



Zones & study results

Zone 1 overview

Zone 1 includes the Wisconsin counties of:

- Adams
- Forest (southwestern portion)
- Fond du Lac (northwest portion)
- Green Lake
- Juneau
- Langlade
- Lincoln
- Marathon
- Marquette
- Monroe (eastern portion)
- Oneida
- Portage
- Shawano (western portion)
- Vernon (eastern portion)
- Vilas (southern portion)
- Waupaca
- Waushara
- Winnebago (western portion)
- Wood

The physical boundaries of Zone 1 and transmission facilities located in Zone 1 are shown in Figure ZS-17.

Land use in Zone 1 is largely rural, including agricultural and forested areas.

Zone 1 typically experiences peak electric demands during the summer months, with some winter peaks appearing in the northern portion. Primary electricity users in Zone 1 include a number of large paper mills and food processing plants.

Zone 1 demographics

The population of the counties in Zone 1 grew at an annual rate of 0.5 percent from 1995 to 2005. The highest growth rate occurred in Adams County, which grew at 1.9 percent, while the highest increase in population occurred in Marathon County, which increased by 7,300 people over the period.

During the same period, the annual employment growth rate was 1.2 percent. The highest growth rate occurred in Adams County, while the largest increase in employment occurred in Marathon County.



Zone 1 future population and employment projections

Population in Zone 1 is projected to grow at 0.5 percent annually between 2001 and 2006 and is projected to grow at 0.7 percent from 2006 through 2011. From 2001 to 2006, Marathon County realized the largest increase in population, while Juneau County has the highest growth rate.

Employment in Zone 1 grew at 0.9 percent annually between 2001 and 2006 and is projected to grow at 1.1 percent from 2006 through 2011. From 2001 to 2006, Marathon County realized the largest increase in employment, while Adams County has the highest growth rate.

Zone 1 environmental considerations

Zone 1 covers the central and north-central portions of Wisconsin and spans a wide range of ecological landscapes varying from the Northern Highland and North Central Forest regions in the northern part of the zone through the Forest Transition, Central Sand Plains and Central Sand Hills regions to the Western Coulee and Ridges region in the southern portions of the zone. Descriptions of the characteristics of each of these ecological landscapes may be found on the Wisconsin Department of Natural Resources Web site: http://www.dnr.state.wi.us/org/land/er/publications/cw/Ecological_landscapes.asp

The northern portion of the zone contains numerous lakes and woodlands, while the southern portion is more agricultural in nature. Lands in this zone primarily are located in the Upper and Central Wisconsin River drainage basins with smaller portions of the zone located in the Fox and Wolf River drainage basins. The Necedah and Fox River National Wildlife Refuges, a small portion of the Nicolet National Forest and several Indian reservations are located in this planning zone.

Zone 1 electricity demand and generation

The coincident peak load forecasts for Zone 1 for 2007, 2011 and 2015 are shown in Table ZS-7. Existing generation, along with proposed generation based on projected in-service year, also is shown. The resultant difference between load and generation, with or without the proposed generation, is shown as well.

The table shows that load is projected to grow at roughly 2.4 percent annually from 2007 through 2015. Comparing load with generation (at maximum output) within the zone indicates that Zone 1 is a net importer of power during peak load periods.

Zone 1 transmission system issues

Key system performance issues in Zone 1 include:



- the load serving capability of the 115-kV loop in northern Zone 1 (Rhineland Loop), including voltage stability,
- the load serving capability of the 138-kV and 69-kV network in southern Zone 1,
- reclosure angle on the Eau Claire-Arpin 345-kV line. This issue can limit the allowable flow on this line. Stability issues can arise if the reclosure angle is too large after a trip of this line.
- operating guides for lower voltage facilities for loss of either the Eau Claire-Arpin or Arpin-Rocky Run 345-kV lines. In particular, the Monroe County-Council Creek 69-kV line and the T Corners-Wien 115-kV line are susceptible to tripping for loss of the Eau Claire-Arpin 345-kV line. For the loss of the Arpin-Rocky Run 345-kV line, the 138-kV system south of Arpin and the 115-kV system north of Arpin are susceptible to overloads. These conditions strain the load serving capability of the network in Zone 1.
- The outage of the Weston Unit 3 generator can result in potential voltage collapse and system instability in the area and can aggravate the Eau Claire-Arpin flow limit issues.
- A fourth large generator will be added at the existing Weston generation station in the Wausau area. Generator interconnection studies were performed indicating that additional 345-kV lines will be required along with upgrades to existing lower voltage facilities.

Zone 1 - 2007 study results

Refer to Table ZS-1 and Figure ZS-1

Summary of key findings

- The Rhineland Loop will require additional interconnections to other portions of the system in order to reliably serve load in the 2008 to 2010 timeframe.
- Interim operating procedures are in place to deal with heavy flows in part due to parallel path flows and imports into the ATC system.
- Construction activity associated with the future completion of the Arrowhead-Gardner Park 345-kV line poses a near-term challenge to our system. The Arrowhead-Gardner Park 345-kV line will significantly reduce or potentially preclude the need for certain operating guides currently in use, will improve system stability and, in concert with other lower-voltage projects, will improve import capability.
- In order to accommodate the proposed generation in the Wausau area, an additional 345-kV line will be required. The difference between the in-service dates of the proposed generation and the 345-kV line needed for the generation will require that lower-voltage upgrades take place before the generation is placed in service with operating restrictions until the 345-kV line is energized.
- Low voltages at and near the Council Creek substation in the Tomah area will require that a combination of reinforcements be implemented to reliably serve load in the future.



10-Year Assessment

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2006

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In Zone 1, there were a number of facility overloads, several facilities near their emergency ratings, low voltages in the Rhinelander Loop and impending low voltages under contingency throughout the zone. In addition, the need exists to address potentially heavy flows due in part to parallel path flows on certain ATC facilities during non-peak periods and to keep the system intact during outages of the Eau Claire-Arpin and Arpin-Rocky Run 345-kV lines.

