Zones & study results

Zone 3 overview

Zone 3 includes the Wisconsin counties of:

- Columbia
- Crawford (southern portion)
- Dane
- Dodge
- Grant
- Green
- Iowa
- Lafayette
- Jefferson
- Richland
- Rock
- Sauk
- Walworth and
- Winnebago, Ill. (northern portion)

The physical boundaries of Zone 3 and transmission facilities located in Zone 3 are shown in Figure ZS-19.

Land use in Zone 3 is largely rural, urban and agricultural.

The major population centers are the Madison metropolitan area and the Janesville/Beloit area.

Zone 3 typically experiences peak demands during the summer months. Manufacturing, food processing, state government and institutional loads are among the largest electricity users in the zone.

Zone 3 demographics

The population of the counties in Zone 3 grew at an annual rate of 1.0 percent from 1995 to 2005. The highest growth rate occurred in Walworth County (1.6 percent), while the largest increase in population over the period occurred in Dane County, which increased by 51,500 people.

During the same period, the annual employment growth rate was 1.5 percent. The highest growth rate occurred in Iowa County, while the largest increase in employment occurred in Dane County.

Zone 3 future population and employment projections

Population in Zone 3 grew at 1.1 percent annually between 2001 and 2006 and is projected to grow at 1.0 percent from 2006 through 2011. From 2001 to 2006, Dane County realized the largest increase in population, while Walworth County has the highest growth rate.

Employment in Zone 3 grew at 1.3 percent annually between 2001 and 2006 and is projected to grow at 1.7 percent from 2006 through 2011. From 2001 to 2006, Dane County realized the largest increase in employment and the highest growth rate.

Zone 3 environmental considerations

Zone 3 covers the south central and southwestern portions of Wisconsin and the Illinois county of Winnebago.

The ecological landscapes in this zone vary from Southeast Glacial Plains in the east through the Central Sand Hills area to areas that are part of the Southwest Savanna and Western Coulee and Ridges landscapes in the west. The eastern portions of the zone generally are level to gently rolling terrain, while the western areas are characterized by the ridges and valleys of the drift less area.

The northern and western portions of this zone are located in the Lower Wisconsin River Drainage Basin, and the Mississippi River forms the zone's western boundary. Other portions of this zone are located in the Grant-Platte, Sugar River-Pecatonica, Upper and Lower Rock and Fox Illinois drainage basins. Horicon Marsh National Wildlife Refuge is located in the northeast part of the zone, and the Upper Mississippi River Wildlife and Fish Refuge is located along the zone's western edge. The Baraboo Hills are located in the north-central portion of the zone. The Lower Wisconsin River State Riverway also is found in this zone.

Zone 3 electricity demand and generation

The coincident peak load forecasts for Zone 3 for 2007, 2011 and 2015 are shown in Table ZS-9. Existing generation, along with proposed generation based on projected in-service year, also are shown. The resultant capacity margins, with or without the proposed generation, are shown as well.

The table shows that load is projected to grow at roughly 2.9 percent annually from 2007 through 2015. Comparing load with generation (at maximum output) within the zone indicates that Zone 3 has more generation than peak load during peak load periods. However, actual operating experience indicates that during most load periods, Zone 3 is a net importer of power.

Zone 3 transmission system issues

Key transmission facilities in Zone 3 include:

- the Columbia-North Madison 345-kV line,
- the Columbia-Rockdale-Paddock-Wempletown 345-kV line
- the Paddock-Wempletown 345-kV line and
- the 138-kV facilities from the Nelson Dewey Power Plant, around the Madison area and in the southeast portion of Zone 3.

Key system performance issues in Zone 3 include:

- import capability into the Madison area, whether from sources internal or external to the zone,
- insufficient 345/138-kV and 138/69-kV transformer capability in Dane and Rock Counties,
- heavily loaded 138- and 69-kV facilities in the eastern portion of Zone 3,
- low voltages on the 138-kV and 69-kV facilities in the western portion of Zone 3,
- Minnesota-eastern Wisconsin power transfers. The 138-kV and 69-kV facilities in the western portion of Zone 3 can be heavily loaded due to load growth combined with large power flows from MAPP,
- Columbia generator reaches maximum reactive power output for the loss of the other Columbia generator,
- parallel path flows from northern Illinois. The 138-kV facilities in the eastern portion of Zone 3 can be heavily loaded in part due to significant generation development in northern Illinois,
- low voltages on facilities in Dane, Dodge, Green, Jefferson and Sauk counties, in particular,
- widespread intact system 138 and 69-kV low voltages in Sauk, Columbia and Dodge counties are a serious emerging problem in 2014 and beyond, and
- impact of new generation.

Zone 3 - 2007 study results

Refer to Table ZS-1 and Figure ZS-7

Summary of key findings

- Low voltages throughout Zone 3 require a total of 294 MVAR of capacitor banks be installed by 2010.
- A significant number of lines and transformers will be uprated to avoid overloads under single contingency.
- Accommodating the Riverside generation (in service) required numerous transmission system reinforcements, which either have been or are being implemented.

- Accommodating the West Campus generation (in service) required several transmission reinforcements, which either have been or are in the process of being implemented. It is also providing much-needed voltage support in the Madison area.
- Maintaining reliability of service to load in and around the Madison area requires that system reinforcements (138-kV and 345-kV) be implemented in the near term and that a number of lines be uprated. Longer term, a 345-kV source on the west side of Madison will be required.
- Load growth in Rock and Walworth counties, higher than the ATC average, is driving the need for system reinforcements in these counties.

In response to low voltages throughout Zone 3, a total of 294 MVAR of capacitor banks distributed at the South Monroe, Rubicon, South Lake Geneva, Brewer, Boscobel, Kilbourn, North Beaver Dam, Spring Green and Artesian substations were deemed to be the most feasible solutions.

During summer peak loading in 2007, a Columbia generator outage could cause the adjacent generating unit to reach its maximum reactive power output. A near-term remedy for the low 138-kV voltages near and around the Columbia Power Plant may be changing the fixed taps on the Columbia 345/138-kV transformers. More study work needs to be done and any changes to these settings must be coordinated with the Columbia Power Plant engineering staff to ensure that the auxiliary plant loads are not adversely affected by these tap changes. We currently mitigate several of the identified 138-kV low voltages through remote control of the 138/69-kV transformers in the affected areas. In certain instances, transformer load tap changers are adjusted to bring the 138-kV contingency voltages above the planning criteria limits while maintaining the 69-kV bus voltages above criteria limits. This is a balancing act, and as loads continue to grow the process will no longer be effective.

When the voltage mitigation measure mentioned above is no longer deemed viable, reinforcements have been proposed to resolve the issues. The two most notable examples of this in Zone 3 are in the Beaver Dam and Wisconsin Dells areas. Two 24.5 MVAR capacitor banks are proposed for the North Beaver Dam 138-kV Substation in 2009. In addition, two 16.33 MVAR capacitor banks are proposed for the Kilbourn 69-kV Substation and two 24.5 MVAR capacitor banks are proposed for the Artesian 138-kV Substation in 2009. These new Kilbourn and Artesian capacitor bank projects replace a previously proposed project to add four 24.5 MVAR capacitor banks at Trienda Substation, resulting in improved system performance.

There were a number of facility overloads and several facilities near their emergency ratings in Zone 3 based on the 2007 analysis. Many projects are either planned or proposed to address these near-term thermal problems by 2009. We plan to install a second Kilbourn 138/69-kV transformer and have proposed a second Hillman 138/69-kV

transformer. We also propose to uprate four 138-kV lines, nine 69-kV lines, one 138/69-kV transformer and one 345/138-kV transformer.

A transmission-to-distribution interconnection proposed for Wyocena Substation provides another reason for extending a transmission line from Columbia to Rio with a loop through to feed into the new substation (2008). This new line will utilize mostly new right-of-way and in addition to supporting the proposed distribution interconnection will provide voltage support and loading relief to the North Randolph to Rio to Academy 69-kV loop.

