



Zone 2 Overview

Zone 2 includes the counties of:

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

The physical boundaries of Zone 2 and transmission facilities located in Zone 2 are shown in [Figure ZS-23](#).

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.

Demographics

The population of the counties in Zone 2 experienced slightly negative growth from 1998 to 2008. The highest growth rate of 0.8 percent per year and the largest increase in population of 1,700 occurred in Vilas County.

Population in Zone 2 is projected to grow on an annual basis of 0.2 percent between 2008 and 2019. For the same period, Vilas County is projected to realize the largest increase in population, as well as the highest growth rate.

During the same period, the annual employment growth rate was 0.6 percent. The highest growth rate and the highest increase in employment occurred in Marquette County (Michigan).

Employment in Zone 2 is projected to grow at 0.8 percent annually between 2008 and 2019. During this time period, Marquette County (Michigan) is projected to realize the largest increase in employment, while Luce County (Michigan) is projected to have the highest growth rate.



10-Year Assessment

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2009

October 2009 10-Year Assessment
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Employment				Population			
Annual Growth Rate				Annual Growth Rate			
1998-2008		2008-2019		1998-2008		2008-2019	
Zone 2	0.6	Zone 2	0.8	Zone 2	-0.1	Zone 2	0.2
Marquette, MI	1.7	Luce, MI	1.6	Vilas, WI	0.8	Vilas, WI	0.7
Total Increase				Total Increase			
1998-2008		2008-2019		1998-2008		2008-2019	
Zone 2	10,525	Zone 2	17,030	Zone 2	-4,619	Zone 2	7,595
Marquette, MI	5,676	Marquette, MI	5,201	Vilas, WI	1,732	Vilas, WI	1,834

Zone 2 environmental considerations

Zone 2 includes a small part of the far northeast portion of Wisconsin and approximately 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 and 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 2010, 2014, 2019 and 2024 are shown in [Table ZS-9](#). Existing generation along with proposed generation based on projected in-service year also are shown. The resultant capacity margins, with or without the proposed generation, are shown as well.

This table shows that load is projected to decrease at roughly 0.6 percent annually from 2010 through 2019. 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.

Transmission study drivers

An overriding general characteristic of the Zone 2 transmission system is the fact that it consists of load islands dispersed over a broad area and numerous components are near limits. Both the local and interconnecting components of this network have been generally adequate by historic standards, however, modern performance requirements, coupled with load increases or generation reductions of "modest" magnitudes could result in reinforcement needs. Furthermore, inability to immediately serve nominal growth or generation changes could emerge. This indicates the need for extensive Strategic Flexibility analysis including the varied internal and external factors. This is the basis for conducting the ATC Energy Collaborative – Michigan study process which constitutes the bulk of the Zone 2 analysis in this 10-Year Assessment.

Key system performance issues in Zone 2 include:

- proposed renewable generation source increases,
- proposed point load increases,
- proposed generation retirements,
- 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 contributes to 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,
- record low Lake Superior water levels in the last few years have resulted in potentially reduced hydro generation, output in the eastern U.P., magnifying reliability concerns in this area,
- low voltages, most pronounced in the western and eastern Upper Peninsula,
- potential low voltages and overloads in the northwestern U.P. due to recent load increases, and
- potential marginal voltages and overloads in the central U.P. due to *potential* load increases.

Please refer to the ATC Energy Collaborative – Michigan for more information on the application of strategic flexibility planning to Zone 2.

Zone 2 - 2010 study results

Refer to Table ZS-1 and Figure ZS-5

Summary of key findings

- In the 2010 study year, potential constraints were identified occurring broadly across the U.P. All identified issues have either a mitigation plan or project associated with them. Please refer to Table ZS-1 (Project or Mitigation column) for details.

We have completed or are currently constructing a series of significant upgrades across Michigan's Upper Peninsula. The most notable projects are:



- The Eastern Upper Peninsula Reliability and Operating Enhancement Phase 1 (EUROPE) projects completed in 2006.
- The Northern Umbrella Projects (NUP) scheduled for completion in 2010.
- Three urgent projects in the Eastern Upper Peninsula completed at the start of the winter of 2007-08. These projects provided a hedge for the risk of low water availability for hydroelectric generation.

Even with these significant upgrades, operational challenges remain in this region due to the delicate balance among generation, load, market flows and transmission facilities that currently exists. There are also continuing asset renewal needs.

Longer term, more robust solutions, involving upgrades, rebuilds, and/or new construction is possible. These results are presented fully in the ATC Energy Collaborative - Michigan section. This section presents a strategic flexibility approach to the multiple factors emerging across the U.P.

Zone 2 - 2014 study results

Refer to Table ZS-2 and Figure ZS-6

Summary of key findings

- In the 2014 study year, potential constraints were identified occurring broadly across the U.P. Most of the identified issues have either a mitigation plan or project associated with them. Please refer to Table ZS-2 (Project or Mitigation column) for details.

Low bus voltages emerge in the eastern U.P. for the outage of the Livingston-Emmett 138-kV line or the Keystone-Ludington 345-kV line. In the short term, these constraints can be mitigated by adjustments taken at existing facilities as modeled:

- available generation increases,
- transformer tap adjustments,
- capacitor bank regulation, and/or
- the currently utilized procedure of splitting the system in the eastern U.P. (for several contingencies in the U.P. and Lower Peninsula of Michigan).

Longer term, more robust solutions, involving upgrades, rebuilds, and/or new construction is possible, and will be presented fully in the ATC Energy Collaborative - Michigan section. This section presents a Strategic Flexibility approach to the multiple factors emerging across the U.P.

Zone 2 - 2019 study results

Refer to Table ZS-3, Table ZS-3a and Figure ZS-7

Summary of key findings

- In the 2019 study year, potential constraints were identified occurring broadly across the U.P. All identified issues have either a mitigation plan or project associated with them. Please refer to Table ZS-3 (Project or Mitigation column) for details.



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Longer term, more robust solutions, involving upgrades, rebuilds, and/or new construction is possible. These results are presented fully in the [ATC Energy Collaborative - Michigan](#) section. This section presents a Strategic Flexibility approach to the multiple factors emerging across the U.P.

Zone 2 - 2019 futures study results

Two potential 2019 futures were studied as part of this Assessment:

- 20% Wind Future
- Slow Growth Future

Please refer to the [Methodology & Assumptions](#) for details about how the futures models were developed.

In the 20% Wind Future, voltages and line overloads in the Escanaba area worsen, but increasing area generation mitigates the situation(s). These results occur because of area generation dispatch and the associated change in the flow of power associated with the 20% Wind scenario.

In the Slow Growth Future, voltages improve throughout Zone 2. In addition, line overloads generally improve, but worsen under certain contingencies. This result is consistent with the reduced loading and associated generation redispatch throughout the zone.

The Pine River-Straits 69-kV line overload, which occurs under single contingency in the 2019 Summer Peak model, does not appear in either the 20% Wind or Slow Growth Future. Please refer to [Table ZS-3a](#) for the limitations and performance criteria exceeded for these futures.

Zone 2 - 2024 study results

Please refer to the [ATC Energy Collaborative – Michigan](#).

Summary of Compliance with NERC Standards

The mitigation plans, planned, proposed and provisional projects identified for Zone 2 in this Assessment will allow the ATC system in Zone 2 to meet NERC standards TPL-001, TPL-002, TPL-003 and TPL-004 in each of the four years 2010-2014, and for the 2015-2019 planning horizon.

TABLE ZS-1

PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2010 Summer Peak, Shoulder and E-W Bias Cases

Planning Zone	Criteria Exceeded/Need	2010 Summer Peak Case		2010 Shoulder Case		2010 E-W Bias Case		Facility Outage(s)	Project or Mitigation
		% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
1	Petenwell, Big Pond, Necedah, Whistling Wings, ACEC Dellwood, Friendship, ACEC Friendship 69-kV buses		89.5 - 91.9%		--		90.8 - 91.6%	Necedah Tap - Big Pond 69-kV line Petenwell - Big Pond 69-kV line Petenwell 138/69-kV transformer	Redispatch generation or McKenna capacitor expansion
1	Petenwell, Council Creek 138-kV bus		90.5 - 91.4%		--		91.3%	Saratoga - Petenwell 138-kV line	Monroe County – Council Creek 161-kV line
1	Harrison 69-kV bus		--		105.0%		--	System Intact	Take Harrison 69-kV capacitor out of service
1	Whitcomb 115-kV bus		--		--		105.5%	System Intact	Take Badger 138-kV capacitor out of service
1	Caroline 115-kV bus		105.1%		105.1%		105.6%	System Intact	Take Badger 138-kV capacitor out of service
1	Coloma 69-kV bus		91.9%		--		--	Chaffee Creek - Coloma Tap 69-kV line	
1	Metomen 138/69-kV transformer #31	93.0% - 100.2%		--		--		System Intact North Randolph - Markesan Tap 69-kV line North Fond du Lac - Rosendale 69-kV line Sunset Point - Winneconne 69-kV line	Metomen transformer replacement
1	Petenwell 138/69-kV transformer #31	89.0%		--		--		System Intact	
1	Whitcomb 115/69-kV transformer #31	91.0%		--		--		System Intact	
1	Castle Rock - ACEC Quincy 69-kV Line	96.2%		--		--		Petenwell - Big Pond 69-kV line Petenwell 138/69-kV transformer #31 Necedah Tap - Big Pond 69-kV line	
2	Pine River - Straits 69-kV line Straits - Evergreen 69-kV line Straits - Evergreen 69-kV line	--		--		98.1 - 124.2%		Brevort - Lakehead 138-kV line Lakehead - Hiawatha 138-kV line Brevort - Straits 138-kV line Pine River - Evergreen 69-kV line Evergreen - Straits 69-kV line ATC_B2_9902	Rebuild Straits-Pine River 69-kV lines
2	Straits - McGulpin 138-kV line #3	--		--		100.2%		Straits - McGulpin 138-kV line #1	Uprate Straits - McGulpin 138-kV line #3
2	Straits - McGulpin 138-kV line #1	--		--		100.3%		Straits - McGulpin 138-kV line #3	Uprate Straits - McGulpin 138-kV line #1
2	Nordic - Mountain 69-kV line	--		107.9%		--		Chandler 138/69-kV transformer #1	Uprate Nordic-Mountain 69-kV line
2	Delta – Mead 69-kV line	99.0 - 157.1 %		102.0 - 108.7%		112.4 - 140.8%		System Intact Chandler-Lakehead Tap 69-kV line Lakehead Tap-Masonville 69-kV line Masonville-Gladstone 69-kV line Gladstone-North Bluff 69-kV line North Bluff-Bay Tap 69-kV line Bay Tap-Mead 69-kV line	Uprate Delta – Mead 69-kV line, Increase generation at Mead/Gladstone
2	Chandler – Delta 69-kV #1 line	106.5%		117.1%		--		Chandler-Delta 69-kV #2 line	Uprate Chandler – Delta 69-kV #1 line