We anticipate that the parallel path flow and import issues will be addressed in large part by the planned Arrowhead-Gardner Park 345-kV transmission line project and other lower-voltage projects. However, the projected in-service date for the Arrowhead-Gardner Park project is the end of June 2008, so interim mitigation measures will be necessary to ensure continued reliable transmission service. We expect that modifications to existing operating guides dealing with parallel path flow and imports will be utilized prior to the completion of the Arrowhead-Gardner Park project.

For Arrowhead-Gardner Park, the current plan is to construct the 345-kV line project in phases. In the first phase, new 345- and 115-kV switchyards (Gardner Park Substation) will be constructed on the Weston Power Plant site along with the southern portion of the Arrowhead-Gardner Park line, from Gardner Park to Stone Lake. The Gardner Park substation was completed in the spring of 2006 while the Gardner Park-Stone Lake line is scheduled to be completed in late 2006.

The Arrowhead-Gardner Park project initially will require the development of the following 345- and 115-kV facilities at the new Gardner Park Substation:

- a new, four-position 345-kV ring bus to accommodate the new Arrowhead-Gardner Park 345-kV line,
- terminating the existing Weston-Rocky Run 345-kV line,
- two new 500 MVA, 345/115-kV transformers at Gardner Park instead of Weston Substation,
- a new, six-position 115-kV breaker and one-half bus to accommodate the above two 500 MVA transformers and other 115-kV facilities better terminated at Gardner Park instead of Weston,
- two short 115-kV transmission lines connecting the existing Weston 115-kV substation to the new Gardner Park Substation and
- relocating two of the existing 115-kV lines currently terminated at the existing 115-kV Weston bus. Power flow studies and routing constraints at Weston have indicated that moving the Weston-Kelly and the Weston-Blackbrook 115-kV lines to the new Gardner Park Substation provide the optimum network benefits.

At Stone Lake, a 345/161-kV transformer is proposed to be installed and connected to the Gardner Park -Stone Lake line. The existing Stone Lake-Stinson 161-kV line will then be taken out of service and construction on the northern portion of the Arrowhead-Gardner Park line, from Stone Lake to Arrowhead, will begin on the Stone Lake-Stinson right-of-



way. The 345/161-kV transformer at Stone Lake is needed to provide support in northwest Wisconsin, while the Stone Lake-Stinson right-of-way is under construction. The portion of the line from Stone Lake to Stinson will be built as a double-circuit line, carrying the Arrowhead-Gardner Park 345-kV circuit and the Stone Lake-Stinson 161-kV circuit.

ATC evaluated several potential options for making the temporary expansion of the Stone Lake substation permanent. Because of the network benefits this interconnection provides, we have decided to pursue this substation expansion as a permanent facility. As noted above, a 345/161-kV transformer will be installed at Stone Lake during construction of the northern portion of the Arrowhead-Gardner Park line to support the system during the construction-driven outage of the Stone Lake-Stinson 161-kV line. Making this installation permanent will provide long-term support to the northern Wisconsin system and improve the operating characteristics of the Arrowhead-Gardner Park 345-kV line. Other related projects include installation of capacitor banks and an inductor bank for both switching and operating the Arrowhead-Gardner Park line.

The steady state and voltage stability studies for the reactive support requirements for the Arrowhead-Gardner Park 345-kV line indicate the following capacitor installations as the configurations providing the most system benefits:

- Two 75 MVAR capacitor banks at the Arrowhead 345-kV bus
- One 75 MVAR capacitor bank at the Stone Lake 345-kV bus
- Three 50 MVAR capacitor banks at the Gardner Park 115-kV bus

There are a number of projects associated with the Arrowhead-Gardner Park 345-kV line needed to achieve the level of import capability contemplated in the Wisconsin Reliability Assessment Organization report. ATC's projects include constructing a 345-kV switchyard at Weston, replacing the existing 345/115-kV transformer at Weston, rebuilding the Kelly-Whitcomb and the Weston-Northpoint 115-kV lines and installing capacitor banks at Weston, Arrowhead and Rocky Run. The Kelly-Whitcomb and Weston-Northpoint projects are discussed in more detail below.

In addition to the Arrowhead-Gardner Park facility additions at the Weston Power Plant site, a new 550-MW generator also has been proposed at this site. This generator is currently under construction with a projected in-service date of June 2008. We have conducted generator interconnection studies and transmission service studies to ensure the generator can be operated without stability limitations and the output of the generator can be delivered reliably. The analyses showed that the addition of the proposed generator will cause overloads and system instability if the transmission system in this area is not reinforced. The analysis indicates that a new 345-kV line from Weston is needed to maintain stability and to deliver the generator output, in addition to the Arrowhead-Gardner Park 345-kV line.



Based on the results of the Weston generator studies, we are proposing the following transmission project. Appropriate applications to the Public Service Commission of Wisconsin have been developed and were submitted to the PSCW in March 2005. The PSCW recently approved our application in July 2006.

- Construct a new 345-kV line from the Gardner Park Substation to a new substation, currently called Central Wisconsin, located near the midpoint of the proposed Morgan-Werner West 345-kV line (near Shawano). We are proposing to license, construct and put this line in service by December 2009.

The scheduled in-service date for the new Weston 550-MW generator is June 2008, and the projected in-service date for the Gardner Park-Central Wisconsin 345-kV line is December 2009. Based on the 18-month in-service date difference between the generator and 345-kV line project, additional studies were performed to determine if any feasible projects exist for delivery of all or a portion of the generator capacity prior to the in-service date of the Gardner Park-Central Wisconsin 345-kV line project. The interim transmission service and generator interconnection studies identified the following projects that will allow the generator to operate during this interim period under certain operating limitations and restrictions. Full generator operation, without restrictions, will not be allowed until all required 345-kV lines are placed in service.