Overloads for outages of the Dane to Waunakee or West Middleton to Pheasant Branch 69-kV lines and the North Madison 138/69-kV transformer highlight the need for additional transmission reinforcements in this area. The first phase of the reinforcements is complete. This included uprating the Dane-Waunakee, Waunakee-Huiskamp and West Middleton-Pheasant Branch 69-kV lines as well as uprating the North Madison 138/69-kV transformer. The second phase of the reinforcements includes the construction of a new 138-kV line, North Madison-Huiskamp, and the construction of a new substation with a 138/69-kV transformer near Huiskamp (2008).

In order to provide transmission service for the West Campus cogeneration facility, the Columbia-North Madison line conversion project, along with a new 345-kV bus at North Madison Substation and replacement of the existing 345/138-kV transformers at North Madison was completed in 2006. In addition, the Kegonsa Substation was expanded to accommodate interconnecting the Christiana-Fitchburg 138-kV circuit and the Kegonsa-Femrite 69- to 138-kV voltage conversion project. Both of these projects will improve voltage profiles and relieve heavy line loading on the east side of Madison and through downtown Madison for the next several years. However, one or more new 345-kV circuits to the west side of Madison eventually will be needed to provide long-term reliable service to the area and to provide a source to the 138-kV network in southwest Wisconsin.

Several pending overloads and low voltages in southern Dane and Green counties are prompting the need for additional transmission system support in the area. The existing 69-kV line between Oregon and Verona substations is being rebuilt on new structures with larger conductor in part because of its deteriorated condition. This rebuild will help relieve some of the voltage and loading problems in the near term. In addition, a new 138-kV line from the Fitchburg area (Oak Ridge Substation) to Verona (previously Montrose Substation) is being planned to provide additional support that is needed as loads continue to grow in southern Dane County at a rate of two to three times the ATC system average. The Montrose endpoint is changed to the existing Verona Substation due to routing issues, public input and the Oregon-Verona rebuild plan.

Dodge County is also experiencing considerable load growth. The Rubicon-Horicon 138-kV line project is needed in 2008 to relieve several low 69- and 138-kV bus voltages during a number of key contingencies. The Academy 138/69-kV transformer that supplies power

into Beaver Dam Substation and several 69-kV lines feeding the county will be susceptible to overloads under contingency. The Rubicon-Horicon project will eliminate those potential overloads as well.

The western portion of Jefferson County and the eastern portion of Dane County have also experienced high residential, commercial, and industrial load growth. Much of the area is served by the Rockdale Substation. Studies conducted by Planning indicate that by 2008, unacceptable voltages could be experienced in the Academy, Boxelder, London, Cambridge, Lakehead, and Jefferson substation areas with the outage of any segment of the Rockdale-Boxelder or Rockdale-Jefferson 138-kV lines. In order to provide reliable service to the area, a new Jefferson-Lake Mills-Stony Brook 138-kV line has been planned.

There are several pockets of low voltages and some overloads in eastern Rock and western Walworth counties. The maintenance rebuild of the Turtle-West Darien 69-kV line with initial operation at 69 kV will remedy this situation. In conjunction with this project, a new line from West Darien through a new Southwest Delavan Substation to the Delavan area is planned. This project will allow ATC to retire a portion of the existing Turtle-Bristol line, which is routed through an environmentally sensitive area, and to provide service to requested transmission-to-distribution interconnections (Southwest Delavan and North Shore substations).

Projects whose "Need date" precedes the "In-service" date:
Uprate Rock River 138/69-kV transformer terminal equipment to achieve a 65 MVA summer emergency rating and uprate Rock River-Turtle 69-kV line to a 94 MVA summer emergency rating: The need year is listed as 2006. The in-service year is still to be determined due to resource constraints in 2007. The Turtle-Bristol (Y-3) conversion project in 2009 will be the long-term plan to address these overloads. Interim solutions are still under review for the 2006-2008 timeframe.

Upgrade the 5.4 MVAR capacitor bank to 10.8 MVAR at New Glarus Substation: The need year is listed as 2006. The in-service year is to be determined due to resource constraints in 2007. The Oak Ridge-Verona 138-kV project in 2009 will be the long-term plan to address low voltage issues in the New Glarus area. Interim solutions are still under review for the 2006-2008 timeframe including possible distribution capacitor bank installation(s).

Uprate Colley Road-Park Avenue Tap 69-kV line to 95 MVA: The need year is listed as 2006. The in-service year is currently summer of 2007. The Colley Road-Park Avenue Tap 69-kV line is overloaded for the loss of the Paddock 138/69-kV transformer in our 2006 summer peak model. This overload was an issue in our previous 10-Year Assessment, however it was inadvertently missed. Interim operating steps are still under review for the summer of 2006.

Uprate Brodhead-South Monroe 69-kV line to 48 MVA: The need year is listed as 2006. The in-service year is summer of 2007 due to a construction delays. Interim operating steps are still under review for the summer of 2006.

Install 2-16.33 MVAR capacitor banks at Rubicon 138-kV Substation: The need year is listed as 2006. The in-service year is summer of 2007 due to construction delays. Dispatching Concord generation will be a possible operating step to address the low voltages issues in 2006.

Uprate North Lake Geneva-Lake Geneva 69-kV line to 84 MVA: The need year is listed as 2006. The in-service year is summer of 2007. This is a recently discovered overload due to revised load and modeling information. Load bridging capability between Lake Geneva and North Lake Geneva substations will help relieve the existing overload issues in 2006.

Construct new 69-kV line from Columbia to Rio to feed the proposed Wyocena Substation: The need year is 2004. The in-service year is 2007 due primarily to construction and resource constraints. An operating restriction on the load added at Rio Substation allows for the delay.

Install 1-16.33 MVAR 69-kV capacitor bank at South Lake Geneva Substation: The need year is listed as 2007. The in-service year is summer of 2008. The delay is due to resource constraints. Load bridging capability between Lake Geneva and North Lake Geneva substations and load tap changers at both North Lake Geneva and Brick Church substations will help relieve the existing low voltage issues in 2007-2008.

Construct a Jefferson-Stony Brook 138-kV line: The need year is 2006. The in-service year is 2008. The difference is mainly due to the regulatory process and a T-D interconnection delay. Dispatching Concord generation and/or load tap changers at Academy and North Randolph transformers will help relieve the low voltage issues in 2006-2007.

Install 2-24.5 MVAR 138-kV capacitor banks at North Beaver Dam Substation: The need year is 2005 and the in-service year is 2008. System operating controlled load tap changer adjustments at the North Beaver Dam, North Randolph and Academy transformers allow this project to be delayed until 2008.

Install a second 138/69-kV transformer at Hillman Substation: The need year is 2008 and the in-service year is 2009. This delay is due to resource constraints. Interim operating steps are still under review for the summer of 2008.

Convert Rock River to Bristol to Elkhorn to 138-kV operation and rebuild Bristol Substation with a new 138-kV bus: The need year is 2008 and the in-service year is 2009. This delay is due to the regulatory process. Interim operating steps are still under review for the summer of 2008.

Loop Nine Springs-Pflaum 69-kV line into Femrite Substation: The need year is 2006 and the in-service year is 2010. This delay is mainly due to resource constraints. A possible interim system solution could be a mixture of dispatching the Nine Springs generation and/or bridging load (i.e. transferring load from one source to another).

Zone 3 - 2011 study results

Refer to Table ZS-2 and Figure ZS-8

Summary of key findings

- The numerous low voltages and line overloads along with the potential for voltage collapse in the Madison area signal the need for another new 345-kV source on the west side of Madison in addition to the second Columbia-North Madison 345-kV line.
- Intact system 138-kV voltages in the Columbia and Sauk County areas are approaching 95 percent by 2011 without additional reactive support. This is due in large part to the high loads in the area.
- The Fitchburg to Royster 69-kV line will be overloaded and the area will experience low voltages under single contingency conditions. Looping the line in and out of Femrite Substation is proposed to address these issues.
- Load growth in Green County, west of Rock County and south of Dane County requires one additional 138-kV source into the area. Adding Bass Creek 138/69-kV transformation will address a number of potential low voltage problems and transformer overloads.
- The 69-kV system on the northeast side of Dane County requires one additional 138-kV source to avoid line overloads and low voltages. The Yahara River 138/69-kV transformer project will adequately address the issues.
- Walworth County will require additional support to accommodate several transmission-to-distribution interconnections, mitigate impending overloads on various facilities and support voltages at numerous substations under contingency. The conversion of the Rock River-Elkhorn line from 69-kV to 138 kV is proposed to resolve these issues.
- Import capability from Illinois can be severely limited by transmission facilities outside of our system for loss of the Wempletown-Paddock 345-kV line (ATC/Commonwealth Edison facility). This limitation has been addressed to some degree by installing a second 345-kV line between Wempletown and south central Wisconsin (Paddock Substation). The underlying 138-kV transmission system in the Janesville area and to the north still poses limitations for transfers into the Madison area.