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Planning Zone	Criteria Exceeded/Need	2010 Summer Peak Case		2010 Shoulder Case		2010 E-W Bias Case		Facility Outage(s)	Project or Mitigation
		% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
2	Chandler – Delta 69-kV #2 line	101.7%		111.7%		--		Chandler-Delta 69-kV #1 line	Uprate Chandler – Delta 69-kV #2 line
2	Atlantic – M38 69-kV line	117.5 - 118.1%		95%		115.3 - 115.4%		Atlantic 138/69-kV transformer #1 Atlantic - M-38 138-kV line ATC_B2_ATLAN (both of the above)	Uprate Atlantic – M38 69-kV line
2	Chandler – Lakehead Tap 69-kV line Masonville – Lakehead Tap 69-kV line Masonville – Gladstone 69-kV line Gladstone – North Bluff 69-kV line North Bluff – Bay Tap 69-kV line Mead – Bay Tap 69-kV line	119.1 - 159.0%		97.3 - 107.3%		106.3 - 142.0%		Delta - Mead 69-kV line	Uprate Chandler-Masonville, Masonville-Gladstone, Gladstone-North Bluff, North Bluff-Mead 69-kV lines
2	Lakota Road 69-kV bus		--		--		105.4% - 118.5%	System Intact Conover - Lakota 69-kV line	Adjust 138/69-kV transformer taps at Lakota Road
2	Engadine, Straits, St. Ignace, Hiawatha, Manistique, Valley, Glen Jenks, Indian Lake, Evergreen 69-kV buses		--		105.2% - 105.5%		105.1% - 105.8%	System Intact	Adjust 138/69-kV transformer taps at Indian Lake, Hiawatha, and Straits
2	WE-Greenstone, Barnum Tap, Barnum Sub, Humboldt Tap, Foundry, North Lake 69-kV buses		--		105.3 - 105.5%		--	System Intact	Adjust 138/69-kV transformer taps at North Lake
2	Munising, Alger, Alger Delta Hiawatha 69-kV buses		--		105.1 - 105.5%		--	System Intact	Adjust 138/69-kV transformer taps at Munising
2	Cornell Tap, Delta, Escanaba 1, Escanaba 2, Masonville, Mead, Gladstone, West Tap, West, Lakehead Tap, Lakehead, Bay Tap, Bay View, North Bluff, Cornell, Harris, Harris Tap 69-kV buses		90.5 - 91.9%		88.3 - 91.5%		--	Chandler 138/69-kV transformer #1	Increase local generation at Gladstone/Mead/Escanaba
2	Engadine, Newberry, Newberry Hospital, Newberry Hospital Tap, Newberry Village, Louisiana Pacific, Roberts, Hulbert, Eckerman, Raco, Talentino, Talentino 6950, Goetzville, Brimley, DeTour 69-kV buses		71.8 - 91.6%		--		--	Hiawatha – Engadine 69-kV line	Increase generation at Newberry, Dafter, DeTour, US Hydro, Edison Sault
2	Straits, Brevort, Lakehead, Hiawatha 138-kV buses		89.3 - 91.1%		--		--	Livingston – Emmett 138-kV line	Increase generation at Newberry, Dafter, DeTour, US Hydro, Edison Sault
2	Atlantic 138-kV bus		88.0%		--		89.0%	Atlantic-M38 138-kV line	Adjust 138/69-kV transformer taps at Atlantic

TABLE ZS-1

PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2010 Summer Peak, Shoulder and E-W Bias Cases

Planning Zone	Criteria Exceeded/Need	2010 Summer Peak Case		2010 Shoulder Case		2010 E-W Bias Case		Facility Outage(s)	Project or Mitigation
		% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
3	No criteria limits exceeded or constraints	--	--	--	--	--	--	System Intact	
3	Hubbard and Hustisford 138-kV buses		84.4 – 86.9%		86.6 – 87.3%		86.7 – 87.3%	Rubicon – Hustisford 138-kV line Hustisford – Hubbard 138 kV line	Local Operating Steps
3	Crawfish River 138-kV bus		91.4%		--		--	Jefferson – Crawfish River 138-kV line	Increase Concord generation
3	Verona - Sun Valley 69-kV line	110.9%-101.3%		--		101.3%		Stoughton - Stoughton South 69-kV line Kegonsa - Stoughton North 69-kV line Kegonsa 138/69-kV transformer #31	Y119 Verona-Oregon 69-kV line rebuild
3	McCue - Harmony - Lamar 69-kV line	98%-95.4%		--		--		Kegonsa - Stoughton North 69-kV line	Y61 McCue - Lamar line uprate
3	Fitchburg - Syene 69-kV line	109.6%		--		98.8%		Royster - AGA Tap 69-kV line	Uprate Fitchburg-Nine Springs line, uprate Pflaum - Royster line, install 2-16.33 MVAR 69 kV capacitor banks at Nine Springs and move the AGA load onto Femrite - Royster line
3	Royster - AGA Tap 69-kV line	106.7%		--		96.6%		Fitchburg - Syene 69-kV line	Uprate Fitchburg-Nine Springs line, uprate Pflaum - Royster line, install 2-16.33 MVAR 69 kV capacitor banks at Nine Springs and move the AGA load onto Femrite - Royster line
3	Verona 138-kV bus		90.1%		-		90.7%	Verona - Oak Ridge 138-kV line	Adjust Verona 138/69-kV transformer setting
3	Harmony, Lamar, Fulton and Saunders Creek 69-kV buses		87.8-91.9%		--		90.1-91.3%	McCue - Harmony 69-kV line Harmony - Lamar 69-kV line	Lamar 2-16.33 MVAR 69-kV capacitor banks
3	Huiskamp – Mendota - Ruskin 69-kV line	--		101.6%-97.7%		--		North Madison - Vienna 138-kV line Vienna - Yahara River 138-kV line Yahara River - American Center 138-kV line	Bypass the Mendota line switch as a short term solution; the 2011 Mendota Substation retirement project will remove the line switch limitation
3	Paddock – Townline 138-kV line	--		97%-95.2%		--		Blackhawk – Northwest Beloit Tap 138-kV line Northwest Beloit Tap – Paddock 138-kV line	Increase Rock River generation
4	Chalk Hills and Alger Delta Nathan 69-kV buses		105.1 – 105.8%		--		106.4 – 107.1%	System Intact	Modeling Corrections
4	Bell Plaine and Badger 115-kV buses		105.4%		--		105.7%	System Intact	Local Operating Steps
5	Germantown 138-kV bus		--		95.8%		--	System Intact	Run Germantown generation
5	Bain 345/138-kV transformer #5	158.5%		131.2%		158.6%		Pleasant Prairie 345-kV 3-4 bus tie	Reduce Pleasant Prairie #2 generation

TABLE ZS-1

PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2010 Summer Peak, Shoulder and E-W Bias Cases

Planning Zone	Criteria Exceeded/Need	2010 Summer Peak Case		2010 Shoulder Case		2010 E-W Bias Case		Facility Outage(s)	Project or Mitigation
		% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
5	Albers – Bain 138-kV line	96.4%		--		101.6%		Bain-Kenosha 138-kV line	Upgrade Bain – Albers 138-kV line
5	Albers – Kenosha 138-kV line			114.6%		106.3%		Albers – Bain 138-kV line	Upgrade Albers – Kenosha 138-kV line
5	Oak Creek8 – Elm Road 345/230-kV transformer #884	101.8%		--		--		Oak Creek 230-kV 6-7 bus tie	Reduce Oak Creek generation on units 7 or 8.
5	Arcadian4- Waukesha1 138-kV line	98.8%		105.1%		114.9%		Arcadian6 – Waukesha3 138-kV line	Upgrade Arcadian – Waukesha 138-kV lines or investigate other alternatives
5	Arcadian 345/138-kV transformer #3	99.0%		95.1%		103.9%		Arcadian 345/138-kV transformer #1	Replace Arcadian transformers or investigate other alternatives
5	Arcadian 345/138-kV transformer #2	--		--		95.1%		Arcadian 345/138-kV transformer #1	Replace Arcadian transformers or investigate other alternatives
5	Hartford 138-kV bus		91.6%		--		--	Hartford – St. Lawrence 138-kV line	Increase Concord generation
5	Oak Creek8 – Elm Road 345/230-kV transformer #884	95.8		--		--		Oak Creek 230-kV 6-9 bus tie	Reduce Oak Creek generation on 6, 7, or 8
5	Harbor – Kansas 138-kV line	--		95.4% 96.3% 96.5% 99.3%		--		Montana – Dewey 138-kV line Dewey 138-kV bus Dewey – Norwich 138-kV line Kansas – Norwich 138-kV line	Replace 138-kV underground segment of the Kansas – Harbor 183kV line
5	Arcadian6 – Waukesha3 138-kV line	97.9%		104.2%		114.0%		Arcadian4 - Waukesha1 138-kV line	Upgrade Arcadian – Waukesha 138-kV lines or investigate other alternatives

**Table ZS-2
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2014 Summer Peak without Nelson Dewey, with Nelson Dewey, Shoulder, E-W Bias and High Load Cases**

Planning Zone	Criteria Exceeded/Need	2014 Summer Peak Case Without Nelson Dewey		2014 Summer Peak Case With Nelson Dewey		2014 Shoulder Case		2014 E-W Bias Case		2014 High Load Case		Facility Outage(s)	Project or Mitigation
		% of Facility Rating	% of Nominal Voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
1	Fountain Valley, Redgranite, ACEC Spring Lake, Silver Lake 69-kV bus		91.3 - 91.7%		90.7 - 91.7%		--		--		90.0 - 91.1%	Wautoma - Silver Lake Tap 69-kV line	No project needed at this time
1	Dartford, Northwest, Ripon Industrial Park, Ripon, Southwest Ripon 69-kV bus		--		91.9%		--		--		91.0 - 91.8%	Metomen - Ripon 69-kV line Ripon - Northwest Ripon Tap 69-kV line	No project needed at this time
1	Winneconne 69-kV bus		--		--		--		--		91.5%	Sunset Point - Winneconne 69-kV line	No project needed at this time
1	Aurora Street 115-kV bus Antigo 115-kV bus		--		--		--		--		90.4 - 90.5%	Antigo - Black Brook 115-kV line	No project needed at this time
1	Petenwell, Big Pond, Necedah, Whistling Wings, ACEC Dellwood, Friendship, ACEC Friendship, Houghton Rock 69-kV buses		88.1 - 91.7%		87.8 - 91.5%		--		89.3 - 91.9%		87.3 - 91.9%	Petenwell 138/69-kV transformer #31 Petenwell - Big Pond 69-kV line Big Pond - Necedah Tap 69-kV line Necedah Tap - Whistling Wings Tap 69-kV line	McKenna capacitor bank expansion
1	Petenwell, Council Creek 138-kV buses		90.5% - 91.6%		90.3 - 91.4%		--		91.8%		95.4 - 95.6% 90.0 - 91.9%	System Intact Saratoga - Petenwell 138-kV line	Monroe County - Council Creek 161-KV line
1	Caroline 115/69-kV transformer #61	95.5%		--		--		--		101.6%		Whitcomb 115/69-kV transformer #31	No project needed at this time
1	Castle Rock - ACEC Quincy 69-kV line	96.1%		103.0%		--		--		97.5%		Petenwell 138/69-kV transformer #31 Petenwell - Big Pond 69-kV line Big Pond - Necedah Tap 69-kV line	Uprate Castle Rock - McKenna 69-KV line
1	Council Creek - Tomah Industrial Park Tap 69-kV line	97.7%		98.1%		--		--		--		System Intact	No project needed at this time
1	Northwest Ripon - Ripon 69-kV line	--		--		--		--		98.7%		Sunset Point - Winneconne 69-kV line	No project needed at this time
1	Whitcomb 115/69-kV transformer #31	--		--		--		--		96.4%		System Intact	No project needed at this time
1	Metomen 138/69-kV transformer #31	99.0 - 104.0%		103.3% 97.6%				100.8 - 107.4%		109.0%		System Intact North Fond du Lac - Rosendale Tap 69-kV line Metomen - Rosendale Tap 69-kV line North Randolph - Markesan Tap 69-KV line Sunset Point - Winneconne 69-KV line	Metomen transformer replacement

TABLE ZS-2

PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2014 Summer Peak without Nelson Dewey, with Nelson Dewey, Shoulder, E-W Bias and High Load Cases

