

ZONE & 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-20](#).

Land use in Zone 3 is largely rural 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 1.3 percent from 1994 to 2004. The highest growth rate occurred in Walworth County (more than 2 percent), while the largest increase in population occurred in Dane County, which increased by about 61,000 people.

During the same period, the employment growth rate was 1.7 percent. The highest growth rate occurred in Sauk County, while the largest increase in employment occurred in Dane County.

Zone 3 future population and employment projections

Population in Zone 3 is projected to grow at 0.9 percent annually between 2000 and 2005 and at 0.8 percent from 2005 through 2010. Dane County is projected to realize the largest increase in population and to have the highest growth rate.

Employment in Zone 3 is projected to grow at 1.1 percent annually between 2000 and 2005 and at 1.5 percent from 2005 through 2010. Dane County is projected to realize the largest increase in employment, while Sauk County is projected to have 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 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 driftless 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 2006, 2010 and 2014 are shown in [Table ZS-12](#). 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 3.3 percent annually from 2006 through 2014. 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 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,
- ❑ MAPP-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.
- ❑ dynamic voltage support issues in the Madison area,
- ❑ 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.
- ❑ stability of generation in Columbia and Rock Counties,
- ❑ 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 proposed new generation.

For a comprehensive list and graphical depiction of projects in Zone 3, please refer to Table PR-15 and Figure PR-3.

*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
Uprate North Lake Geneva to Lake Geneva 69-kV line to 72 MVA	2004	2005	3	reliability	Proposed
Uprate Brick Church to Walworth 69-kV line to 48 MVA	2004	2005	3	reliability	Proposed
Uprate Brick Church to Katzenberg 69-kV line to 93 MVA	2004	2005	3	reliability	Proposed
Uprate Sun Prairie to Gaston Road 69-kV line to 48 MVA	2004	2005	3	reliability	Proposed
Uprate Colorado to Sun Prairie 69-kV line to 72 MVA	2004	2005	3	reliability	Proposed
Uprate Dane to Waunakee and Waunakee to Huiskamp 69-kV lines	2004	2005	3	reliability	Proposed
Reconnect the 138/69-kV transformers at Kilbourn on separate breakers to operate individually	2006	2006	3	reliability	Provisional
Construct Butler Ridge 138-kV Substation	2006	2006	3	new generation	Planned
Install 36 MVAR capacitor bank at Hartford 138-kV Substation	2006	2006	3	reliability	Planned
Uprate Colley Road 138/69-kV transformer	2006	2006	3	reliability	Proposed
Uprate North Monroe 138/69-kV transformer	2006	2006	3	reliability	Proposed
Uprate Paddock-Shaw 69-kV line	2006	2006	3	reliability	Proposed
Uprate Brodhead-South Monroe 69-kV line	2006	2006	3	reliability	Provisional
Uprate McCue 138/69-kV transformer	2006	2006	3	reliability	Proposed
Construct new 69-kV line from Columbia to Rio to feed the proposed Wyocena Substation	2004	2006	3	T-D interconnection, reliability	Planned
Rebuild Turtle-Bristol 69-kV line to 138 kV and operate at 69 kV	2004	2006	3	condition, reliability, new generation	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
Build new breaker and a half 345/138-kV substation on site adjacent to existing North Madison Substation and replace existing transformers with two new 500 MVA units	2006	2006	3	reliability, new generation	Planned
Reconfigure 345-kV bus at Columbia	2006	2006	3	reliability, new generation	Planned
Convert Columbia-North Madison 138-kV line to 345 kV	2005	2006	3	reliability, new generation	Planned
Construct new line from West Darien to Southwest Delavan at 138 kV, operate at 69 kV	2006	2006	3	T-D interconnection	Planned
Uprate McCue-Janesville 69-kV line	2007	2007	3	reliability	Proposed
Rebuild the Verona to Oregon 69-kV line Y119	2006	2007	3	reliability	Proposed
Uprate Rockdale to Jefferson 138-kV line	2007	2007	3	reliability, service limitation	Planned
Uprate Rockdale to Boxelder 138-kV line	2007	2007	3	reliability, service limitation	Planned
Uprate Boxelder to Stonybrook 138-kV line	2007	2007	3	reliability, service limitation	Planned
Construct a Jefferson-Lake Mills-Stony Brook 138-kV line	2006	2007	3	reliability, T-D interconnection	Proposed
Convert Kegonsa-McFarland-Femrite 69-kV line to 138 kV	2007	2007	3	reliability, new generation	Proposed
Construct Sprecher-Femrite 138-kV line	2007	2007	3	reliability, new generation	Proposed
Install 138/69-kV transformer at Femrite	2007	2007	3	reliability, new generation	Proposed
Install 138/69-kV transformer at Reiner	2007	2007	3	reliability, new generation	Proposed
Convert Sycamore-Reiner-Sprecher from 69 kV to 138 kV	2007	2007	3	reliability	Proposed
Install/upgrade capacitor bank at South Monroe 69 kV to 32 MVAR	2007	2007	3	reliability	Proposed
Construct new line from Southwest Delavan to Delavan or Bristol at 138 kV, operate at 69 kV	2007	2007	3	T-D interconnection	Proposed
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

*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 138/69-kV substation at a site near Horicon and install a 138/69-kV transformer	2008	2008	3	reliability	Proposed
Convert Rock River to Bristol to Elkhorn 138 kV operation; rebuild Bristol with a new 138-kV bus	2008	2008	3	reliability	Proposed
Construct a new 138-kV line from North Madison to Waunakee	2005	2008	3	reliability	Proposed
Construct a new 138/69-kV substation near Waunakee and install a 100 MVA 138/69-kV transformer	2005	2008	3	reliability	Proposed
Install 1-8.16 MVAR capacitor bank at Richland Center 69 kV and upgrade existing 5.4 MVAR bank with an 8.16 MVAR bank	2008	2008	3	reliability	Provisional
Install 4-25 MVAR capacitor banks at Portage 138 kV	2009	2009	3	reliability	Provisional
Construct new 138-kV bus and install a 138/69-kV 100 MVA transformer at South Lake Geneva	2009	2009	3	reliability	Provisional
Construct new 138-kV line from South Lake Geneva to White River	2009	2009	3	reliability, T-D interconnection	Provisional
Construct new 138-kV bus and 138/69-kV 100 MVA transformer at Montrose Substation	2009	2009	3	reliability	Proposed
Construct new Montrose-Sun Valley-Oak Ridge 138-kV line	2009	2009	3	reliability	Proposed
Upgrade Colley Road to Brick Church 69-kV line to 72 MVA	2008	2009	3	reliability	Proposed
Install a second 138/69-kV transformer at Hillman	2009	2009	3	reliability	Proposed
Install a 69-kV 16.32 MVAR capacitor bank at Kilbourn Substation	2009	2009	3	reliability	Provisional

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

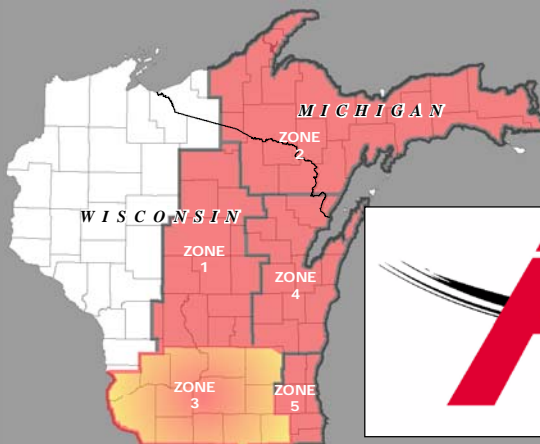
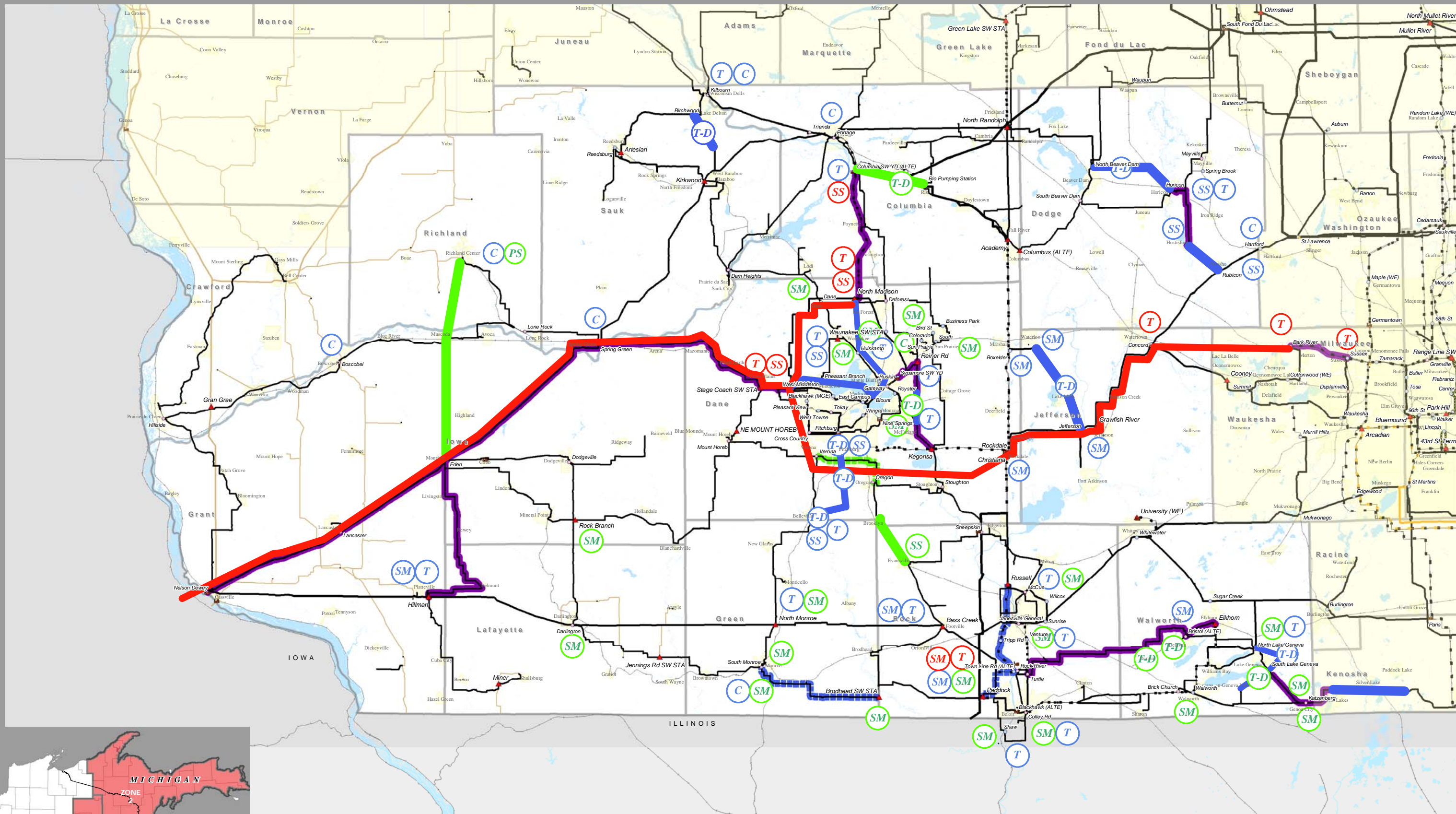
System additions	System need year	Projected in-service year	Planning zone	Need category	Planned, Proposed or Provisional
Construct Rockdale-Concord 345-kV line in parallel with existing 138 kV on existing double-width right-of-way	2007	2009	3 & 5	reliability, service limitation	Proposed
Construct a 345-kV bus and install a 345/138-kV, 500 MVA transformer at Concord	2007	2009	3 & 5	reliability	Proposed
Install a 69-kV bus and 138/69-kV 100 MVA transformer at Northwest Beloit	2010	2010	3	reliability	Provisional
Reroute Paddock to Shirland Avenue 69-kV line into and out of Northwest Beloit	2010	2010	3	reliability	Provisional
Loop the Femrite to Royster 69-kV line into AGA Gas	2010	2010	3	reliability	Provisional
Convert Hillman to Eden 69-kV line to 138 kV	2010	2010	3	reliability	Proposed
Install 1-8.16 MVAR capacitor bank at Boscobel 69 kV and upgrade existing 5.4 MVAR bank with an 8.16 MVAR bank	2010	2010	3	reliability	Provisional
Rebuild Brodhead to South Monroe 69-kV line using 477 ACSR	2010	2010	3	reliability	Provisional
Convert Waunakee-Blount 69-kV line to 138 kV	2010	2010	3	reliability	Proposed
Uprate Darlington-Rock Branch 69-kV line	2010	2010	3	reliability	Provisional
Uprate existing 18 MVAR capacitor bank at Spring Green 138 kV with a 50 MVAR bank	2010	2010	3	reliability	Provisional
Convert Bark River-Mill Road 138-kV line to 345 kV	2009	2010	3 & 5	reliability, new generation	Proposed
Construct a Concord-Bark River 345-kV line	2009	2010	3 & 5	reliability, new generation	Proposed
Construct a 345-kV bus and install a 345/138-kV, 500 MVA transformer at Bark River	2009	2010	3 & 5	reliability, new generation	Proposed
Uprate Yahara-Token Creek 69-kV line	2011	2011	3	reliability	Provisional
Construct Evansville-Brooklyn 69-kV line	2011	2011	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 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	2011	2011	3	reliability	Proposed
Install a 138/69-kV transformer and 69-kV bus at Yahara River Substation	2011	2011	3	reliability	Provisional
Loop the Deforest to Token Creek 69-kV line into the Yahara River Substation	2011	2011	3	reliability	Provisional
Construct a Lake Delton-Birchwood 138-kV line	2011	2011	3	reliability	Provisional
Install a second 138/69-kV transformer at Janesville Substation	2011	2011	3	reliability	Provisional
Uprate Sun Prairie-Bird Street 69-kV line	2012	2012	3	reliability	Proposed
Uprate North Monroe-Idle Hour 69-kV line	2012	2012	3	reliability	Provisional
Install 138/69-kV transformer at Bass Creek	2012	2012	3	reliability	Provisional
Rebuild and convert West Middleton-Spring Green 69-kV line to 138 kV	2012	2012	3	reliability	Provisional
Construct West Middleton-Stagecoach double-circuit 138/69-kV line	2012	2012	3	reliability	Provisional
Construct 69-kV line Eden through Muscoda to Richland Center	2012	2012	3	reliability	Provisional
Move Lone Rock 69-kV phase shifter to Richland Center	2012	2012	3	reliability	Provisional
Salem-Spring Green-West Middleton 345-kV proxy for Large Access Project, includes rebuild Nelson Dewey-Spring Green-West Middleton 138/69 kV to double-circuit 345/138 kV	2013	2013	3	access initiative	Provisional
Expand 345 kV to 6 positions at Paddock	2013	2013	3	access initiative	Provisional
Expand 138 kV to 7 positions at Paddock	2013	2013	3	access initiative	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
Install second 345/138-kV transformer at Paddock (500 MVA normal/625 MVA emergency)	2013	2013	3	access initiative	Provisional
Rebuild Paddock-Town Line Road 138 kV to double-circuit 1600 Amps minimum summer emergency each	2013	2013	3	access initiative	Provisional
Reconductor Town Line Road-Russell 138 kV to 1600 Amps minimum summer emergency	2013	2013	3	access initiative	Provisional
Construct new 69-kV line from South Lake Geneva to Lake Shore Substation	2013	2013	3	T-D interconnection	Provisional
Convert South Lake Geneva to Twin Lakes 69-kV line to 138 kV	2013	2013	3	reliability	Provisional
Construct new 138-kV line from Twin Lakes to Spring Valley	2013	2013	3	reliability	Provisional
Construct a Horicon-East Beaver Dam 138-kV line	2013	2013	3	reliability	Provisional
Install a second 138/69-kV transformer at North Monroe	2014	2014	3	reliability	Provisional
Construct West Middleton-Blount 138-kV line	2014	2014	3	reliability	Provisional
Construct West Middleton-North Madison 345-kV line	2014	2014	3	reliability, access initiative	Proposed
Install 1-16.32 MVAR capacitor bank at Burke 69 kV	2014	2014	3	reliability	Provisional
Install a second Femrite 138/69-kV transformer	2014	2014	3	reliability	Provisional
Replace the Kilbourn 47 MVA 138/69-kV transformer with a 100 MVA unit	2014	2014	3	reliability	Provisional
Uprate Colley Road to Park Street Tap 69-kV line to 114 MVA	2014	2014	3	reliability	Provisional
Replace the Colley Road 138/69-kV transformer	2015	2015	3	reliability	Provisional