- reconductor Weston-Northpoint 115-kV line
- uprate Weston-Kelly 115-kV line
- rebuild Weston-Sherman St. and Sherman St.-Hilltop 115-kV lines as double circuits with the second circuit on each section being the new Gardner Park-Hilltop 115-kV circuit
- uprate Kelly-Whitcomb 115-kV line

Based on a recent inspection of the Weston-Northpoint 115-kV line it was determined that the existing wood structures were in poor condition. This resulted in this project being split into two separate projects to help secure the transmission system for construction related outages and cutovers associated with the Arrowhead-Gardner Park and the Weston G4 projects in the Wausau area. The first phase of this project will consist of increasing the conductor clearance of the existing conductor to 300F. This work was completed in early 2006. The second phase of this project consists of reconductoring and rebuilding the circuit with new structures and a larger conductor. This portion of the project will be deferred to a December 31, 2007 in-service date. All structures replaced in the first phase of this project will be designed to accommodate the larger conductor called for in the initial project scope. The work included in phase two consists of the majority of the overall work and will require ATC to file for a Certificate of Authority (CA) with the PSCW. The application was filed with the PSCW in March 2006.

To address overloads and achieve the desired emergency ratings on the Weston-Kelly and Kelly-Whitcomb 115-kV lines, we are recommending that line clearances be increased to 300 degrees F and substation facilities be upgraded at the Kelly Substation. The work



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required to upgrade the Weston-Kelly 115-kV circuit was completed in early 2006. The new 115-kV line between the Gardner Park and Hilltop Substation in the Wausau area is proposed to address the overloads on the two parallel Weston-Sherman Street 115-kV lines. This project was approved by the PSCW in May 2006. The Weston-Sherman Street (O-41) and Sherman Street-Hilltop single circuit H-frame lines will be replaced with double-circuit structures. The Weston-Sherman Street and Sherman Street-Hilltop 115-kV lines will retain their original terminations at the Weston, Sherman Street and Hilltop substations. The second circuit on each section will be the proposed new 115-kV circuit and will terminate at the Gardner Park and Hilltop substations. This project is being recommended instead of rebuilding the existing two parallel Weston – Sherman Street 115-kV lines to avoid rebuilding the Sherman Street Substation at a significant investment and to reduce the risk to the Wausau area because of the outage requirements that would be needed to rebuild the Sherman Street Substation. It also addresses one of the more significant outages for the Rhinelander Loop by providing a parallel path to the Sherman Street-Hilltop 115-kV line.

For the heavy flows on and the contingency separation of certain 69-kV and 138-kV facilities on the western edge of our service territory, the primary solution would be the Arrowhead-Gardner Park project. However, as noted above, this project is not expected to be in service until the end of June 2008. Several potential projects have been evaluated to address the separation of the ATC-Dairyland Power Cooperative facilities at the Council Creek Substation. They include a phase-shifting transformer, series reactor, capacitor banks, operating guides, or a combination. To address the near-term pre- and post-contingency issues, capacitor banks were installed on the Council Creek 138-kV bus in 2006 in combination with the continued use of the Council Creek operation guide. We also are working in cooperation with Dairyland Power Cooperative and Xcel Energy to develop a more comprehensive long-term solution to address reliability issues in the Tomah area as well as the limitations of the Monroe County-Council Creek transmission corridor. The proposed solution will be to replace the existing 69 kV circuit between the Monroe County and Council Creek Substations with a new 161/69 kV double circuit line in 2010. The Monroe County-Council Creek 161-kV line will also drive an upgrade to the Petenwell-Saratoga 138-kV line.

The portion of the transmission system referred to as the Rhinelander Loop consists of the 115-kV facilities in north central Wisconsin or, more specifically, the 115-kV network north of Wausau. The Rhinelander Loop is particularly sensitive to low voltage during certain contingencies. A primary reason for this condition is that loads within the Rhinelander Loop during recent summers have exceeded what had been forecasted prior to ATC's formation. This higher-than-anticipated load growth has accelerated the potential for such low voltages under single contingency conditions.

As part of the analyses of potential solutions for the Rhinelander Loop, we considered additional system issues that needed to be addressed on the adjacent 69-kV network to the



north of the Rhinelander Loop (in Zone 2) and transfer capability needs between Wisconsin and Michigan's Upper Peninsula.

Due to the severity of the problems, it was necessary to address the needs of the Rhinelander Loop in stages. The short-term solution, that is, projects that were implemented prior to 2005 to address the immediate needs of the loop, included the conversion of WPS's 46-kV system between Pine-Grandfather-Tomahawk-Eastom to 115 kV and constructing a new 115-kV line between Skanawan and Highway 8 substations. The conversion was completed in early May 2004 and the new 115-kV line was completed in June 2005.

Alternatives considered as longer-term solutions for the Rhinelander Loop limitations include:

- rebuilding additional portions of the Rhinelander Loop,
- constructing a new 115-kV or 138-kV line from Cranberry north to Conover combined with the conversion of the Conover-Plains or Conover-Winona 69-kV lines to 138 kV,
- constructing a new 115-kV or 138-kV line from Venus east to the Amberg or Plains substations or tie into the Plains-Morgan 345-kV line near Dunbar,
- constructing a new 115-kV line from Clear Lake west to the Park Falls Substation (Xcel Energy),
- constructing a new 115-kV or 345-kV line from Weston north to Venus, or
- a combination of the above.

Based on analyses, our preferred longer-term solution is a specific part of the second bullet above, constructing a Cranberry-Conover 115-kV line and rebuilding the Conover-Iron River-Plains 69-kV line and converting to 138-kV operation. This alternative addresses the longer-term reliability issues of the Rhinelander Loop, provides substantial voltage support to the 69-kV system in the western portion of the Upper Peninsula and addresses potential long-term condition issues due to the age of the existing 69-kV system. The new 115-kV line between Cranberry and Conover is needed by January 2008, specifically to accommodate a transmission service request, with the remainder of the project needed by 2010 to meet reliability standards for serving the Rhinelander Loop. The 2010 date for the Conover-Plains portion of the project is only permissible by implementing some interim procedures and solutions. Without the Conover-Plains portion of this solution, overloads and voltage issues begin to reappear in the Wausau/Rhinelander Loop area in this timeframe.