Planning Zone	Criteria Exceeded/Need	2014 Summer Peak Case Without Nelson Dewey		2014 Summer Peak Case With Nelson Dewey		2014 Shoulder Case		2014 E-W Bias Case		2014 High Load Case		Facility Outage(s)	Project or Mitigation
		% of Facility Rating	% of Nominal Voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
2	DeTour, Goetzville, Talentino, Mich Limestone, Rockview, Magazine, Pickford, Talentino, Talentino 6950 69-kV buses Straits, Brevort, Lakehead, Hiawatha 138-kV buses		86.3 - 91.8%		89.2 - 91.9%		--		Did not converge		Did not converge	Livingston – Emmett 138-kV line	
2	Straits, Brevort, Lakehead, Hiawatha 138-kV buses		90.1 - 92.0%		--		--		Did not converge		Did not converge	Keystone – Ludington 345-kV line	
2	Pine River - Straits 69-kV, Straits-Evergreen 69-kV, Pine River-Evergreen 69-kV lines	--		--		--		96.2 -135.8%		--		Brevort - Lakehead 138-kV Line Lakehead - Hiawatha 138-kV Line Brevort - Straits 138-kV Line Pine River - Evergreen 69-kV Line Evergreen - Strait 69-kV line ATC_B2_9902	Rebuild Straits-Pine River 69 kV lines
2	Straits - McGulpin 138-kV line #3	--		--		--		112.6%		--		Straits - McGulpin 138-kV line #1	Uprate Straits - McGulpin 138-kV line #3
2	Straits - McGulpin 138-kV line #1	--		--		--		112.6%		--		Straits - McGulpin 138-kV line #3	Uprate Straits - McGulpin 138-kV line #1
2	Delta – Mead 69-kV line	100.0 - 157.2%		100.0 - 158.0%		--		112.7 - 141.8%		105.8 - 165.2%		System Intact Chandler - Lakehead Tap 69-kV line Lakehead Tap - Masonville 69-kV line Masonville - Gladstone 69-kV line Gladstone - North Bluff 69-kV line North Bluff - Bay Tap 69-kV line Bay Tap - Mead 69-kV line	Uprate Delta - Mead 69-kV line, increase generation at Mead/Gladstone
2	Chandler – Delta 69-kV #1 line	108.1%		108.1%		117.9%		95.7%		97.9 - 117%		Chandler - Delta 69-kV #2 line, Chandler - Lakehead Tap 69-kV line	Uprate Chandler - Delta 69-kV line #1
2	Chandler – Delta 69-kV #2 line	102.6%		102.4%		112.6%				111.7%		Chandler - Delta 69-kV #1 line	Uprate Chandler-Delta 69-kV line #2
2	Atlantic – M38 69-kV line	117.6 - 118.2%		118.2 - 118.8%		96.3%		116.8%		119.7 - 120.0%		Atlantic - M-38 138-kV line, Atlantic 138/69-kV transformer #1, Both	Uprate Atlantic-M38 69-kV line or increase local generation at Portage
2	Chandler - Lakehead Tap, Lakehead Tap - Masonville, Masonville - Gladstone, Gladstone - North Bluff, North Bluff - Bay Tap, Bay Tap - Mead 69-kV lines	120.2 - 160.5%		120.3 - 160.7%		98.0 - 108.3%		106.8 - 142.6%		128.4 - 171.4%		Delta-Mead 69-kV line	Uprate Chandler-Masonville, Masonville-Gladstone, Gladstone-North Bluff, North Bluff-Mead 69-kV lines; increase generation at Mead/Gladstone
2	Nordic – Mountain 69-kV line	110.8%		--		106.1%		--		119.7%		Chandler 138/69-kV transformer #1	Uprate Nordic-Mountain 69-kV line
2	Ontonagon - UPPSCO Tap 69-kV line	--		--		--		--		105.9% - 106.9%		Victoria - Rockland Junction 2 69-kV, Rockland Junction 2 - Rockland 69-kV, Rockland - Mass 69-kV lines	Uprate Ontonagon - UPPSCO Tap 69-kV line Reduce generation at White Pine Mine/Victoria Hydro
2	New Quinnesec - Kingsford Tap 69-kV line	--		--		--		--		95.2 - 95.3%		Twin Falls North-Twin Falls South Twin Falls South-Bass Lake 69-kV lines	Uprate New Quinnesec -Kingsford Tap 69-kV line
2	WE-Greenstone, Barnum Tap, Barnum Sub, Humboldt Tap, Foundry, North Lake 69-kV buses		--		--		105.0 - 105.6%		--		---	System Intact	Adjust 138/69-kV transformer taps at North Lake

TABLE ZS-2

PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2014 Summer Peak without Nelson Dewey, with Nelson Dewey, Shoulder, E-W Bias and High Load Cases

Planning Zone	Criteria Exceeded/Need	2014 Summer Peak Case Without Nelson Dewey		2014 Summer Peak Case With Nelson Dewey		2014 Shoulder Case		2014 E-W Bias Case		2014 High Load Case		Facility Outage(s)	Project or Mitigation
		% of Facility Rating	% of Nominal Voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
2	Straits, St Ignace, Manistique, Valley, Glen Jenks, Indian Lake, Evergreen 69-kV buses		--		--		105.1 - 105.6%		104.7 - 105.4%		--	System Intact	Adjust 138/69-kV transformer taps at Indian Lake, Hiawatha, and Straits
2	Lakota Rd 115-kV bus		--		--		105.2%		105.0%		--	System Intact	Adjust 138/69-kV transformer taps at Lakota Road
2	Hiawatha, Lakehead, Brevort 138-kV buses		--		--		--		88.8 % - 92.0%		--	Morgan - Highway 22 345-kV line Morgan - Plains 345-kV line Remove Weston Unit 4, Livingston - Vanderbilt 138-kV line Riggsville - Rondo 138-kV line McGulpin - Oden 138-kV line, Remove Kewaunee unit 1, Gallagher - Gallagher Tap, Gallagher - Livingston, Gallagher - Tittabawassee 345-kV lines	Adjust 138/69-kV transformer taps at Hiawatha
2	Atlantic 138-kV bus		--		--		105.8%		--		--	System Intact	Reduce capacitor bank MVAR at Atlantic 69 kV bus
2	Centennial Mine, Centennial Tap, MTU, Osceola, Henry Sub, Henry Tap 69-kV buses		--		--		--		--		90.8 - 91.7%	Atlantic - M38 138-kV line Atlantic 138/69-kV transformer #1	Increase generation at Portage
2	Aspen, Iron Grove 138-kV buses		--		--		--		--		91.0%	Aspen - Plains 138-kV Line	Adjust 138/69-kV transformer taps at Aspen, Iron Grove
2	Iron Grove 138-kV bus		--		--		--		--		91.2 - 91.5%	Aspen - Iron Grove 138-kV Line	Adjust 138/69-kV transformer taps at Iron Grove
2	Lakehead, Strawberry Hill, Strawberry Hill Tap, Iron Grove 69-kV buses		--		--		--		--		91.7 - 91.9%	Iron Grove 138/69-kV transformer #G1	Add second Iron Grove 138/69-kV transformer
2	Land O Lakes, Conover, Lakota Road 69-kV buses		--		--		90.5 - 90.9%		--		--	Conover-Lakota 69-kV line, Lakota Road 138/69-kV transformer #G2	Utilize available capacitance at Conover
2	Lakota Road 69-kV, 115-kV buses		110.3 - 118.8%		110.1 - 118.8%		--		--		117.4%	Eagle River Muni - Lakota Road 115-kV line Eagle River Muni - Cranberry 115-kV line	Adjust 138/69-kV transformer taps, 138-kV capacitor banks at Lakota Road
2	Chandler, Delta, West Side, Escanaba 1, Escanaba 2, Masonville, Mead, Gladstone, West, Lakehead Tap, Lakehead, Bay View, North Bluff, Cornell, Harris, Harris Tap 69-kV buses		89.0 - 91.9%		89.2 - 91.2%		88.3 - 91.5%		--		87.0 - 90.4%	Chandler 138/69-kV transformer #1	Increase generation at Mead/Gladstone/Escanaba
2	Newberry Village, Louisiana Pacific, Newberry, Newberry Hospital, Roberts, Hulbert, Eckerman, Raco, Brimley, Goetzville 69-kV buses		80.0 - 91.8%		80.6 - 91.8%		80.6 - 91.9%		Did not converge 87.1 - 91.8%		80.4 - 92.0%	Hiawatha - Engadine 69-kV line, Engadine-Newberry 69-kV line, Newberry - Newberry Village 69-kV line	Increase generation at Newberry, Dafter, DeTour, US Hydro, Edison Sault

TABLE ZS-2

PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2014 Summer Peak without Nelson Dewey, with Nelson Dewey, Shoulder, E-W Bias and High Load Cases

Planning Zone	Criteria Exceeded/Need	2014 Summer Peak Case Without Nelson Dewey		2014 Summer Peak Case With Nelson Dewey		2014 Shoulder Case		2014 E-W Bias Case		2014 High Load Case		Facility Outage(s)	Project or Mitigation
		% of Facility Rating	% of Nominal Voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
2	DeTour, Goetzville, Talentino 6906, Mich Limestone, Rockview 69-kV buses Brevort, Lakehead, Hiawatha 138-kV buses		--						89.4 - 92.0%		--	Brevort - Straits 138-kV line Brevort - Lakehead 138-kV line Hiawatha - Lakehead 138-kV line, Remove US Hydro Unit 1	Increase generation at Newberry, Dafter, DeTour, US Hydro, Edison Sault
2	Atlantic 138-kV bus		87.2%		87.0%		--		88.4%		84.8%	Atlantic-M-38 138-kV line	Adjust taps at Atlantic 138/69-kV transformer #1
3	Kirkwood - Rock Springs 138-kV line	--		--		--		--		95.1%		Trienda – Lewiston ACEC 138-kV line	No project needed at this time
3	Kilbourn 138/69-kV transformer #1	--		--		--		100.3%		--		Kilbourn 138/69-kV transformer #2	
3	Fitchburg –Syene - Ninesprings 69-kV line	114.9 - 96%		115 - 96.1%		--		103.2%		120.8 - 100.8%		Royster - AGA Tap 69-kV line; AGA Tap - Pflaum 69-kV line	Uprate Fitchburg-Nine Springs line, uprate Pflaum - Royster line, install 2-16.33 MVAR 69 kV capacitor banks at Nine Springs and move the AGA load onto Femrite - Royster line
3	Royster-AGA Tap-Pflaum 69-kV line	112.6 - 98.2%		112.6 - 98.3%		--		101.1 - 96.9%		118.3 - 96.8%		Fitchburg - Syene 69-kV line	Uprate Fitchburg-Nine Springs line, uprate Pflaum - Royster line, install 2-16.33 MVAR 69 kV capacitor banks at Nine Springs and move the AGA load onto Femrite - Royster line
3	Dana – Sheepskin 69-kV line	104.7 - 100%		104.7 - 100%		--		--		111.3 - 107.2%		McCue - Harmony 69-kV line; Harmony - Lamar 69-kV line	Sheepskin substation project which will uprate Y-61 Sheepskin-Dana 69-kV line to 95 MVA SE
3	McCue – Harmony - Lamar 69-kV line	104.0 - 95.4%		103.0 - 96.4%		--		--		112.2 - 97.6%		Kegonsa - Stoughton North 69-kV line ; Kegonsa 138/69-kV transformer; Stoughton North - Stoughton East 69-kV line	Y61 McCue-Lamar line uprate
3	Harmony, Lamar, Fulton, Saunders Creek, Dana, Sheepskin, Evansville 69-kV buses		84.2 -91.9%		84.3 -91.9%		--		88 -91.7%		83.1 -91.3%	McCue - Harmony 69-kV line; Harmony - Lamar 69-kV line	Lamar 2-16.33 Mvar 69-kV capacitor banks
3	Verona 138-kV bus		89.1%		89.0%		--		90.1%		88.5%	Verona - Oak Ridge 138-kV line	Lock the Verona 138/69-kV transformer setting at 1.0 to achieve 98%
3	Brodhead Muni 3, Brodhead Muni 2, Brodhead Muni 1, Brodhead and REC Orfordville 69-kV buses		91 - 91.8%		91 - 91.8%		--		--		89.4 - 91.7%	Brodhead Switching Station- Brodhead Muni 3 69-kV line; Brodhead Muni 3-Brodhead Muni 2 69-kV line	Install a 138/69-kV transformer at Bass Creek Substation
3	Muscoda 69-kV bus		--		91.9%		--		--		91.8%	Lone Rock-Spring Green 69-kV line	Install 1-8.16 MVAR capacitor bank at Boscobel 69-kV Substation and upgrade existing 5.4 MVAR bank with an 8.16 MVAR bank
3	AGA, Pflaum 69-kV buses		91.9%		91.8 - 91.9%		--		--		91.4 - 91.5%	Royster-AGA Tap 69-kV line	Loop Ninesprings-Pflaum line in and out of Femrite
3	Paddock-Townline 138-kV line	--		--		97.8 – 96.0%		--		--		Paddock-Northwest Beloit Tap 138-kV line; Northwest Beloit Tap-Black Hawk 138-kV line	Possible mitigation is to dispatch Riverside generation

TABLE ZS-2
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2014 Summer Peak without Nelson Dewey, with Nelson Dewey, Shoulder, E-W Bias and High Load Cases