The Rockdale-West Middleton 345-kV line will address line overloads and low voltage issues in Dane County and is planned to be service by 2011. Demand in Dane County is projected to grow at an above-average rate for the ATC system. High demand coupled with

generation retirements, concerns about the age and high cost of remaining generators, and stress on the transmission lines that are critical for importing power to Dane County will continue to increase. By 2011 Madison Gas and Electric (MGE) will stop burning coal at their Blount Power Plant and will retire units 3, 4 and 5. The remaining two units at Blount will stay in service and will use natural gas as the primary fuel.

The Columbia and Sauk County areas are experiencing high load growth, especially in Wisconsin Dells. A total of 82 MVAR of capacitor banks are planned to be installed at the Kilbourn and Artesian substations in 2009. However, potential Kirkwood to Artesian line overloads and serious post-contingency low voltages around the Reedsburg loop call for additional transmission reinforcements. The Lake Delton-Birchwood 138-kV project in 2013 will not only interconnect a new T-D substation, but also address impending low voltages and overloads identified on the transmission system.

The Fitchburg to Royster 69-kV line is susceptible to thermal overloads and the area experiences low voltages at Syene, Nine Springs, and Pflaum for loss of either end of the line. In the 2005 10-Year Assessment, a 2010 project (looping the Femrite to Royster 69-kV line into AGA Gas Substation) was proposed to resolve these issues. However, based on a more detailed study, looping the Nine Springs to Pflaum 69-kV line in and out of the Femrite Substation provides improved system performance over the previous project. Another possible alternative is to rebuild the Fitchburg to Royster 69-kV line and install additional capacitor banks along the line. This alternative will need to be considered and analyzed in order to ensure that the best value solution is chosen, meeting system needs while minimizing costs and public impact.

The Evansville and Brodhead areas are facing unacceptably low voltages under single contingency conditions. In addition, the North Monroe 138/69-kV transformer loading is approaching to its summer normal rating under system intact conditions. A new Bass Creek 138/69-kV transformer and the Townline Road–Bass Creek 138-kV line reconductor in 2010 will address these problems and provide one additional 138-kV source into Green County. This project will also allow us to delay a new Brooklyn to Evansville 69-kV line project from 2011 to 2016 and a second North Monroe 138/69-kV transformer project from 2014 to beyond 2016.

Potential thermal overloads for the Columbia to Deforest 69-kV line and widespread low voltages in northeast Dane County in 2011 call for additional transmission reinforcement into the area. Installing a 138/69-kV transformer at Yahara River Substation and looping the Deforest -Token Creek 69-kV line in and out of Yahara River will address these problems in the long term. Other alternatives such as a line rebuild or capacitor banks will be compared during the scoping development process to determine the best plan.

The 138-kV Rock River to Elkhorn line conversion project will not only address a number of line and transformer overloads but also make the system ready for rebuilding both Colley

Road to Brick Church 138- and 69-kV lines. These two lines have condition issues that require they be rebuilt in the near future. In addition, the current operating guide which is to open the Colley Road to Brick Church 69-kV line for the loss of the Colley Road to Brick Church 138-kV line can be eliminated.

Import capability from the areas to the south and southwest of Zone 3 continues to be a major concern and is being addressed in our Access Initiative. On March 23, 2006, the Public Service Commission of Wisconsin (PSCW) released the *Commission Staff Final Report on Transmission Access* which states that "…Wisconsin ratepayers could benefit from expanded interstate transmission investment, particularly from investment in targeted smaller scale projects"[1]. The Paddock-Rockdale 345-kV transmission project is such a "targeted smaller scale project" with significant ratepayer benefits. As a result, ATC plans to develop a Certificate of Public Convenience and Necessity (CPCN) application for Paddock-Rockdale as an Access Initiative project with a 2010 in-service date. This application will include additional analyses to further examine the merits, risks and impacts of the project under a wide variety of scenarios and sensitivities to ensure that the project is robust under a realistic range of potential futures. Preparation for filing the CPCN will include significant additional regional cooperation and planning and public input.

Zone 3 - 2015 study results

Refer to Table ZS-3 and Figure ZS-9

Summary of key findings

- ❑ Load growth in the Janesville area causes several transmission elements to be overloaded.
- ❑ The three Columbia 345/138-kV transformer loadings under single contingency are approaching to their maximum summer emergency rating by 2015.
- ❑ The 138-kV line from Nelson Dewey to Columbia substations will require more voltage support. Adding two-16.33 MVAR capacitor banks at Eden Substation may adequately address these problems.
- ❑ Low voltages along the long 69-kV lines from Stage Coach to Spring Green to Gran Grae substations signal the need for reinforcements in that area. Capacitor bank projects may adequately address these issues.

The McCue and Janesville 138/69-kV transformers are overloaded for loss of one or the other in 2013. In addition, the McCue-Janesville 69-kV line is overloaded for loss of the McCue transformer in the same timeframe. A second McCue 138/69-kV transformer has been proposed to address these thermal issues.

[1] Commission Staff Final Report on Transmission Access, page 1.

Both of the Columbia 200 MVA, 345/138-kV transformer loadings are close to their summer emergency ratings for the loss of the Columbia 400 MVA, 345/138-kV transformer by 2015. In addition, the Columbia-Portage 138-kV line is overloaded for the loss of the other Columbia to Portage 138-kV line in 2014. Adding a North Randolph 345/138-kV transformer is proposed to relieve these overloads. This project is expected to provide needed voltage support for Dodge and Jefferson counties.

Low voltages in several rural areas along the long 69-kV lines from Stage Coach to Gran Grae Substation are signaling the need for additional reactive power support. We plan to install one-8.16 MVAR capacitor bank at Boscobel Substation and upgrade the existing 5.4 MVAR capacitor bank to 8.16 MVAR in 2013. In addition, two-12.33 MVAR capacitor banks are proposed to be installed at the Mazomanie 69-kV Substation in 2014. These capacitor bank projects along with the 2011 Spring Green capacitor bank and the 2014 Eden capacitor bank projects combine to delay three major line projects beyond 2016 (West Middleton-Spring Green 138-kV conversion project, Eden-Muscoda-Richland Center 69-kV line project and the Hillman-Eden 138-kV conversion project).

High growth in demand in Dane County, concerns about an aging local generation fleet, the high cost of local generation, not having enough local generation to meet the demand, and increased dependence on imports from outside Dane County will continue to require new transmission lines every few years. Another phase of reinforcements for Dane County is the closing of the 345-kV loop around Madison by constructing a 345-kV line from West Middleton to North Madison (2015). MGE has recently announced that by 2011 generating units at Blount Power Plant will stop burning coal and 3 of 5 units will be retired. The remaining two units at Blount will stay in service and will use natural gas as primary fuel. Study work to determine the impact of the retirement is on-going and may result in additional projects or acceleration of the existing plans.

