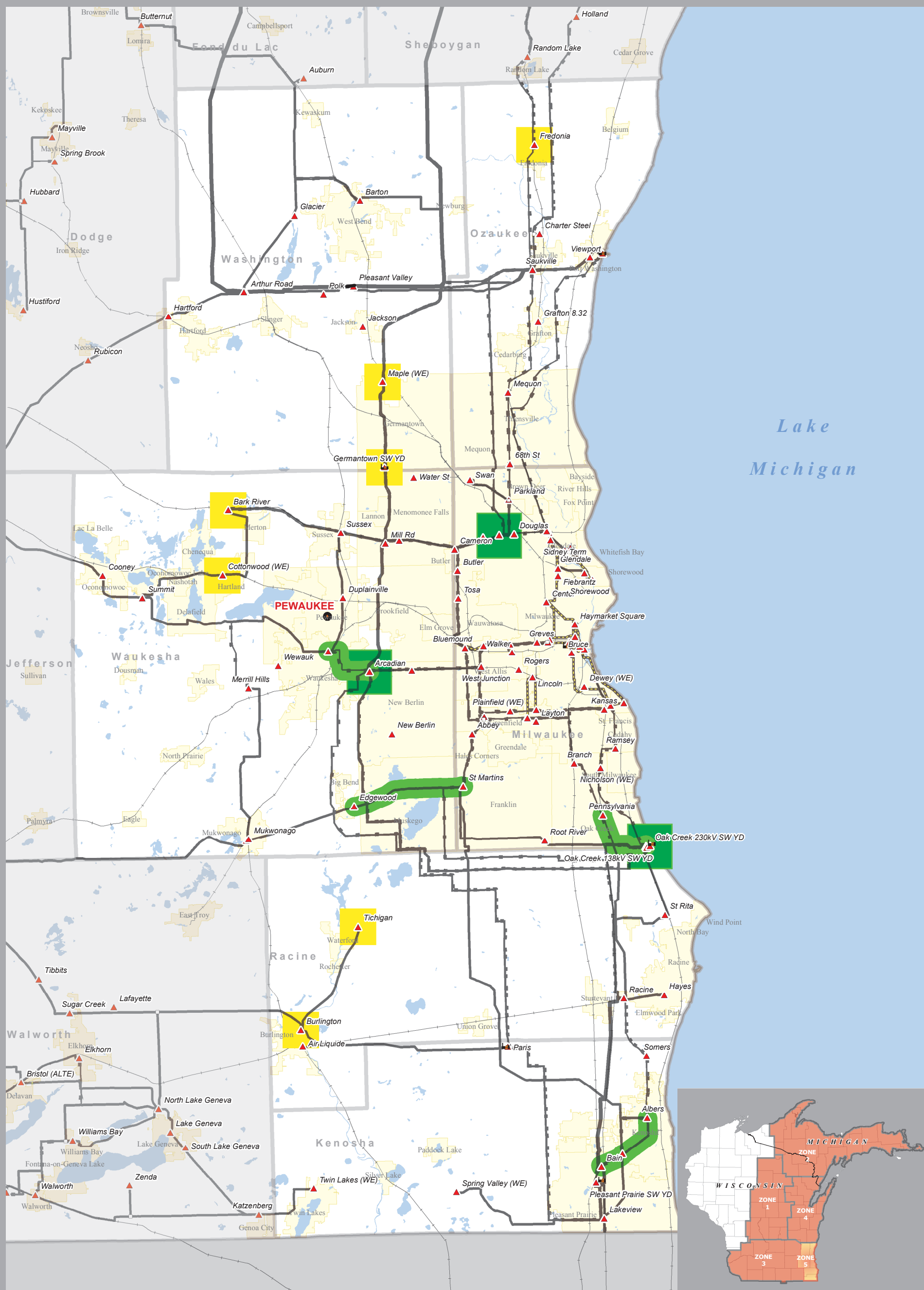


Currently, ATC owns or operates transmission facilities in 50 Wisconsin counties and in 15 Michigan counties. Facilities include:  
 \* Approximately 8900 miles of transmission lines  
 \* 98 wholly owned substations  
 \* 358 jointly owned substations  
 \* Offices in Madison (2), Cottage Grove, Pewaukee,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