Planning Zone	Criteria Exceeded/Need	2014 Summer Peak Case Without Nelson Dewey		2014 Summer Peak Case With Nelson Dewey		2014 Shoulder Case		2014 E-W Bias Case		2014 High Load Case		Facility Outage(s)	Project or Mitigation
		% of Facility Rating	% of Nominal Voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
3	Rockdale - Wempletown 345-kV line	--		--		98.0%		--		--		Wempletown - Paddock 345-kV line	Possible mitigation is to dispatch Riverside generation
3	McCue – Harmony - Lamar 69-kV line	--		--		--		--		95.8%		System Intact	Construct double-circuit line between McCue and Lamar substations
3	North Monroe - Idle Hour 69-kV line	--		--		--		--		97.1%		Paddock - Newark 69-kV line	Install a 138/69-kV transformer at Bass Creek Substation
3	Stoughton - Sheepskin 69-kV line	--		--		--		--		99.2%-95.6%		McCue - Harmony 69-kV line; Harmony - Lamar 69-kV line	Construct double-circuit line between McCue and Lamar substations
3	Gran Grae – Wauzeka - Boscobel 69-kV line	--		--		--		--		95.7%-95.4%		Spring Green - Lone Rock 69-kV line	Uprate Y-40 Gran Grae-Boscobel 69-kV line to achieve a 99 MVA summer emergency rating
3	West Middleton - Timberlane 69-kV line	--		--		--		--		98.3%		Spring Green 138/69-kV transformer #31	Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating
3	Waunakee Switching Station - Waunakee 2 69-kV line	--		--		--		--		96.3%		West Middleton - Pheasant Branch 69-kV line	Potential Waunakee Switching Station-Waunakee 2 69-kV 0.58 miles of line (Y-131) and terminal uprate to achieve 115 MVA SE
3	Academy – Columbus Muni #3 Tap 69-kV line	95.0 – 99.7%		98.4 – 102.8%		--		98.3%	--	98.6%		North Randolph – Fox Lake 138-kV line Fox Lake – North Beaver Dam 138-kV line	Model corrections
3	Columbus Muni #3 Tap – Columbus 69-kV line	98.1%		96.8 – 101.2%		--		96.8%	--	96.9%		North Randolph – Fox Lake 138-kV line Fox Lake – North Beaver Dam 138-kV line	Model corrections
3	Koch Oil Tap – Waupun 69 kV line	--		--		--		--		99.3%		North Randolph – Fox Lake 138-kV line	Horicon – East Beaver Dam 138 kV line project
3	Koch Oil Tap – South Fond du Lac 69 kV line	--		--		--		--		98.5%		North Randolph – Fox Lake 138-kV line	Horicon – East Beaver Dam 138 kV line project
3	Hubbard and Hustisford 138-kV buses		86.4 – 90.8%		86.0 – 90.2%		86.6 – 86.9%		86.4 – 87.1%		85.8 – 86.3%	Rubicon – Hustisford 138-kV line Hustisford – Hubbard 138-kV line Hartford – St. Lawrence 138-kV line	Local operating steps
3	Fox Lake, North Beaver Dam and East Beaver Dam 138-kV buses		--		88.9 – 90.0%		--		--		--	North Randolph – Fox Lake 138-kV line	Local operating steps
3	Fort Atkinson 138-kV bus		91.9%		91.6%		--		--		--	Jefferson – Lakehead – Rockdale 138-kV line	Increase generation at Concord
3	Concord 138-kV bus		95.5% 91.6%		95.3% 91.2% 91.9%		--		--		--	System Intact Jefferson – Crawfish River 138-kV line Hartford – St. Lawrence 138-kV line	Increase Concord generation Install Concord capacitors
3	Rubicon 138-kV bus		91.0%		90.4%		--		--		--	Hartford – St. Lawrence 138-kV line	Increase Concord generation Install Concord capacitors
3	Lake Geneva 69-kV bus		91.9%		91.9%		--		--		90.9%	North Lake Geneva – Lake Geneva 69-kV line	Spring Valley – Twin Lakes line
3	Twin Lakes 69-kV bus		--		--		--		--		91.4%	North Lake Geneva – Lake Geneva 69-kV line	Spring Valley – Twin Lakes line
3	Dickinson 138-kV bus		91.5%		91.6%		--		91.3%		91.1%	Colley Road – Dickinson 138-kV line	Brick Church capacitors
3	Brick Church 138-kV bus		--		--		--		91.9%		91.8%	Colley Road – Dickinson 138-kV line	Brick Church capacitors
3	Crawfish River 138-kV bus		90.2%		89.8%		--		91.7%		--	Jefferson – Crawfish River 138-kV line	Increase Concord generation
3	South Lake Geneva 69-kV bus		--		--		--		--		91.5%	North Lake Geneva – Lake Geneva 69-kV line	Spring Valley – Twin Lakes line

TABLE ZS-2
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2014 Summer Peak without Nelson Dewey, with Nelson Dewey, Shoulder, E-W Bias and High Load Cases

Planning Zone	Criteria Exceeded/Need	2014 Summer Peak Case Without Nelson Dewey		2014 Summer Peak Case With Nelson Dewey		2014 Shoulder Case		2014 E-W Bias Case		2014 High Load Case		Facility Outage(s)	Project or Mitigation
		% of Facility Rating	% of Nominal Voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
3	Lake Geneva – South Lake Geneva 69-kV line	99.0%		98.9%		--		--		104.3%		Cobblestone – Brick Church 69-kV line	Spring Valley – Twin Lakes line
3	Cobblestone – Zenda Tap 69-kV line	--		--		--		--		98.7%		North Lake Geneva – Lake Geneva 69-kV line	Spring Valley – Twin Lakes line
3	Williams Bay, Bristol, Delavan, North Shore, Rock River, Blackhawk, Paddock, Colley Road, Dickinson, Brick Church, Elkhorn 69-kV buses		--		--		92.0 – 91.0%		--		--	Paddock 345/138-kV transformer #21	
3	Colley Road 138/69-kV transformer #31	--		--		--		--		95.7%		Paddock 138/69-kV transformer #31	Install Bass Creek transformer
4	Chalk Hills and Alger Delta Nathan 69-kV buses		--		--		105.8 – 106.3%		--		--	System Intact	Model corrections
4	Bell Plaine 115-kV bus		--		--		105.3%		--		--	System Intact	Local operating steps
5	Harbor – Kansas 138-kV line	--		--		107.3% 107.1% 106.1% 103.3% 102.3% 99.2%		--		--		Dewey – Norwich 138-kV line Split Dewey 138-kV bus Montana – Dewey 138-kV line Kansas – Norwich 138-kV line Montana – Valley 138-kV line Harbor – Norwich 138-kV line	increase Valley generation
5	Arcadian4-Waukesha1 138-kV line	113.8%		115.7%		118.5%		131.1%		112.9%		Arcadian 6–Waukesha3 138-kV line	Upgrade Arcadian – Waukesha 138-kV lines or investigate other alternatives
5	Arcadian transformer #3 Arcadian transformer #2	106.9% 96.9%		108.1% 97.4%		99.8%		111.7% 102.8%		109.5% 98.2%		Arcadian transformer #1	Replace Arcadian transformers or investigate other alternatives
5	Pleasant Valley 138-kV bus		--		91.8%		--		--		--	Pleasant Valley – Saukville 138-kV line	Increase Concord generation
5	Arcadian6 – Waukesha3 138-kV line	112.9%		114.8% 96.7%		117.6% 105.6%		130.1% 114.2%		111.9%		Arcadian4- Waukesha1 138-kV line Waukesha 138-kV 1-2 bus tie	Upgrade Arcadian – Waukesha 138-kV lines or investigate other alternatives
5	Bain 345/138-kV transformer #5	158.9% 100.5%		158.9% 98.9% 95.3%		147.0%		158.8%		159.2% 99.8% 96.8%		Pleasant Prairie 345-kV 3-4 bus tie Pleasant Prairie 345-kV 2-3 bus tie Bain 345/138-kV transformer #4	Reduce Pleasant Prairie generation
5	Bain 345/138-kV transformer #4	--		--		--		--		96.0%		Bain 345/138-kV transformer #5	Reduce Pleasant Prairie generation
5	Albers – Bain 138-kV line	112.5%		114.0%		102.9% 96.2%		116.6%		115.4%		Bain - Kenosha 138-kV line Albers – Kenosha 138-kV line	Upgrade Bain – Albers 138-kV line
5	Albers – Kenosha 138-kV line	--		--		124.9%		112.8%		--		Albers – Bain 138-kV line	Increase Paris generation
5	Edgewood – St. Martins 138-kV line	--		--		102.0% 95.5% 97.2%		--		--		Merrill Hills - Waukesha 138-kV line Paris – Air Liquide - Burlington 138-kV line Paddock – Wempletown 345kV line	Increase Concord generation
5	Tichigan 138-kV bus		--		--		91.3%		--		--	Burlington 138-kV 1-2 bus tie	Increase University generation
5	Burlington 138-kV bus		--		--		91.6%		--		--	Burlington 138-kV 1-2 bus tie	Increase University generation
5	Germantown 138-kV bus		--		--		--		89.8%		--	Maple – Saukville 138-kV line	Increase Germantown generation
5	Maple 138-kV bus		--		--		--		89.4%		--	Maple – Saukville 138-kV line	Increase Germantown generation
5	Nicholson – Ramsey 138-kV line	--		--		--		95.0%		--		Oak Creek – Pennsylvania 138-kV line	Increase Germantown generation
5	Hartford 138-kV bus		90.0%		89.5%		--		--		--	Hartford – St. Lawrence 138-kV line	Increase Concord generation Install Concord capacitors
5	Butler Ridge 138-kV bus		90.5%		89.9%		--		--		--	Hartford – St. Lawrence 138-kV line	Increase Concord generation Install Concord capacitors
5	Cooney 138-kV bus		95.9% 91.5%		95.7% 91.0%		--		--		--	System Intact Cooney – Summit 138-kV line	Increase Concord generation Install Concord capacitors

**TABLE ZS-3
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2019 Summer Peak with Nelson Dewey and without Nelson Dewey**

Planning Zone	Criteria Exceeded/Need	2019 Summer Peak Case without Nelson Dewey		2019 Summer Peak Case with Nelson Dewey		Facility Outage(s)	Project or Mitigation
		% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
1	Berlin, River Run, Fountain Valley, Redgranite, ACEC Spring Lake, Silver Lake, Fox River 69-kV buses		86.8 - 91.9%		86.6 - 91.9%	Wautoma - Silver Lake Tap 69-kV line Silver Lake - ACEC Spring Lake 69-kV line ACEC Spring Lake - Redgranite 69-kV line Ripon - Northwest Ripon Tap 69-kV line Metomen - Ripon 69-kV line	Ripon capacitor bank expansion & Metomen transformer replacement
1	Dartford, Northwest Ripon, Industrial Park, Ripon, Southwest Ripon 69-kV buses		86.6 - 91.6%		86.5 - 91.8%	Ripon - Northwest Ripon Tap 69-kV line Metomen - Ripon 69-kV line Sunset Point - Winneconne 69-kV line Wautoma - Silver Lake Tap 69-kV line	Ripon capacitor bank expansion
1	Winneconne, Omro Industrial Park 69-kV buses		86.3 - 91.9%		85.7 - 91.9%	Sunset Point - Winneconne 69-kV line Ripon - Northwest Ripon Tap 69-kV line Metomen - Ripon 69-kV line Winneconne - Omro Tap 69-kV line	Ripon capacitor bank expansion, Metomen transformer replacement and Wautoma 2 nd transformer
1	Lincoln Pumping Station, Grand Marsh (PP&L), ACEC Brooks 69-kV buses		91.1 - 91.9%		90.7 - 91.8%	Necedah Tap - Big Pond 69-kV line Petenwell - Big Pond 69-kV line Petenwell 138/69 kV transformer	No project needed at this time
1	Sigel 138-kV bus		91.8%		91.8%	Sigel - Arpin 138-kV line	No project needed at this time
1	Petenwell, Council Creek 138-kV buses		94.6 - 95.0% 88.4 - 91.6%		94.5 - 94.8% 88.0 - 91.7%	System Intact Saratoga - Petenwell 138-kV line Sigel - Arpin 138-kV line	Monroe County – Council Creek 161-kV line
1	Baker, Saratoga 115-kV buses		91.6%		91.4%	Baker - Coyne 115-kV line	No project needed at this time
1	Petenwell, Big Pond, Necedah, Whistling Wings, ACEC Dellwood, Friendship, ACEC Friendship, Houghton Rock, McKenna 69-kV buses		84.0 - 91.1%		83.6 - 91.7%	Necedah Tap - Big Pond 69-kV line Petenwell - Big Pond 69-kV line Petenwell 138/69-kV transformer Necedah Tap – Whistling Wings Tap 69-kV line	McKenna capacitor expansion
1	ACEC Coloma 69-kV bus		--		91.9%	Chaffee Creek - Coloma Tap 69-kV line	No project needed at this time
1	Fairwater 69-kV bus		91.9%		91.8%	Metomen 138/69-kV transformer	No project needed at this time
1	Antigo, Aurora Street 115-kV buses		90.0 - 90.1%		90.0 - 90.2%	Antigo - Black Brook 115-kV line	No project needed at this time
1	Petenwell 138/69-kV transformer #31	98.1% 95.7%		99.8% 95.7%		System Intact McKenna - Houghton Rock 69-kV line	No project needed at this time
1	McKenna - ACEC Quincy 69-kV line Castle Rock - ACEC Quincy 69-kV line	97.8 - 113.8%		97.0 - 120.7%		Necedah Tap - Big Pond 69-kV line Petenwell - Big Pond 69-kV line Petenwell 138/69 kV transformer Necedah - Whistling Wings Tap 69-kV line Kilbourn - Winnebago ACEC 69-KV line	Uprate Castle Rock - McKenna 69-KV line
1	Caroline 115/69-kV transformer #61	109.0%		108.6%		Whitcomb 115/69-kV transformer #31	Reduce area capacitor banks and redispach area generation.