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%	Chaffee 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-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, Elkhorn 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%	Neevin-Woodenshoe 138-kV line outage		91%
4	Ellington-Hintz 138-kV line	107.6%		North Appleton-Werner West 345-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%		Splitting Pleasant Prairie 345-kV bus sections 3 & 4	164%	
5	Oak Creek 345/230-kV transformer T884	101-108%		Various Oak Creek 230-kV bus outages	106–111%	
5	Pleasant Valley – Saukville 138-kV line	123%		Various 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, Eastom, 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		80 – 92%		--
1	Bunker Hill – Blackbrook 115-kV line	108%		Gardner Park-Blackbrook 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	101%		96 – 107%	
1	Council Creek 69-kV bus tie	--		Hillsboro-Hillsboro tap 69-kV line outage	96%		95 – 113%	
1	Council Creek and Petenwell 138-kV bus voltage		90 – 95%	Base Case 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 Various line outages	95 – 117%		--	
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	97 – 112%		--	
1	NW Ripon – Ripon 69-kV line	102%		Winneconne-Sunset Point 69-kV line outage	98 – 109%		--	
1	Winneconne – Sunset Point 69-kV line	95%		NW Ripon - Ripon 69-kV line outage	102%		--	
1	Omro – Winneconne 69-kV line	--		NW Ripon - Ripon 69-kV line outage	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		84 – 90%		--
1	Whitcomb 115/69-kV transformer	99%		Antigo-Blackbrook 115-kV line outage	97 – 112%		--	
1	Caroline 115/69-kV transformer	--		Whitcomb 115/69-kV transformer	96%		--	
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-Belmont 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	% of Facility 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 Martinsville-West Middleton 138-kV line outage	102%			
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%		
3	Harmony, Lamar, Fulton, Saunders Creek, Dana Cooperation, RCEC Edgerton, Sheepskin 69-kV bus voltages			McCue-Harmony 69-kV line outage				89-92%
3	Lamar, Fulton 69-kV bus voltages			Harmony-Lamar 69-kV line outage		90-91%		
3	Lamar, Fulton, Saunders Creek, Dana Cooperation, Sheepskin, 69-kV bus voltages			Harmony-Lamar 69-kV line outage				89-92%
3	Pine River, Richland Center, Richland, Lone Rock 69-kV bus voltages		90%	Pine River-Richland 69-kV line outage, Lone Rock-Richland 69-kV line outage, Lone Rock 69 kV phase shifter outage		89-90%		
3	Avoca, Muscoda, Lone Rock, Blue River 69-kV bus voltages		91-92%	Lone Rock-Spring Green 69-kV line outage		89-91%		
3	Arena 69-kV bus voltage		92%	Spring Green-Arena 69-kV line outage				
3	Spring Green, Avoca, Muscoda, Lone Rock, Arena, Mazomanie, Mazomanie Industrial, Blue River, Pine River, Richland Center 69-kV bus voltages		88-92%	Spring Green 138/69-kV transformer outage		88-92%		
3	Spring Green, Arena 69-kV bus voltages			Spring Green 138/69-kV transformer outage				92%
3	McFarland, Femrite 138-kV bus voltages		91%	McFarland-Kegonsa 138-kV line outage		91%		
3	Femrite 138-kV bus voltage		92%	McFarland-Femrite 138-kV line outage		92%		
3	Burke, Colorado 69-kV bus voltages		87-91%	Reiner-Burke Tap 69-kV line outage		86-90%		
3	Burke, Colorado, Reiner 69-kV bus voltages		87-91%	Reiner 138/ 69-kV transformer outage		86-90%		
3	Burke 69-kV bus voltage			Reiner-Burke Tap 69-kV line outage, Reiner 138/ 69-kV transformer outage				92%
3	Hubbard 138-kV bus voltage		90%	Hustiford-Hubbard 138-kV line outage		90%		89%
3	Hustisford, 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				91-92%
3	Lancaster, Eden, Wyoming Valley, Spring Green, Troy 138-kV bus voltages		90-92%	Nelson Dewey-Lancaster 138-kV line outage		88-92%		
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-Manrap 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	Germantown 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 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
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
1	Berlin area 69-kV bus voltages		85 – 92%	NW Ripon - Ripon 69-kV line outage 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
1	Whitcomb 115/69-kV transformer	95 – 98%		Gardner Park-Blackbrook-Antigo 115-kV line outage Antigo-Blackbrook 115-kV line outage Werner West-White Lake 138-kV line outage
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, Wonewoc 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
3	Hillman-Elmo 69-kV line	99%		Pilot NB-Galena 69-kV line outage
3	North Monroe-Monticello Tap 69-kV line	95%		Wempletown-Rockdale 345-kV line outage
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 Dells-Lewiston 138-kV line outage, East Dells-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 Dells-Kilbourn 138-kV line	96%		Lake Delton-Trienda 138-kV line outage
3	East Dells-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,		90-91%	Eden-Lancaster 138-kV line outage
3	Wyoming Valley, Spring Green, Troy 138-kV bus voltages, Avoca, Muscoda 69-kV bus voltages		91-92%	Eden-Wyoming Valley 138-kV line outage
3	North Monroe, Darlington 138-kV bus voltages		90-92%	North Monroe-Albany 138-kV line outage
3	Albany, North Monroe, Darlington, Lafayette Wind 138-kV bus voltages		88-92%	Town line Road-Albany 138-kV line outage
3	Dickinson, Brick Church, Williams Bay 138-kV bus voltages		89-91%	Colley Road-Dickinson 138-kV line outage
3	Brick Church, Williams Bay 138-kV bus voltages		91-92%	Dickinson-Brick Church 138-kV line outage
3	Spring Green, Troy 138-kV bus voltages		91-92%	Spring Green-Wyoming Valley 138-kV line outage
3	Fort Atkinson 138-kV bus voltage		92%	Rockdale-Lakehead Cambridge 138-kV line
3	Reiner Road, Sprecher 138-kV bus voltages		91-92%	Reiner Rd-Sycamore 138-kV line outage
3	Fox Lake, Beaver Dam East bus voltages		91-92%	North Randolph-Fox Lake 138-kV line outage
3	Rockvale 138-kV bus voltage		91-92%	Bark River-Cottonwood 138-kV line outage, Bark River-Sussex 138-kV line outage
3	LCI, Pflaum, Femrite, Nine Springs, Syene 69-kV bus voltages		90-92%	Femrite 138/69-kV transformer outage
3	Brisbois, Grangrae, Boscobel, Boscobel Muni, Wauzeka, Hillside, Lapointe 69-kV bus voltages		91-92%	Grangrae 138/69-kV transformer outage
3	Miner 69-kV bus voltage		92%	DPC Terr TP – Pilot NB 69-kV line outage
3	Miner, Shullsburg 69-kV bus voltages		91%	DPC Pilot NB-Galena 69-kV line outage
3	Boscobel, Muscoda, Blue River, Brisbois 69-kV bus voltages		91-92%	Seneca-Genoa 161-kV line outage
3	Vienna, Yahara River, American Center, Reiner Rd, Sprecher, Femrite, Sycamore, Blount 138-kV bus voltages		91-92%	North Madison-Vienna 138-kV line outage
3	Yahara River, American Center, Reiner Road, Sprecher, Femrite, Sycamore 138-kV bus voltages		91-92%	Yahara River-Vienna 138-kV line outage
3	Reiner Rd, Sprecher, Femrite, Sycamore 138-kV bus voltages		91-92%	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		86-91%	Verona-Oakridge 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 138/69-kV transformer outage
3	Sun Valley, Oregon, Brooklyn 69-kV bus voltages		88-90%	Sun Valley-Verona 69-kV line outage
3	Cobble Stone, Lake Shore, Zenda Tap, Zenda, Katzenberg, Richmond, Twin Lakes 69-kV bus voltages		88-92%	Cobble Stone-Brick Church 69-kV line outage
4	Pulliam-Van Buren 69-kV line	97%		Pulliam-Danz Avenue 69-kV line outage
4	Henry-Danz Avenue 69-kV line	105%		Pulliam-Van Buren 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%		Ellinwood-Twelfth Avenue 69-kV line outage
4	Sunset Point 138/69-kV transformer #1	101%		Sunset Point 138/69-kV transformer #2 outage
4	Sister Bay 69-kV bus voltage		95%	Base Case
4	Bluestone, Wesmark 69-kV bus voltages		86-88%	Finger Road-Bluestone 69-kV line outage
4	Booster, Barnett, Beardsley St, East Krok 69-kV bus voltages		90-91%	East Krok 138/69-kV transformer outage
4	Quarry Run, Woodenshoe, Mears Corners, Sunset Point 138-kV bus voltages		89-91%	Neevin-Quarry Run 138-kV line outage, Quarry Run-Woodenshoe 138-kV line outage
4	Hickory, Butternut, Forward Energy Center 138-kV bus voltages		92%	Hickory-South Fond du Lac 138-kV line outage
5	Oak Creek 345/230-kV transformer	100%		Splitting Oak Creek 230-kV bus 78
5	Granville 345/138-kV transformer	95%		Splitting Granville 345-kV bus 23
5	Tichigan and Burlington 138-kV bus voltages		89-90%	Spliiting Burlington 138-kV bus
5	Edgewood – St. Martins 138-kV line	102%		Walworth – Mukwonago 138-kV bus outage
5	Albers – Bain 345-kV line	110%		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-9
Forecast of Peak Load and Generation in Zone 3