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

PLANNING ZONE 3

- | | | | | | | | |
|------|--------------------------|-------|-------------------------|---------------|--------------------------------------|---------------------|---------------------------------|
| (SS) | New Substation | (C) | Capacitor Bank | (Red line) | 345 kV Transmission Line | (Green line) | 69 kV Transmission Line |
| (SM) | Substation Modifications | (T-D) | New T-D Interconnection | (Blue line) | 115 or 138 kV Transmission Line | (Green dashed line) | 69 kV Transmission Line Rebuild |
| (T) | Transformer | (PS) | Phase Shifter | (Purple line) | Transmission Line Voltage Conversion | | |

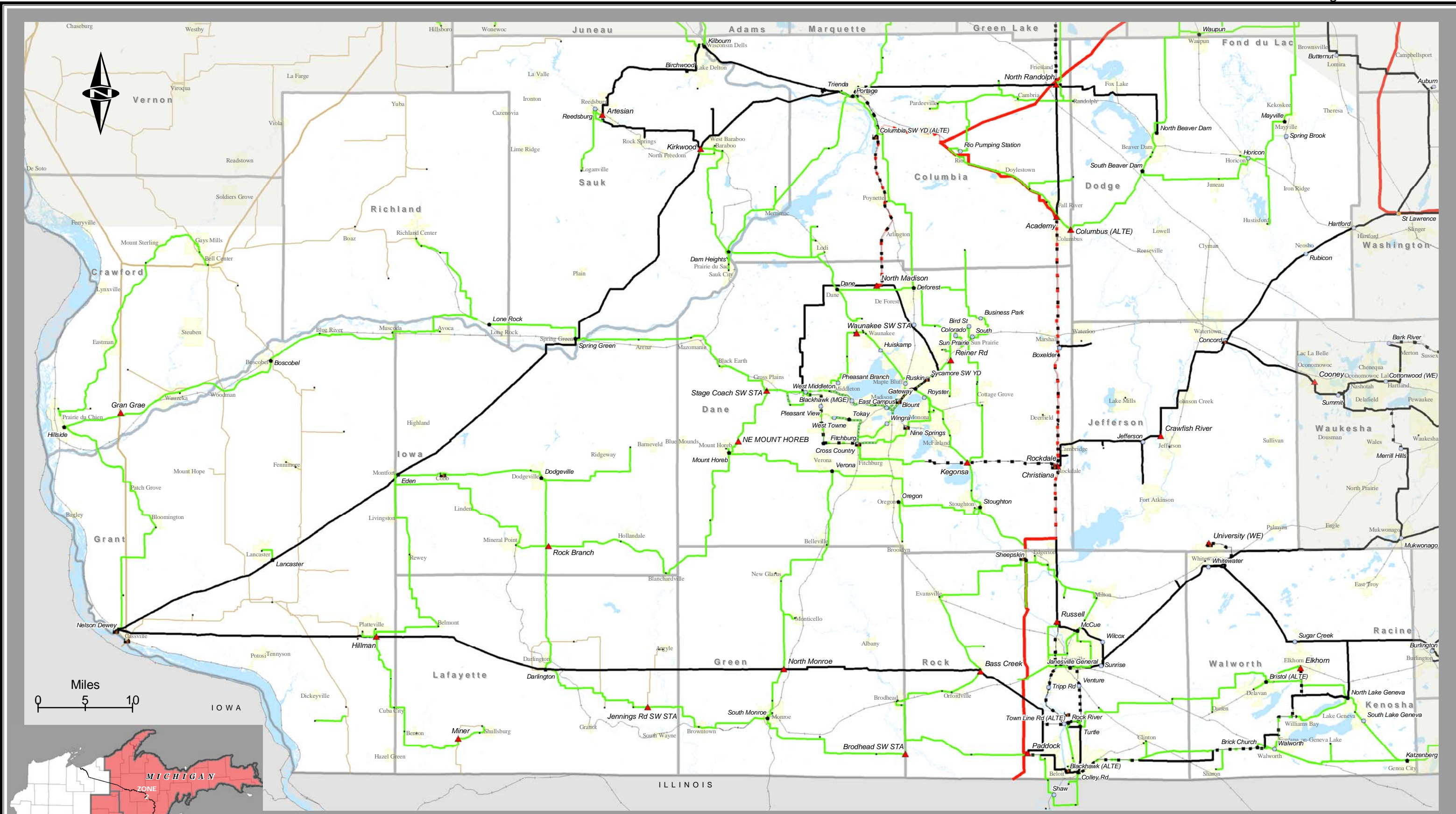
- Transmission Related Facilities**
- ▲ ATC Owned Substation
 - Joint Owned Substation - Assets Conveyed
 - Joint Owned Substation - Assets Retained
 - Proposed/Design/Construction
 - Generation
 - Other Facility
 - ATC Office Location

*Table ZS-12
Forecast of Peak Load and Generation in Zone 3*

	2006	2010	2014
Peak Forecast (megawatts)	3290.4	3609.9	4234.3
Average Peak Load Growth	N/A	2.34%	4.07%
Existing Generation Capacity (megawatts)	3898.4	3898.4	3898.4
Existing Capacity Less Load	608	288.5	-335.9
Existing Generation Capacity plus Modeled Generating Capacity Additions (megawatts)	3952.9	3952.9	3952.9
Modeled Capacity Less Load (megawatts)	662.5	343	-281.4

*Modeled generating capacity additions in the table above reflect those proposed capacity additions that were included in the 2005 Assessment analyses models, as listed in the **Projects** section.*

Figure ZS-20



**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
- 98 wholly owned substations
- 358 jointly owned substations
- ATC offices in Madison (2), Cottage Grove, Pewaukee, De Pere, Wausau and Kingsford, WI

Transmission Line Voltage

69 kV	69 kV Double Circuit
115 kV	115 kV Double Circuit
138 kV	138 kV Double Circuit
230 kV	230 kV Double Circuit
345 kV	345 kV Double Circuit

Transmission Related Facilities

69 kV Underground	138 kV Underground
Non-ATC Line	

- ▲ ATC Owned Substation
- Joint Owned Substation - Assets Conveyed
- Joint Owned Substation - Assets Retained
- Proposed/Design/Construction
- ATC Office Location
- Generation
- Other Facility



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

ZONE & STUDY RESULTS > zone 3 – 2006 study results

Refer to [Table ZS-1](#) and [Figure ZS-7](#)

Summary of key findings

- ❑ Intact system 138-kV voltages in the Columbia and Sauk county areas are approaching 95 percent. This is due in large part to the higher load demands in the area than in the previous Assessment as well as lower (100 percent or less) 138-kV bus voltages at Columbia during summer peaks.
- ❑ Accommodating the Riverside generation (in service) required numerous transmission system reinforcements, which have been and are being implemented.
- ❑ Accommodating the West Campus generation (in service) required several transmission reinforcements, which have been and 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.
- ❑ A significant number of lines and transformers will need to be uprated by 2006 to avoid overloads under contingency. These line and transformer overloads were discovered as a result of rating reviews that lowered the emergency ratings.
- ❑ Higher than average load growth in Rock and Walworth counties is driving the need for system reinforcements.
- ❑ Import capability from Illinois can be severely limited by transmission facilities outside of our system for loss of the Commonwealth Edison/ATC Wempletown-Paddock 345-kV line. This limitation has been addressed to some degree by installing a second 345-kV line between Wempletown and south central Wisconsin. The underlying 138-kV transmission system in the Janesville area and to the north still poses limitations for transfers into the Madison area.