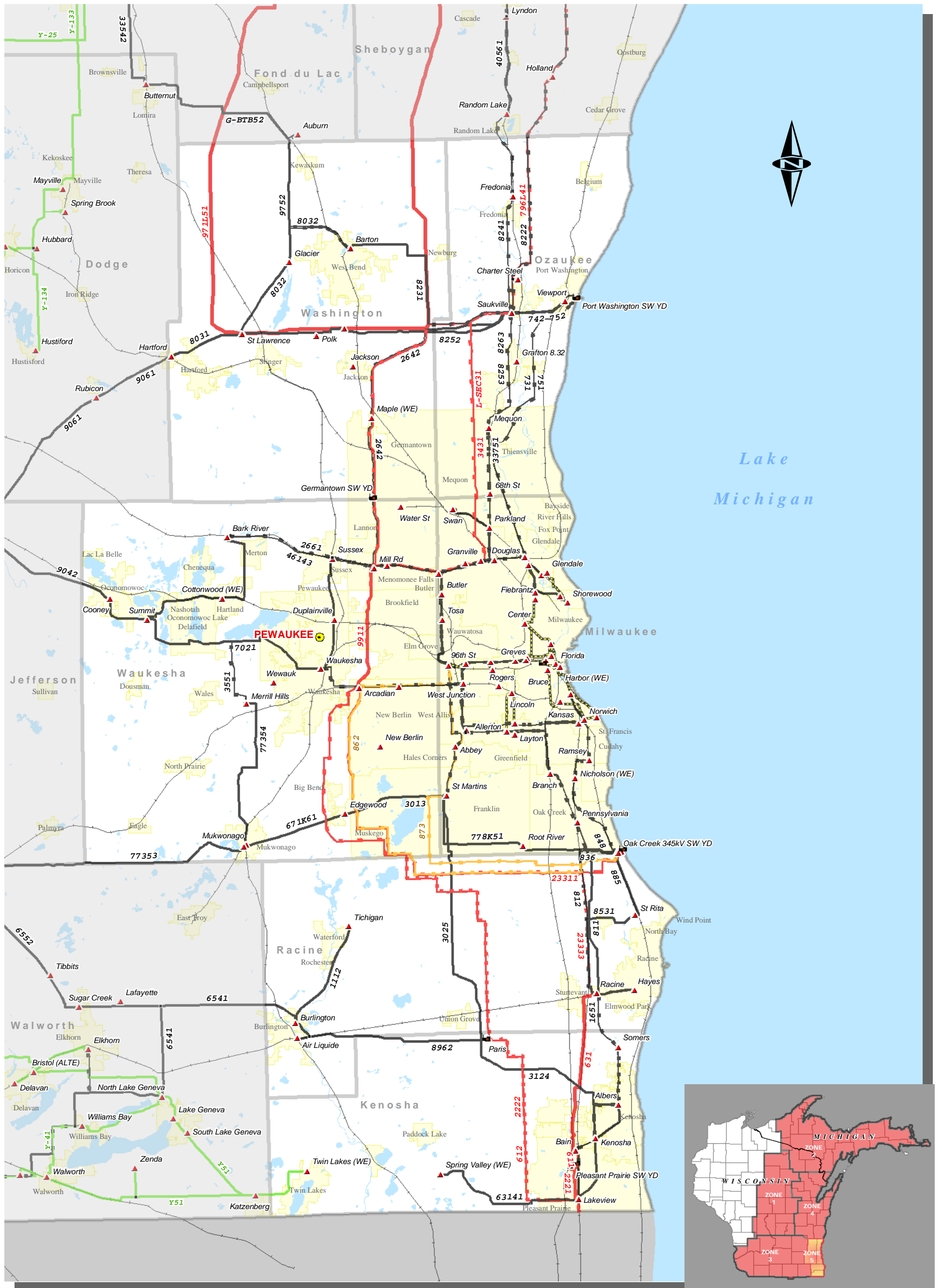
Performance Criteria Limits Exceeded and Other Constraints 2012-2015  
**PLANNING ZONE 5**

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.



