

ZONE & STUDY RESULTS > Zone 2 overview

Zone 2 includes the counties of:

- ❑ Alger, Mich.
- ❑ Baraga, Mich.
- ❑ Chippewa, Mich.
- ❑ Delta, Mich.
- ❑ Dickinson, Mich.
- ❑ Florence, Wis.
- ❑ Forest, Wis.
- ❑ Gogebic, Mich. (eastern portion)
- ❑ Houghton, Mich.
- ❑ Iron, Mich.
- ❑ Keweenaw, Mich.
- ❑ Luce, Mich.
- ❑ Mackinac, Mich.
- ❑ Marinette, Wis. (northern portion)
- ❑ Marquette, Mich.
- ❑ Menominee, Mich.
- ❑ Ontonagon, Mich. (eastern portion)
- ❑ Schoolcraft, Mich.
- ❑ Vilas, Wis.

The physical boundaries of Zone 2 and transmission facilities located in Zone 2 are shown in Figure ZS-19.

Land use in Zone 2 is largely rural and heavily forested.

Zone 2 typically experiences peak electric demands during the winter months. Ore mining and paper mills are the largest electricity users in the zone.

Zone 2 demographics

The population of the counties in Zone 2 experienced no overall growth from 1994 to 2004. The highest growth rate occurred in Luce County (almost 2 percent), while the largest increase in population occurred in Chippewa County, which increased by almost 2,000 people.

During the same period, the employment growth rate was 0.9 percent. The highest growth rate occurred in Keweenaw County, while the highest increase in employment occurred in Dickinson County.

Zone 2 future population and employment projections

Population in Zone 2 is projected to remain basically flat between 2000 and 2005 and grow slightly (at 0.2 percent) from 2005 through 2010. Chippewa County is projected to realize the largest increase in population and the highest growth rate.

Employment in Zone 2 is projected to grow at 0.6 percent annually between 2000 and 2005 and at 1.3 percent from 2005 through 2010. Marquette County is projected to realize the largest increase in employment, while Forest County is projected to have the highest growth rate.

Zone 2 environmental considerations

Zone 2 includes a small part of the far northeast portion of Wisconsin and the eastern two-thirds of the Upper Peninsula of Michigan. The Wisconsin portions of the zone fall into the Northeast Sands and North Central Forest ecological landscape regions. The portions of the zone located in Michigan are part of the Eastern Upper Peninsula eco-region. A description of the characteristics of the Eastern Upper Peninsula eco-region may be found on the Michigan Department of Environmental Quality Web page at http://www.michigan.gov/dnr/0,1607,7-153-10366_11865-31471--,00.html.

Large expanses of this zone are forested and there are large numbers of streams, lakes and wetlands throughout the zone. The Niagara Escarpment is situated in the Eastern Upper Peninsula. Lakes Superior, Huron and Michigan form the northern and eastern boundaries of the zone. Two Michigan State Natural Rivers (Fox and Two-Hearted) and nine National Wild and Scenic Rivers (Tahquamenon, Indian, Sturgeon, Whitefish, Yellow Dog, Ontonagon, Paint, Carp, north Sturgeon) are found in this zone. Portions of the Nicolet, Ottawa and Hiawatha national forests, and numerous state forests and parks are found in this zone. Several Indian reservations are found in this zone. The Seney National Wildlife Area, Pictured Rocks National Lakeshore and numerous federal wilderness areas also are found in this zone.

Zone 2 electricity demand and generation

The coincident peak load forecasts for Zone 2 for 2006, 2010 and 2014 are shown in Table ZS-11. 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.

This table shows that load is projected to grow at roughly 0.8 percent annually from 2006 through 2014. Comparing load with generation (at maximum output) within the zone indicates that Zone 2 has more generation than peak load, though actual operating experience indicates that during most periods, Zone 2 is a net importer of power.

Zone 2 transmission system issues

Key transmission facilities in Zone 2 include:

- the Morgan-Plains and Plains-Dead River 345-kV lines,

- ❑ the Plains-Stiles 138-kV double-circuit line and
- ❑ the 138-kV facilities tying the Upper Peninsula of Michigan to the Lower Peninsula.

Key system performance issues in Zone 2 include:

- ❑ limited import and export capability,
- ❑ aging 69-kV and 138-kV infrastructure throughout the Upper Peninsula,
- ❑ generator stability at the Presque Isle Power Plant,
- ❑ parallel path flow around Lake Michigan that causes heavy loading on the 138-kV and 69-kV systems, and results in the need for transmission loading relief incidents and reconfiguration of the system, and
- ❑ low voltages, most pronounced in the western and eastern Upper Peninsula.

*Table PR-14
Transmission System Additions for Zone 2*

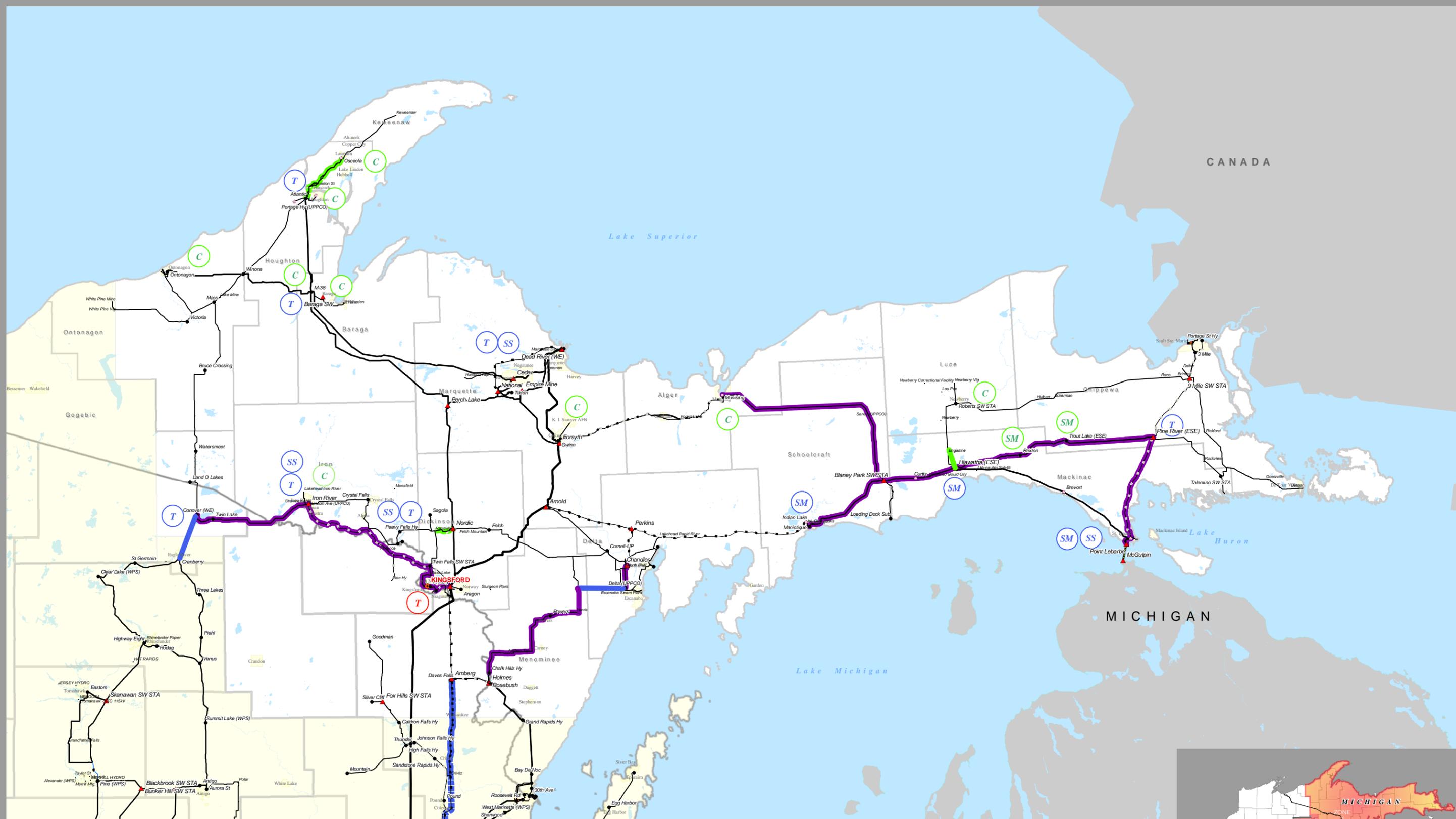
System additions	System need year	Projected in-service year	Planning zone	Need category	Planned, Proposed or Provisional
Install 1-5.4 MVAR capacitor bank at Munising 69 kV	2006	2006	2	reliability	Proposed
Install 1-5.4 MVAR capacitor bank at Sawyer 69 kV	2006	2006	2	reliability	Proposed
Construct Hiawatha-Engadine 69-kV line	2003	2006	2	reliability	Planned
Rebuild and convert one Hiawatha-Indian Lake 69-kV circuit to double-circuit 138-kV standards, string two circuits initially and operate one at 69 kV	2004	2006	2	reliability, service limitation	Planned
Install 2-8.16 MVAR capacitor banks at Lincoln 69 kV	2006	2006	2	reliability	Proposed
Rebuild from Nordic to Randville Substation (5 miles) of single circuit 69-kV line to double-circuit 69 kV	2005	2006	2	reliability, condition	Planned
Rebuild Stiles-Amberg double-circuit 138-kV line	1996	2006	2 & 4	reliability, service limitation, condition	Planned
Construct Mackinac 138-kV Substation (new Straits Substation)	2005	2007	2	reliability, service limitation	Proposed
Relocate Cedar Substation (North Lake)	2005	2007	2	reliability, condition	Proposed
Relocate Brule Substation (Aspen)	2007	2007	2	reliability, condition	Proposed
Install 2-8.16 MVAR capacitor banks at Ontonagon 138 kV	2007	2007	2	reliability	Proposed
Rebuild Atlantic-Osceola 69-kV line (Laurium #1)	2006	2008	2	reliability, condition	Planned
Increase ground clearance of Atlantic-Osceola (Laurium #2) 69-kV line from 120 to 167 degrees F	2008	2008	2	reliability	Proposed
Install second 345/138-kV transformer at Plains	2008	2008	2	reliability	Provisional