To address low voltages elsewhere in Zone 1, capacitor banks are needed at the Summit Lake and Wautoma substations in 2006 and 2007. To address facility overloads, the Metomen-North Fond du Lac 69-kV line needs to be uprated and the Wien-Stratford-McMillan 115-kV line needs to be reconducted. Minor facility upgrades were implemented to allow for the deferral of the Wien-Stratford-McMillan reconductor project from 2005 to



2006 to better align with available construction resources and outage requirements. Overloads on the Arpin 345/138-kV transformer and Arpin-Sigel 138-kV line are being addressed by the Arpin Operating Guide. The low voltages at the Council Creek 138-kV Substation are being addressed through manual control of load tap changers on the Council Creek 138/69-kV transformer and the installation of a capacitor bank in 2006. Completion of the Arrowhead-Gardner Park 345-kV line should provide additional relief.

In response to customer requests for new distribution interconnections, a new 115-kV transmission line is planned in 2007 from the Venus Substation to a new Metonga Substation to be sited on the southwest side of Crandon. Also, a new substation will be constructed adjacent to the existing Cranberry Substation near Eagle River to accommodate a new distribution transformer in response to customer requests for new transmission interconnections. A new distribution interconnection, Fairwater, in the greater Ripon area is currently under evaluation that will require a new 69-kV transmission line. The proposed Fairwater Substation will require a new radial 69-kV line be extended from the Brandon 69-kV Substation.

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

Metomen-North Fond du Lac 69-kV line uprate: Although this project appears with a need date of 2006, interim operating steps are available to avert this overload until the project is in service in 2007.

Zone 1 - 2011 study results

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

Summary of key findings

- ❑ The Rhinelander Loop will require additional reinforcement prior to and sometime after 2008. One alternative, a 115-kV line from Cranberry to Conover combined with the conversion of the Conover-Iron River-Plains 69-kV system to 138 kV, will considerably improve the load serving capability of the Rhinelander Loop transmission system. Also, it is anticipated that another source to the Loop, in addition to the Cranberry-Conover-Plains project, will be needed at some point beyond the current planning horizon.
- ❑ Accommodating the proposed new generation at the Weston Power Plant will play a role in defining many of the larger system reinforcement projects within Zone 1.
- ❑ The Arrowhead-Gardner Park 345-kV line project is an integral part of solutions to a variety of Zone 1 issues.
- ❑ Overloaded 115-kV facilities in and around the Wausau area will require that a combination of reinforcements be implemented.
- ❑ Low voltages and overloaded 69-kV facilities around the Berlin-Ripon area will necessitate a combination of reinforcement projects.



Similar to and in addition to the 2007 results, there were a number of facilities overloaded and several others were near their emergency ratings within Zone 1. After the completion of the short-term Rhinelander Loop projects, low voltages begin to reappear in the Rhinelander Loop. Under single contingency conditions, impending low voltages are seen throughout the zone including the northern Wausau area.

As discussed in the 2007 analysis, ATC's preferred alternative to address the low voltages within the Rhinelander Loop is to construct a Cranberry-Conover 115-kV line in combination with the rebuilding of the Conover-Iron River-Plains 69-kV line and converting to 138-kV operation. This alternative not only addresses intermediate and longer-term reliability needs of the Rhinelander Loop, but it also provides immediate support and future reinforcement flexibility to the transmission system in the western portion of the Upper Peninsula. See [Zone 1 - 2007 study results](#) for additional details outlining the alternatives that were evaluated to address this system issue.

In the 2008 - 2010 timeframe, several 115-kV lines in the Wausau area are either overloaded or are approaching their emergency ratings. These system conditions are not only caused by existing network issues, but also are aggravated by the addition of the proposed generation at Weston. The 115-kV lines in question are the two parallel Weston-Sherman Street 115-kV lines and the Weston-Kelly 115-kV line. See [Zone 1 - 2007 study results](#) for details regarding the solutions to these system limitations. Also, two additional 115-kV lines in the Wausau area are near their emergency ratings: Sherman Street-Hilltop-Maine and the Weston-Blackbrook 115-kV lines. The impending overload of the Sherman Street-Hilltop 115-kV line will be addressed by the new Gardner Park-Hilltop 115-kV line solution discussed in the [Zone 1 - 2007 study results](#), while the Weston-Blackbrook 115-kV line will require the upgrading of terminal equipment along with some conductor replacements. The Arrowhead-Gardner Park 345-kV line and associated projects discussed in the [Zone 1 - 2007 study results](#) are integral parts of the solution to several Zone 1 issues.

To address low voltages and overloads elsewhere within Zone 1, additional capacitor banks will be needed at the Berlin Substation in 2008 and at the Ripon Substation in 2011. The Metomen 138/69-kV transformer will also need to be upgraded in 2010.

Zone 1 - 2015 study results

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

Summary of key findings

- ❑ The Rhinelander Loop will require additional reinforcements at some time beyond the current planning horizon. These reinforcements will consist of smaller projects, such as expansion of existing or new capacitor bank installations and eventually



more robust reinforcements like an additional transmission source into the Rhinelander Loop.

- ❑ Low voltages and line overloads in the greater Berlin/Ripon area will require that a new source be connected to the existing 69-kV network.

Many alternatives have been evaluated as long-term solutions for the Rhinelander Loop as discussed in the 2007 and 2011 sections. Not included in preceding discussions were potential 345-kV alternatives because the lead-time needed to implement such projects far exceeds the date needed. Of the 345-kV alternatives that have been evaluated, the best performing project consisted of a new Gardner Park-Venus-Plains 345-kV line utilizing the existing 345-kV facilities between Gardner Park and Black Brook. Although this 345-kV alternative meets the needs for the Rhinelander Loop for the foreseeable future, we currently are favoring a lower-voltage and lower-cost solution.