**TABLE ZS-3
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2019 Summer Peak with Nelson Dewey and without Nelson Dewey**

Planning Zone	Criteria Exceeded/Need	2019 Summer Peak Case without Nelson Dewey		2019 Summer Peak Case with Nelson Dewey		Facility Outage(s)	Project or Mitigation
		% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal Bus voltage		
1	Council Creek - Tomah Industrial Park Tap 69-kV line	103.5%		103.8%		System Intact	Monroe County – Council Creek 161-kV line
1	Harrison 138/69-kV transformer	--		99.9%		System Intact	No project needed at this time
1	Metomen - Ripon 69-kV line	98.4% 98.1 - 105.8%		93.0% 97.3 - 101.9%		System Intact Sunset Point - Winneconne 69-kV line North Randolph - Markesan Tap 69-kV line Winneconne - Omro Tap 69-kV line	Reconfigure the North Randolph-Ripon 69-kV line to form a second Ripon-Metomen 69-kV line and retire the circuit between Metomen and the Mackford Prairie tap
1	Metomen 138/69-kV transformer #31	113.6% 108.7 - 130.9%		111.7% 107.7 - 126.5%		System Intact Ripon - Southwest Ripon Tap 69-kV line Southwest Ripon - Mackford Prairie 69-kV line North Randolph - Markesan Tap 69-kV line North Fond du Lac - Rosendale 69-kV line	Metomen transformer replacement
1	Northwest Ripon - Ripon 69-kV line	101.3 - 113.4%		98.2 - 110.5%		Sunset Point - Winneconne 69-kV line Winneconne - Omro Tap 69-kV line	SW Ripon T-D interconnection
1	Omro - Winneconne 69-kV line Winneconne - Sunset Point 69-kV line	97.0 - 103.3%		95.4 - 107.5%		Ripon - Northwest Ripon Tap 69-kV line Metomen - Ripon 69-kV line	Load forecast variations
1	Rocky Run 345/115-kV transformer #4	95.9 - 97.1%		96.3 - 97.5%		Rocky Run 345/115-kV transformer #1 Rocky Run 345/115-kV transformer #2	No project needed at this time
1	Whitcomb 115/69-kV transformer #31	101.1%		101.6%		System Intact	Reduce area capacitor banks and redispach area generation
1	Wautoma 138/69-kV transformer #31	112.0% 95.6 - 99.8%		108.2% 95.2 - 99.2%		System Intact Portage - Lakehead Pipeline Portage 69-kV line Sand Lake Tap - Sand Lake 69-kV line Sand Lake 138/69-kV transformer #31 Endeavor - Lakehead Pipeline 69-kV line Ripon - Northwest Ripon Tap 69-kV line	Install a second 138/69-kV transformer at Wautoma Substation
2	Delta – Mead 69-kV line	101.0 – 158.1%		100.9 – 158.1%		System Intact Chandler-Lakehead Tap 69-kV line Lakehead Tap-Masonville 69-kV line Masonville-Gladstone 69-kV line Gladstone-North Bluff 69-kV line North Bluff-Bay Tap 69-kV line Bay Tap-Mead 69-kV line	Uprate Delta-Mead-North Bluff 69-kV line
2	Chandler-Delta 69-kV #1 line	109.5%		109.6%		Chandler-Delta 69-kV #2 line	Uprate Chandler-Delta 69-kV line #1
2	Chandler – Delta 69-kV #2 line	103.4%		103.4%		Chandler - Delta 69-kV #1 line	Uprate Chandler-Delta 69-kV line #2
2	Atlantic - M38 69-kV line	121.3 - 122.4%		121.9 - 122.0%		Atlantic - M-38 138-kV line Atlantic 138/69-kV transformer #1	Uprate Atlantic - M38 69-kV line

**TABLE ZS-3
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2019 Summer Peak with Nelson Dewey and without Nelson Dewey**

Planning Zone	Criteria Exceeded/Need	2019 Summer Peak Case without Nelson Dewey		2019 Summer Peak Case with Nelson Dewey		Facility Outage(s)	Project or Mitigation
2	Chandler-Lakehead Tap 69-kV line Lakehead Tap-Masonville 69-kV line Masonville-Gladstone 69-kV line Gladstone-North Bluff 69-kV line North Bluff-Bay Tap 69-kV line Bay Tap-Mead 69-kV line	121.6 - 162.2%		121.4 - 162.0%		Delta - Mead 69-kV line	Uprate Chandler-Masonville, Masonville-Gladstone, Gladstone-North Bluff, Delta-Mead-North Bluff 69-kV lines
2	Pine River - Straits 69-kV line Straits-Evergreen 69-kV line Pine River-Evergreen 69-kV line	98.0 - 109.2%		96.1 - 106.5%		Brevort - Straits 138-kV line Brevort - Lakehead 138-kV line Hiawatha - Lakehead 139-kV line Straits - Evergreen 69-kV line	Rebuild Straits-Pine River 69 kV lines
2	Pine River-Rudyard 69-kV line Rudyard-Tone 69-kV line	97.3%		99.8% - 103.9%		Hiawatha - Engadine 69-kV line, Pine River - 9 Mile 69-kV line	Uprate or rebuild Pine River - Rudyard - Tone 69-kV line
2	Nordic - Mountain 69-kV line	111.4%		--		Chandler 138/69-kV transformer #1	Uprate Nordic-Mountain 69-kV line
2	New Quinnesec – Kingsford Tap 69-kV line	100.0% - 100.3%		99.7% - 99.9%		Twin Falls North -Twin Falls South 69-kV line Twin Falls South - Bass Lake 69-kV line	Uprate New Quinnesec - Kingsford Tap 69-kV line
2	Lakota 69-kV bus		117.1%		117.2%	Conover - Lakota 69-kV line	Adjust 138/69-kV transformer taps at Lakota Road
2	Chandler, Cornell Tap, Delta, Escanaba 1, Escanaba 2, Masonville, Mead, Gladstone, West, Lakehead, Bay View, North Bluff, Cornell, Harris 69-kV buses		88.4% - 91.4%		88.2% - 91.2%	Chandler 138/69-kV transformer #1	Increase generation at Escanaba/Mead/Gladstone
2	Hulbert, Eckerman, Newberry Village, Louisiana Pacific, Newberry, Newberry Hospital, Roberts, Raco 69-kV buses		78.9% - 91.9%		76.0% - 92.0%	Hiawatha-Engadine, Engadine-Newberry, Newberry-Newberry Hospital Tap, Newberry Hospital Tap-Roberts 69-kV lines	Increase generation at Newberry, Dafter, DeTour, US Hydro, Edison Sault
2	Atlantic 138-kV bus Keweenaw 69-kV bus		86.1 - 91.8%		86.0%	Atlantic-M-38 138-kV line ATC_B2_ATLAN	increase generation at Portage
2	Munising 138-kV bus		91.8%		91.8%	Forsyth-Munising 138-kV line	Adjust 138/69-kV transformer taps at Munising
2	Aspen, Iron Grove 138-kV buses		91.1% - 91.5%		91.0% - 91.3%	Aspen-Plains 138-kV line	Adjust 138/69-kV transformer taps at Aspen, Iron Grove
2	Iron Grove 138-kV bus		91.0%		91.3%	Aspen-Iron Grove 138-kV line	Adjust 138/69-kV transformer taps at Iron Grove
2	Lakehead 69-kV bus		91.9%		--	Iron Grove 138/69-kV transformer	Add second Iron Grove 138/69-kV transformer
3	Artesian - Rock Springs 138-kV line Rock Springs - Kirkwood 138-kV line	100.3 - 104.4%		99.0 - 103.4%		Trienda - Lewiston ACEC 138-kV line Lewiston - Kilbourn ACEC 138-KV line	Construct a Lake Delton-Birchwood 138-kV line
3	Dane - Lodi Tap 69-kV line	100.6%		100.9%		Island Street - Kirkwood 69-kV line	Rebuild Dane-Dam Heights 69-KV line
3	Portage – Trienda 138-kV line	96.1%		--		Portage – Trienda1 138-kV line	No project needed at this time.
3	Lake Geneva – South Lake Geneva 69-kV line	126.3% 104.7%		126.3% 104.8%		Cobblestone–Brick Church 69-kV line Cobblestone–Zenda Tap 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Katzenberg - South Lake Geneva 69-kV line	96.7%		96.7%		Cobblestone–Brick Church 69-kV line	Spring Valley – Twin Lakes line
3	Colley Road 138/69-kV transformer #31	103.6%		103.2%		Paddock 138/69-kV transformer #31	Install Bass Creek transformer
3	Enzyme – RC3 69-kV line	95.4%		--		Brick Church 138/69-kV transformer #31	Rebuild Y-32 Colley Road-Brick Church 69-kV line
3	Colley Road – Marine 138-kV line			99.6%		Paddock-Northwest Beloit 138-kV line	Upgrade Colley Road – Marine 138-kV line
3	Cobblestone – Brick Church 69-kV line	102.2%		102.2%		North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138kV line

**TABLE ZS-3
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2019 Summer Peak with Nelson Dewey and without Nelson Dewey**