Table PR-14
Transmission System Additions for Zone 2 (continued)

System additions	System need year	Projected in-service year	Planning zone	Need category	Planned, Proposed or Provisional
Install 1-5.4 MVAR capacitor bank at L'Anse 69 kV	2008	2008	2	reliability	Provisional
Install 2-8.16 MVAR capacitor banks at M38 69 kV	2008	2008	2	reliability	Proposed
Install 2-5.4 MVAR capacitor banks at Osceola 69 kV	2008	2008	2	reliability	Proposed
Uprate Atlantic 138/69-kV transformer	2008	2008	2	reliability	Proposed
Construct Cranberry-Conover 115-kV line	2008	2008	1 & 2	reliability, transfer capability	Proposed
Rebuild/convert Conover-Plains 69-kV line to 138 kV	2008	2008	1 & 2	reliability, transfer capability	Proposed
Construct 138-kV bus and install 138/115-kV 150 MVA and 138/69-kV 60 MVA transformers at Conover	2008	2008	1 & 2	reliability, transfer capability	Proposed
Construct 138-kV bus and install a 138/69-kV, 60 MVA transformer at Iron Grove	2008	2008	1 & 2	reliability, transfer capability	Proposed
Construct 138-kV bus and install a 138/69-kV, 60 MVA transformer at Aspen	2008	2008	1 & 2	reliability	Proposed
Relocate Iron River Substation (Iron Grove)	2008	2008	1 & 2	reliability	Proposed
Relocate 69-kV Rexton tap to 69-kV Hiawatha-Pine River line (6909)	2009	2009	2	condition	Provisional
Relocate 69-kV Trout Lake tap to 69-kV Hiawatha-Pine River line (6909)	2009	2009	2	condition	Provisional
Construct Mackinac 138-kV Substation additions (portions may be earlier for maintenance issues)	2009	2009	2	reliability, service limitation	Provisional
Rebuild Hiawatha-Pine River-Mackinac 69 kV to 138 kV	2009	2009	2	reliability, condition	Provisional
Construct 138-kV bus and install one 138/69-kV, 50 MVA transformer at Pine River	2009	2009	2	reliability	Provisional

*Table PR-14
Transmission System Additions for Zone 2 (continued)*

System additions	System need year	Projected in-service year	Planning zone	Need category	Planned, Proposed or Provisional
Convert rebuilt Hiawatha-Indian Lake circuit (operated at 69 kV) to 138 kV	2009	2009	2	reliability, service limitation	Planned
Construct 138-kV ring bus at Hiawatha Substation	2009	2009	2	reliability, service limitation	Planned
Install 138-kV substation modifications at Indian Lake Substation	2009	2009	2	reliability, service limitation	Planned
Install 1-5.4 MVAR capacitor bank at MTU or Henry Street 69 kV	2009	2009	2	reliability	Proposed
Install 1-5.4 MVAR capacitor bank at Roberts 69 kV	2009	2009	2	reliability	Proposed
Uprate M38 138/69-kV transformer	2012	2012	2	reliability	Provisional
Rebuild Blaney Park-Munising 69 kV to 138 kV	2012	2012	2	reliability, condition	Provisional
Rebuild/convert Chalk Hills-Chandler 69 kV to 138 kV operation	2013	2013	2 & 4	reliability	Provisional
Install 2-5.4 MVAR capacitor banks at M-38 69 kV	2015	2015	2	reliability	Provisional



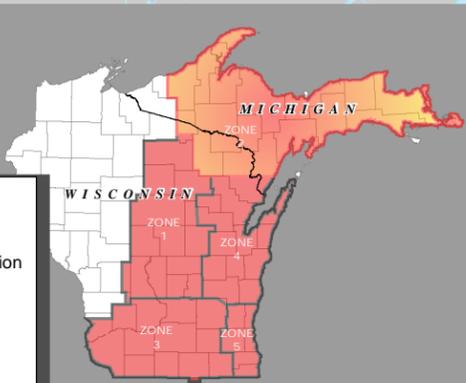
Transmission System Additions (May be Planned, Proposed or Provisional)
PLANNING ZONE 2



- (SM) Substation Modifications
- (C) Capacitor Bank
- (T) Transformer
- (T-D) New T-D Interconnection
- (SS) New Substation
- (C) Rebuilt 69 kV Transmission
- (Blue line) 115 or 138 kV Transmission Line
- (Dashed blue line) Rebuilt 115 or 138 kV Transmission
- (Purple line) Transmission Line Voltage Conversion
- (Green line) 69 kV Transmission Line