In response to low voltages throughout Zone 3, a total of 205 MVAR in capacitor banks distributed at South Monroe, Hartford, Richland Center, Boscobel, Kilbourn and Portage were deemed to be the most feasible solutions. The most significant capacitor bank addition is needed in the Portage area due to low 138-kV intact system voltages in the area. In addition, during summer peak loading in 2010 a Columbia unit 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.

A transmission-to-distribution interconnection proposed for Wyocena provides another reason for extending a transmission line from Columbia to Rio with a loop through feed into the new substation (2006). 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.

There were a number of single contingency overloads in Zone 3 based on the 2006 analysis. Many of these overloads appeared earlier than in previous studies due to a significant increase (8 percent) in the load projection forecast from WPL. In addition, the Columbia-Portage double-circuit 138-kV line was uprated in 2005, and the Rockdale-Jefferson 138-kV line and the Rockdale-Boxelder 138-kV line will need to be uprated by 2007.

Overloads for outages of the Dane-Waunakee or West Middleton-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 reinforcements is complete. This included the uprating of the Dane-Waunakee, Waunakee-Huiskamp and West Middleton-Pheasant Branch 69-kV lines as well as the uprating of the North Madison 138/69-kV transformer. The second phase of support includes the construction of a new 138-kV line from North Madison-Waunakee (Huiskamp) and the construction of a new substation with a 138/69-kV transformer near Waunakee (2008). The final phase of support for this area is the extension of a Waunakee-Blount 138-kV line along the existing corridor along with a parallel 69-kV line. This project will require the installation of fluid-filled cables in underground pipe that is being installed during the Wisconsin Department of Transportation East Washington Street reconstruction. Also, it is expected that a GIS 138-kV bus will be installed at Blount Street Substation due to limited space at this site. The final phase of this reinforcement currently is scheduled for 2010.

While these projects will improve reliability in the Madison area, an overriding long-term concern for the area is the lack of a strong source to the west side of Madison where growth is the most prolific. Studies of this situation indicate that even reinforcements at 138-kV will not be adequate in the long term. Various alternatives were considered including a new Rockdale-West Middleton 345-kV circuit, a new North Madison-West Middleton 345-kV circuit, or both. However, it is recognized that either of these projects, or their equivalents, will take several years to implement, and more immediate relief in this area is needed. The preferred alternative for providing such interim relief is to convert the existing Columbia-North Madison 345/138 double-circuit line to double-circuit 345-kV. Other options considered involved new 138-kV or 345-kV transmission lines on new right-of-way, which would likely impose similar longer-term schedule constraints as the 345-kV line options.

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 and replacing the existing 345/138-kV transformers at North Madison are in construction (2006). In addition, the Kegonsa Substation was expanded to accommodate interconnecting the Christiana-Fitchburg circuit and the Kegonsa-Femrite 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 complete the reinforcements necessary to provide reliable long-term 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 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) to the Montrose area is being planned to accommodate three distribution interconnections and 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.

A number of projects related to proposed generation additions have been completed. The outstanding projects that are in progress are listed below:

- constructing a Femrite-Sprecher 138-kV line*,
- converting the Kegonsa-Femrite 69-kV and Sycamore-Sprecher 69-kV lines to 138 kV*,
- installing a 138/69-kV transformer at Femrite*,
- replacing the existing 345/138-kV transformers at North Madison*,
- converting the Columbia-North Madison 138-kV circuit to 345 kV * and
- installing a 138/69-kV transformer at Reiner*.

* provide load-serving benefits as well.

There are several pockets of low voltages and some overloads in the eastern Rock and western Walworth counties. The maintenance rebuild of the Turtle-West Darien portion of this 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 us 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).

**TABLE ZS-1
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2006**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
1	Antigo, Aurora Street and Summit Lake 115-kV bus voltages		89 – 92%	Gardner Park-Blackbrook-Antigo 115-kV line outage	Load Serving
1	Gardner Park-Blackbrook 115-kV line	96%		Hilltop-Sherman Street 115-kV line outage	Load Serving
1	Gardner Park-Kelly 115-kV line	96%		Hilltop-Sherman Street 115-kV line outage	Load Serving
1	Weston-Sherman Street 115-kV line	96 – 104%		Weston-Morrison 115-kV line outage Morrison-Sherman Street 115-kV line outage	Load Serving
1	Weston-Morrison 115-kV line	100%		Weston-Sherman Street 115-kV line outage	Load Serving
1	Morrison-Sherman Street 115-kV line	109%		Weston-Sherman Street 115-kV line outage	Load Serving
1	Wien-Stratford 115-kV line	98 -104%		Arpin 138/115-kV Transformer outage Arpin – Powers Bluff 115-kV line outage Powers Bluff – Hume 115-kV line outage Arpin 345/138-kV transformer outage	Load Serving
1	Stratford-McMillan 115-kV line	95-96%		Arpin 138/115-kV Transformer outage Arpin – Powers Bluff 115-kV line outage	Load Serving
1	McMillan, Wildwood, Hume and Powers Bluff 115-kV bus voltages		91 – 92%	Arpin 138/115-kV Transformer outage Arpin – Powers Bluff 115-kV line outage	Load Serving
1	Sigel, Lakehead Vesper and Port Edwards 138-kV bus voltages		89 – 91%	Arpin 345/138-kV Transformer outage Arpin-Sigel 138-kV line outage Sigel-Lakehead Vesper 138-kV line outage	Load Serving
1	Port Edwards, Hollywood and Saratoga 138-kV bus voltages		91 – 92%	Arpin-Sigel 138-kV line outage	Load Serving
1	Wautoma, Sand Lake and Roeder 138-kV bus voltages		88 – 95%	Base Case Various contingencies	Load Serving
1	Metomen-Ripon 69-kV line	97%		Winneconne-Sunset Point 69-kV line outage	Load Serving
1	Metomen-Rosendale 69-kV line	96 – 120%		Various contingencies	Load Serving
1	North Fond du Lac-Rosendale 69-kV line	106%		Metomen 138/69-kV transformer	Load Serving
1	Ripon-Mackford Prairie 69-kV line	97%		Metomen-Ripon 69-kV line outage	Load Serving
1	Berlin area 69-kV bus voltages		88 – 92%	Various line outages	Load Serving
1	Council Creek and Petenwell 138-kV bus voltages		88 – 95%	Base Case Various contingencies	Load Serving
1	Council Creek 69-kV bus tie	100 – 106%		King-Eau Claire-Arpin 345-kV line outage Eau Claire-Arpin 345-kV line outage Hillsboro-Hillsboro tap 69-kV line outage	Load Serving
1	Necedah, Whistling Wings, Dellwood, Friendship, Houghton Rock 69-kV bus voltages		91 – 92%	Various outages	Load Serving
1	Hilltop, Mauston, Lyndon Station, Wisconsin Dells and Kilbourn 69-kV bus voltages		90-91%	Kilbourn 138/69-kV transformer	Load Serving
1	Neenah Creek, Glen and Winnebago 69-kV bus voltages		90 – 92%	Kilbourn 138/69-kV transformer	Load Serving
1	Whitcomb-Wittenberg 69-kV line	95 – 105%		Gardner Park-Blackbrook-Antigo-Aurora Street 115-kV outage Gardner Park-Blackbrook-Antigo 115-kV outage Blackbrook-Antigo 115-kV outage	Load Serving
1	Deer Trail-Polar tap 69-kV line	98%		Gardner Park-Blackbrook-Antigo 115-kV outage	Load Serving
1	Roslin, Endeavor and Lakehead Portage 69-kV bus voltages		89 – 91%	Portage-Lakehead Portage 69-kV line outage	Load Serving
2	Atlantic-Elevation Tap #1 69-kV	138%		Atlantic-Elevation Tap #2 69-kV line outage	Load Serving
2	Osceola-Elevation Tap #1 69-kV	110%		Atlantic-Elevation Tap #2 69-kV line outage	Load Serving

TABLE ZS-1 (continued)
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2006

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
2	Atlantic-Elevation Tap #2 69-kV	106%		Atlantic-Elevation Tap #1 69-kV line outage	Load Serving
2	Atlantic-Elevation Tap #1 69-kV	106%		Osceola-Elevation Tap #2 69-kV line outage	Load Serving
2	Sawyer, Gwinn, Chatham, Forest Lake and Seney Tap 69-kV bus voltages		84-91%	Forsyth-Gwinn 69-kV line outage	Load Serving
2	Bruce Crossing, Watersmeet, Land O Lakes, Conover and Twin Lakes 69-kV bus voltages		84-89%	Mass-Bruce Crossing 69-kV line outage	Load Serving
2	L'Anse and M38 69-kV bus voltages		88-90%	M38 138/69-kV transformer outage	Load Serving
2	Seney Tap, Timber Products and Munising 69-kV bus voltages		87-92%	Forsyth-Munising 138-kV line outage	Load Serving
2	Atlantic, Stone Container, M38, Winona and Ontonagon 138-kV buses, L'Anse 69-kV and M38 69-kV bus voltages		89-90%	M38-Perch Lake 138-kV line outage	Load Serving
2	Seney Tap, Timber Products and Munising 69-kV bus voltages		90-92%	Munising 138/69-kV transformer outage	Load Serving
2	Stone Container, Ontonagon and Winona 138-kV bus voltages		90%	Winona-M38 138-kV line outage	Load Serving
2	Brevort, Hiawatha and Lakehead 138-kV bus voltages		90%	Brevort-Straits 138-kV line outage	Load Serving
2	Hiawatha and Lakehead 138-kV bus voltages		90%	Brevort-Lakehead 138-kV line outage	Load Serving
2	Stone Container and Ontonagon 138-kV bus voltages		91%	Winona-Ontonagon 138-kV line outage	Load Serving
3	North Beaver Dam, Fox Lake, East Beaver Dam 138-kV bus voltages		97%	Base Case due-tap settings at Columbia on the 345/138-kV transformers	Load Serving
3	Hillman 138/69-kV transformer	118%		Pilot Knob – Galena 69-kV line outage	Load Serving
3	North Monroe 138/69-kV transformer	95-108%		Kegonsa-Stoughton 69-kV line segments, Darlington-South Monroe 69-kV line segments, Darlington 138/69-kV transformer, Brodhead-Newark 69-kV line, Stoughton-Aaker Road 69-kV line, Paddock 138/69-kV transformer	Load Serving
3	Brodhead-Blacksmith and Brodhead-Newark 69-kV lines	105-115%		North Monroe 138/69-kV transformer, North Monroe-Idle Hour 69-kV line outage, Town Line Road-Albany 138-kV line	Load Serving
3	Turtle–Rock River 69-kV line	104%		Colley Road-Dickinson 138-kV line outage	Load Serving
3	Columbia 138/69-kV transformer	109%		Portage 138/69-kV transformer	Load Serving
3	Colley Road-Brick Church 69-kV line	115%		Colley Road-Brick Church 138-kV line	Load Serving
3	Rock River 138/69-kV transformer	98-103%		Colley Road-Brick Church 138-kV line, Black hawk 138/69-kV transformer	Load Serving
3	Colley Road 138/69-kV transformer	111-125%		Paddock-Shirland Ave 69-kV line, Paddock 138/69-kV transformer, Colley Road-Brick Church 138-kV line	Load Serving
3	Paddock 138/69-kV transformer	98%		Colley Road 138/69-kV transformer	Load Serving
3	Brick Church 138/69-kV transformer	97%		Brick Church-Williams Bay 138-kV line	Load Serving
3	McCue-Milton Lawns 69-kV line	98%		Janesville 138/69-kV transformer	Load Serving
3	North Stoughton-Kegonsa 69-kV line	98%		McCue-La Mar 69-kV line	Load Serving
3	Verona-Oregon 69-kV line	123%		Stoughton-Aaker Road 69-kV line	Load Serving
3	Blount-Ruskin 69-kV lines (both circuits)	103-128%		North Madison 138/69-kV transformer, Blount-Ruskin 69-kV adjacent line	Load Serving