Planning Zone	Criteria Exceeded/Need	2019 Summer Peak Case without Nelson Dewey		2019 Summer Peak Case with Nelson Dewey		Facility Outage(s)	Project or Mitigation
		% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
3	Cobblestone – Zenda Tap 69-kV line	123.3%		123.4%	95.0%	North Lake Geneva – Lake Geneva 69-kV line Lake Geneva – South Lake Geneva 69kV line	Spring Valley – Twin Lakes line
3	Katzenberg – Zenda Tap 69-kV line	109.5%		109.5%		North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Cobblestone 69-kV bus		89.9%		89.8%	Cobblestone–Brick Church 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Zenda 69-kV bus		91.4%		91.3%	North Lake Geneva-Lake Geneva 69-kV line Cobblestone–Brick Church 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
			90.9%		90.8%		
3	Brick Church 138-kV bus		91.2%		91.2%	Beloit Gateway–Dickinson 138-kV line Colley Road–Dickinson 138-kV line	Brick Church capacitors or Spring Valley – Twin Lakes line
			90.4%		90.5%		
3	Williams Bay 138-kV bus		91.9%		91.9%	Colley Road–Dickinson 138-kV line	Brick Church caps or Spring Valley – Twin Lakes line
3	Lake Geneva 69-kV bus		83.5%		83.5%	North Lake Geneva–Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Katzenberg 69-kV bus		85.1%		85.1%	North Lake Geneva–Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Twin Lakes 69-kV bus		84.4%		84.3%	North Lake Geneva–Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	South Lake Geneva 69-kV bus		84.2%		84.2%	North Lake Geneva–Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Dickinson 138-kV bus		89.4%		89.4%	Colley Road–Dickinson 138-kV line	Brick Church caps or Spring Valley – Twin Lakes line
3	Concord 138-kV bus		90.2%		89.7%	Concord 138-kV 4-5 bus tie	Install Concord capacitors
3	Butler Ridge 138-kV bus		--		91.7%	Concord 138-kV 4-5 bus tie	Install Concord capacitors
3	Rubicon 138-kV bus		91.9%		91.4%	Concord 138-kV 4-5 bus tie	Install Concord capacitors
3	Academy – Columbus Muni #3 Tap 69-kV line	--		106.7 – 112.2%		North Randolph – Fox Lake 138-kV line Fox Lake – North Beaver Dam 138-kV line	Horicon – East Beaver Dam 138-kV line project
3	Columbus Muni #3 Tap – Columbus 69-kV line	--		104.9 – 100.4%		North Randolph – Fox Lake 138-kV line Fox Lake – North Beaver Dam 138-kV line	Horicon – East Beaver Dam 138-kV line project
3	South Beaver Dam – Center Street 69-kV line	--		98.3%		North Randolph – Fox Lake 138-kV line	
3	South Fond du Lac – Koch Oil Tap 69-kV line	--		97.3 – 102.2%		North Randolph – Fox Lake 138-kV line Fox Lake – North Beaver Dam 138-kV line	Horicon – East Beaver Dam 138-kV line project
3	Koch Oil Tap – Waupun 69-kV line	--		97.9 – 103.1%		North Randolph – Fox Lake 138-kV line Fox Lake – North Beaver Dam 138-kV line	Horicon – East Beaver Dam 138-kV line project
3	Hubbard and Hustisford 138-kV buses		--		96.0 – 96.2%	System Intact Rubicon – Hustisford 138-kV line Hustisford – Hubbard 138-kV line	Horicon – East Beaver Dam 138-kV line project
					85.0 – 90.6%	Concord 138-kV 4-5 bus tie	
3	Fox Lake, North Beaver Dam and East Beaver Dam 138-kV buses		--		90.2 – 90.4%	North Randolph – Fox Lake 138-kV line	Horicon – East Beaver Dam 138-kV line project
3	Koch Oil 69-kV bus		--		92.0%	South Fond du Lac – Koch Oil Tap 69-kV line	No project identified. Additional study needed.
3	Horicon Industrial Park 69-kV bus		--		91.9%	Hubbard – Horicon Ind. Park 69-kV line	No project identified. Additional study needed.
3	McCue – Harmony - Lamar 69-kV line	--		104.1 - 101%		System Intact	Construct double-circuit line between McCue and Lamar substations
3	Hillman 138/69-kV transformer #31	101.3 - 98.5%		105.5 - 96.7%		DPC Galena - Pilot 69-kV line Pilot -Terr Tap 69-kV line Terr Tap-LNGHLLW8 69-kV line	Replace the existing 46 MVA Hillman 138/69-kV transformer with a 100 MVA transformer
3	McCue – Harmony - Lamar 69-kV line	102.5 - 95.0%		123.0 - 96.0%		Various outages	Y61 McCue-Lamar line uprate and 2017 Construct double-circuit line between McCue and Lamar substations

**TABLE ZS-3
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2019 Summer Peak with Nelson Dewey and without Nelson Dewey**

Planning Zone	Criteria Exceeded/Need	2019 Summer Peak Case without Nelson Dewey		2019 Summer Peak Case with Nelson Dewey		Facility Outage(s)	Project or Mitigation
		% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
3	North Monroe – Idle Hour 69-kV line	103.1 - 95.8%		107.2 - 97.4%		Darlington- Gratiot 69-kV line; Darlington 138/69-kV transformer; Browntown -Jennings Rd 69-kV line; Gratiot - Wiota 69-kV line; Wiota – Jennings Road 69-kV line; Brodhead - Newark 69-kV line; Paddock -Newark 69-kV line; Paddock 138/69-kV transformer #31	Install a 138/69-kV transformer at Bass Creek Substation
3	Dana – Sheepskin 69-kV line	115.2 - 110.8%		133.4 - 127.4%		McCue - Harmony 69-kV line Harmony -Lamar 69-kV line	Sheepskin substation project which will uprate Y-61 Sheepskin-Dana 69-kV line to 95 MVA and 2017 Construct double-circuit line between McCue and Lamar substations
3	Stoughton - Sheepskin 69-kV line	--		114.9 - 110.1%		McCue - Harmony 69-kV line Harmony-Lamar 69-kV line	Construct double-circuit line between McCue and Lamar substations
3	Spring Green 138/69-kV transformer #31	--		95.2%		Gran Grae-Wauzeka 69-kV line	Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating
3	Gran Grae – Wauzeka - Boscobel 69-kV line	100 - 96.2%		105.6 - 100.4%		Spring Green 138/69-kV transformer #31; Lone Rock-Spring Green 69-kV line; Nelson Dewey-Lancaster 138-kV line; Lancaster-Eden 138-kV line; Eden-Wyoming Valley 138-kV line; Spring Green-Wyoming Valley 138-kV line	Uprate Y-40 Gran Grae-Boscobel 69-kV line to achieve a 99 MVA summer emergency rating
3	Boscobel - Blue River 69-kV line	--		96.3 - 95.2%		Spring Green 138/69-kV transformer #31 Nelson Dewey-Lancaster 138-kV line	No project identified
3	West Middleton - Timberlane 69-kV line	106.5%		97.9%		Spring Green 138/69-kV transformer #31	Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating
3	Waunakee Industrial Park - Huiskamp 69-kV line	95.3%		94.0%		North Madison 138/69-kV transformer #31	Potential Y132 line switch replacement project at Waunakee Industrial Park to achieve 170 MVA SE out of ten years
3	Waunakee Switching Station - Waunakee 2 69-kV line	101.3%		101.5%		West Middleton - Pheasant Branch 69-kV line	Potential Waunakee Switching Station-Waunakee 2 69-kV 0.58 miles of line (Y-131) and terminal uprate to achieve 115 MVA SE
3	Fitchburg-Syene - Ninesprings 69-kV line	126.2 - 107.9%		129.2 - 107.7%		Royster - AGA Tap 69-kV line AGA Tap - Pflaum 69-kV line	Uprate Fitchburg-Nine Springs line, uprate Pflaum - Royster line, install 2-16.33 MVAR 69 kV capacitor banks at Nine Springs and move the AGA load onto Femrite - Royster line
3	Royster - AGA Tap - Pflaum 69-kV line	126.5 - 102.8%		126.5 - 103%		Fitchburg - Syene 69-kV line Ninesprings - Syene 69-kV line	Uprate Fitchburg-Nine Springs line, uprate Pflaum - Royster line, install 2-16.33 MVAR 69 kV capacitor banks at Nine Springs and move the AGA load onto Femrite - Royster line
3	West Middleton - West Town 69-kV line	--		95%		West Middleton - Pleasant View 138-kV line	Potential 1.98 miles West Middleton-West Town 69-kV line (6997) uprate and terminal uprate to achieve 106 MVA SE out of ten years
3	Royster - Sycamore 69-kV line	96.5%		96.8%		Femrite 138/69-kV transformer #31	Uprate the 6986 Royster to Sycamore 69-kV line to 115 MVA
3	Verona, Oak Ridge, Fitchburg and Cross Country 138-kV buses		95 - 95.7%		94.6 - 95.9%	System intact	Verona 1-16.33 Mvar 69-kV cap bank and potential 2-49 Mvar 138kV cap banks at Oak Ridge
3	Harmony, Lamar, Fulton, Saunders Creek , Dana, Sheepskin, Bass Creek, Footville, Center, Union Townline, Orfordville and Evansville 69-kV buses		88.9 - 90.6%		76.2 - 91.3%	McCue-Harmony 69-kV line Harmony-Lamar 69-kV line	Lamar 2-16.33 Mvar 69-kV cap banks; 2017 Construct double-circuit line between McCue and Lamar substations
3	Verona 138-kV bus		86.3%		85.5%	Verona-Oak Ridge 138-kV line	Verona 1-16.33 Mvar 69-kV cap bank / Adjust Verona 138/69-kV transformer setting
3	Verona 138-kV bus		--		91.9%	Rockdale-West Middleton 345-kV line	Verona 1-16.33 Mvar 69-kV cap bank and potential 2-49 Mvar 138kV capacitor banks at Oak Ridge
3	Southwest Verona 69-kV bus		90.4%		90%	Verona-Southwest Verona 69-kV line	Potential Mount Horeb capacitor bank upgrade or addition
3	Brodhead Muni 3, Brodhead Muni 2, Brodhead Muni 1, Brodhead, RCEC Orfordville, Bass Creek, Footville, Center, Union Townline and Evansville 69-kV buses		--		87 - 91.8%	Brodhead Switching Station-Brodhead Muni 3 69-kV line; Brodhead Muni 3-Brodhead Muni 2 69-kV line	Install a 138/69-kV transformer at Bass Creek Substation
3	Muscoda, Lone Rock, Avoca, and Blue River 69-kV buses		90.3 - 91.8%		90 - 91.8%	Lone Rock-Spring Green 69-kV line Spring Green 138/69-kV transformer #31	Install 1-8.16 MVAR capacitor bank at Boscobel 69-kV Substation and upgrade existing 5.4 MVAR bank with an 8.16 MVAR bank

**TABLE ZS-3
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2019 Summer Peak with Nelson Dewey and without Nelson Dewey**

Planning Zone	Criteria Exceeded/Need	2019 Summer Peak Case without Nelson Dewey		2019 Summer Peak Case with Nelson Dewey		Facility Outage(s)	Project or Mitigation
		% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
3	Burke, Reiner and Colorado 69-kV buses		91.9%		91.5 - 91.6%	Reiner 138/69-kV transformer #31 Reiner-Burke Tap 69-kV line	Install 2-16.33 Mvar 69-kV capacitor banks at Sun Prairie
3	AGA, Pflaum 69-kV buses		90.5 - 90.7%		90.6 - 90.8%	Royster-AGA Tap 69-kV line	Uprate Fitchburg-Nine Springs line, uprate Pflaum - Royster line, install 2-16.33 MVAR 69 kV capacitor banks at Nine Springs and move the AGA load onto Femrite - Royster line
3	Lancaster, Wyoming Valley and Eden 138-kV buses		90.9 - 91.9%		89.8 - 90.8%	Nelson Dewey-Lancaster 138-kV line Lancaster-Eden 138-kV line	Install 2-16.33 Mvar 69-kV capacitor banks at Eden Substation
3	Pleasant View, Hawk, Fitchburg and Cross Country 138-kV buses		91.5 - 91.9%		91.2 - 91.6%	West Middleton-Pleasant View 138-kV line	Verona 1-16.33 Mvar 69-kV cap bank and potential 2018 2-49 Mvar 138kV cap banks at Oak Ridge
4	Bluestone 69-kV bus		--		91.4%	Finger Road – Bluestone 69-kV line	???
4	Sister Bay 69-kV bus		--		95.9%	System Intact	Canal – Dunn Road 138-kV line project
5	Bain 345/138-kV transformer #5	159.1%		159.1%		Pleasant Prairie 345-kV 3-4 bus tie	Reduce Pleasant Prairie generation
5	Albers – Kenosha 138-kV line	97.8%		95.9%		Bain – Kenosha 138-kV line	Increase Paris generation
5	Arcadian4- Waukesha1 138-kV line	113.6%		115.2%		Arcadian 6 – Waukesha3 138-kV line	Upgrade Arcadian – Waukesha 138-kV lines or investigate other alternatives
5	Arcadian 345/138-kV transformer #3 Arcadian 345/138-kV transformer #2	108.7% 97.6%		109.7% 98.8%		Arcadian 345/138-kV transformer #1	Replace Arcadian transformers or investigate other alternatives
5	Branch – Kansas 138-kV line	100.5%		100.5%		Oak Creek – Pennsylvania 138-kV line	Load shift – investigate future projects to resolve loading on the Branch – Kansas 138kV line.
5	Arcadian 6 – Waukesha3 138-kV line	112.6%		114.3%		Arcadian 4- Waukesha1 138-kV line	Upgrade Arcadian – Waukesha 138-kV lines or investigate other alternatives
5	Bark River 138-kV bus		95.8% 91.8%		95.7% 91.7%	System Intact Bark River–Sussex 138-kV line	Increase Germantown generation
5	Hartford 138-kV bus		--		91.9%	Concord 138-kV 3-4 bus tie	Install Concord capacitors
5	Tichigan 138-kV bus		91.4%		91.3%	Split Burlington 138-kV bus	Load shift – Investigate future projects for voltage support at Tichigan
5	Cottonwood 138-kV bus		--		95.3% 91.9%	System Intact Bark River–Sussex 138-kV line	Install Summit & Concord capacitors
5	Germantown 138-kV bus		95.5% 88.7%		95.4% 88.6%	System Intact Maple – Saukville 138-kV line	Increase Germantown generation
5	Maple 138-kV bus		95.7% 88.2%		95.6% 88.1%	System Intact Maple – Saukville 138-kV line	Increase Germantown generation