Transmission Related Facilities

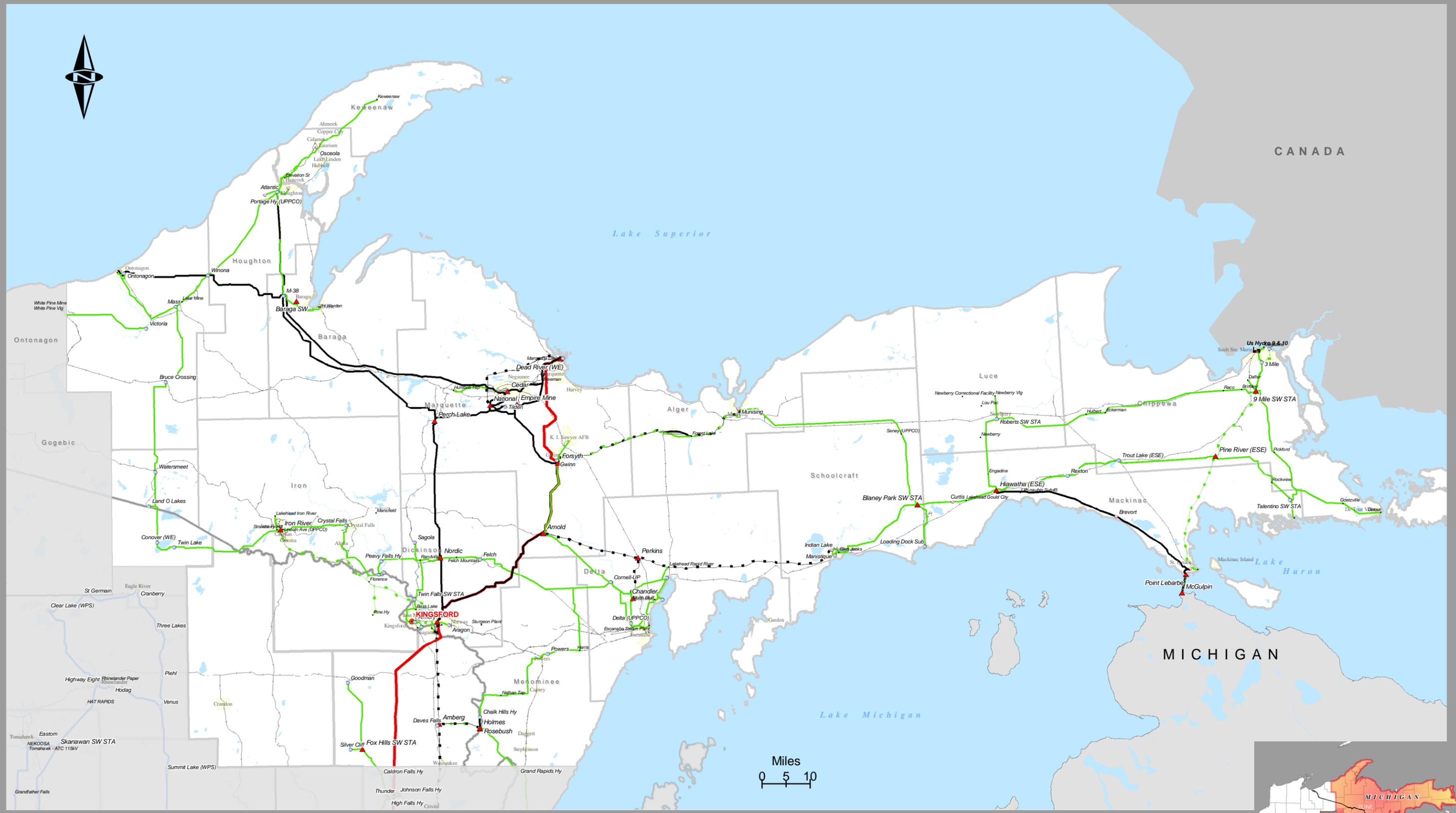
- ▲ ATC Owned Substation
- ▲ Joint Owned Substation - Assets Conveyed
- ▲ Joint Owned Substation - Assets Retained
- ▲ Proposed/Design/Construction
- ATC Office Location
- Generation
- Other Facility



*Table ZS-11
Forecast of Peak Load and Generation in Zone 2*

	2006	2010	2014
Peak Forecast (megawatts)	905.9	933.8	966.5
Average Peak Load Growth	N/A	0.76%	0.86%
Existing Generation Capacity (megawatts)	1083.4	1083.4	1083.4
Existing Capacity Less Load	177.5	149.6	116.9
Existing Generation Capacity plus Modeled Generating Capacity Additions (megawatts)	1083.4	1083.4	1083.4
Modeled Capacity Less Load (megawatts)	177.5	149.6	116.9

*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.*



Electric Transmission Network & Substations
PLANNING ZONE 2

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

Transmission Related Facilities

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

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

ZONE & STUDY RESULTS > Zone 2 – 2006 study results

Refer to [Table ZS-1](#) and [Figure ZS-4](#)

Summary of key findings

- ❑ The first phase of the Hiawatha-Indian Lake line rebuild project will address overloads, improve the voltage profile in the area and preclude the need for opening the existing 69-kV line during off-peak periods.
- ❑ The 138-kV Stiles-Plains double-circuit line rebuild project will begin to address the limitations on the transfer capability from Wisconsin to the Upper Peninsula which result in numerous transmission loading relief incidents and costly generation redispatch and are hampered by limited redispatch options. By addressing these issues, the difference between the locational marginal price of energy in the Upper Peninsula and the rest of the ATC footprint will be reduced.
- ❑ The construction of the new 138-kV Mackinac Substation (replaces the existing 138-kV Straits Substation) will provide flexibility for future 138-kV system enhancements in eastern Zone 2 as well as helping to address near-term maintenance issues.
- ❑ Low voltages and overloads for critical outages in Zone 2 may be adequately addressed with capacitor bank installations and conversions of the 69-kV Plains-Iron River-Twin Lakes-Conover line, the 69-kV Indian Lake-Hiawatha double-circuit lines, and the conversion of the 69-kV Hiawatha-Pine River-Straits line to 138 kV in the future.

The first contingency overloads of the Atlantic-Osceola 69-kV lines, one for the loss of the other, are becoming more severe. One of the lines is scheduled to be rebuilt in 2008 to address existing condition issues. A companion project also is being initiated to improve the capability of the other Atlantic-Osceola 69-kV line in the same time frame.

Numerous voltages less than 90 percent of nominal will occur for various first contingency outages including Bruce Crossing, Watersmeet, Land O Lakes, Conover, KI Sawyer, Munising, M38, and Twin Lakes 69-kV buses. Additional capacitor banks at Lincoln Avenue (2x8 MVAR), Sawyer (1x5.4 MVAR) and at Munising (1x5.4 MVAR) will be needed by 2006. Converting the 69-kV Plains-Iron River-Twin Lakes-Conover line to 138 kV also will improve voltages in the area for critical system outages.

There have been numerous transmission loading relief incidents in recent years during off-peak periods involving the Hiawatha-Indian Lake 69-kV circuits (see [Tables ZS-4 through ZS-7](#)). In addition, low voltages were identified at Lakehead, Brevort and Hiawatha. There are at least two reasons for the large power flows over this system, which occur during off-peak periods. One reason is the cycling of the Ludington pumped storage facility in the Lower Peninsula of Michigan. Another reason is the increase in use of this system for transactions between our customers and entities to the east of Wisconsin. We have and

continue to take various measures to reduce the occurrence of these transmission loading relief incidents, including opening one of the Hiawatha-Indian Lake lines as normal operation and constructing a second Indian Lake-Manistique (via Glen Jenks) 69-kV line.

However, these preventive actions are not considered an appropriate long-term solution. Therefore, as a long-term solution, we are replacing the key limiting element -- one of the 69-kV lines between Indian Lake and Hiawatha -- with a double-circuit 138-kV line. This project will address existing and projected limitations west of Hiawatha. One of the 69-kV lines between Indian Lake and Hiawatha needs to be rebuilt due to its condition. Thus, replacing this line with a double-circuit 138-kV line will:

- (i) eliminate system limitations between Indian Lake and Hiawatha,
- (ii) address the facility condition issue of one of the existing 69-kV lines, and
- (iii) improve the system from a strategic standpoint by providing for expansion of the 138-kV network from Plains to Straits.