To address Rhinelander Loop voltage and thermal loading issues beyond the planning horizon, potential alternatives, in addition to the 345-kV projects described above, could include the following:

- ❑ stringing the second 115-kV circuit on the proposed Cranberry-Conover structures
- ❑ constructing a new 138-kV line from Metonga to the Plains or Amberg substations and/or
- ❑ the addition of another 115-kV circuit serving the Rhinelander Loop from the south by rebuilding select 115-kV facilities as double-circuit lines.

Unless other need drivers appear, the lower-voltage solutions may be the best suited for area needs.

To address low voltages elsewhere within Zone 1, new or additional 69-kV capacitor banks will be needed at the McKenna Substation in 2013 and the Hilltop Substation in 2016. To address facility overloads, we propose to install a second 138/69-kV transformer at Wautoma Substation to address the Sand Lake and Wautoma transformer loading issues. To address maintenance, voltage and thermal issues in the greater Berlin/Ripon area a reconfiguration of the North Randolph-Ripon 69-kV line is proposed. A new 69-kV line will connect the Fairwater and Mackford Prairie substations forming a new 69-kV line from North Randolph to Metomen Substation. The northern portion of the existing Mackford Prairie Tap-Ripon 69-kV line will then be extended into a vacant terminal position at Metomen Substation, creating a second Ripon-Metomen 69-kV line. This will allow for the retirement of a portion of the North Randolph-Ripon circuit between Metomen and Mackford Prairie substations which is where a significant portion of the maintenance issues are located.

**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 Sigel-Arpin 138-kV line outage		90 – 95%		--
1	Sand Lake 138/69-kV transformer	95 – 101%		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, 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, Artesian, 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	Germentown 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

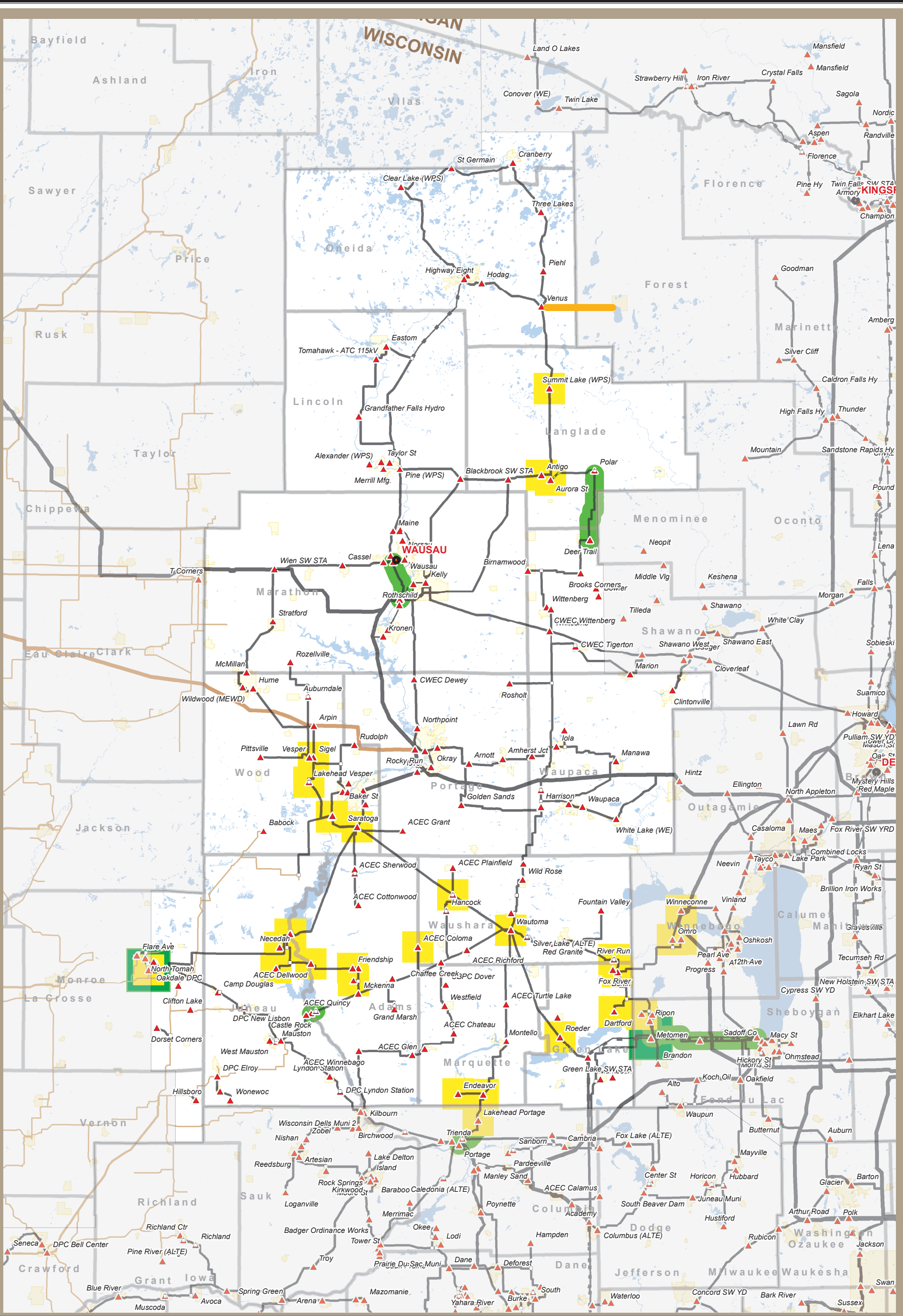
**TABLE ZS-3
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2015 Peak Summer Case (continued)**

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-7
Forecast of Peak Load and Generation in Zone 1*

	2007	2011	2015
Peak Forecast (megawatts)	1763.7	1945.4	2127.6
Average Peak Load Growth	N/A	2.48%	2.26%
Existing Generation Capacity (megawatts)	747	747	747
Existing Capacity Less Load	-1016.7	-1198.4	-1380.6
Existing Generation Capacity plus Modeled Generating Capacity Additions (megawatts)	747	1297	1297
Modeled Capacity Less Load (megawatts)	-1016.7	-648.4	-830.6