Table ZS-3a
2009 10-Year Assessment - 2019 Futures Constraints

Planning Zone	Criteria Exceeded/Need	2019 Summer Peak Case		2019 DOE 20% Wind Future		2019 Slow Growth Future		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage		
1	Berlin, River Run, Fountain Valley, Redgranite, ACEC Spring Lake, Silver Lake, Fox River 69-kV buses		86.8 - 91.9%		88.3% - 91.9%		--	Wautoma - Silver Lake Tap 69-kV line Silver Lake - ACEC Spring Lake 69-kV line ACEC Spring Lake - Redgranite 69-kV line Ripon - Northwest Ripon Tap 69-kV line	
1	Dartford, Northwest Ripon, Industrial Park, Ripon, Southwest Ripon 69-kV buses		86.6 - 91.6%		88.2% - 91.6%		--	Metomen - Ripon 69-kV line Ripon - Northwest Ripon Tap 69-kV line Metomen - Ripon 69-kV line Sunset Point - Winneconne 69-kV line	
1	Winneconne, Omro Industrial Park 69-kV buses		86.3 - 91.9%		89.4% - 90.0%		--	Wautoma - Silver Lake Tap 69-kV line Sunset Point - Winneconne 69-kV line Ripon - Northwest Ripon Tap 69-kV line Metomen - Ripon 69-kV line	
1	Lincoln Pumping Station, Grand Marsh (PP&L), ACEC Brooks 69-kV buses		91.1 - 91.9%		--		--	Necedah Tap - Big Pond 69-kV line Petenwell - Big Pond 69-kV line Petenwell 138/69-kV transformer	No project needed at this time
1	Sigel 138-kV bus		91.8%		--		--	Sigel - Arpin 138-kV line	No project needed at this time
1	Petenwell, Council Creek 138-kV buses		94.6 - 95.0% -- 88.4 - 91.6%		95.4% 90.6 - 91.9%		96.9% --	System Intact Saratoga - Petenwell 138-kV line Sigel - Arpin 138-kV line	Monroe County – Council Creek 161-kV line
1	Baker, Saratoga 115-kV buses		91.6%		91.0%		--	Baker - Coyne 115-kV line	No project needed at this time
1	Petenwell, Big Pond, Necedah, Whistling Wings, ACEC Dellwood, Friendship, ACEC Friendship, Houghton Rock, McKenna 69-kV buses		84.0 - 91.1%		88.5 - 91.8%		89.4% - 91.9%	Necedah Tap - Big Pond 69-kV line Petenwell - Big Pond 69-kV line Petenwell 138/69-kV transformer #31 Necedah Tap - Whistling Wings Tap 69-kV line	McKenna capacitor expansion
1	Fairwater 69-kV bus		91.9%		--		--	Metomen 138/69-kV transformer #31	No project needed at this time
1	Antigo, Aurora Street 115-kV buses		90.0 - 90.1%		89.0 - 91.9%		--	Antigo - Black Brook 115-kV line	No project needed at this time
1	Petenwell 138/69-kV transformer #31	98.1% 95.7%		112.9% --		97.0% --		System Intact McKenna - Houghton Rock 69-kV line	No project needed at this time
1	McKenna - ACEC Quincy 69-kV line Castle Rock - ACEC Quincy 69-kV line	97.8 - 113.8%		99.2 - 100.0%		97.6%		Necedah Tap - Big Pond 69-kV line Petenwell - Big Pond 69-kV line Petenwell 138/69-kV transformer #31 Necedah - Whistling Wings Tap 69-kV line Kilbourn - Winnebago ACEC 69-kV line	Uprate Castle Rock - McKenna 69-KV line
1	Arnott 138/69-kV transformer #31	--		102.0%		--		Harrison 138/69-kV transformer #31	
1	Caroline 115/69-kV transformer #61	109.0%		95.9%		--		Whitcomb 115/69-kV transformer #31	
1	Council Creek - Tomah Industrial Park Tap 69-kV line	103.5%		99.3%		91.0%		System Intact	
1	Harrison 138/69-kV transformer	--		113.3%		90.0%		System Intact	
1	Hartman Creek - Harrison 138-kV line	--		101.7 - 96.6%		--		Port Edwards - Sand Lake 138-kV line Wautoma 138/69-kV transformer #31 Sigel - Arpin 138-KV line	

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Planning Zone	Criteria Exceeded/Need	2019 Summer Peak Case		2019 DOE 20% Wind Future		2019 Slow Growth Future		Facility Outage(s)	Project/Mitigation	
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage			
1	Metomen - Ripon 69-kV line	98.4%		--		--		System Intact		
		98.1 - 105.8%						Sunset Point - Winneconne 69-kV line		
		--						North Randolph - Markesan Tap 69-kV line		
		--						Winniconne - Omro Tap 69-kV line		
1	Metomen 138/69-kV transformer #31	113.6%		100.4%		--		System Intact	Metomen Transformer Replacement	
		--		--				Ripon - Southwest Ripon Tap 69-kV line		
		108.7 - 130.9%		99.1%				Southwest Ripon - Mackford Prairie 69-kV line		
		--		--				North Randolph - Markesan Tap 69-kV line		
		--		--				North Fond du Lac - Rosendale 69-kV line		
		--		--				Rocky Run - Whiting Avenue 115-kV line		
1	Rocky Run - Plover 115-kV line		96.9%		--		--	Rocky Run - Whiting Avenue 115-kV line		
	Rocky Run - Whiting Avenue 115-kV line		97.4%					Rocky Run - Plover 115-kV line		
1	Northwest Ripon - Ripon 69-kV line	101.3 - 113.4%		--		--		Sunset Point - Winneconne 69-kV line		
								Winniconne - Omro Tap 69-kV line		
1	Omro - Winneconne 69-kV line	97.0 - 103.3%		--		--		Ripon - Northwest Ripon Tap 69-kV line		
	Winneconne - Sunset Point 69-kV line								Metomen - Ripon 69-kV line	
1	Rocky Run 345/115-kV transformer #4	95.9 - 97.1%		112.6 - 96.0%		--		Rocky Run 345/115-kV Transformer #2		
								Rocky Run 345/115-kV Transformer #1		
								Sigel - Arpin 138-kV line		
								Arpin 345/138-kV transformer		
								Werner West - Rocky Run 345 KV line		
1	Sand Lake - Sand Lake Tap 69-kV line	--		96.3%		--		Wautoma 138/69-kV transformer #31		
1	Sigel - Arpin 138-kV line	--		97.1%		95.5%		Baker - Coyne 115-kV line		
1	Whitcomb 115/69-kV transformer	101.1%		105.5%		95.3%		System Intact		
1	Wautoma 138/69-kV transformer	112.0%		112.8%		--		System Intact		
		95.6 - 99.8%		104.7% - 95.5%				Portage - Lakehead Pipeline Portage 69-kV line		
									Sand Lake Tap - Sand Lake 69-kV line	
									Sand Lake 138/69-kV transformer #31	
									Endeavor - Lakehead Pipeline 69-kV line	
									Ripon - Northwest Ripon Tap 69-kV line	
									System Intact	
2	Delta - Mead 69-kV line	101 - 158.1%		--		--		Chandler - Lakehead Tap 69-kV line	Uprate Delta-Mead-North Bluff 69-kV line, or increase generation at Mead/Gladstone	
								Lakehead Tap - Masonville 69-kV line		
								Masonville - Gladstone 69-kV line		
								Gladstone - North Bluff 69-kV line		
								North Bluff - Bay Tap 69-kV line		
								Bay Tap - Mead 69-kV line		
2	Chandler - Delta 69-kV #1 line	109.5%		--		--		Chandler - Delta 69-kV #2 line	Uprate Chandler-Delta 69-kV line #1, or increase generation at Escanaba/Mead/Gladstone	
2	Chandler - Delta 69-kV #2 line	103.4%		--		--		Chandler - Delta 69-kV #1 line	Uprate Chandler-Delta 69-kV line #2, or increase generation at Escanaba/Mead/Gladstone	
2	Atlantic - M38 69-kV line	121.3 - 122.4%		--		--		Atlantic - M-38 138-kV line	Uprate Atlantic - M38 69-kV line	
								Atlantic 138/69-kV transformer #1	or increase generation at Portage	
								Both		

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Planning Zone	Criteria Exceeded/Need	2019 Summer Peak Case		2019 DOE 20% Wind Future		2019 Slow Growth Future		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage		
2	Chandler-Lakehead Tap 69-kV line	121.6 - 162.2%		--		--		Delta - Mead 69-kV line	Uprate Chandler-Masonville, Masonville-Gladstone, Gladstone-North Bluff, Delta-Mead-North Bluff 69-kV lines; or increase generation at Mead/Gladstone
	Lakehead Tap-Masonville 69-kV line								
	Masonville-Gladstone 69-kV line								
	Gladstone-North Bluff 69-kV line								
	North Bluff-Bay Tap 69-kV line								
Bay Tap-Mead 69-kV line									
2	Pine River-Straits 69-kV line	98 - 109.2%		--		--		Brevort - Straits 138-kV line	Rebuild Pine River-Straits 69-kV lines
	Straits-Evergreen 69-kV line								
	Pine River-Evergreen 69-kV line								
2	Rudyard - Tone 69-kV line	97.3%		--		--		Hiawatha - Engadine 69-kV line	Uprate Rudyard - Tone 69-kV line, Increase generation at Newberry, Dafter, DeTour, US Hydro, Edison Sault
2	Nordic - Mountain 69-kV line	111.4%		--		--		Chandler 138/69-kV transformer #1	Uprate Nordic - Mountain 69-kV line, Increase generation
2	New Quinnesec - Kingsford Tap 69-kV line	100.0%		--		--		Twin Falls North - Twin Falls South 69-kV line	Uprate New Quinnesec - KFM Tap 69-kV line
		100.3%						Twin Falls South - Bass Lake 69-kV line	
2	Lakota 69-kV bus		117.1%		--	--		Conover - Lakota 69-kV line	Change controlled bus for Lakota 138/69-kV tcul transformer to Lakota 69-kV bus instead of Conover 69-kV bus
2	Chandler, Delta, Escanaba 1, Escanaba 2, Masonville, Mead, Gladstone, West, Lakehead, Bay View, North Bluff, Cornell,		88.4-91.4%		--	--		Chandler 138/69-kV transformer #1	Increase generation at Escanaba/Mead/Gladstone
2	Hulbert, Eckerman, Newberry Village, Louisiana Pacific, Newberry, Newberry Hospital, Roberts, Raco 69-kV buses		87.2 - 90.3%		--	--		Engadine - Newberry 69-kV line	Increase generation at Newberry, Dafter, DeTour, US Hydro, Edison Sault
2	Newberry Village, Louisiana Pacific, Newberry Hospital, Roberts, Hulbert, Eckerman 69-kV buses		78.9 - 91.9%		--	--		Newberry - Newberry Hospital Tap 69-kV line Hiawatha - Engadine 69-kV line Newberry Hospital Tap-Roberts 69-kV lines	Increase generation at Dafter, DeTour, US Hydro, Edison Sault
2	Atlantic 138-kV bus		86.1 - 91.8%		--	--		Atlantic - M-38 138-kV line	Adjust taps at Atlantic 138/69-kV transformer
	Keweenaw Tap, Keweenaw 69-kV buses							ATC_B2_ATLAN	
2	Munising 138-kV bus		91.8%		--	--		Forsyth - Munising 138-kV line	Adjust taps at Munising 138/69-kV transformer
2	Aspen, Iron Grove 138-kV buses		91.1 - 91.5%		--	--		Aspen - Plains 138-kV line	Adjust taps at Iron Grove, Aspen 138/69-kV
2	Iron Grove 138-kV bus		91.0%		--	--		Aspen - Iron Grove 138-kV line	Adjust taps at Iron Grove 138/69-kV transformers
2	Lakehead 69-kV bus		91.9%		--	--		Iron Grove 138/69-kV transformer #G1	Add second Iron Grove 138/69-kV transformer
3	Artesian - Rock Springs 138-kV line	100.3 - 104.4%		--		--		Trienda - Lewiston ACEC 138-kV line	
	Rock Springs - Kirkwood 138-kV line							Lewiston - Kilbourn ACEC 138-KV line	
3	Dane - Lodi Tap 69-kV line	100.6%		--		--		Island Street - Kirkwood 69-kV line	Rebuild Dane-Dam Heights 69-KV line
3	Portage - Trienda 138-kV line	96.1%		--		--		Portage - Trienda1 138-kV line	No project needed at this time
3	Artesian - Rock Springs 138-kV line	100.3 - 104.4%		--		--		Trienda - Lewiston ACEC 138-kV line	
	Rock Springs - Kirkwood 138-kV line							Lewiston - Kilbourn ACEC 138-KV line	