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

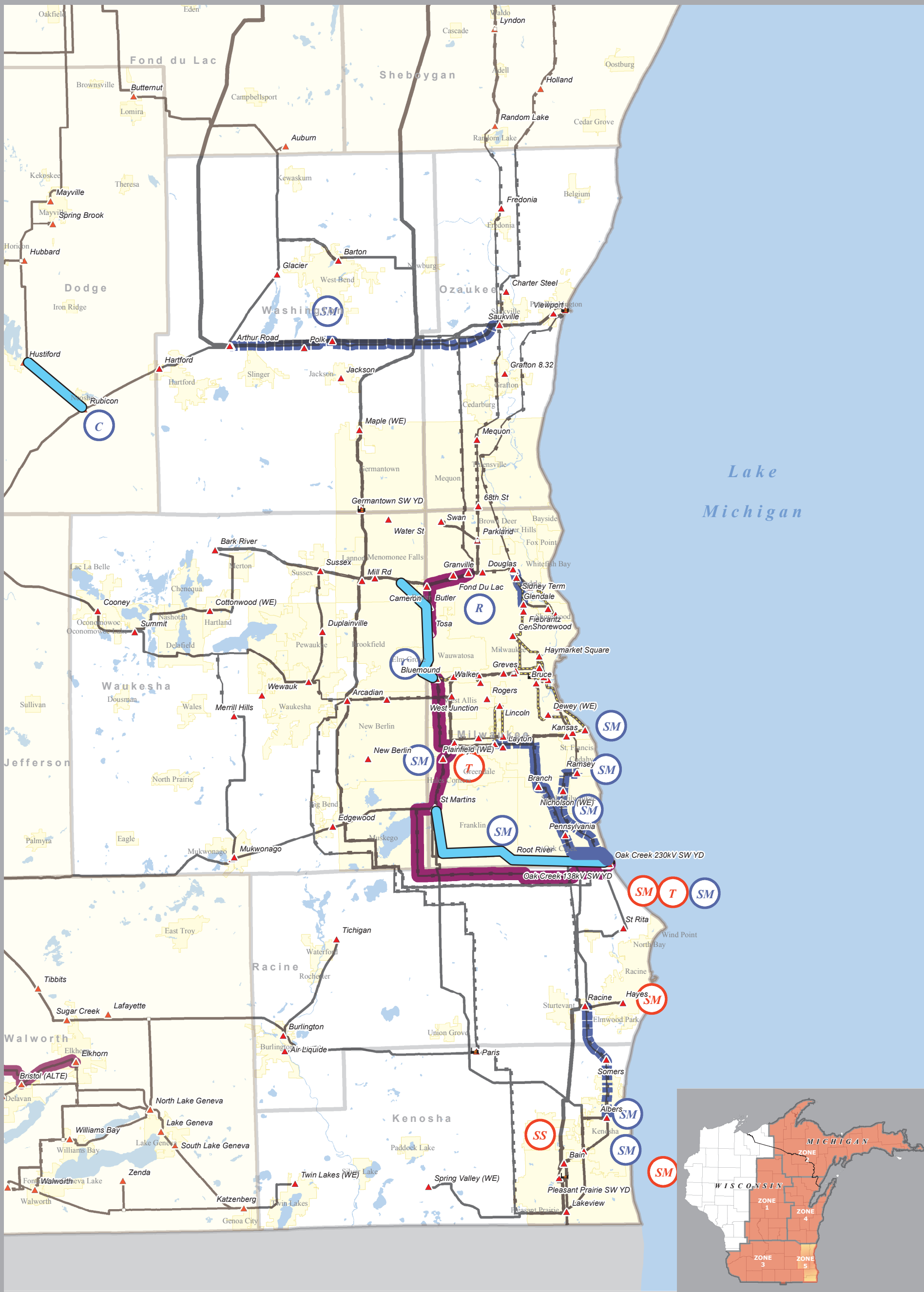


Currently, ATC owns or operates transmission facilities in 50 Wisconsin counties and in 15 Michigan counties. Facilities include:

- \* Approximately 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

- | Transmission Line Voltage |                       | Transmission Related Facilities |                                   |
|---------------------------|-----------------------|---------------------------------|-----------------------------------|
| 69 kV                     | 69 kV Double Circuit  | 69 kV Underground               | Substation or Switchyard          |
| 115 kV                    | 115 kV Double Circuit | 138 kV Underground              | ATC Office Location               |
| 138 kV                    | 138 kV Double Circuit | Non-ATC Line                    | Tap or Switching Structure        |
| 230 kV                    | 230 kV Double Circuit |                                 | Generation                        |
| 345 kV                    | 345 kV Double Circuit |                                 | Facility (Design or Construction) |