	2007	2011	2015
Peak Forecast (megawatts)	3059.1	3440.5	3842.8
Average Peak Load Growth	N/A	2.98%	2.80%
Existing Generation Capacity (megawatts)	3921.6	3921.6	3921.6
Existing Capacity Less Load	862.5	481.1	78.8
Existing Generation Capacity plus Modeled Generating Capacity Additions (megawatts)	3983.6	3983.6	3983.6
Modeled Capacity Less Load (megawatts)	924.5	543.1	140.8

*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.*

Figure ZS-7

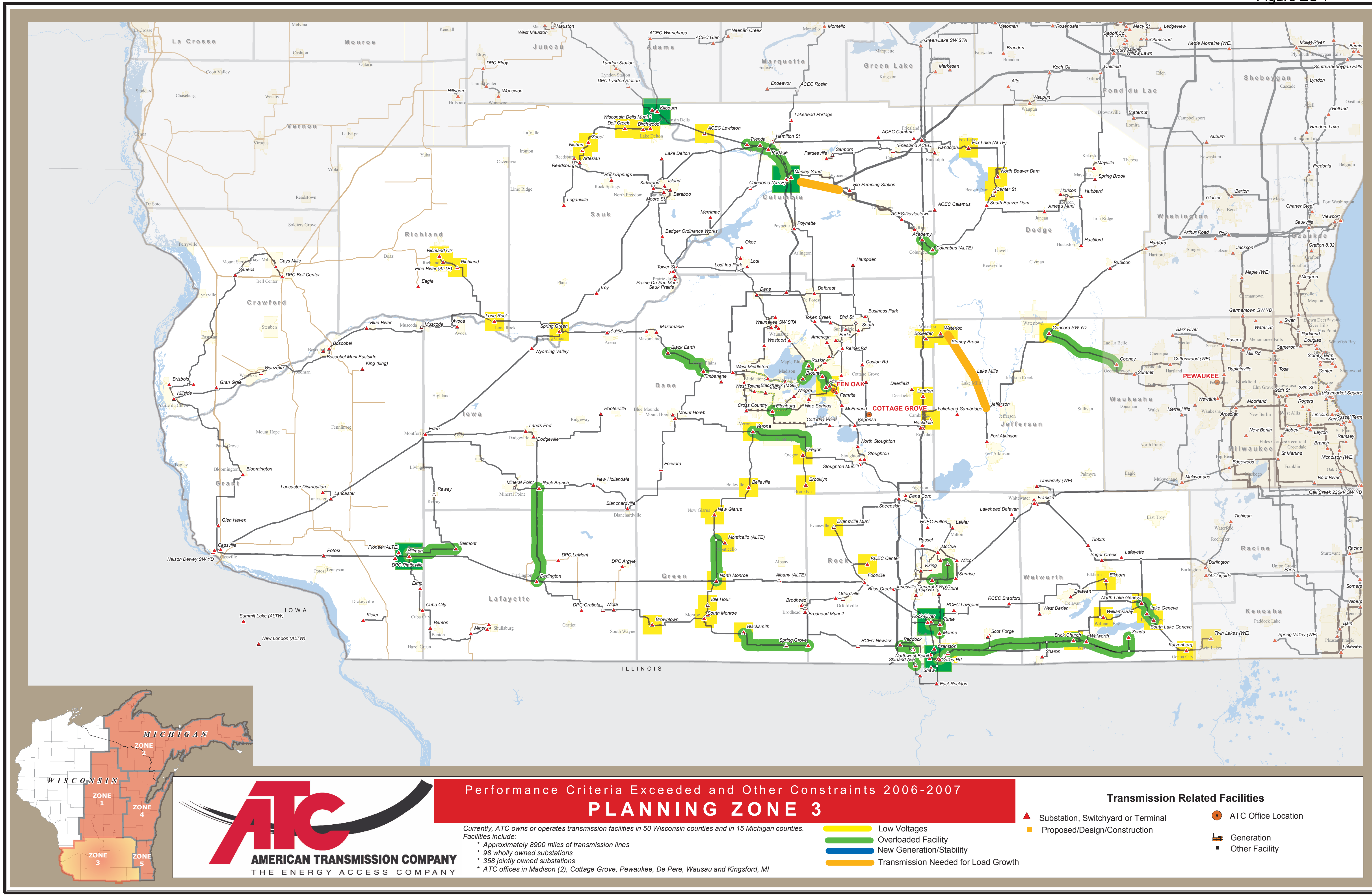
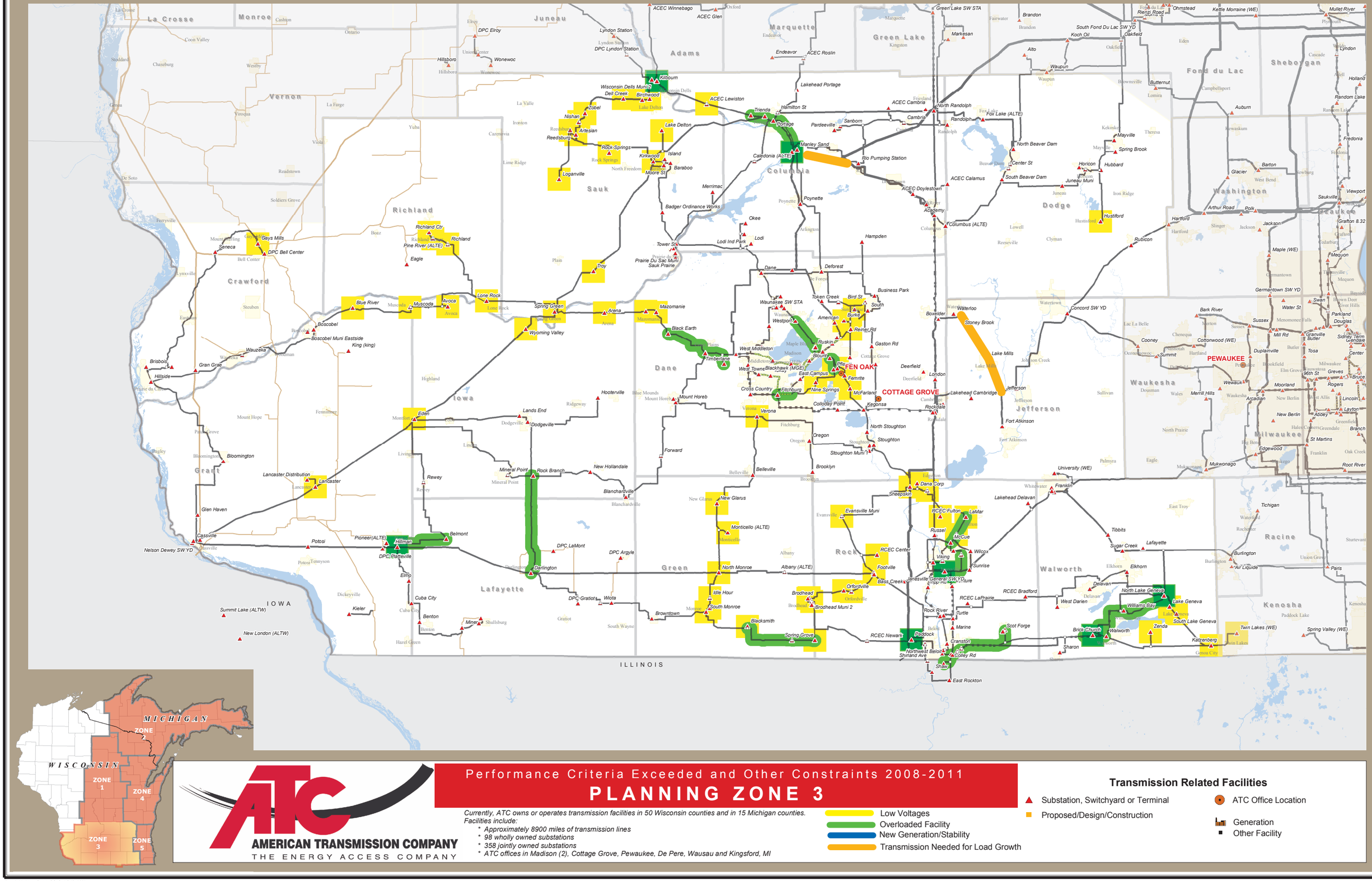
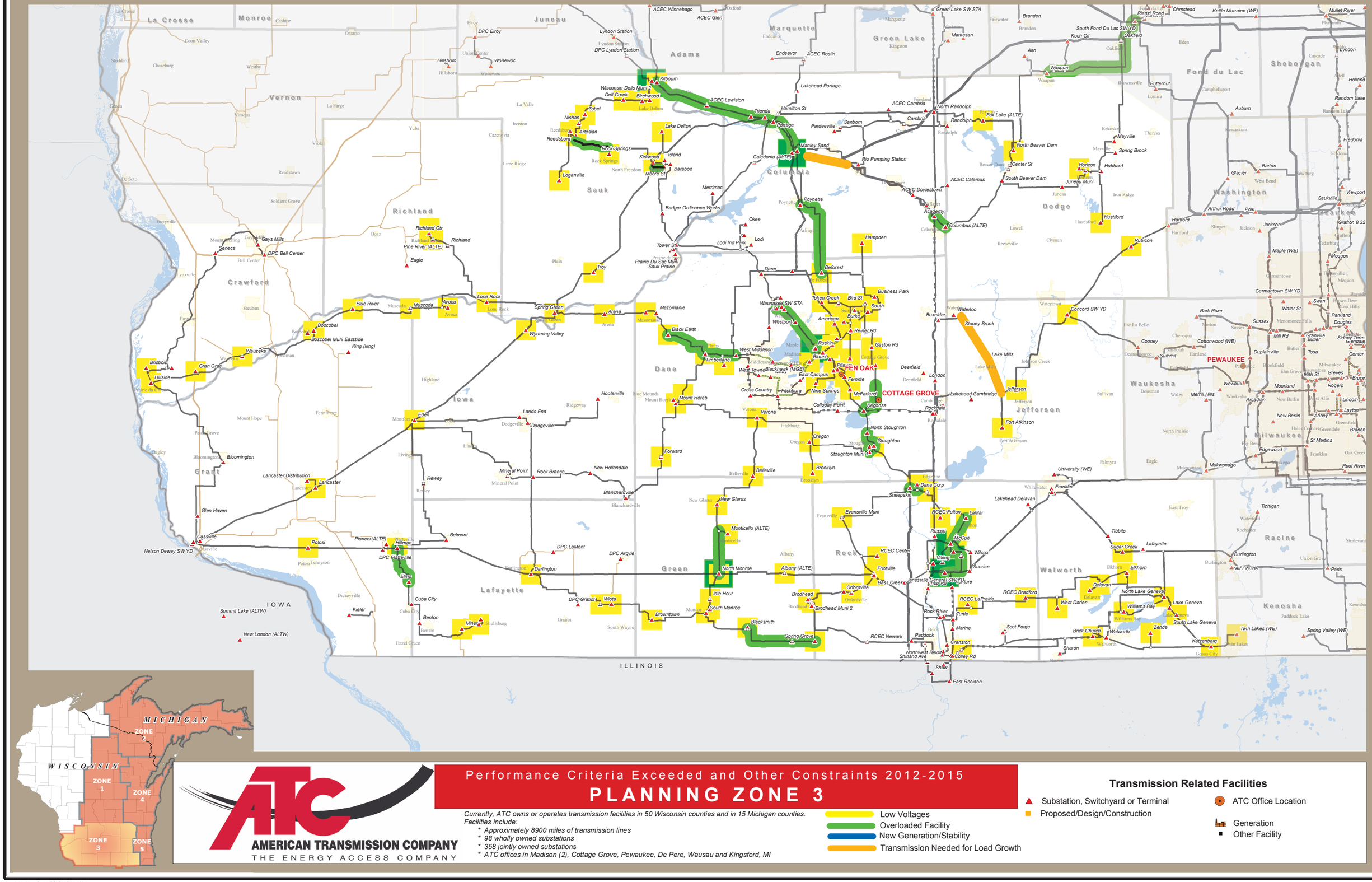