*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 1



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

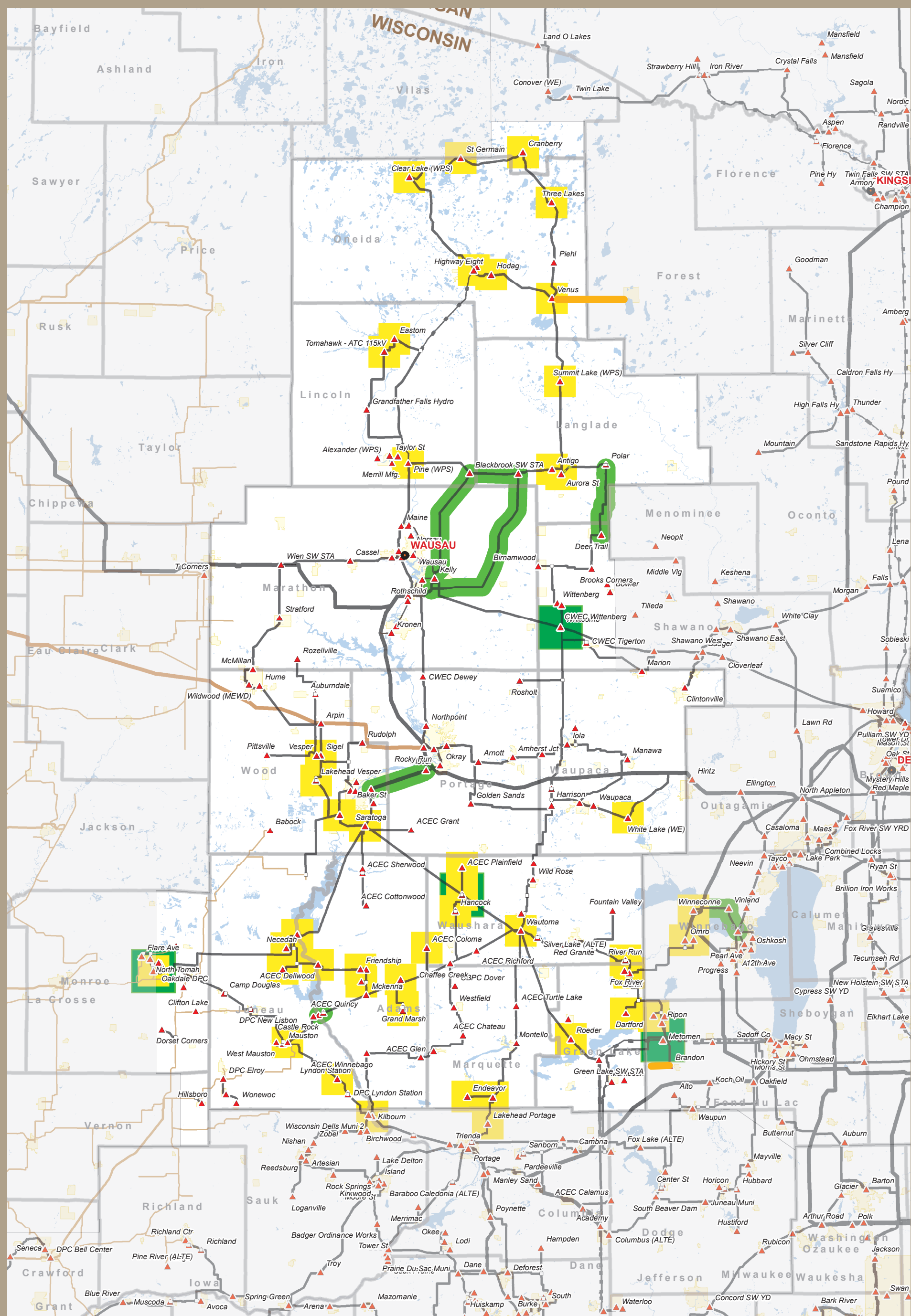
- Low Voltages
- Overloaded Facility
- New Generation/Stability
- Transmission Needed for Load Growth

Transmission 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.