However, until a second 138-kV circuit from Hiawatha to Straits is completed and the Plains-Amberg-Stiles constraint is resolved (see below), it will be necessary to operate the rebuilt Hiawatha-Indian Lake line at 69-kV to avoid aggravation of existing equipment loading issues.

The proposed solution for providing voltage support, addressing transmission loading relief incidents, and resolving load serving issues in Zone 2 for the long term would be to have two 138-kV circuits between Straits and Plains. This solution would require that the limiting 69-kV circuit between Indian Lake and Hiawatha be replaced with a double-circuit 138-kV line, as described above, and eventually adding a second 138-kV circuit between Hiawatha and Straits. To allow this robust solution to be completely effective, the facility with the second most frequent transmission loading relief incidents also will require reinforcement. This additional limiter to flows into and across Zone 2 is the Stiles-Amberg-Plains 138-kV double-circuit line (see Zone 4 - 2006 study results).

The Nordic-Randville 69-kV line is partially built for double-circuit operation. This line has been identified as a candidate to be rebuilt based on its condition. The addition of a second 69-kV circuit on this line segment will provide for a 69-kV network connection between Plains and Nordic, which are the two 138-kV sources for the 69-kV system in this area, increasing reliability of the system during contingencies. After the construction of the 69-kV Nordic-Randville line, the special protection scheme (SPS) at Nordic Substation will be removed and the SPS at Presque Isle (including Dead River, Plains, Empire, and Nordic) will need to be reset.

The poor physical condition of the 138-kV Straits Substation is to be addressed with the new 138-kV Mackinac Substation. The new 138-kV Mackinac Substation will facilitate 138-kV expansion plans for the area and allow consideration of enhanced ties to the Lower Peninsula of Michigan and from Canada.

**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

Table ZS-4 Summary of Transmission Loading Relief Incidents - 2004

Limiting Element	Anticipated Element Outage	# of	# of	# of	Total Declarations at 3, 4 or 5*
		Level 3	Level 4	Level 5	
Albers-Paris 138-kV	Wempletown-Paddock 345-kV	26	3		29
Arpin 345/138-kV transformer	Arpin-Rocky Run 345-kV	2			2
Badger-Caroline 115-kV	North Appleton-Rocky Run 345-kV		1		1
Butler-Granville 138-kV	Arcadian-Granville 345-kV	2	1		3
Butler-Granville 138-kV	Bluemound-Tosa 138-kV	1	3		4
Center-Fiebrantz 138-kV	Arcadian-Granville 345-kV		1		1
Columbia 345/138-kV transformer	Columbia-North Madison 345-kV		1		1
Eau Claire-Arpin 345-kV		10			10
Eau Claire-Arpin 345-kV	Wempletown-Paddock 345-kV	1			1
Ellinwood 138/69 kV transformer	Fitzgerald-Sunset Point 138-kV	4	4		8
Fitchburg-Wingra 69 kV	West Middleton-Blackhawk 69 kV		1		1
Fitzgerald-Sunset Point 138-kV	Edgewater-Saukville 345-kV	3	5		8
Fitzgerald 345/138-kV transformer	Edgewater-Saukville 345-kV	1			1
Highway V-Preble 138-kV	DePere-Glory Road 138-kV		2		2
Highway V-Preble 138-kV	Lost Dauphin-Red Maple 138-kV	9	20		29
Highway V-Preble 138-kV	North Appleton-Mason Street 138-kV		1		1
Highway V-Preble 138-kV	North Appleton-White Clay 138-kV		9		9
Kenosha-Albers 138-kV	Wempletown-Paddock 345-kV	2			2
Mukwonago-Merrill Hills 138-kV	Waukesha-Merrill Hills 138-kV		2		2
Mukwonago-Merrill Hills 138-kV	Rockdale-Lakehead Cambridge-Jefferson 138-kV		3		3
North Appleton-Rocky Run 345-kV		6			6
Oak Creek 345/230-kV transformer	Oak Creek banks T851/T895	2	22		24
Paddock 345/138-kV transformer	Paddock-Rockdale 345-kV	8			8
Paris-Burlington 138-kV	Wempletown-Paddock 345-kV	2			2
Pleasant Prairie-Racine 345-kV	Wempletown-Paddock 345-kV	5			5
Pulliam4-Stiles 138-kV	Pulliam5-Stiles 138-kV		2		2
Rhineland area voltages			1		1
Rockdale 345/138-kV transformer #2	Rockdale 345/138-kV transformer #3	1			1
Rocky Run-Northpoint 115-kV	Weston-Rocky Run 345-kV	4	5		9
Rocky Run-Weston 115-kV	Weston-Rocky Run 345-kV	1	2		3

Table ZS-4 Summary of Transmission Loading Relief Incidents – 2004 (continued)

Limiting Element	Anticipated Element Outage	# of	# of	# of	Total Declarations at 3, 4 or 5*
		Level 3	Level 4	Level 5	
Rocky Run-Weston 345-kV		2	5		7
Rosebush 138/69 kV transformer			1		1
Stiles-Amberg 138 & Stiles-Crivitz 138-kV	Morgan-Plains 345-kV	8	142	4	154
Stiles-Pioneer 138-kV	White Clay-Morgan 138-kV	6	13		19
Stiles-Pioneer 138-kV	North Appleton-White Clay 138-kV		7		7
Wempletown-Paddock 345-kV		4			4
White Clay-Morgan 138-kV	Stiles-Sherwood 138-kV		4		4
White Clay-Morgan 138-kV	Pulliam-Stiles 138-kV	3	19		22
Whitewater-Mukwonago 138-kV	Rockdale-Jefferson 138-kV		1		1

Note: * -Sum of number of declarations is based on determining the highest service limitation level for a given occurrence so that each is counted once