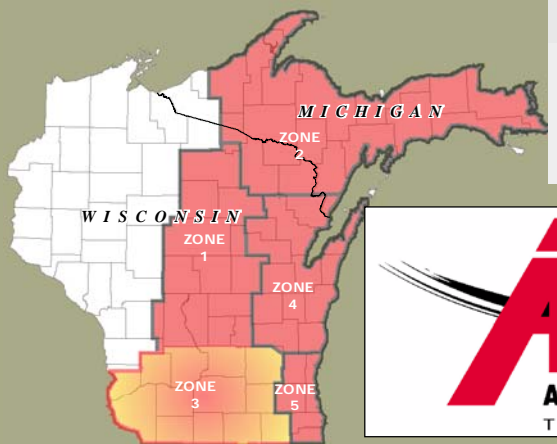
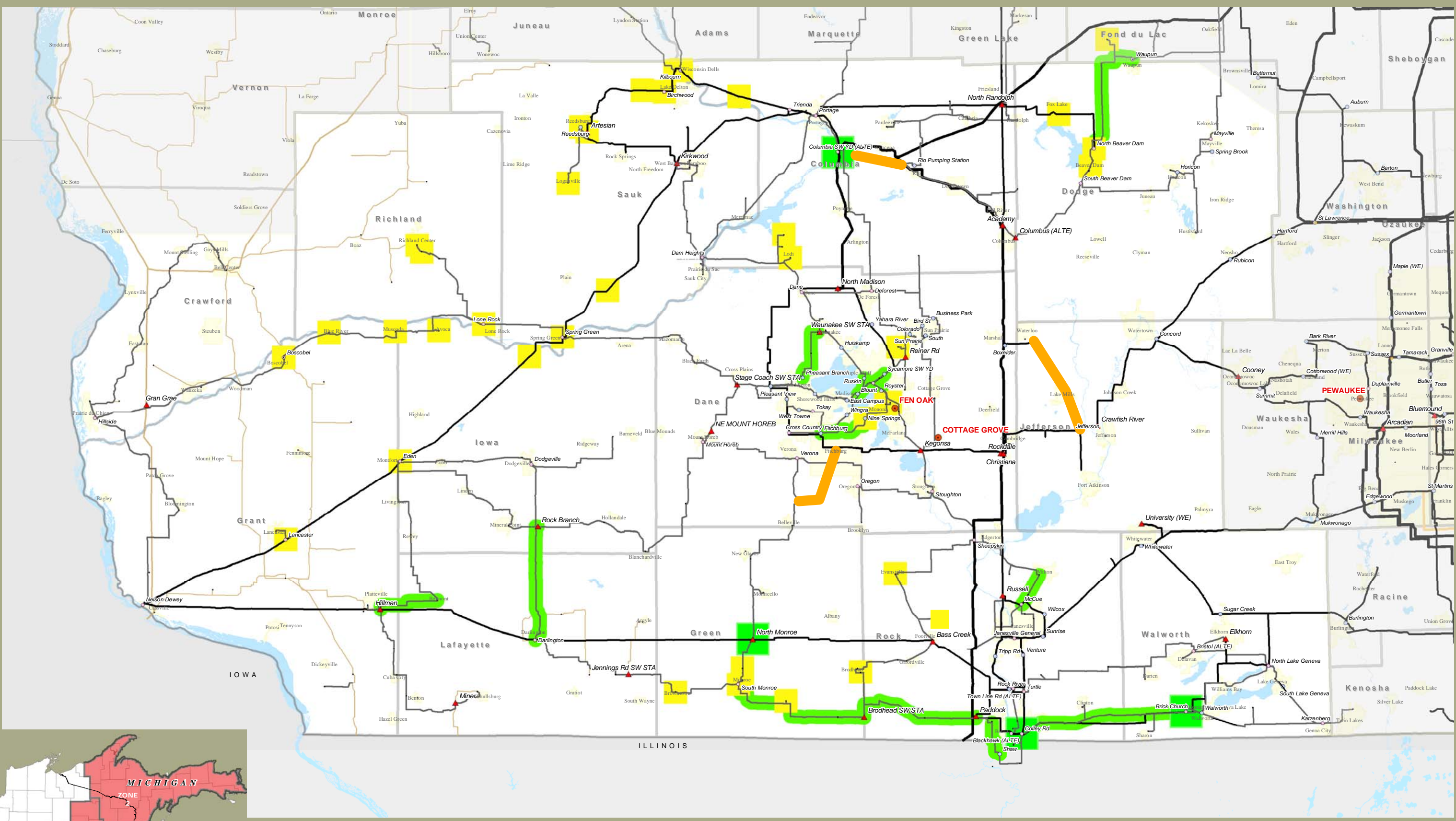
TABLE ZS-1 (continued)
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2006

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
3	Royster-Pflaum Tap 69-kV line	103%		Fitchburg-Nine Springs 69-kV line	Load Serving
3	Pheasant Branch-West Port 69-kV line	102%		West Middleton-Pheasant 69-kV line	Load Serving
3	Dane-North Madison 69-kV line	97%		American Center-Sycamore 138-kV line	Load Serving
3	Paddock-Shirland Ave 69-kV line	97-133%		Colley Road-Park Ave 69-kV line, Colley Road 138/69-kV transformer	Load Serving
3	Monticello, New Glarus, Belleville 69-kV buses		87-89%	North Monroe-Monticello 69-kV line	Load Serving
3	Reiner, Burke and Sprecher 69-kV buses		90-91%	Reiner Tap-Sycamore 69-kV line	Load Serving
3	Oregon and Brooklyn 69 buses		89%	Oregon-Aaker Road 69-kV line	Load Serving
3	Monroe, Idle Hour, South Monroe, Black Smith, Browntown, Jennings Road, Argyle (DPC) 69-kV buses		85-92%	North Monroe-Idle Hour Tap 69-kV line	Load Serving
3	Verona, Monroe, Idle Hour, South Monroe, New Glarus, Monticello, Black Smith, Browntown, Jennings Road, Argyle (DPC) 69-kV buses		85-92%	North Monroe 138/69-kV transformer	Load Serving
3	Muscoda, Avoca, Spring Green, Lone Rock, Arena 69-kV bus voltages		92%	Lone Rock-Spring Green 69-kV line	Load Serving
3	Aaker Road (Stoughton), Oregon, Brooklyn and Verona 69-kV buses		82-91%	Stoughton-Aaker Road 69-kV line outage	Load Serving
3	Brodhead Municipal, Orfordville, Footville, Bass Creek 69-kV buses		90-92%	Brodhead SS-Brodhead Muni 69-kV line	Load Serving
3	Concord 138-kV bus 6, Rubicon 138-kV buses		85-87%	Concord Bus 6 – 5 Bus tie outage	Load Serving
3	Eden, Lancaster, Wyoming Valley, 138-kV bus voltages		90-91%	Nelson Dewey-Eden 138-kV line segments	Load Serving
3	Brick Church, Dickinson 138-kV bus voltages		91%	Colley Road-Brick Church 138-kV line outage	Load Serving
3	Cambridge, London, Boxelder, Stonybrook, Friesland, East Beaver Dam, Academy, North Randolph, Fox Lake, North Beaver Dam, Lakehead Pumping 138-kV bus voltages		85-92%	Rockdale-Cambridge Tap 138-kV line outage	Load Serving
3	Kilbourn, Platte, Finnegan 69-kV buses		89%	Kilbourn 138/69-kV transformer	Load Serving
3	Rock Springs, Artesian, Nishan, Zobel, Lewiston, Loch Mirror Birchwood, Dell Creek 138-kV buses / Artesian, Loganville, Reedsburg, Lewiston 69-kV buses		88-92%	Kilbourn-Trienda 138-kV line segments	Load Serving
3	Rock Springs, Artesian, Nishan, Zobel, Troy, Kirkwood, Lake Delton 138-kV buses / Artesian, Loganville and Reedsburg 69-kV buses		90-92%	Trienda-Kirkwood 138-kV line segments	Load Serving
3	North Beaver Dam, Fox Lake and East Beaver Dam 138-kV bus voltages		82-95%	North Randolph – East Beaver Dam 138-kV line segments, Portage-Friesland 138-kV line segments, Rockdale-Boxelder 138-kV line segments	Load Serving
3	Pine River, Richland Center, Richland, Eagle (DPC) 69-kV bus voltages		89%	Lone Rock Phase Shifter, Lone Rock-Richland, Dayton-Richland Center Tap 69-kV line outage	Load Serving
4	Crivitz-High Falls 69-kV line	96%		Pioneer-Sandstone 69-kV line outage	Load Serving
4	Pioneer-Sandstone 69-kV line	101%		Crivitz-High Falls 69-kV line outage	Load Serving
4	Ellinwood 138/69-kV T1 transformer	99%		Fitzgerald-Sunset Point 138-kV line outage	Load Serving

TABLE ZS-1 (continued)
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2006

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
4	Goodman 69-kV bus voltage		94%	Base Case	Load Serving
5	Pleasant Prairie-Bain 345-kV line	161%		Splitting Pleasant Prairie 345-kV bus sections 3 and 4	Load Serving
5	Bluemound 230-kV bus voltage		91%	Pleasant Prairie-Racine 345-kV line Outage	Load Serving
5	Pleasant Valley-Saukville 138-kV line	112%		Splitting Concord 5 and 6	Load Serving

Figure ZS-7



Performance Criteria Exceeded and Other Constraints 2005-2006
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

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

Transmission Related Facilities

- ▲ ATC Owned Substation
- Joint Owned Substation - Assets Conveyed
- Joint Owned Substation - Assets Retained
- Proposed/Design/Construction
- ATC Office Location
- Generation
- Other Facility

ZONE & STUDY RESULTS > Zone 3 – 2010 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 a new 345-kV source on the west side of Madison.
- ❑ The 138-kV line from Nelson Dewey to Columbia will require voltage support from other areas adjacent to this line. Projects are planned to address these problems, including several voltage conversions and a major new transmission line to the west side of Madison.
- ❑ The West Middleton-Verona-Kegonsa 69-kV network will need additional reinforcements by 2009. The Fitchburg (Oak Ridge) to Montrose line is proposed to resolve these issues.
- ❑ Low intact and contingency 138-kV system voltages in Columbia, Dodge, Sauk, Iowa and Grant counties signal the need for substantial reactive support in these areas.
- ❑ Walworth and Kenosha counties will require additional support to accommodate several transmission-to-distribution interconnections, to mitigate impending overloads on various facilities and to 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 problems.
- ❑ Overloads on 69-kV lines and 138/69-kV transformers in Rock County are impending by 2010. Some smaller-scale projects are proposed to resolve these problems. The 69-kV system in Rock County needs to be monitored to determine if a more robust solution in the area is warranted beyond 2010.
- ❑ Low voltages at/near Richland Center and along the 69-kV line from Gran Grae to Lone Rock signal the need for reinforcements in that area.

Several line and transformer overloads and numerous pockets of low voltage were identified in Zone 3. 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](#). The addition of 345-kV facilities is proposed to increase import capability into our system through Zone 3 and resolve load serving area problems in Dane, Iowa and Sauk counties.

High load growth in southern Dane County has resulted in low voltages and pending overloads on the transmission facilities feeding the Verona, Oregon and Stoughton areas. Even with the addition of a capacitor bank upgrade at Oregon (2004), the voltages in this area continue to be a concern. A new 138-kV line from Oak Ridge (Fitchburg) to Montrose will adequately address these problems and will provide transmission service to two proposed Alliant substations (Sun Valley and Montrose). As these loads continue to grow, additional support will be needed (see [Zone 3 - 2014 study results](#)).