Figure ZS-2



Performance Criteria Limits Exceeded and Other Constraints 2008-2011

PLANNING ZONE 1



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

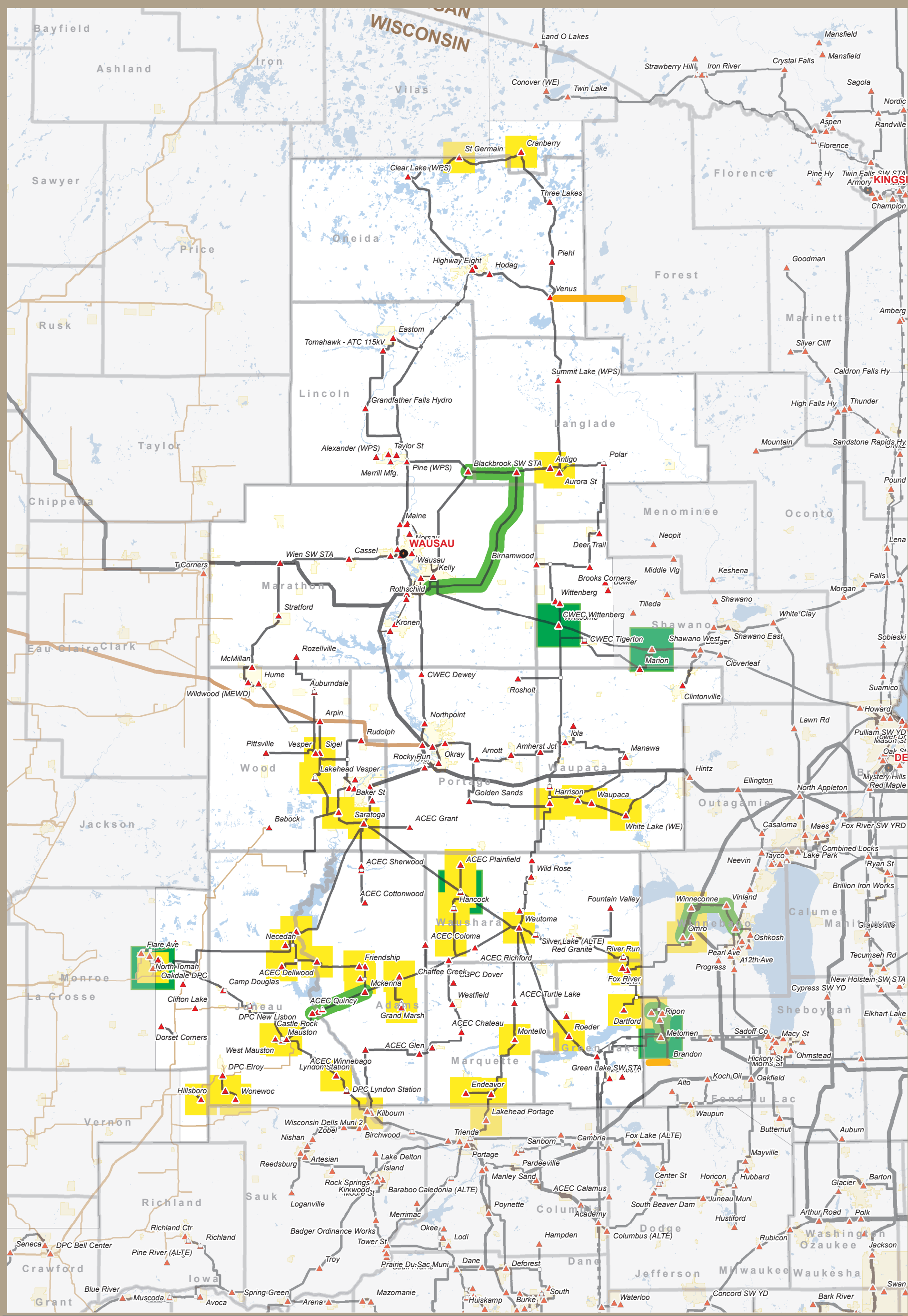
- Low Voltages
- Overloaded Facility
- New Generation/Stability
- Transmission Needed for Load Growth

Transmission 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.

Figure ZS-3



Performance Criteria Limits Exceeded and Other Constraints 2012-2015

PLANNING ZONE 1



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

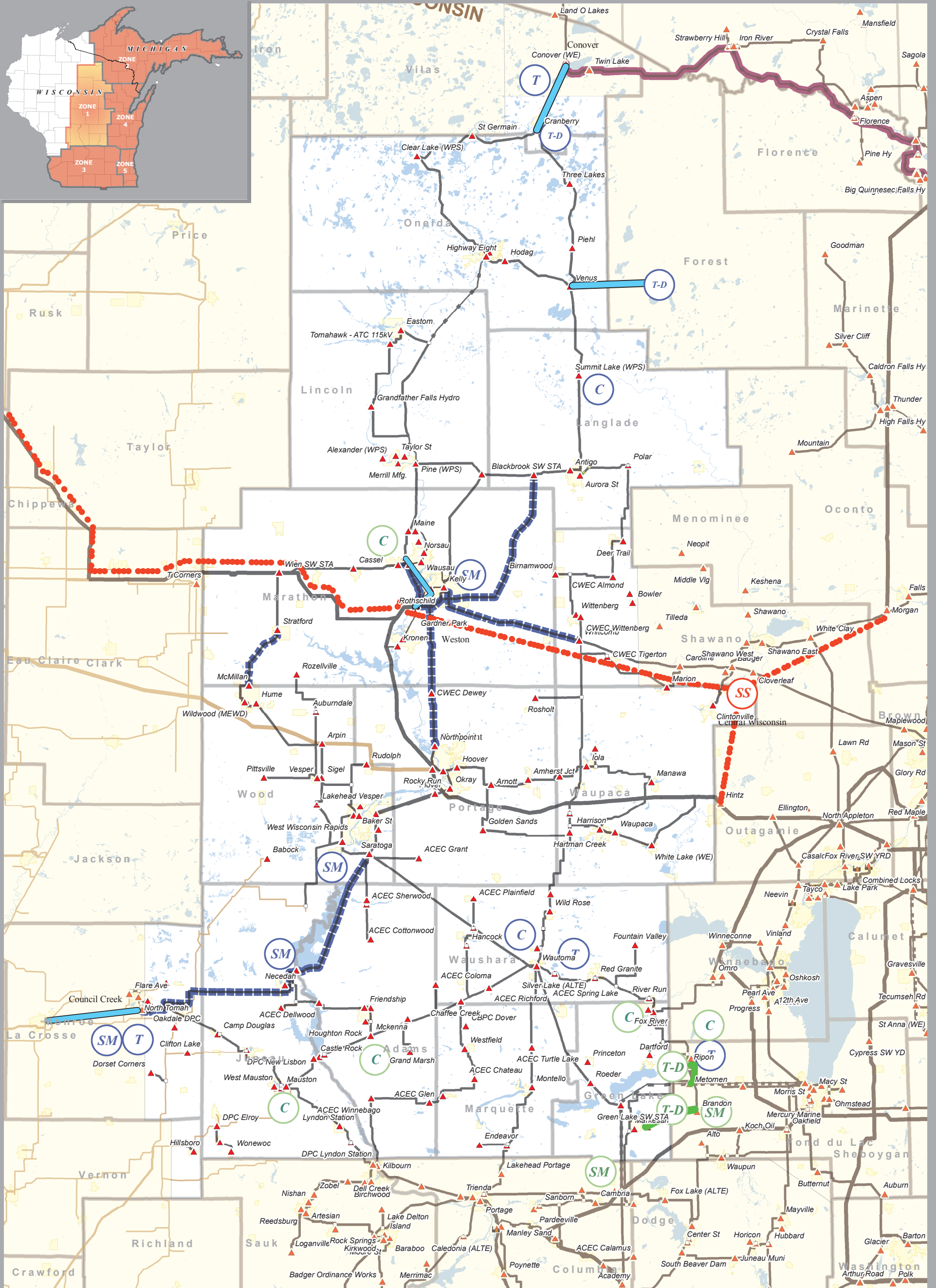
- Low Voltages
- Overloaded Facility
- New Generation/Stability
- Transmission Needed for Load Growth

Transmission 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.