Level 3: non-firm transmission service curtailments

Level 4: transmission system reconfiguration/redispach

Level 5: firm transmission service curtailments/redispach

Table ZS-5 Summary of Transmission Loading Relief Incidents - 2003

Limiting Element	Anticipated Element Outage	# of	# of	# of	Total Declarations at 3, 4 or 5*
		Level 3	Level 4	Level 5	
Albers-Paris 138-kV	Wempletown-Paddock 345-kV	52	13		65
Albers-Paris 138-kV	Pleasant Prairie-Racine 345-kV		3		3
Badger-Caroline 115-kV	North Appleton-Rocky Run 345-kV		2		2
Center-Cornell 138-kV	Arcadian-Granville 345-kV		1		1
Christiana-Kegonsa 138-kV	Christiana-Fitchburg 138-kV		2		2
DePere-Glory Road 138-kV	Kewaunee-East Krok 138-kV		4		4
Eau Claire-Arpin 345-kV		5			5
Fiebrantz-Center 138-kV	Arcadian-Granville 345-kV		1		1
Forest Junction-Kaukauna 138-kV	City Limits-Butte Des Morts 138-kV		1		1
Forest Junction-Rockland 138-kV	Kewaunee-East Krok 138-kV	1			1
Forest Junction-Rockland 138-kV	North Appleton-White Clay 138-kV	1			1
Granville-Swan 138-kV	Saukville 345/138-kV transformer		1		1
Green Lake-Roeder 138-kV	North Appleton-Rocky Run 345-kV	1			1
Highway V-Preble 138-kV	Lost Dauphin-Red Maple 138-kV	12	10		22
Highway V-Preble 138-kV	North Appleton-White Clay 138-kV	2	8		10
Kenosha-Albers 138-kV	Wempletown-Paddock 345-kV		1		1
Lost Dauphin-Highway V 138-kV	DePere-Glory Road 138-kV		1		1
Lost Dauphin-Red Maple 138-kV	Kewaunee-East Krok 138-kV		4		4
Manistique-Hiawatha 69 kV			7		7
Mukwonago-Merrill Hills 138-kV	Merrill Hills-Waukesha 138-kV	1			1
North Appleton-Rocky Run 345-kV		4			4
N. Appleton-White Clay 138-kV	Stiles-Pulliam 138-kV	4	4		8
North Lake Geneva-Sugar Creek 138-kV			1		1
Paddock 345/138-kV transformer		1			1
Paddock 345/138-kV transformer	Paddock-Rockdale 345-kV	38			38
Paddock-Townline 138-kV	Paddock-Rockdale 345-kV	3	1		4
Paris-Burlington 138-kV	Wempletown-Paddock 345-kV	1			1
Paris-St Martins 138-kV		1			1
Perch Lake-M38 138-kV	Cedar-M38 138-kV		1		1
Pleasant Prairie-Racine 345-kV	Wempletown-Paddock 345-kV	2			2
Pleasant Valley-St. Lawrence 138-kV	Jefferson-Lakehead 138-kV		1		1
Pulliam4-Stiles 138-kV	Pulliam5-Stiles 138-kV	1	1		2

Table ZS-5 Summary of Transmission Loading Relief Incidents – 2003 (continued)

Limiting Element	Anticipated Element Outage	# of	# of	# of	Total Declarations at 3, 4 or 5*
		Level 3	Level 4	Level 5	
Rhineland area voltages			27		27
Rockdale 345/138-kV transformer #2	Rockdale 345/138-kV transformer #3	7	7		14
Rockdale 345/138-kV transformer	Paddock 345/138-kV transformer	2	1		3
Rock River-Janesville 138-kV	Paddock-Rockdale 345-kV	2			2
Rocky Run-Northpoint 115-kV	Weston-Rocky Run 345-kV	6	17		23
Russell-Rockdale 138-kV	Paddock-Rockdale 345-kV	5	1		6
Stiles-Amberg 138 & Stiles-Crivitz 138-kV	Morgan-Plains 345-kV	1	148	4	153
Stiles4-Pulliam 138-kV	Stiles5-Pulliam 138-kV	1	11		12
Stiles-Pulliam 138-kV	Morgan White Clay 138		1		1
Stiles-Amberg 138-kV	Morgan-Plains 345-kV		1		1
Stiles-Pioneer 138-kV	Morgan-White Clay 138-kV	2	16		18
Stiles-Pioneer 138-kV	North Appleton-White Clay 138	8	12		20
Straits 138/69 kV transformer	Hiawatha-Straits 138-kV		1		1
Wempletown-Paddock 345-kV		2			2
White Clay-Morgan 138-kV	Pulliam-Stiles 138-kV		3	1	4
Weston-Kelly 115-kV		1			1

Note: * -Sum of number of declarations is based on determining the highest service limitation level for a given occurrence so that each is counted once

Level 3: non-firm transmission service curtailments

Level 4: transmission system reconfiguration/redispatch

Level 5: firm transmission service curtailments/redispatch

Table ZS-6 Summary of Transmission Loading Relief Incidents - 2002

Limiting Element	Anticipated Element Outage	# of Level 3	# of Level 4	# of Level 5	Total Declarations at 3, 4 or 5*
Albers-Paris 138-kV	Wempletown-Paddock 345-kV	24			24
Amberg-Plains 138-kV	Plains-Morgan 345-kV		1		1
Blackhawk-Colley Road 138-kV	Paddock-Rockdale 345-kV	5			5
Blackhawk-Colley Road 138-kV	Paddock-Rock River 138-kV	21	1		22
Butler-Granville 345-kV	Arcadian-Granville 345-kV	3			3
Christiana-Kegonsa 138-kV	Christiana-Fitchburg 138-kV	2	1		3
Eau Claire-Arpin 345-kV		54		4	58
Granville-Swan 138-kV	Sauville 345/138-kV transformer	1			1
Hillman-Darlington 138-kV	Wempletown-Paddock 345-kV	1			1
Janesville-Rock River 138-kV	Paddock-Rockdale 345-kV		1		1
Kewaunee 345/138-kV transformer	Kewaunee-North Appleton 345-kV	33	60		93
Kewaunee 345/138-kV transformer			2		2
Manistique-Hiawatha 69 kV			148		148
Mukwonago-St. Martins 138-kV	Wempletown-Paddock 345-kV	1			1
Mass-Bruce Crossing 69 kV	M38-Cedar 138-kV		1		1
N. Appleton-Lost Dauphin 138-kV	Kewaunee 345/138-kV transformer	28	37		65
N.Appleton 345/138 transformer #1	N. Appleton 345/138-kV transformer #2		2		2
N. Appleton 345/138-kV transformer #1	N. Appleton 345/138-kV transformer #3		1		1
N. Appleton-White Clay 138-kV	Stiles-Pulliam 138-kV	1			1
Nelson-Dewey transformer	Wempletown-Paddock 345-kV	1			1
Paddock 345/138-kV transformer	Paddock-Rockdale 345-kV	98			98
Paris-Burlington 138-kV	Wempletown-Paddock 345-kV	2			2
Paris-St Martins 138-kV			1		1
Pleasant Prairie-Racine 345-kV	Wempletown-Paddock 345-kV	2			2
Rhineland area voltages	Aurora-Black Brook 115-kV		21		21
Rockdale 345/138-kV transformer	Paddock 345/138-kV transformer	8	2	1	11
Rock River-Janesville 138-kV	Paddock-Rockdale 345-kV	2			2
Rocky Run-Northpoint 115-kV	Weston-Rocky Run 345-kV	2	17		19
Rocky Run-Northpoint 115-kV	Rocky Run-N. Appleton 345-kV		1		1
Russell-Rockdale 138-kV	Paddock-Rockdale 345-kV	12	4		16
Russell-Rockdale 138-kV	King-Eau Claire-Arpin 345-kV		1		1

Table ZS-6 Summary of Transmission Loading Relief Incidents – 2002 (continued)

Limiting Element	Anticipated Element Outage	# of Level 3	# of Level 4	# of Level 5	Total Declarations at 3, 4 or 5*
Stiles-Amberg 138 and Stiles-Crivitz 138-kV	Morgan-Plains 345-kV	2	96		98
Stiles-Amberg 138-kV	Morgan-Plains 345-kV	1	10		11
Stiles-Pioneer 138-kV	N.Appleton-White Clay 138-kV	16	30		46
Whitewater-Mukwonago 138-kV	Cherry Valley-Silver Lake 345-kV		1		1
Whitewater-Mukwonago 138-kV	Rockdale-Jefferson 138-kV		2		2
Valley-Haymarket 138-kV	Granville-Arcadian 345-kV	1			1
W. Marinette-Menominee 69 kV	Pioneer-W. Marinette 138-kV		1		1
Weston-Kelly 115-kV			1		1
Weston-Rocky Run 115-kV	Weston-Rocky Run 345-kV	1	1		2

Note: * -Sum of number of declarations is based on determining the highest service limitation level for a given occurrence so that each is counted once