The 138-kV Nelson Dewey-Columbia line will require voltage support in the 2009 timeframe. Due to the length of this line and the high load growth in Sauk County, the voltage profile along this 138-kV line is an ongoing concern. Several projects are planned to address these problems including: additional capacitor banks at Spring Green and Portage, the conversion of West Middleton-Spring Green from 69-kV to 138 kV, the conversion of Hillman-Eden from 69-kV to 138 kV and the construction of a new 345-kV line from Rockdale to West Middleton Substation along with voltage transformations at strategic locations along the way. The Rockdale-West Middleton 345-kV line also is required to provide voltage stability support for the entire Madison area. The Southwest Access Initiative also could help address some of these voltage issues by extending a 345-kV line from Salem to Spring Green to West Middleton with transformation at Spring Green (see [Access Initiative](#)).

The Walworth County area is experiencing high load growth, especially in the Delavan and Lake Geneva areas. The conversion of the Rock River-Elkhorn line will address impending low voltages and overloads identified on the system in eastern Rock and western Walworth counties. This load growth also is causing several problems on the transmission system in the greater Lake Geneva area. Extension of 138 kV from North Lake Geneva to South Lake Geneva resolves the Lake Geneva area voltage problems; however, load growth along the Illinois border in Wisconsin require additional measures be taken. One proposed plan is to convert the 69-kV South Lake Geneva-Twin Lakes line to 138 kV and construct a new 138-kV line from Twin Lakes to Spring Valley Substation. This will provide area voltage and load serving support and will provide another west to east corridor for transferring power into and through southern Wisconsin.

In Rock County, several single contingency overloads of 138/69-kV transformers will be mitigated by adding a 138/69-kV transformer at the new Northwest Beloit Substation. Investigations are under way to determine whether emergency overload capabilities exist on these transformers. Previous studies assumed that these area transformers could be updated. If so, this project may be deferred or eliminated.

Low voltages in several rural areas are signaling the need for new transmission lines, since capacitor banks will not completely relieve these problems. The Richland Center area, even after the installation of 22 MVAR of additional capacitors, is expected to experience marginal to low voltages under contingency beyond 2009. A new 69-kV line from Eden through Muscoda to Richland Center solves these problems, but represents a significant addition of new right-of-way on new corridors. This alternative will require extensive analysis and other alternatives will need to be considered and analyzed in order to ensure the optimum solution is chosen that will meet system needs while minimizing costs and public impact. In the Beaver Dam, Juneau and Mayville areas, 69-kV line loadings and voltages are a concern under contingency in 2005 and become critical in 2009. A new 138-kV line from Rubicon to Horicon (new line on new right-of-way from Rubicon to Hustisford and rebuild/conversion of the Hustisford to Horicon 69-kV-line to 138 kV) along with a new substation near Horicon will address these and other problems in Dodge County for several



10-Year Assessment

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

2005

www.atc10yearplan.com

years to come. A new line between Horicon and Beaver Dam is needed to support area voltages in about 2013 as the area loads continue to grow.

**TABLE ZS-2
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2010**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
1	Gardner Park-Kelly 115-kV line	96 - 103%		Maine-Hilltop 115-kV line outage Maine-Pine 115-kV line outage	Load Serving
1	Arpin 345/138-kV Transformer	102%		Arpin-Rocky Run 345-kV line outage	Off Peak Load Serving
1	Sigel-Arpin 138-kV line	104%		Arpin-Rocky Run 345-kV line outage	Off Peak Load Serving
1	Young Road-Sigel 138-kV line	109%		Arpin-Rocky Run 345-kV line outage	Off Peak Load Serving
1	Young Road-Lakehead Vesper 138-kV line	108%		Arpin-Rocky Run 345-kV line outage	Off Peak Load Serving
1	Sigel, Lakehead Vesper and Port Edwards 138-kV bus voltages		90 – 91%	Arpin-Sigel 138-kV line outage	Load Serving
1	Port Edwards, Hollywood and Saratoga 138-kV bus voltages		91 – 92%	Arpin-Sigel 138-kV line outage	Load Serving
1	Wautoma, Sand Lake and Roeder 138-kV bus voltages		90 – 95%	Base Case Various contingencies	Load Serving
1	Metomen-Ripon 69-kV line	98%		Winneconne-Sunset Point 69-kV line outage	Load Serving
1	Omro-Winneconne 69-kV line	98%		NW Ripon 69-kV line outage	Load Serving
1	Wautoma-Spring Lake 69-kV line	100 – 103%		NW Ripon 69-kV line outage Winneconne-Sunset Point 69-kV line outage	Load Serving
1	Berlin area 69-kV bus voltages		88 – 92%	Various contingencies	Load Serving
1	Council Creek 69-kV bus tie	95 – 124%		King-Eau Claire-Arpin 345-kV line outage Eau Claire-Arpin 345-kV line outage Hillsboro-Hillsboro tap 69-kV line outage	Network
1	Necedah, Whistling Wings, Dellwood, Friendship, Houghton Rock 69-kV bus voltages		91 – 92%	Petenwell 138/69-kV transformer outage Petenwell-Big Pond 69-kV line outage Big Pond-Necedah tap 69-kV line outage	Load Serving
1	Hilltop, Mauston, Lyndon Station, Wisconsin Dells and Kilbourn 69-kV bus voltages		90 - 91%	Kilbourn-Wisconsin Dells #2 line outage	Load Serving
1	Roslin, Endeavor and Lakehead Portage 69-kV bus voltages		88 – 91%	Portage-Lakehead Portage 69-kV line outage	Load Serving
2	Winona-Twin Lakes 69-kV	97%		Atlantic-M 38 69-kV line outage, Atlantic 138/69-kV transformer outage	Load Serving
2	Atlantic, Stone Container, M38, Winona and Ontonagon 138-kV buses and L'Anse 69-kV bus voltages		90-92%	M38-Perch Lake 138-kV line outage	Load Serving
2	L'Anse 69-kV bus voltage		91%	M38 138/69-kV transformer outage	Load Serving
2	Atlantic, Stone Container, M38, Winona and Ontonagon 138-kV buses and L'Anse 69-kV bus voltages		90-91%	M38-Perch Lake 138-kV line outage	Load Serving
2	L'Anse 69-kV bus voltage		92%	M38 138/69-kV transformer outage	Load Serving
2	Stone Container, Ontonagon and Winona 138-kV bus voltages		91-92%	Winona-M38 138-kV line outage	Load Serving
2	Land O' Lakes and Conover 69-kV bus voltages		91%	Conover 138/69-kV transformer outage	Load Serving
2	Winona-Twin Lakes-Portage Tap-Atlantic 69-kV line	160-98%		Atlantic 138/69-kV transformer outage, M38 138/69-kV transformer outage, Atlantic-M 38 138-kV line outage, M38-Perch Lake 138-kV line outage	Load Serving
2	Atlantic-Henry St Tap 69-kV line	127%		M38-Perch Lake 138-kV line outage	Load Serving

TABLE ZS-2 (continued)
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2010

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
2	Atlantic 138/69-kV transformer	117-96%		M38 138/69-kV transformer outage, Atlantic-Portage Tap 69-kV line outage, Winona-Twin Lakes 69kV line outage, Winona-M38 138-kV line outage, Twin Lakes-Portage Tap 69-kV line outage, M38-Perch Lake 138-kV line outage	Load Serving
2	M38-Atlantic 69-kV line	115-98%		Atlantic 138/69-kV transformer outage, M38 138/69-kV transformer outage, Atlantic-M 38 138-kV line outage	Load Serving
2	Atlantic-Elevation Tap #2 69-kV line	115%		Atlantic-Elevation Tap #1 69-kV line outage	Load Serving
2	Hiawatha 69-138-kV transformer (reverse flow limitation)	96%		Straits 138/69-kV transformer outage	Load Serving
2	North Lake-M38 138-kV line	98%		M38-Perch Lake 138-kV line outage	Load Serving
2	Atlantic, Stone Container, Ontonagon, Winona, M38 and Indian Lake 138-kV buses and L'Anse and M38 69-kV bus voltages		91-95%	Base Case	Load Serving
2	Atlantic, L'Anse, Keweenaw, Keweenaw Tap, MTU, Osceola, Henry St, Henry St Tap, M38, Elevation #2, 1 Elevation Tap #2, Elevation #1, Elevation Tap #1, Portage, Portage Tap, Ontonagon, Twin Lakes, UPSCO, Winona, Lake Mine, Mass, Rockland Junction, Rockland, Victoria, Bruce Crossing, Toll Free, White Pine Village and White Pine Mine 69-kV buses and Atlantic, Stone Container, Ontonagon, Winona and M38 138-kV bus voltages		74-92%	M38-Perch Lake 138-kV line outage	Load Serving
2	Keweenaw, Keweenaw Tap, MTU, Osceola, Henry St, Henry St Tap, Elevation #2, 1 Elevation Tap #2, Elevation #1, Elevation Tap #1, Portage, Atlantic, Portage Tap, L'Anse, M38 and Twin Lakes 69-kV buses and Stone Container, Ontonagon, Winona and M38 138-kV bus voltages		77-91%	Atlantic-M 38 138-kV line outage	Load Serving
2	Keweenaw, Keweenaw Tap, MTU, Osceola, Henry St, Henry St Tap, Elevation #2, Elevation Tap #2, Elevation #1, Elevation Tap #1, Portage, Atlantic, Portage Tap, L'Anse, M38 and Twin Lakes 69-kV buses and Stone Container, Ontonagon, Winona and M38 138-kV bus voltages		77-92%	Atlantic 138/69-kV transformer outage	Load Serving
2	L'Anse, M38, Keweenaw, Keweenaw Tap, MTU, Osceola, Henry St and Henry St Tap 69-kV buses and Atlantic, Stone Container, Ontonagon, Winona and M38 138-kV bus voltages		80-92%	M38 138/69-kV transformer outage	Load Serving
2	Sawyer, Gwinn, Chatham, Forest Lake, Seney Tap, Timber Products, Alger 69-kV buses and Munising 69 and 138-kV bus voltages		80-92%	Forsyth-Gwinn 69-kV line outage	Load Serving
2	Stone Container and Ontonagon 138-kV bus voltages		87-91%	Ontonagon-UPSCO Tap 138-kV line outage, Victoria-Rockland Junction 69-kV line outage, Rockland Junction-UPSCO Tap 69-kV line outage, Winona-Ontonagon 138-kV line outage	Load Serving
2	Stone Container, Ontonagon and Winona 138-kV buses and Ontonagon 69-kV bus voltages		87-92%	Winona-M38 138-kV line outage	Load Serving
2	Seney Tap, Timber Products, Munising and Alger 69-kV bus voltages		87-91%	Forsyth-Munising 138-kV line outage	Load Serving
2	Newberry Village, Louis Pacific, Newberry, Newberry Hospital, Roberts and Hulbert		89-92%	Engadine-Newberry 69-kV line outage, Hiawatha-Engadine 69-kV line outage	Load Serving