Figure PR-1



Transmission System Additions (May be Planned, Proposed or Provisional)

PLANNING ZONE 1



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

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

- Transmission Related Facilities**
- ▲ Substation, Switchyard or Terminal
 - ▲ ATC Office Location
 - Proposed/Design/Construction
 - 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.

Table PR-13
Transmission System Additions for Zone 1

System additions	System need year	Projected in-service year	Planning zone	Need category	Planned, Proposed or Provisional
Install a 345/161-kV transformer at Stone Lake Substation (temporary installation for construction outages)	2006	2006	1	reliability	Planned
Construct Gardner Park-Stone Lake 345-kV line	1997	2006	1	service limitation, reliability, import capability & Weston stability	Planned
Reconductor Stratford-McMillan 115-kV line (MEWD portion)	2006	2006	1	reliability	Planned
Construct new Eagle River Muni distribution substation directly adjacent to the existing Cranberry 115-kV Substation	2006	2006	1	T-D interconnection	Planned
Increase size of existing Summit Lake 115-kV capacitor bank from 11.3 to 16.9 MVAR	2006	2006	1	reliability	Planned
Rebuild Weston-Sherman St. and Sherman St.-Hilltop 115-kV lines as double circuits with a new Gardner Park-Hilltop 115-kV line	2007	2007	1	new generation, reliability	Planned
Reconductor Weston-Northpoint 115-kV line	2007	2007	1	achieve transfer capability associated with Arrowhead-Gardner Park, reliability, new generation	Planned
Construct Venus-Metonga 115-kV line	2007	2007	1	T-D interconnection	Planned
Upgrade Metomen-North Fond du Lac 69-kV line terminal equipment	2006	2007	1	reliability	Planned
Install 2-24.5 MVAR capacitor banks at the Wautoma 138-kV and one-16.33 MVAR capacitor bank at the 69-kV Substation	2007	2007	1	reliability	Planned
Upgrade Kelly-Whitcomb 115-kV line conductor clearances to 300F	2008	2008	1	achieve transfer capability associated with Arrowhead-Gardner Park	Planned
Construct Stone Lake-Arrowhead 345-kV line	1997	2008	1	service limitation, reliability, import capability & Weston stability	Planned
Construct the new permanent Stone Lake 345/161-kV Substation	2008	2008	1	reliability, import capability & Weston stability	Planned
Install 1-75 MVAR capacitor bank and 1-45 MVAR inductor at Stone Lake 345-kV Substation	2008	2008	1	achieve transfer capability associated with Arrowhead-Gardner Park	Planned
Construct new Arrowhead 345-kV Substation, install 2-75 MVAR capacitor banks, 1-800 MVA PST and 1-800 MVA 345/230-kV transformer	2008	2008	1	achieve transfer capability associated with Arrowhead-Gardner Park	Planned

**Table PR-13
Transmission System Additions for Zone 1 (continued)**

System additions	System need year	Projected in-service year	Planning zone	Need category	Planned, Proposed or Provisional
Construct Cranberry-Conover 115-kV line	2008	2008	1	reliability, transfer capability	Planned
Upgrade 4.1 MVAR capacitor bank to 8.2 MVAR and install a new 8.2 MVAR capacitor bank at Berlin 69-kV Substation	2008	2008	1	reliability	Planned
Construct Brandon-Fairwater 69-kV line	2008	2008	1	T-D interconnection	Proposed
Construct Gardner Park-Central Wisconsin 345-kV line	2009	2009	1	service limitation, reliability, import capability and Weston stability	Planned
Construct new Central Wisconsin 345-kV Substation	2009	2009	1	service limitation, reliability, import capability and Weston stability	Planned
Construct Monroe County-Council Creek 161-kV line	2010	2010	1	access initiative, reliability	Provisional
Install a 161/138-kV transformer at Council Creek Substation	2010	2010	1	access initiative, reliability	Provisional
Upgrade Council Creek-Petenwell 138-kV line	2010	2010	1	access initiative, reliability	Provisional
Rebuild/reconductor Petenwell-Saratoga 138-kV line	2010	2010	1	access initiative, reliability	Provisional
Replace 138/69-kV transformer at Metomen Substation	2010	2010	1	reliability	Provisional
Upgrade 4.1 MVAR capacitor bank to 8.2 MVAR and install a new 8.2 MVAR capacitor bank at the Ripon 69-kV Substation	2011	2011	1	reliability	Provisional
Construct a 69-kV line from SW Ripon Substation to the Ripon-Metomen 69-kV line	2012	2012	1	T-D interconnection	Provisional
Upgrade Gardner Park-Black Brook 115-kV line – scope TBD	2012	2012	1	reliability	Provisional
Upgrade Mckenna 6.3 MVAR capacitor bank to 10.8 MVAR and install a second new 10.8 MVAR capacitor bank	2013	2013	1	reliability	Provisional
Construct Fairwater-Mackford Prairie 69-kV line	2014	2014	1	reliability	Provisional

**Table PR-13
Transmission System Additions for Zone 1 (continued)**

System additions	System need year	Projected in-service year	Planning zone	Need category	Planned, Proposed or Provisional
Reconfigure the North Randolph-Ripon 69-kV line to form a second Ripon-Metomen 69-kV line and retire the circuit between Metomen and the Mackford Prairie tap	2014	2014	1	reliability	Provisional
Install a second 138/69-kV transformer at Wautoma Substation	2015	2015	1	reliability	Provisional
Install a 12.2 MVAR capacitor bank at Hilltop 69-kV Substation	2016	2016	1	reliability	Provisional