Performance Criteria Exceeded and Other Constraints 2006-2007
PLANNING ZONE 3
Currently, ATC owns or operates transmission facilities in 50 Wisconsin counties and in 15 Michigan counties.
Facilities include:
* Approximately 8900 miles of transmission lines
* 98 wholly owned substations
* 358 jointly owned substations
* ATC offices in Madison (2), Cottage Grove, Pewaukee, De Pere, Wausau and Kingsford, MI
AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY
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
MICHIGAN
WISCONSIN
ZONE 1
ZONE 2
ZONE 3
ZONE 4
ZONE 5
IOWA
ILLINOIS
La Crosse
Monroe
Juneau
Adams
Marquette
Green Lake
Fond du Lac
Sheboygan
Vernon
Richland
Sauk
Columbia
Dodge
Washington
Ozaukee
Crawford
Dane
Jefferson
Waukesha
Milwaukee
Grant
Iowa
Lafayette
Green
Rock
Walworth
Racine
Kenosha
PEWAUKEE
FEN OAK
COTTAGE GROVE
Zone3 11x17.mxd Modified: Jul 18, 2003

Figure ZS-8



Zone3 11x17.mxd Modified: Jul 18, 2003

Figure ZS-9



Performance Criteria Exceeded and Other Constraints 2012-2015

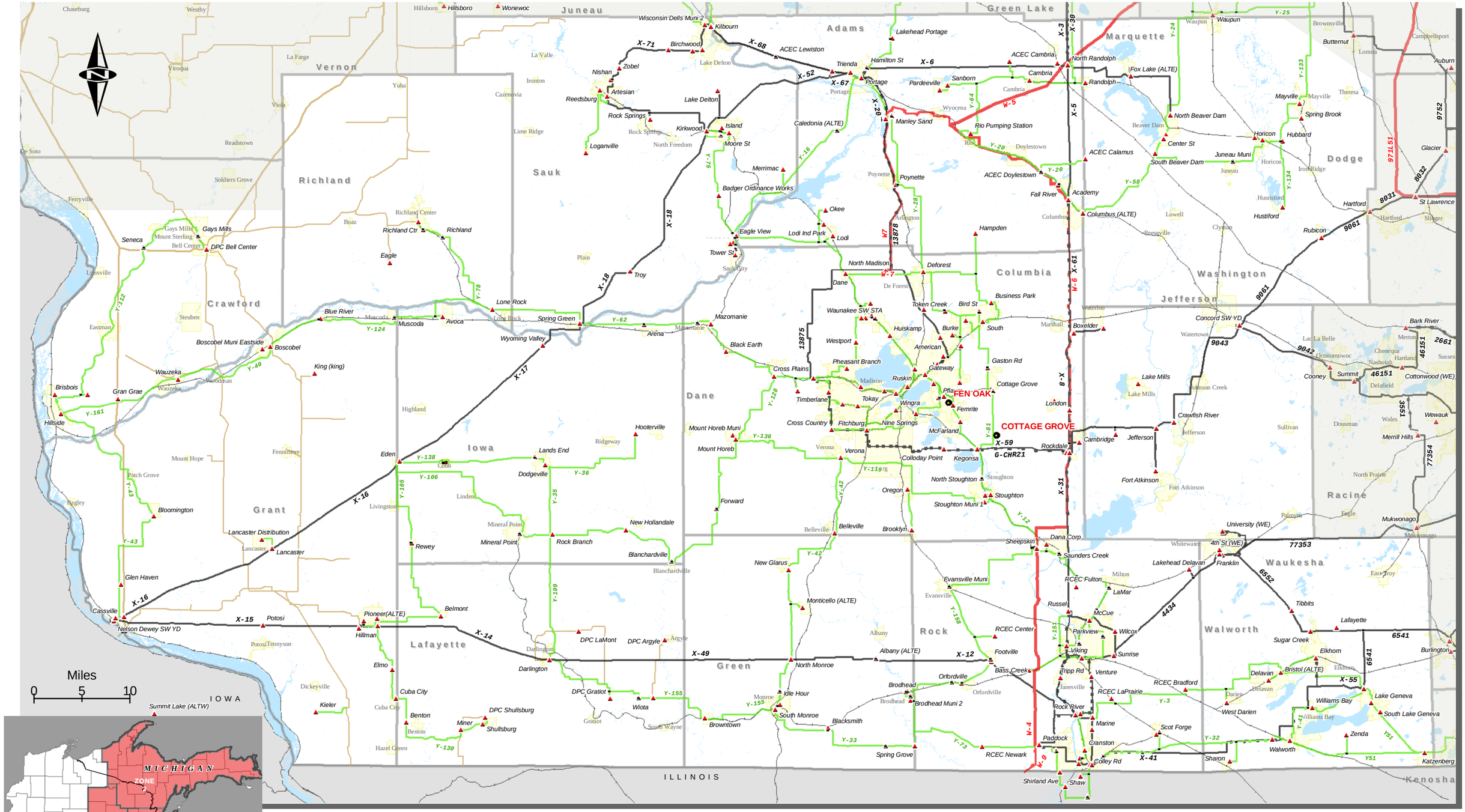
PLANNING ZONE 3

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*
- *ATC offices in Madison (2), Cottage Grove, Pewaukee, De Pere, Wausau and Kingsford, MI*

Zone3 11x17.mxd Modified: Jul 26, 2006

Figure ZS-19



Electric Transmission Network & Substations

PLANNING ZONE 3

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

- *Approximately 8900 miles of transmission lines*
- *101 wholly owned substations*
- *394 jointly owned substations*
- *ATC offices in Madison (2), Cottage Grove, Pewaukee, De Pere, Wausau and Kingsford, MI*

AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

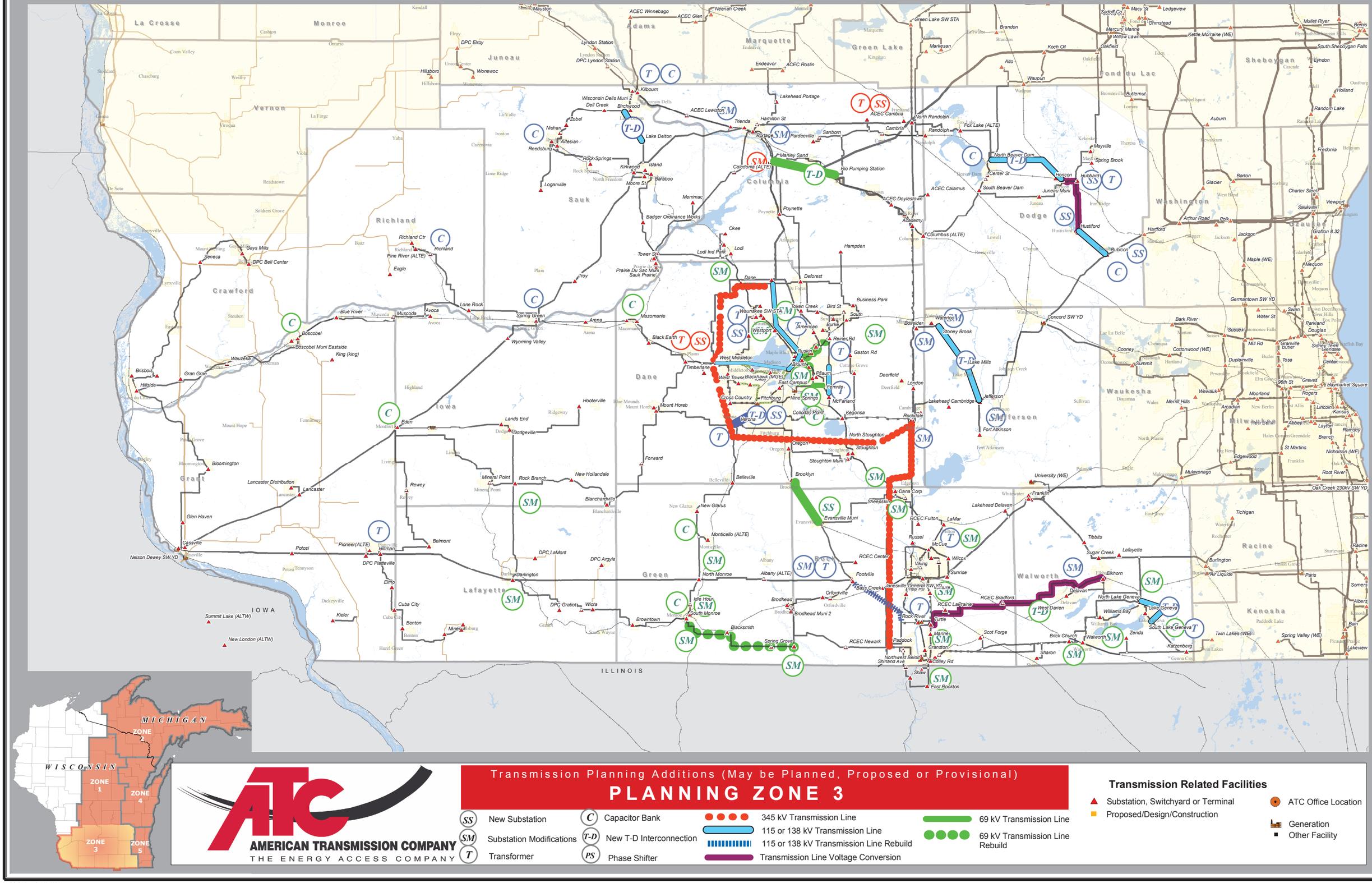
Transmission Line Voltage

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

Transmission Related Facilities

- Substation or Switchyard
- Tap or Switching Structure
- Facility (Design or Construction)
- ATC Office Location
- Generation

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.



Modified: November 10, 2006