TABLE ZS-2 (continued)
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2010

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
2	Seney Tap, Timber Products, Alger and Munising 69-kV bus voltages		89-91%	Munising 138/69-kV transformer outage	Load Serving
2	Keweenaw, Keweenaw Tap, Elevation #1, Elevation Tap #1 and Osceola 69-kV bus voltages		90-91%	Atlantic-Elevation Tap #1 69-kV line outage	Load Serving
2	Atlantic, Stone Container, Winona, Ontonagon and M38 138-kV buses and L'Anse and M38 69-kV bus voltages		89-92%	Presque Isle-Perch Lake 138-kV line outage	Load Serving
2	Brevort, Lakehead and Hiawatha 138-kV bus voltages		91%	Straits-Brevort 138-kV line outage	Load Serving
2	L'Anse 69-kV bus voltage		90%	Atlantic-M38 69-kV line outage	Load Serving
2	Newberry Village, Louis Pacific, Newberry Hospital and Roberts 69-kV bus voltages		91-92%	Newberry-Newberry Tap 69-kV line outage	Load Serving
2	Lakehead and Hiawatha 138-kV bus voltages		91%	Brevort-Lakehead 138-kV line outage	Load Serving
2	L'Anse, M38, Keweenaw, Keweenaw Tap, MTU and Osceola 69-kV buses and Atlantic, Stone Container, Ontonagon, Winona and M38 138-kV bus voltages		87-92%	Northlake-M38 138-kV line outage	Load Serving
2	Land O Lakes 69-kV bus voltage		92%	Conover-Land O Lakes 69-kV line outage	Load Serving
3	Richland Center 69-kV bus voltage		94.5%	Base case	Load Serving
3	North Monroe Transformer	97-100%		Darlington-Gratiot 69-kV line outage, Paddock-Brodhead Switching Station 69-kV line outage and Darlington 138/69-kV transformer	Load Serving
3	Brodhead Switching Station-South Monroe 69-kV line	100-105%		North Monroe-South Monroe 69-kV line outage and North Monroe 138/69-kV transformer	Load Serving
3	Paddock-Brodhead Switching Station 69-kV line	100-112%		Albany-Townline Road 138-kV, Rockdale-Wempletown 345-kV, North Monroe-South Monroe 69-kV, McCue-LaMar 69-kV line outages and North Monroe 138/69-kV transformer	Load Serving
3	Monroe, South Monroe, Idle Hour, Browntown and Blacksmith 69-kV bus voltages		88-91%	North Monroe-Idle Hour Tap 69-kV line outage	Load Serving
3	Brodhead Muni 69-kV bus voltages		91%	Brodhead Switching Station-Brodhead Muni 69-kV line outage	Load Serving
3	Evansville, RCEC Center 69-kV bus voltages		91%	Evansville-Sheepskin 69-kV line outage	Load Serving
3	Colley Road-Brick Church 69-kV line	95-116%		Brick Church 138/69-kV transformer outage	Load Serving
3	Colley Road 138/69-kV transformer	101%		Northwest Beloit-Shirland Ave 69-kV line outage	Load Serving
3	Northwest Beloit-Shaw 69-kV line	101-108%		Colley Road 138/69-kV transformer outage	Load Serving
3	Brick Church 138/69-kV transformer	104%		North Lake Geneva 138/69-kV transformer outage	Load Serving
3	McCue 138/69-kV transformer	106%		Janesville 138/69-kV transformer outage	Load Serving
3	McCue-Milton Lawns 69-kV line	97%		Janesville 138/69-kV transformer outage	Load Serving
3	Lancaster 69-kV bus, Eden, Spring Green, Troy, Lancaster, Wyoming Valley 138-kV bus voltages		80-91%	Nelson Dewey-Lancaster 138-kV line outage	Load Serving

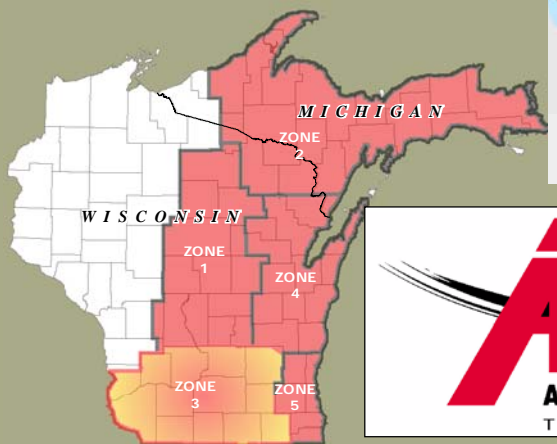
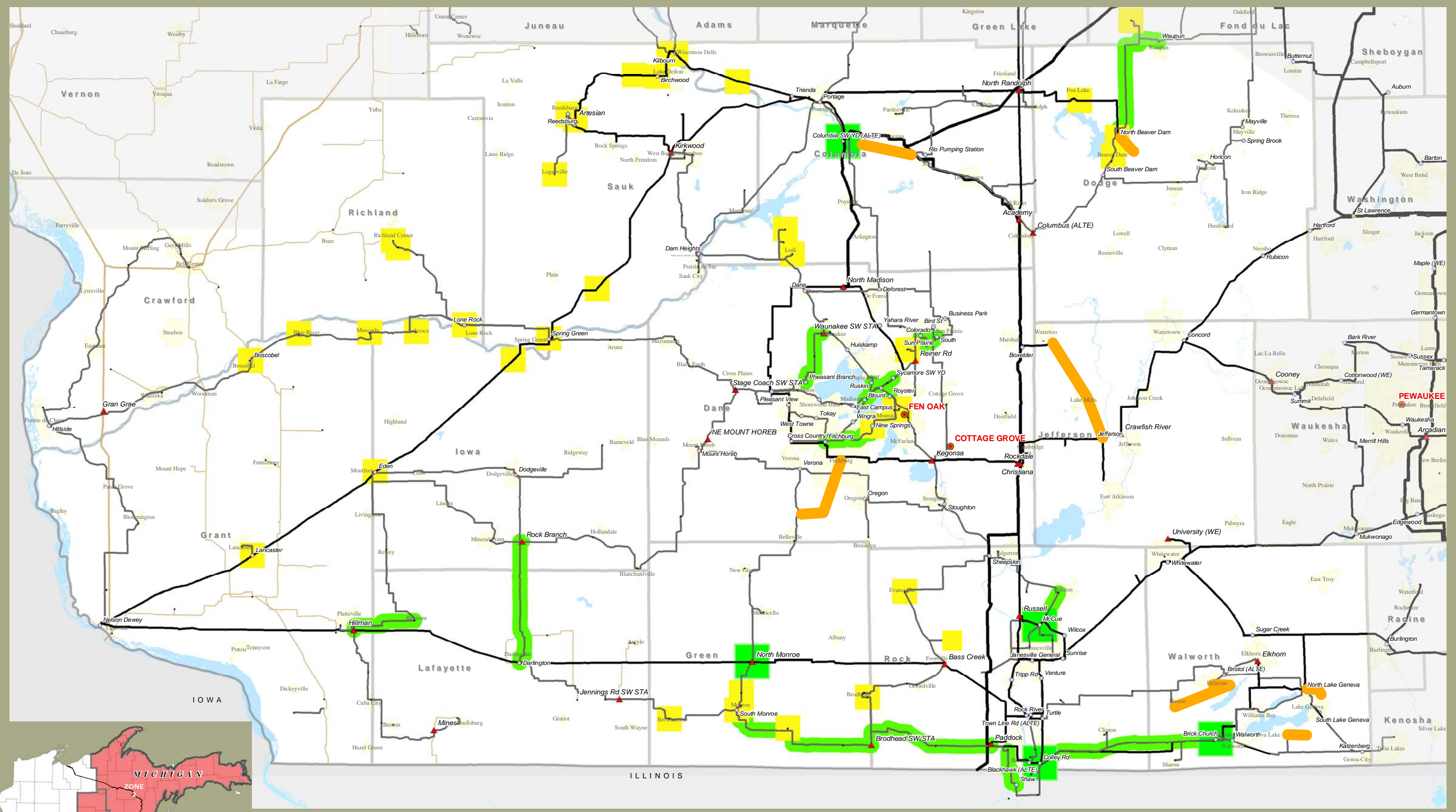
TABLE ZS-2 (continued)
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2010

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
3	Pine River, Richland Center, Lone Rock 69-kV bus voltages		80-92%	Lone Rock-Richland Center 69-kV line segment outages, Lone Rock Phase Shifter, Spring Green-Lone Rock 69-kV line outage	Load Serving
3	Boscobel, Blue River, Muscoda, Avoca 69-kV bus voltages		87-92%	Spring Green 138/69-kV transformer outage, Spring Green-Lone Rock and Lone Rock-Avoca 69-kV line outages	Load Serving
3	Colorado-Sun Prairie South 69-kV line	105%		Reiner Road-Burke Tap 69-kV line outage and Reiner 138/69-kV transformer outage	Load Serving
3	Burke 69-kV bus voltage		90%	Reiner Road-Burke Tap 69-kV line outage and Reiner 138/69-kV transformer outage	Load Serving
3	Columbia 138/69-kV transformer	98-107%		North Madison-De Forest 69-kV line outage, Portage 138/69-kV transformer outage	Load Serving
3	Lodi and Okee 69-kV bus voltages		92%	Dane-Lodi Tap 69-kV line outage	Load Serving
3	Pheasant Branch-Westport, West Port-Waunakee 69-kV lines	96-126%		North Madison-Sycamore 138-kV, North Madison-West Middleton 138-kV, West Middleton-Pheasant Branch 69-kV, Waunakee-Ruskin 69-kV line segment outages	Load Serving
3	Blount-Ruskin 69-kV lines	97%		Waunakee-Waunakee Tap 69-kV line outage	Load Serving
3	Fitchburg-South Nine Springs 69-kV line	108%		Royster-Pflaum Tap 69-kV line outage	Load Serving
3	Nine Springs, LCI, Pflaum 69-kV bus voltages		91%	Royster-Pflaum Tap 69-kV line outage	Load Serving
3	Platte, Finnegan, Reedsburg, Kilbourn, Lewiston and Loganville 69-kV buses; Dell Creek, East Wisconsin Dells, Artesian, Zobel, Nishan, Birchwood, Lewiston and Kilbourn 138-kV bus voltages		89-92%	Kilbourn-Trienda 138-kV line segment outages	Load Serving
3	Hillman-Belmont and Darlington-Rock Branch 69-kV line	102-135%		Nelson Dewey-Eden 138-kV line segment outages	Load Serving
3	Columbia 345/138-kV 200 MVA transformers	107%		Columbia 345/138-kV 200 MVA transformer outage	Load Serving
3	Fox Lake, North Beaver Dam and East Beaver Dam 138-kV buses; Alto, Third Street, North Beaver Dam and North Fox Lake 69-kV bus voltages		90-92%	North Randolph-North Beaver Dam 138-kV line outage	Load Serving
3	North Beaver Dam-Waupun 69-kV line	105-120%		Alto Tap-Koch Tap 69-kV line outage	Load Serving
3	Royster-Sycamore 69-kV line	95%		Femrite 138/69-kV transformer outage	Load Serving
4	Canal 138/69-kV transformer #1	99%		Canal 138/69-kV transformer #2 outage	Load Serving
4	Canal 138/69-kV transformer #2	98%		Canal 138/69-kV transformer #1 outage	Load Serving
4	Crivitz-High Falls 69-kV line	99%		Pioneer-Sandstone 69-kV line outage	Load Serving
4	Pioneer-Sandstone 69-kV line	103%		Crivitz-High Falls 69-kV line outage	Load Serving
4	Sunset Point-Pearl Avenue 69-kV line	106%		Ellinwood-Twelfth Ave 69-kV line outage	Load Serving
4	Melissa-Tayco 138-kV line	102%		Butte Des Mortes bus tie outage	Load Serving
4	Kaukauna Central Tap-Melissa 138-kV line	95%		Butte Des Mortes bus tie outage	Load Serving

TABLE ZS-2 (continued)
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2010

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
4	West Marinette 138/69-kV transformer #1	105-108%		Wells St-Roosevelt Rd 69-kV line outage Roosevelt 138/69-kV transformer outage	Load Serving
4	West Marinette 138/69-kV transformer #2	95- 98%		Wells St-Roosevelt Rd 69-kV line outage Roosevelt 138/69-kV transformer outage	Load Serving
4	Roosevelt Road 138/69-kV transformer	95%		W. Marinette 138/69-kV transformer #2 outage	Load Serving
4	Ellinwood 138/69-kV transformer #1	103%		Fitzgerald-Sunset Point 138-kV line outage	Load Serving
4	Northgate-20th Street 138-kV line	97%		Edgewater-Huebner 138-kV line outage	Load Serving
4	Egg Harbor 69-kV bus voltage		95%	Base Case	Load Serving
4	Sister Bay 69-kV bus voltage		90-93%	Base Case Canal-Dunn Rd 69-kV line outage First Ave-Sawyer 69-kV line outage	Load Serving
4	Canal 138-kV bus voltage		91%	Canal-East Krok 138-kV line outage	Load Serving
5	Bain transformer #5	99 – 162%		Splitting Pleasant Prairie 345-kV bus between bus sections 2 and 3 or 3 and 4	Load Serving
5	Bain – Kenosha 138-kV line	107-120%		Various contingencies	Load Serving
5	Albers – Bain 138-kV line	100%		Bain – Kenosha 138-kV line outage	Load Serving
5	Oak Creek 230-kV bus tie 59	94–113%		Various contingencies	Load Serving
5	Oak Creek 230-138-kV transformer	94-121%		Various contingencies	Load Serving
5	Harbor–Ramsey 138-kV line	93–110%		Various contingencies	Load Serving
5	Bluemound–Brookdale 138-kV line	99%		Bluemound – 96 th St line outage	Load Serving
5	Racine–Oak Creek 345-kV line	101 %		Arcadian – Oak Creek 345-kV line outage	Load Serving
5	Oak Creek–Pennsylvania 138-kV line	93-101%		Various contingencies	Load Serving
5	Oak Creek–Ramsey 138-kV line	93-109%		Various contingencies	Load Serving
5	Allerton–Oak Creek 138-kV line	95%		Oak Creek – Pennsylvania 138-kV line outage	Load Serving