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



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

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

- 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
  - Other Facility
  - ATC Office Location
  - Generation



Table PR-17  
Transmission System Additions for Zone 5

System additions	System need year	Projected in-service year	Planning zone	Need category	Planned, Proposed or Provisional
Improve clearance on Kenosha-Lakeview 138-kV line KK9341	2006	2006	5	congestion, reliability	Proposed
Reconductor Pleasant Valley-Saukville 138-kV line	2008	2008	5	new generation	Planned
Reconductor Pleasant Valley-St Lawrence 138-kV line	2008	2008	5	new generation	Planned
Install series reactor at Cornell Substation	2007	2008	5	congestion, generator deliverability	Proposed
Install 200 MVAR capacitor bank at Bluemound Substation	2007	2008	5	reliability	Provisional
Replace relaying on 230-kV circuits at Oak Creek Substation	2009	2009	5	new generation	Proposed
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	Proposed
Expand Oak Creek 345-kV switchyard to interconnect one new generator	2009	2009	5	new generation	Proposed
Reconductor Oak Creek-Ramsey 138-kV line	2009	2009	5	new generation	Proposed
Reconductor Oak Creek-Allerton 138-kV line	2009	2009	5	new generation	Proposed
Install second 500 MVA 345/138-kV transformer at Oak Creek Substation	2009	2009	5	new generation	Proposed
Loop Ramsey5-Harbor 138-kV line into Norwich and Kansas to form new Ramsey-Norwich and Harbor-Kansas 138-kV lines	2009	2009	5	new generation	Provisional
Replace CTs at Racine 345-kV Substation	2009	2009	5	new generation	Proposed
Construct a 345-kV bus at Bain Substation	2005	2009	5	reliability	Provisional
Construct a 138-kV bus at Hale Substation to permit third Brookdale distribution transformer interconnection	2009	2009	5	T-D interconnection	Proposed
Construct a 138-kV bus at Pleasant Valley Substation to permit second distribution transformer interconnection	2009	2009	5	T-D interconnection	Proposed
Expand 345-kV switchyard at Oak Creek to interconnect one new generator	2010	2010	5	new generation	Proposed
Upgrade Oak Creek-Root River 138-kV line	2010	2010	5	new generation	Proposed
Upgrade Oak Creek-Nicholson 138-kV line	2010	2010	5	new generation	Proposed

**Table PR-17**  
**Transmission System Additions for Zone 5**

<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>
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
Expand Oak Creek 345-kV switchyard to interconnect three new generators plus one new 345-kV line and 138 kV switchyard to accommodate new St. Martins line	2013	2013	5	new generation	Provisional
Construct a 345/138-kV switchyard at Hale (Brookdale) to accommodate two 345-kV lines, a 500 MVA 345/138-kV transformer and 4-138-kV lines plus three 138-26.2 kV transformers	2013	2013	5	new generation	Provisional
Install two 345-kV line terminations at Pleasant Prairie and loop Zion-Arcadian 345-kV line into Pleasant Prairie Substation	2013	2013	5	new generation	Provisional
Construct an Oak Creek-Hale (Brookdale) 345-kV line installing 4 mi. new structures, converting 16.2 mi. of non-operative 230 kV and 5 mi. 138 kV	2013	2013	5	new generation	Provisional
Construct Oak Creek-St. Martins 138-kV circuit #2 installing 16.6 mi. conductor on existing towers	2013	2013	5	new generation	Provisional
Construct a Hale (Brookdale)-Granville 345-kV line converting/reconducting 5.6 mi. 138 kV, rebuilding 7 mi. 138-kV double-circuit tower line and converting/reconducting 3 mi. 138 kV on existing 345-kV structures	2013	2013	5	new generation	Provisional
Restring Bluemound-Butler 138-kV line (KK5051) on new 345-kV structures installed with Hale (Brookdale)-Granville line	2013	2013	5	new generation	Provisional
String Butler-Tamarack 138-kV line on new 345-kV structures installed with Hale (Brookdale)-Granville line	2013	2013	5	new generation	Provisional
Reconductor Cornell-Range Line 138-kV line	2014	2014	5	new generation	Proposed