Level 3: non-firm transmission service curtailments

Level 4: transmission system reconfiguration/redispach

Level 5: firm transmission service curtailments/redispach

Table ZS-7 Summary of Transmission Loading Relief Incidents - 2001

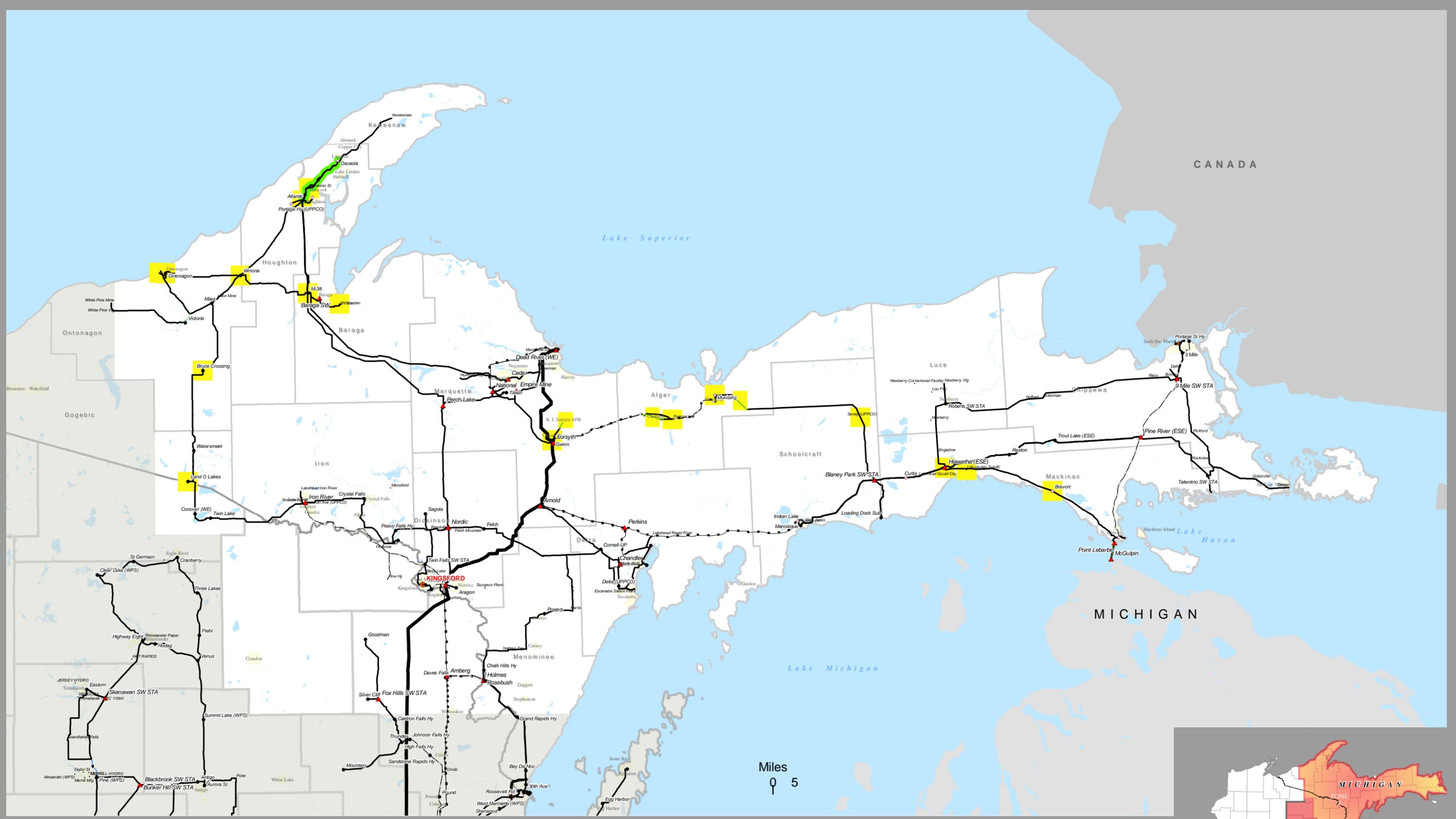
Limiting Element	Anticipated Element Outage	# of Level 3	# of Level 4	# of Level 5	Total Declarations at 3, 4 or 5*
Albers - Paris 138-kV	Wempletown - Paddock 345-kV	20	1		21
Albers - Paris 138-kV		1			1
Blackhawk - Colley Road 138-kV	Paddock - Rock River 138-kV	8	1	3	12
Butler - Granville 345-kV	Arcadian - Granville 345-kV	1			1
Christiana - Kegonsa 138-kV	Christiana - Fitchburg 138-kV	1			1
Eau Claire - Arpin 345-kV		5	5		10
Ellington - Hintz 138-kV	North Appleton - Rocky Run 345-kV	1			1
Green Lake - Roeder 138-kV	North Appleton - Rocky Run 345-kV	1		8	9
Kewaunee 345/138-kV Transformer	Point Beach - North Appleton 345-kV			5	5
Kewaunee 345/138-kV Transformer		2			2
Manistique - Hiawatha 69kV		2	203		205
Mukwonago - Whitewater 138-kV	South Fond du Lac - Columbia 345-kV	1	1		2
North Appleton - Apple Hills 138-kV	North Appleton - Ellington 138-kV	1			1
North Appleton - Lost Dauphin 138-kV	Kewaunee 345/138-kV Transformer	35	5	6	46
North Appleton - Lost Dauphin 138-kV	North Appleton - White Clay 138-kV		2		2
North Appleton - White Clay 138-kV	Stiles - Pulliam 138-kV	1			1
North Appleton 345/138-kV Transformer #1	North Appleton 345/138-kV Transformer #3		2		2
Paddock - Blackhawk 138-kV	Paddock - Rock River 138-kV	4			4
Paddock 345/138kV Transformer	Paddock - Rockdale 345-kV	22			22
Pleasant Prairie - Racine 345kV	Wempletown - Paddock 345-kV	1			1
Rockdale 345/138-kV Transformer #1	Rockdale 345/138-kV Transformer #2	1			1
Rockdale 345/138-kV Transformer #2	Paddock 345/138-kV Transformer	1			1
Rockdale 345/138-kV Transformer #2	Rockdale 345/138-kV Transformer #1	1			1
Rocky Run - North Appleton 345-kV		6			6
Russell - Rockdale 138-kV	Paddock - Rockdale 345-kV	8			8
Stiles - Amberg 138-kV	Morgan - Plains 345-kV	14	67	4	85
Stiles - Pioneer 138-kV	North Appleton - White Clay 138-kV	7	2	1	10
Wempletown - Paddock 345kV		7			7

Note: * -Sum of number of declarations is based on determining the highest service limitation level for a given occurrence so that each is counted once

Level 3: non-firm transmission service curtailments

Level 4: transmission system reconfiguration/redispach

Level 5: firm transmission service curtailments/redispach



Performance Criteria Limits Exceeded and Other Constraints 2005-2006
PLANNING ZONE 2

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

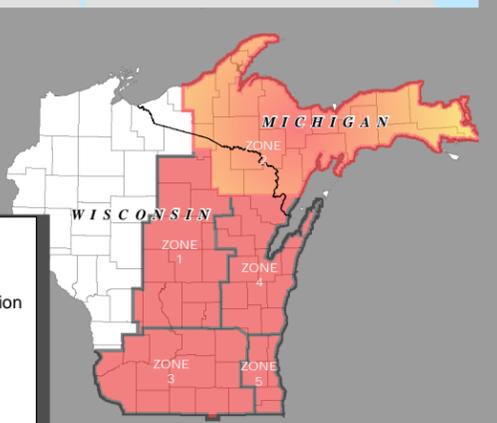
- Approximately 8900 miles of transmission lines
- 98 wholly owned substations
- 358 jointly owned substations
- ATC offices in Madison (2), Cottage Grove, Pewaukee, De Pere, Wausau and Kingsford, MI