Figure ZS-8



Performance Criteria Exceeded and Other Constraints 2007-2010
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

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

Transmission Related Facilities

- ▲ ATC Owned Substation
- Joint Owned Substation - Assets Conveyed
- Joint Owned Substation - Assets Retained
- Proposed/Design/Construction
- ATC Office Location
- Generation
- Other Facility

ZONE & STUDY RESULTS > Zone 3 – 2014 study results

Refer to [Table ZS-3](#) and [Figure ZS-9](#)

Summary of key findings

- ❑ Sauk County likely will need reinforcements to address anticipated load growth in Reedsburg, Baraboo and Wisconsin Dells.
- ❑ Numerous 138-kV system intact, base case voltage violations on buses in the vicinity of the Columbia Power Plant in the summer of 2013 are a cause for concern. These potentially can be remedied by changing the tap settings on the 345/138-kV transformers at Columbia. The feasibility of this solution will have to be determined via a thorough multidisciplinary (operations, engineering and planning) review with Alliant and Madison Gas & Electric, the owners of the power plant.
- ❑ Portions of the 69-kV infrastructure in the Madison area will need to be reinforced in order to continue serving this growing load reliably.
- ❑ Confirmation of the potential for widespread voltage collapse in the metropolitan Madison area is a continuing concern that will require several large-scale projects over several years to resolve.
- ❑ Heavy load growth in the Verona and Oregon areas south of Madison cause 69-kV system overloads and low voltages that will require a new source into the area.
- ❑ The Sun Prairie area continues to grow rapidly and as a result low voltages and overloads begin to occur before 2013. These problems will require another source into the area to mitigate these problems and support continuing rapid growth.
- ❑ Heavy load growth in Waukesha, Washington, Dodge and Jefferson counties will require the construction of 345-kV lines for voltage and load support. A new 345-kV line from Rockdale to Mill Road (formerly Lannon Junction) is proposed to solve these problems (see [Zone 5 - 2010 study results](#)).

We currently mitigate several of the identified 138-kV low voltages by ATC through remote control of a 138/69-kV transformer in a particular area. In certain instances, transformer load tap changers are adjusted to bring the 138-kV contingency voltages above the criteria limits while retaining the 69-kV bus voltages above the criteria limits. This is a balancing act that, as loads continue to grow, eventually will not work. Where this mitigation measure is no longer deemed viable, solutions have been proposed to solve these problems. The two most notable examples of this in Zone 3 are in the Beaver Dam and Wisconsin Dells areas. Near the end of the 10-year study period, a new 138-kV line from the Horicon area to the Beaver Dam area (East Beaver Dam Substation) will address the low voltages near Beaver Dam. This project currently is scheduled for completion in 2013. In the Wisconsin Dells area, where 138-kV bus voltages are supported from the 69-kV system under certain contingencies, a new network line from Lake Delton to Birchwood will be needed (2011) to remedy low voltages for both the 69-kV and 138-kV systems in the area.

Widespread voltage collapse in the Madison area may occur for the loss of the North Madison to Sycamore 138-kV line under heavy load-serving periods. In order to mitigate



the effects of this outage and improve system performance, the Waunakee-Blount 69-kV line is scheduled to be converted to 138 kV by 2010. This will involve the conversion of Huiskamp and Ruskin substations to 138 kV and the installation of a 138-kV GIS bus and breakers at Blount Street Substation. A previously planned project (see [Zone 3 - 2006 study results](#)) calls for the construction of a new 138-kV line from North Madison to Waunakee with a new 138/69-kV transformer at a new site near Waunakee. With these projects complete, a contiguous 138-kV electrical path from North Madison to Blount will be in service that will provide a parallel path for power to flow into the center of Madison, thus mitigating the effects of the North Madison to Sycamore 138-kV outage. In addition to this project, detailed studies indicate that a new 345-kV line from Rockdale to West Middleton with a 345/138-kV transformer will be needed in 2011. 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 (2014).

**TABLE ZS-3
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2014**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
1	Bunker Hill-Blackbrook 115-kV line	103%		Gardner Park-Blackbrook 115-kV line outage	Load Serving
1	Antigo and Aurora St. 115-kV bus voltages		90 -92%	Gardner Park-Blackbrook 115-kV line outage Gardner Park-Blackbrook-Antigo 115-kV line outage	Load Serving
1	Gardner Park-Blackbrook 115-kV line	101 - 102%		Maine-Pine 115-kV line outage Maine-Hilltop 115-kV line outage	Load Serving
1	Rocky Run-Plover 115-kV line	99%		Rocky Run-Whiting Ave. 115-kV line outage	Load Serving
1	Hollywood-Port Edwards 138-kV line	98 – 105%		Sigel-Arpin 138-kV line outage Arpin 345/138-kV transformer outage	Load Serving
1	Hollywood-Saratoga 138-kV line	101 - 108%		Sigel-Arpin 138-kV line outage Arpin 345/138-kV transformer outage	Load Serving
1	Sigel, Lakehead Vesper & Port Edwards 138-kV bus voltages		89 – 90%	Arpin-Sigel 138-kV line outage	Load Serving
1	Port Edwards, Hollywood & Saratoga 138-kV bus voltages		90 – 91%	Arpin-Sigel 138-kV line outage	Load Serving
1	Council Creek 138/69-kV transformer	103 – 105%		King-Eau Claire-Arpin 345-kV line outages Eau Claire-Arpin 345-kV line outage	Network
1	Hilltop, Mauston, Lyndon Station, Wisconsin Dells and Kilbourn 69-kV bus voltages		84 – 91%	Kilbourn-Wisconsin Dells #2 69-kV line outage	Load Serving
1	Necedah, Whistling Wings, Dellwood, Friendship, Houghton Rock 69-kV bus voltages		87 – 92%	Big Pond-Necedah tap 69-kV line outage Necedah tap-Whistling Wings tap 69-kV line outage	Load Serving
1	Wautoma, Sand Lake and Roeder 138-kV bus voltages		90 – 95%	Base Case Various contingencies	Load Serving
1	Metomen 138/69-kV transformer	95 – 115%		Various contingencies	Load Serving
1	Metomen-Ripon 69-kV line	95 – 111%		Various contingencies	Load Serving
1	Winneconne-Sunset 69-kV line	99%		Ripon-NW Ripon Tap 69-kV line outage	Load Serving
1	Berlin area 69-kV bus voltages		88 – 92%	Various contingencies	Load Serving
1	Whitcomb 115/69-kV transformer	95 – 96%		Gardner Park-Blackbrook 115-kV line outage Gardner Park-Blackbrook-Antigo 115-kV line outage	Load Serving
1	Coloma and Coloma Tap 69-kV bus voltages		91 – 92%	Chaffee Creek-Coloma 69-kV line outage	Load Serving
2	Atlantic 138/69-kV transformer	134-98%		M38 138/69-kV transformer outage M38-Winona 138-kV line outage Winona-Twin Lakes 69-kV line outage Atlantic-M38 69-kV line outage Atlantic-Portage Tap 69-kV line outage Portage Tap-Twin Lakes 69-kV line outage	Load Serving
2	M38 138/69-kV transformer	108%		Atlantic 138/69-kV transformer outage Atlantic-M38 138-kV line outage	Load Serving
2	Atlantic-Henry Street 69-kV line	95%		Base case	Base Case
2	Hiawatha, Lakehead, Brevort and Straits 138-kV bus voltages		92%	Livingston-Emmit Co 138-kV line outage	Load Serving
2	Atlantic 138-kV bus voltage		91-92%	M38-Perch Lake 138-kV line outage	Load Serving
2	Newberry Village 69-kV bus voltage		92%	Engadine-Newberry 69-kV line outage	Load Serving
2	Seney Tap 69-kV bus voltage		92%	Munising 138/69-kV transformer outage Munising 138-kV line outage	Load Serving
2	Brevort 138-kV bus voltage		92%	Straits-Brevort 138-kV line outage	Load Serving

**TABLE ZS-3
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2014 (continued)**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
3	Oregon-Stoughton 69-kV line	97-107%		Sugar River (Montrose)-Verona 69-kV line outage	Load Serving
3	Stagecoach-Timberlane Tap 69-kV line	97%		Sugar River-Verona 69-kV line and Spring Green 138/69-kV transformer outage	Load Serving
3	North Stoughton-Kegonsa 69-kV line	100-114%		Sugar River-Verona, McCue-Karmony, Stoughton-Sheepskin 69-kV line outages	Load Serving
3	Verona, Aaker Road, Brooklyn, North Stoughton, Oregon 69-kV bus voltages		87-91%	Sugar River-Verona, Stoughton-Aaker Road, Kegonsa-North Stoughton 69-kV line and Sugar River 138/69-kV transformer outages	Load Serving
3	Sugar River-Verona 69-kV line	96-124%		West Middleton-Timberlane Tap and Stoughton-Aaker Road 69-kV line outages	Load Serving
3	North Monroe-Idle Hour 69-kV line	96-109%		Darlington 138/69-kV transformer, Brodhead-South Monroe 69-kV line outages	Load Serving
3	Hooterville 69-kV bus voltage		91%	Eden 138/69-kV transformer outage	Load Serving
3	Darlington-Rock Branch 69-kV line	116%		Eden 138/69-kV transformer outage	Load Serving
3	Brodhead Switching Station-South Monroe 69-kV line	98 - 127%		North Monroe-South Monroe 69-kV line and North Monroe-Albany 138-kV line outages	Load Serving
3	Bird Tap-Sun Prairie 69-kV line	98 - 104%		Reiner Road-Burke Tap 69-kV line and Reiner Road 138/69-kV transformer outages	Load Serving
3	Burke 69-kV bus voltage		89%	Reiner Road 138/69-kV transformer outage	Load Serving
3	Token Creek-Yahara River 69-kV line	126%		Reiner Road 138/69-kV transformer outage	Load Serving
3	Colley Road-Park Street Tap 69-kV line	100%		Northwest Beloit-Shirland Ave 69-kV line outage	Load Serving
3	Kilbourn 47 MVA 138/69-kV transformer	98%		Kilbourn 100 MVA transformer outage	Load Serving
3	Colley Road 138/69-kV transformer	98%		Northwest Beloit-Shirland Ave 69-kV line outage	Load Serving
3	Northwest Beloit-Shaw 69-kV line	101 - 108%		Colley Road 138/69-kV transformer outage	Load Serving
3	Academy-Fall River 69-kV line	101%		Columbia-Manley Sands 69-kV line outage	Load Serving
3	Columbia 138/69-kV transformer	100%		Portage 138/69-kV transformer outage	Load Serving
3	Portage 138/69-kV transformer	102%		Columbia 138/69-kV transformer outage	Load Serving
3	North Beaver Dam-Waupun 69-kV line	96 - 118%		South Fond du Lac-Waupun 69-kV line segment outage	Load Serving
3	Hillman-Potosi 138-kV line	96%		Nelson Dewey-Lancaster 138-kV line outage	Load Serving
3	Stagecoach-Black Earth 69-kV line	102%		Eden-Wyoming Valley 138-kV line outage	Load Serving
3	Portage-Trienda 138-kV circuits	112%		adjacent Portage-Trienda 138-kV circuit outage	Load Serving
3	Columbia-Portage 138-kV circuits	100%		adjacent Columbia-Portage 138-kV circuit outage	Load Serving
3	Columbia 345/138-kV 200 MVA transformers	99%		Columbia 345/138-kV 400 MVA transformer outage	Load Serving
3	North Fox Lake, Alto, Waupun, Koch Oil 69-kV bus voltages		90 - 92%	South Fond Du Lac-North Beaver Dam 69-kV line segment outage	Load Serving