Note that the hard copy Summary Report depicts the alternate route for Paddock-Rockdale, while this figure depicts the preferred route.

Table PR-15
Transmission System Additions for Zone 3

System additions	System need year	Projected in-service year	Planning zone	Need category	Planned, Proposed or Provisional
Reconnect the 138/69-kV transformers at Kilbourn Substation on separate breakers to operate individually	2006	2006	3	reliability	Planned
Construct new 138-kV line from North Beaver Dam to East Beaver Dam Substation	2006	2006	3	T-D interconnection	Planned
Convert Kegonsa-McFarland-Femrite 69-kV line to 138 kV	2007	2007	3	reliability, new generation	Planned
Construct Sprecher-Femrite 138-kV line	2007	2007	3	reliability, new generation	Planned
Install 138/69-kV transformer at Femrite Substation	2007	2007	3	reliability, new generation	Planned
Install 138/69-kV transformer at Reiner Substation	2007	2007	3	reliability, new generation	Planned
Convert Sycamore-Reiner-Sprecher from 69 kV to 138 kV	2007	2007	3	reliability	Planned
Uprate Rock River 138/69-kV transformer to 65 MVA and uprate Rock River-Turtle 69-kV line to 94 MVA	2006	TBD	3	reliability	Provisional
Upgrade the 5.4 MVAR capacitor bank to 10.8 MVAR at New Glarus Substation	2006	TBD	3	reliability	Provisional
Uprate Colley Road-Park Ave Tap 69-kV line to 95 MVA	2006	2007	3	reliability	Proposed
Construct Butler Ridge 138-kV Substation	2007	2007	3	new generation	Provisional
Uprate Brodhead-South Monroe 69-kV line	2006	2007	3	reliability	Proposed
Construct new 69-kV line from Columbia to Rio to feed the proposed Wyocena Substation	2004	2007	3	T-D interconnection, reliability	Planned
Install 2-16.33 MVAR capacitor banks at Rubicon 138-kV Substation	2006	2007	3	reliability	Planned
Construct new line from Southwest Delavan to Bristol at 138 kV and operate at 69 kV	2007	2007	3	T-D interconnection	Planned
Uprate Janesville-Parkview 69-kV line to 92 MVA	2007	2007	3	reliability	Proposed
Uprate North Lake Geneva-Lake Geneva 69-kV line to 84 MVA	2006	2007	3	reliability	Proposed
Uprate Brick Church-Zenda 69-kV line to 115 MVA	2008	2008	3	reliability	Proposed