- Low Voltages
- Overloaded Facility
- Transmission Service Limiter

Transmission Related Facilities

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

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



ZONE & STUDY RESULTS > Zone 2 – 2010 study results

Refer to [Table ZS-2](#) and [Figure ZS-5](#)

Summary of key findings

- ❑ Construction of a second Hiawatha-Mackinac 138-kV circuit will improve 138-kV voltage profiles in the eastern Upper Peninsula of Michigan and complete two 138-kV circuits across the Upper Peninsula.
- ❑ Energizing the second circuit between Hiawatha and Indian Lake and the conversion of the operating voltage of both circuits from 69 to 138 kV will improve voltages in the central and eastern Upper Peninsula as well as facilitate reducing the limitations to granting transmission service between the Upper Peninsula and Wisconsin.
- ❑ The construction of a new Cranberry-Conover 115-kV line and conversion of Conover-Iron River-Plains 69-kV system to 138 kV helps address low voltages in the western Upper Peninsula and the Rhinelander area (see [Zone 1 - 2006 study results](#)).
- ❑ The second 345/138-kV transformer at Plains will improve reliability in the area and facilitate an improvement in transfer capability between Zone 2 and Zone 4.
- ❑ The addition of capacitor banks at Ontonagon (two 8 MVAR), M38 (two 8 MVAR), Osceola (two 5.4 MVAR), L'Anse (one 5.4 MVAR), and MTU (one 5.4 MVAR) will help mitigate the potential low-voltage issues in the northwestern Upper Peninsula of Michigan.
- ❑ Increasing the ground clearance of the M38-Atlantic and Winona-Atlantic 69-kV lines along with the uprate of the M38 and Atlantic 138/69-kV transformers will address overloads of these facilities.

The eastern Upper Peninsula has transmission system issues that require extensive reinforcements if a robust plan is followed. This robust plan has two major components.

One component of the plan is needed because the continued load growth projected in the eastern Upper Peninsula is projected to cause low voltages at some 138-kV substations. Rebuilding the existing 69-kV circuits from Hiawatha through Pine River to Mackinac and converting these to 138-kV operation, along with the installation of a 138/69-kV transformer at Pine River, will result in a system that will be better able to handle a variety of issues in the future, including the completion of a 138-kV conduit through the Upper Peninsula.

The second component of the plan involves installation of the second circuit on the planned rebuild of the Hiawatha-Indian Lake line (2006) along with conversion of the operating voltage of both circuits to 138 kV as proposed for 2009. This project will improve voltage profiles in the eastern and central Upper Peninsula, address the transmission loading relief incidents experienced on this line and complete the conduit through to Hiawatha. This project will be constructed once the Hiawatha-Pine River-Mackinac projects discussed above have been completed.



However, the conversion of these eastern Upper Peninsula facilities mentioned above to 138 kV is an expensive project relative to the benefits that can be seen at this time. We are investigating other alternatives to enhance reliability and access for customers in this area.

Converting some of the Conover-Plains 69-kV system to 138 kV will provide another needed transmission source to the Rhinelander Loop, address 69-kV line condition issues, and, along with capacitor banks, will help address low-voltage conditions in western Upper Peninsula.

The second 345/138-kV transformer will strengthen the connection between the 345-kV system and the 138-kV system at the Plains Substation. It also will help to improve the transfer capacity between the Upper Peninsula and Wisconsin.

**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

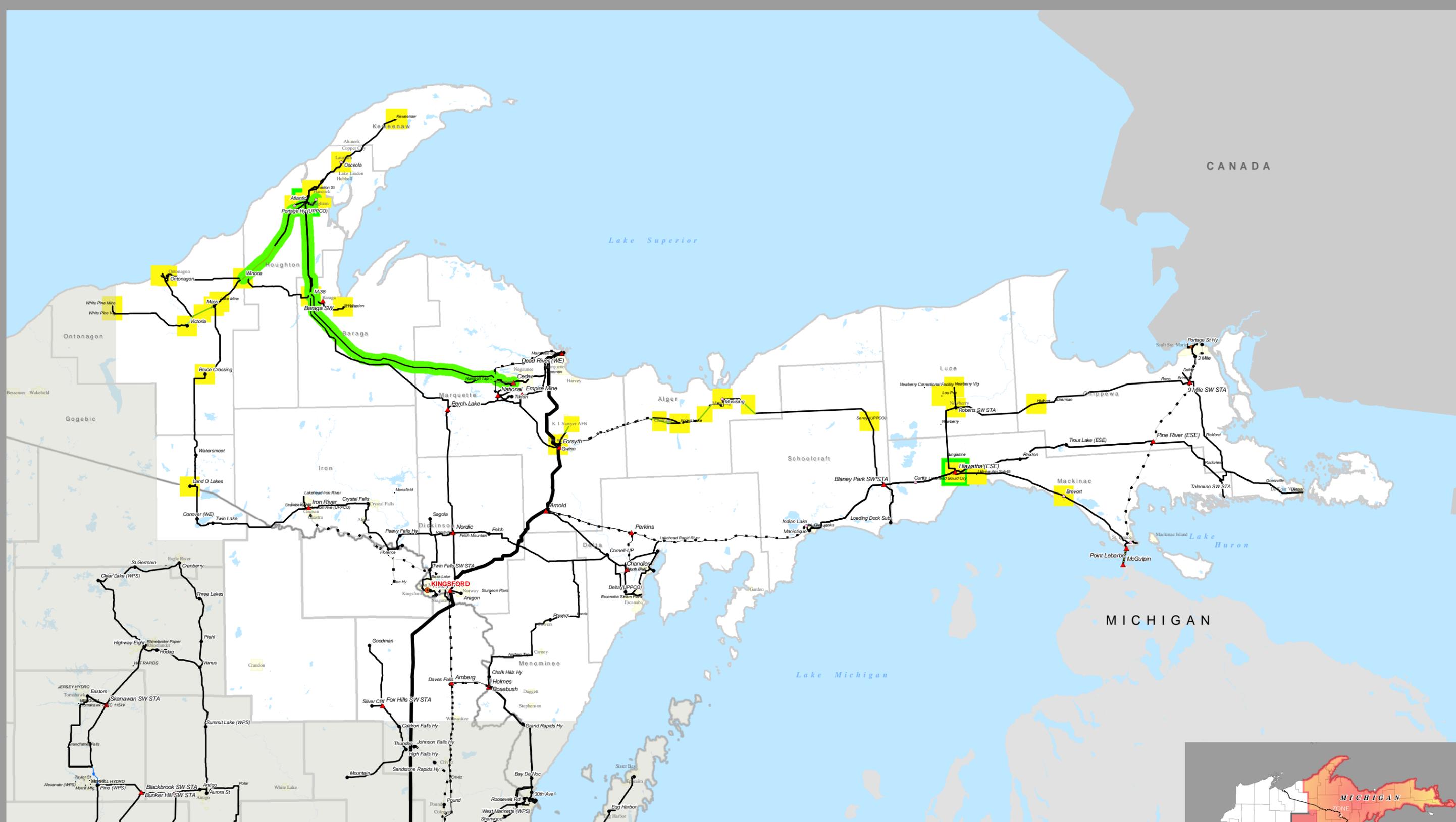
Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
2	Seney Tap, Timber Products, Alger and Munising 69-kV bus voltages		89-91%	Munising 138/69-kV transformer outage	Load Serving
2	Keweenaw, Keweenaw Tap, Elevation #1, Elevation Tap #1 and Osceola 69-kV 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 Morts bus tie outage	Load Serving
4	Kaukauna Central Tap-Melissa 138-kV line	95%		Butte Des Morts 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