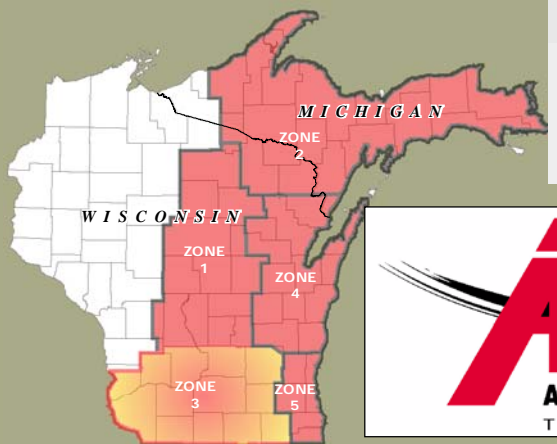
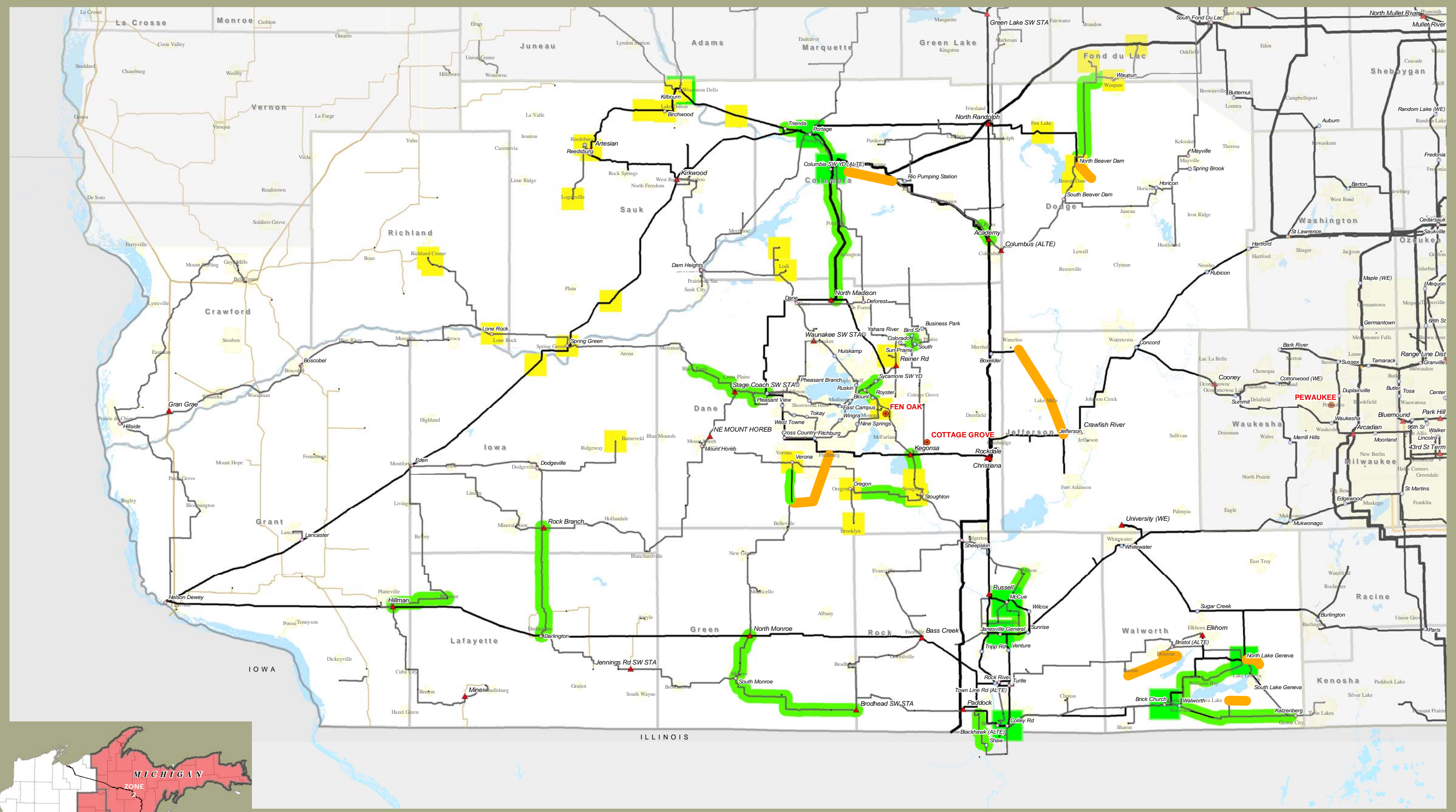
**TABLE ZS-3
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2014 (continued)**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
3	Columbia-North Madison 345-kV Circuit #1	102%		adjacent Columbia-North Madison 345-kV circuit outage	Load Serving
3	Lodi and Okee 69-kV bus voltages		91%	Dane-Lodi Tap 69-kV line outage	Load Serving
3	Royster-Sycamore 69-kV line	95%		Femrite 138/69-kV transformer outage	Load Serving
3	Platte, Finnegan, Reedsburg, Kilbourn, Lewiston and Loganville 69-kV buses; Dell Creek, East Wisconsin Dells, Artesian, Zobel, Nishan, Birchwood, Lewiston and Kilbourn 138-kV buses		92%	Kilbourn-Trienda 138-kV line segment outage	Load Serving
3	Pine River, Richland Center, Lone Rock 69-kV buses		87 - 90%	Lone Rock-Richland Center, Richland Center-Dayton, Lone Rock Phase Shifter outage	Load Serving
3	Brick Church-Katzenberg 69-kV line	98 - 122%		North Lake Geneva-South Lake Geneva 69-kV line, North Lake Geneva 138/69-kV transformer outages	Load Serving
3	Brick Church-North Lake Geneva 69-kV line	98 - 110%		North Lake Geneva and Brick Church 138/69-kV transformer outages	Load Serving
3	North Lake Geneva 138/69-kV transformer	105%		Brick Church 138/69-kV transformer outage	Load Serving
3	McCue 138/69-kV transformer	102%		Janesville 138/69-kV transformer outage	Load Serving
3	McCue-Milton Lawns 69-kV line	116%		Janesville 138/69-kV transformer outage	Load Serving
3	Janesville 138/69-kV transformer	97%		McCue 138/69-kV transformer outage	Load Serving
3	Janesville-Park View 69-kV line	103%		McCue 138/69-kV transformer outage	Load Serving
3	Spring Green, Arena, Mazomanie bus voltages		92%	Spring Green-Arena 69-kV line, the Spring Green 138/69-kV transformer outages	Load Serving
3	West Middleton-Black Earth 69-kV line	95 - 105%		Spring Green 138/69-kV transformer outage	Load Serving
4	Egg Harbor 69-kV bus voltage		91 - 93%	Base Case First Avenue-Sawyer 69-kV line outage Canal-Dunn Road 69-kV line outage Canal-East Krok 138-kV line outage	Load Serving
4	Sister Bay 69-kV bus voltage		88 - 91%	Base Case Various contingencies	Load Serving
4	Quarry Run, Woodenshoe 138-kV bus voltages		92%	Quarry Run-Neevin 138-kV line outage	Load Serving
4	Dyckesville, Ontario, Rosiere, Scottwood, 138-kV bus voltages		90 - 92%	Highway V-Ontario 138-kV line outage	Load Serving
4	Canal 138-kV bus voltage		89 - 91%	Highway V-Ontario 138-kV line outage Canal-East Krok 138-kV line outage	Load Serving
4	South Sheboygan Falls 138/69-kV transformer	102%		North Mullet River-Mullet River 69-kV line outage Mullet River 138/69-kV transformer outage	Load Serving
4	North Mullet River- Mullet River 69-kV line	100 - 120%		Northside Tap-Sheboygan Falls 69-kV line outage South Sheboygan Falls-Bemis Tap 69-kV line outage South Sheboygan Falls 138/69-kV transformer outage Monroe-Bemis Tap 69-kV line outage	Load Serving
4	Adams Street-Sheboygan Falls 69-kV line	106%		South Sheboygan Falls-Bemis Tap 69-kV line outage South Sheboygan Falls 138/69-kV transformer outage	Load Serving
4	Sheboygan-Edgewater 69-kV line	99%		South Sheboygan Falls-Edgewater 138-kV line outage	Load Serving

**TABLE ZS-3
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2014 (continued)**

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
4	Edgewater 345/138-kV transformer #2	98%		Edgewater 345/138-kV #1 outage	Load Serving
4	Edgewater-Huebner 138-kV line	95%		Edgewater-Sauktrail 138-kV line outage	Load Serving
4	Edgewater-Sauktrail 138-kV line	96%		Edgewater-Huebner 138-kV line outage	Load Serving
4	Northgate-20th Street 138-kV line	106 - 119%		Edgewater-Huebner 138-kV line outage Lodestar-Huebner 138-kV line outage	Load Serving
4	Edgewater-Washington Street 69-kV line	109%		Edgewater-Nicolet 69-kV line outage	Load Serving
4	Washington Street-Riverside 69-kV line	109%		Edgewater-Nicolet 69-kV line outage	Load Serving
4	Edgewater-Nicolet 69-kV line	117%		Erdman-32nd St 69-kV line outage	Load Serving
4	Pulliam-Danz 69-kV line	97%		Pulliam-Van Buren 69-kV line outage	Load Serving
4	Canal-Dunn Road 69-kV line	101%		1st Avenue-Sawyer 69-kV line outage	Load Serving
4	1st Avenue-Dunn Road 69-kV line	106%		Canal-Dunn Road 69-kV line outage	Load Serving
4	Canal 138/69-kV transformer #2	111%		Canal 138/69-kV transformer #1 outage	Load Serving
4	Canal 138/69-kV transformer #1	111%		Canal 138/69-kV transformer #2 outage	Load Serving
4	Tecumseh 138/69-kV transformer	98%		Glenview-Gravesville 69-kV line outage	Load Serving
4	Glenview 138/69-kV transformer #1	96%		Glenview 138/69-kV transformer #2 outage	Load Serving
4	Glenview 138/69-kV transformer #2	96%		Glenview 138/69-kV transformer #1 outage	Load Serving
4	Sunset Point-Pearl Ave 69-kV line	108%		Ellinwood-Twelfth Avenue 69-kV line outage	Load Serving
4	Ellinwood 138/69-kV transformer #1	99 - 107%		Fitzgerald-Sunset Point 138-kV line outage Ellinwood 138/69-kV transformer #2 outage	Load Serving
4	Sunset Point 138/69-kV transformer #2	96%		Sunset Point 138/69-kV transformer #1 outage	Load Serving
4	Sunset Point 138/69-kV transformer #1	96%		Sunset Point 138/69-kV transformer #2 outage	Load Serving
4	Melissa-Tayco 138-kV line	100 - 120%		Butte Des Mortes 138-kV bus tie outage North Appleton-High Point 138-kV line outage Butte Des Mortes-High Point 138-kV line outage	Load Serving
4	Kaukauna Central Tap-Melissa 138-kV line	111%		Butte Des Mortes 138-kV bus tie outage	Load Serving
4	Butte Des Mortes 138-kV bus tie	96%		Fitzgerald 345/138-kV transformer outage	Load Serving
5	Albers – Kenosha 138-kV line	100%		Bain – Kenosha 138-kV line outage	Load Serving

Figure ZS-9



Performance Criteria Exceeded and Other Constraints 2011-2014
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

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

Transmission Related Facilities

- ▲ ATC Owned Substation
- Joint Owned Substation - Assets Conveyed
- Joint Owned Substation - Assets Retained
- Proposed/Design/Construction
- ATC Office Location
- Generation
- Other Facility