Table PR-15
Transmission System Additions for Zone 3 (continued)

System additions	System need year	Projected in-service year	Planning zone	Need category	Planned, Proposed or Provisional
Install 1-16.33 MVAR 69-kV capacitor bank at South Lake Geneva Substation	2007	2008	3	reliability	Provisional
Uprate Portage-Trienda 138-kV line to 339 MVA	2008	2008	3	reliability	Proposed
Uprate Columbia 345/138-kV transformer T-22 to 527 MVA	2008	2008	3	reliability	Provisional
Install 2-16.33 MVAR capacitor bank at the South Monroe 69-kV Substation and remove existing 10.8 MVAR bank	2007	2008	3	reliability	Proposed
Uprate Rockdale to Jefferson 138-kV line	2008	2008	3	reliability	Planned
Uprate Rockdale to Boxelder 138-kV line	2008	2008	3	reliability	Planned
Uprate Boxelder to Stonybrook 138-kV line	2008	2008	3	reliability	Planned
Construct a Jefferson-Lake Mills-Stony Brook 138-kV line	2006	2008	3	reliability	Planned
Construct a Rubicon-Hustisford 138-kV line	2008	2008	3	reliability	Proposed
Rebuild Hustisford-Horicon 69 kV to 138 kV	2008	2008	3	reliability	Proposed
Construct 138/69 kV substation at a site near Horicon Substation and install a 138/69-kV transformer	2008	2008	3	reliability	Proposed
Construct a new 138-kV line from North Madison to Huiskamp (was Waunakee)	2008	2008	3	reliability	Proposed
Construct a new 138/69-kV substation near Huiskamp and install a 187 MVA 138/69-kV transformer	2008	2008	3	reliability	Proposed
Rebuild the Verona to Oregon 69-kV line Y119	2008	2008	3	reliability	Proposed
Rebuild Brodhead to South Monroe 69-kV line	2008	2008	3	generation interconnection, reliability	Proposed
Uprate Darlington-Rock Branch 69-kV line	2008	2008	3	reliability	Proposed
Install 2-24.5 MVAR 138-kV capacitor banks at North Beaver Dam Substation	2005	2009	3	reliability	Provisional
Install a second 138/69-kV transformer at Hillman Substation	2008	2009	3	reliability	Provisional
Install 2-8.16 MVAR capacitor banks at new Brewer 69-kV Substation	2009	2009	3	reliability	Proposed
Convert Rock River to Bristol to Elkhorn 138-kV operation; rebuild Bristol with a new 138 kV bus	2008	2009	3	reliability	Planned

Table PR-15
Transmission System Additions for Zone 3 (continued)

System additions	System need year	Projected in-service year	Planning zone	Need category	Planned, Proposed or Provisional
Construct new Oak Ridge-Verona 138-kV line and install a 138/69-kV transformer at Verona Substation	2009	2009	3	reliability	Proposed
Uprate North Lake Geneva-Lake Geneva 69-kV line to 115 MVA	2009	2009	3	reliability	Provisional
Uprate Walworth- North Lake Geneva 69-kV to 69 MVA	2009	2009	3	reliability	Provisional
Install 2-16.33 MVAR 69 kV capacitor banks at Kilbourn Substation and install 2-24.5 MVAR 138-kV capacitor banks at Artesian Substation	2009	2009	3	reliability	Provisional
Construct second Paddock-Rockdale 345-kV line	2010	2010	3	access initiative	Proposed
Loop Nine Springs-Pflaum 69-kV line into Femrite Substation	2006	2010	3	reliability	Provisional
Install 2-16.33 MVAR capacitor banks at Spring Green 69-kV Substation	2010	2010	3	reliability	Provisional
Install a 138/69-kV transformer at Bass Creek Substation	2010	2010	3	reliability	Provisional
Rebuild/reconductor Town Line Road-Bass Creek 138-kV line	2010	2010	3	reliability	Provisional
Install the second 16.33 MVAR 69-kV capacitor bank at South Lake Geneva Substation	2010	2010	3	reliability	Provisional
Uprate McCue-Milton Lawns 69-kV line	2011	2011	3	reliability	Provisional
Construct 345-kV line from Rockdale to West Middleton	2011	2011	3	reliability	Proposed
Construct a 345-kV bus and install a 345/138 kV 500 MVA transformer at West Middleton Substation	2011	2011	3	reliability	Proposed
Loop the Deforest to Token Creek 69-kV line into the Yahara River Substation	2011	2011	3	reliability	Provisional
Uprate Yahara River-Token Creek 69-kV line	2011	2011	3	reliability	Provisional
Uprate Brick Church-Walworth 69-kV line to 115 MVA	2012	2012	3	reliability	Provisional
Construct Huiskamp-Blount 138-kV line	2012	2012	3	reliability	Proposed
Uprate North Monroe-Idle Hour 69-kV line	2012	2012	3	reliability	Provisional

Table PR-15
Transmission System Additions for Zone 3 (continued)

System additions	System need year	Projected in-service year	Planning zone	Need category	Planned, Proposed or Provisional
Construct North Lake Geneva-White River 138-kV line	2012	2012	3	T-D interconnection	Provisional
Install 1-8.16 MVAR capacitor bank at Boscobel 69-kV Substation and upgrade existing 5.4 MVAR bank with an 8.16 MVAR bank	2013	2013	3	reliability	Provisional
Uprate Sheepskin-Dana 69-kV line to 95 MVA	2013	2013	3	reliability	Provisional
Construct a Lake Delton-Birchwood 138-kV line	2013	2013	3	reliability	Provisional
Install a second 138/69-kV transformer at McCue Substation	2014	2014	3	reliability	Provisional
Install 2-16.33 MVAR 69-kV capacitor banks at Eden Substation	2014	2014	3	reliability	Provisional
Install 2-16.33 MVAR 69-kV capacitor banks and 2-24.5 MVAR capacitor banks at Femrite Substation	2014	2014	3	reliability	Provisional
Install 2-12.25 MVAR 69-kV capacitor banks at Mazomanie Substation	2014	2014	3	reliability	Provisional
Construct a 345-kV bus, install a 345/138-kV 500 MVA transformer at North Randolph and loop the Columbia to South Fond Du Lac 345-kV line into the substation	2014	2014	3	reliability	Provisional
Uprate X-67 Portage-Trienda 138-kV line to 373 MVA	2014	2014	3	reliability	Provisional
Install 2-16.33 MVAR capacitor banks at Montrose Substation	2014	2014	3	reliability	Provisional
Construct a Horicon-East Beaver Dam 138-kV line	2014	2014	3	reliability	Provisional
Construct new 138-kV bus and install a 138/69-kV 100 MVA transformer at South Lake Geneva Substation	2016	2016	3	reliability	Provisional
Construct new 138-kV line from South Lake Geneva to White River Substation	TBD	TBD	3	reliability, T-D interconnection	Provisional
Construct West Middleton-Blount 138-kV line	2016	2016	3	reliability	Provisional
Uprate the Royster to Sycamore 69-kV line to 115 MVA	2016	2016	3	reliability	Provisional

Table PR-15
Transmission System Additions for Zone 3 (continued)

System additions	System need year	Projected in-service year	Planning zone	Need category	Planned, Proposed or Provisional
Construct West Middleton-North Madison 345-kV line	2016	2016	3	reliability, access initiative	Proposed
Construct Evansville-Brooklyn 69-kV line	2016	2016	3	reliability	Provisional