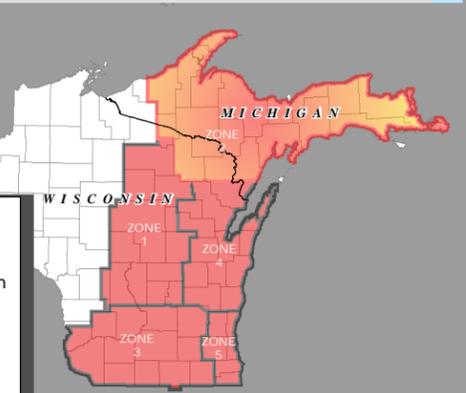
Performance Criteria Limits Exceeded and Other Constraints 2007-2010
PLANNING ZONE 2

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

Transmission Related Facilities

- ▲ ATC Owned Substation
- ATC Office Location
- ◊ Joint Owned Substation - Assets Conveyed
- Joint Owned Substation - Assets Retained
- Generation
- Proposed/Design/Construction
- 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 2 – 2014 study results

Refer to [Table ZS-3](#) and [Figure ZS-6](#)

Summary of key findings

- ❑ The poor condition of the line and system reliability considerations will require rebuilding the Blaney Park-Munising 69-kV line to operate at 138 kV.
- ❑ The poor condition of the line and system reliability considerations may require rebuilding the 69-kV Chalk Hills-Chandler line to operate at 138 kV.
- ❑ Low voltages in Zone 2 may be adequately addressed with capacitor bank installations.

Portions of the Blaney Park-Munising 69-kV line will need to be rebuilt due to poor physical condition. Reliability of service to customers served by this line is also a concern because as currently operated, this relatively long line is operated radially from Munising (open at Blaney Park). The condition and rating of the line prevent us from closing both ends at the same time. If this line is converted to 138 kV it also could provide the continuation of another 138-kV outlet from the Presque Isle Power Plant in the Marquette area. This 138-kV path could be part of one alternative to consider for reducing or even eliminating the need for the remedial action-tripping scheme at Presque Isle.

Portions of the Chalk Hills-Chandler 69-kV line may need to be rebuilt due to poor physical condition. Rebuilding and converting the 69-kV Chalk Hills-Chandler line to 138 kV will allow the line to be operated normally closed (currently a portion of the line is operated radially from Chalk Hills), address physical condition issues associated with the line, and improve and diversify the ties between Zone 2 and Zone 4.

The 2014 analysis also showed low 138-kV voltages in various locations in Zone 2. The proposed rebuild/conversion of the Hiawatha-Pine River-Mackinac and Plains-Iron River-Conover 69-kV lines to 138 kV should address most of these low voltages. If load growth is higher than expected, additional capacitor projects at Hiawatha, M38 and Empire substations may need to be developed in the future.

**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 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 Forsyth- 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)**

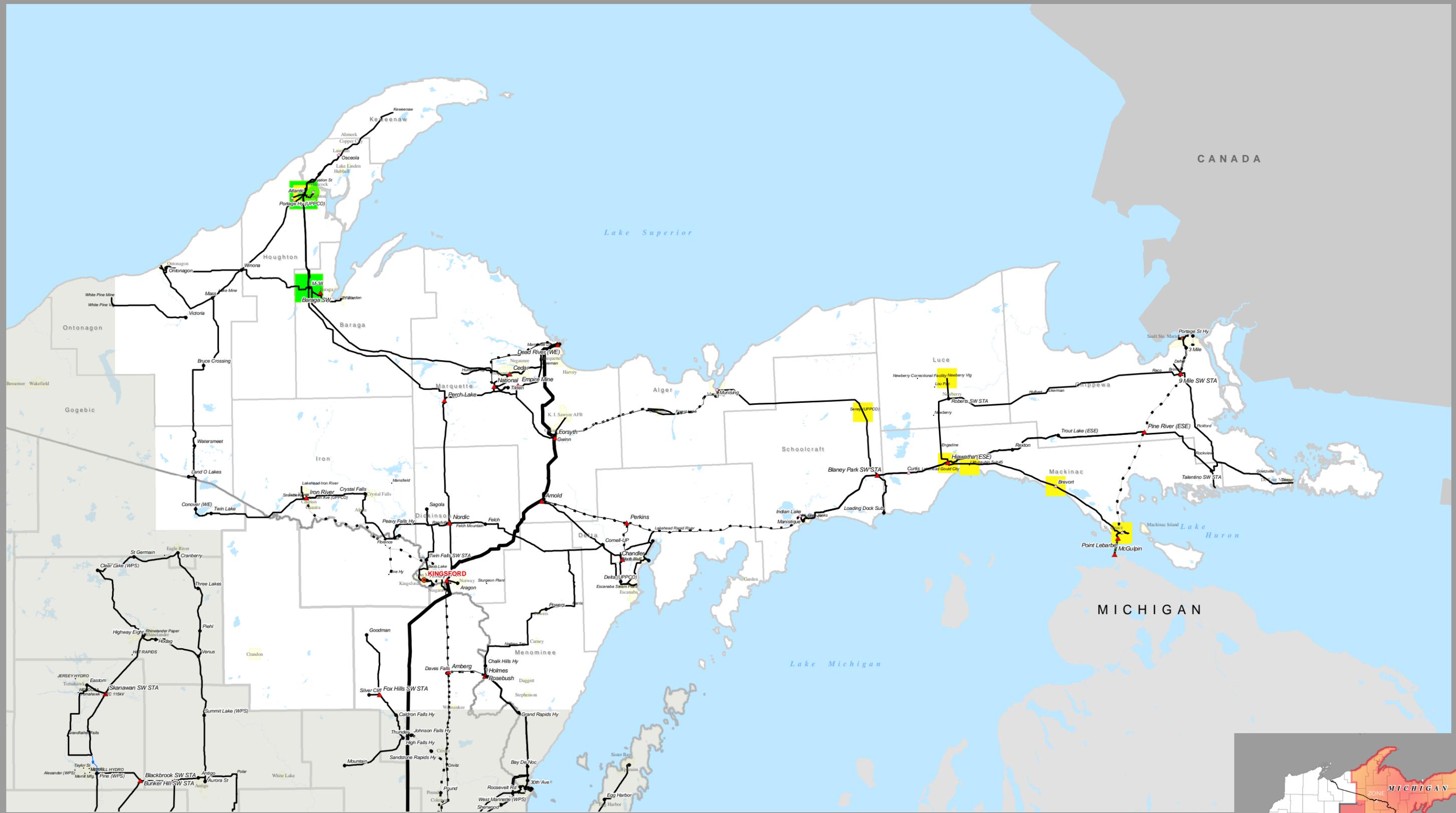
Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
3	Oregon-Stoughton 69-kV line	97-107%		Sugar River (Montrose)-Verona 69-kV line outage	Load Serving
3	Stagecoach-Timberlane Tap 69-kV line	97%		Sugar River-Verona 69-kV line and Spring Green 138/69-kV transformer 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



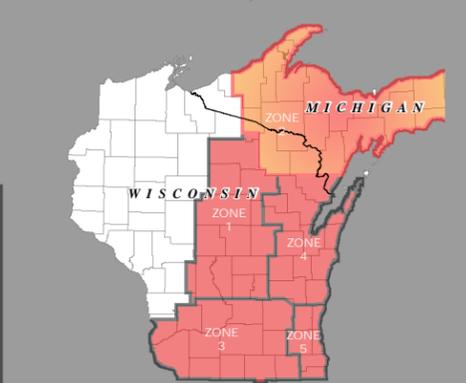
Performance Criteria Limits Exceeded and Other Constraints 2011-2014
PLANNING ZONE 2

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

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



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.