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Planning Zone	Criteria Exceeded/Need	2019 Summer Peak Case		2019 DOE 20% Wind Future		2019 Slow Growth Future		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage		
3	Dane - Lodi Tap 69-kV line	100.6%		--		--		Island Street - Kirkwood 69-kV line	Rebuild Dane-Dam Heights 69-KV line
3	Portage - Trienda 138-kV line	96.1%		--		--		Portage - Trienda 138-kV line	No project needed at this time
3	Academy – Columbus Muni #3 tap 69-kV line	112.2%		108.6%		--		North Randolph – Fox Lake 138-kV line	
		107.1%		102.9%		--		North Randolph–Fox Lake–North Beaver Dam 138-kV line	
		106.7%		102.5%		--		Fox Lake – North Beaver Dam 138-kV line	
3	Columbus Muni #3 Tap – Columbus 69-kV line	110.4%		106.8%		--		North Randolph – Fox Lake 138-kV line	
		105.4%		101.1%		--		North Randolph – Fox Lake – North Beaver Dam 138-kV line	
		104.9%		100.7%		--		Fox Lake – North Beaver Dam 138-kV line	
3	South Beaver Dam – Center Street 69-kV line	98.3%		--		--		North Randolph – Fox Lake 138-kV line	
3	South Fond du Lac – Koch Oil Tap 69-kV line	102.2%		104.1%		--		North Randolph – Fox Lake 138-kV line	
		97.5%		99.0%		--		Fox Lake – North Beaver Dam 138-kV line	
		97.3%		98.8%		--		North Randolph – Fox Lake – North Beaver Dam 138-kV line	
3	Koch Oil Tap – Waupun 69-kV line	103.1%		105.0%		--		North Randolph – Fox Lake 138-kV line	
		98.1%		99.7%		--		Fox Lake – North Beaver Dam 138-kV line	
		97.9%		99.5%		--		North Randolph – Fox Lake – North Beaver Dam 138-kV line	
3	Hubbard and Hustisford 138-kV buses		96.0 – 96.2%		96.8%		95.7 - 96.1%	System Intact	
			85.0 – 85.1%		84.9 - 85.0%		86.7 - 86.8%	Rubicon – Hustisford 138-kV line	
			85.7%		85.6%		87.2%	Hustisford – Hubbard 138-kV line	
			85.7%		85.6%		87.4%	North Randolph–Fox Lake–North Beaver Dam 138-kV line	
			90.6 – 90.9%		91.0 - 91.3%		--	Concord 138-kV 4-5 bus tie	
3	Fox Lake, North Beaver Dam and East Beaver Dam 138-kV buses		90.2 – 90.4%		90.5 - 90.6%		--	North Randolph – Fox Lake 138-kV line	
3	Koch Oil 69-kV bus		92.0%		--		--	South Fond du Lac – Koch Oil Tap 69-kV line	
3	Horicon Industrial Park 69-kV bus		91.9%		--		--	Hubbard – Horicon Ind. Park 69-kV line	
3	Artesian - Rock Springs 138-kV line	100.3 - 104.4%						Trienda - Lewiston ACEC 138-kV line	
	Rock Springs - Kirkwood 138-kV line			--		--		Lewiston - Kilbourn ACEC 138-KV line	
3	Dane - Lodi Tap 69-kV line	100.6%		--		--		Island Street - Kirkwood 69-kV line	Rebuild Dane-Dam Heights 69-KV line
3	Portage - Trienda 138 kV line	96.1%		--		--		Portage - Trienda1 138 kV line	No project needed at this time
3	Lake Geneva – South Lake Geneva 69-kV line	126.3%		122.5%		101.4%		Cobblestone – Brick Church 69-kV line	North Lake Geneva – South Lake Geneva 138kV line
		104.7%		101.8%		--		Cobblestone – Zenda Tap 69-kV line	
3	Katzenberg-South Lake Geneva 69-kV line	96.7%		--		--		Cobblestone – Brick Church 69-kV line	Spring Valley – Twin Lakes line
3	Colley Road 138/69-kV transformer #31	103.6%		98.0%		--		Paddock 138/69-kV transformer #31	Install Bass Creek transformer
3	Enzyme – RC3 69-kV line	95.4%		--		--		Brick Church 138/69-kV transformer #31	Line Y-32 rebuild
3	Cobblestone – Brick Church 69-kV line	102.2%		96.3%		--		North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138kV line
3	Cobblestone – Zenda Tap 69-kV line	123.3%		116.0%		--		North Lake Geneva – Lake Geneva 69-kV line	Spring Valley – Twin Lakes line
3	Katzenberg – Zenda Tap 69-kV line	109.5%		102.7%		--		North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Cobblestone 69-kV bus		89..9%		90.4%		--	Cobblestone – Brick Church 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Zenda 69-kV bus		91.4%		--		--	North Lake Geneva - Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
			90.9%		91.5%		--	Cobblestone – Brick Church 69-kV line	

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Planning Zone	Criteria Exceeded/Need	2019 Summer Peak Case		2019 DOE 20% Wind Future		2019 Slow Growth Future		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage		
3	Brick Church 138-kV bus		91.2%		--		--	Beloit Gateway – Dickinson 138-kV line	Brick Church capacitors or Spring Valley – Twin Lakes
			90.4%		91.1%			Colley Road – Dickinson 138-kV line	
3	Williams Bay 138-kV bus		91.9%		--		--	Colley Road – Dickinson 138-kV line	Brick Church capacitors or Spring Valley – Twin Lakes line
3	Lake Geneva 69-kV bus		83.5%		86.8%		--	North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Katzenberg 69-kV bus		85.1%		88.2%		--	North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Twin Lakes 69-kV bus		84.4%		87.5%		--	North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	South Lake Geneva 69-kV bus		84.2%		87.4%		--	North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Dickinson 138-kV bus		89.4%		89.9%		--	Colley Road – Dickinson 138-kV line	Brick Church caps or Spring Valley – Twin Lakes line
3	Concord 138-kV bus		90.2%		90.0%		--	Concord 138-kV 4-5 bus tie	Install Concord capacitors
3	Crawfish River 138-kV bus		--		--		91.0%	Jefferson - Crawfish River 138-kV line	
3	Butler Ridge 138-kV bus		--		91.8%		--	Concord 138-kV 4-5 bus tie	Install Concord capacitors
3	Rubicon 138-kV bus		91.9%		91.6%		--	Concord 138-kV 4-5 bus tie	Install Concord capacitors
3	McCue - Harmony - Lamar 69-kV line	102.5 - 95%		116.4 - 97.2%		96.9%		Kegonsa - Stoughton North 69-kV line Kegonsa 138/69-kV transformer #31 Stoughton North - Stoughton East 69-kV line	Construct double-circuit line between McCue and Lamar substations
3	Hillman 138/69-kV transformer #31	101.3%-98.5%		96.7%		--		DPC Galena - Pilot 69-kV line Pilot - Terr Tap 69-kV line	Replace the existing 46 MVA Hillman 138/69-kV transformer with a 100 MVA transformer
3	North Monroe - Idle Hour 69-kV line	103.1 - 95.8%		114.7 - 98.1%		101%-96.2%		Darlington- Gratiot 69-kV line Darlington 138/69-kV transformer #31 Browntown-Jennings Rd 69-kV line Gratiot-Wiota 69-kV line Wiota-Jennings Rd 69-kV line Brodhead-Newark 69-kV line Paddock-Newark 69-kV line Paddock 138/69-kV transformer #31 Whistling Wind-Black Smith 69-kV line	Install a 138/69-kV transformer at Bass Creek Substation
3	Dana – Sheepskin 69-kV line	115.2 - 110.8%		126.4 - 121%		97.4%		McCue-Harmony 69-kV line Harmony-Lamar 69-kV line	Sheepskin substation project which will uprate Y-61 Sheepskin-Dana 69-kV line to 95 MVA and 2017 Construct double-circuit line between McCue and Lamar substations
3	Gran Grae-Wauzeka-Boscobel 69-kV line	100%-96.2%		--		--		Spring Green 138/69-kV transformer #31 Lone Rock-Spring Green 69-kV line	Uprate Y-40 Gran Grae-Boscobel 69-kV line to achieve a 99 MVA summer emergency rating
3	West Middleton - Timberlane 69-kV line	106.5%		--		--		Spring Green 138/69-kV transformer #31	Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating

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Planning Zone	Criteria Exceeded/Need	2019 Summer Peak Case		2019 DOE 20% Wind Future		2019 Slow Growth Future		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage		
3	Waunakee Industrial Park - Huiskamp 69-kV line	95.3%		--		--		North Madison 138/69-kV transformer #31	Potential Y132 line switch replacement project at Waunakee Industrial Park to achieve 170 MVA SE out of ten years
3	Waunakee Switching Station - Waunakee 2 69-kV line	101.3%		99.6%		--		West Middleton-Pheasant Branch 69-kV line	Potential Waunakee Switching Station-Waunakee 2 69-kV 0.58 miles of line (Y-131) and terminal uprate to achieve 115 MVA SE
3	Fitchburg - Syene - Ninesprings 69-kV line	126.2 - 107.9%		106.5%		106.0%		Royster-AGA Tap 69-kV line AGA Tap-Pflaum 69-kV line	Uprate Fitchburg-Nine Springs line, uprate Pflaum - Royster line, install 2-16.33 MVAR 69 kV cap banks at Nine Springs and move the AGA load onto Femrite - Royster line
3	Royster - AGA Tap - Pflaum 69-kV line	126.5 - 102.8%		104.8%		104.6 - 101.8%		Fitchburg-Syene 69-kV line Ninesprings-Syene 69-kV line	Uprate Fitchburg-Nine Springs line, uprate Pflaum - Royster line, install 2-16.33 MVAR 69 kV capacitor banks at Nine Springs and move the AGA load onto Femrite - Royster line
3	Royster - Sycamore 69-kV line	96.5%		--		--		Femrite 138/69-kV transformer #31	Uprate the 6986 Royster to Sycamore 69-kV line to 115 MVA
3	Verona, Oak Ridge, Fitchburg and Cross Country 138-kV buses		95.0 - 95.7%		95.2%		--	System intact	Verona 1-16.33 Mvar 69-kV capacitor bank and potential 2-49 Mvar 138-kV capacitor banks at Oak Ridge
3	Harmony, Lamar, Fulton 69-kV buses		88.9 - 90.6%		78.6 - 91.8%		86.4 - 91.8%	McCue-Harmony 69-kV line Harmony-Lamar 69-kV line	Lamar 2-16.33 Mvar 69-kV cap banks; Construct double-circuit line between McCue and Lamar substations
3	Verona 138-kV bus		86.3%		86.2%		88.5%	Verona-Oak Ridge 138-kV line	Verona 1-16.33 Mvar 69-kV cap bank / Adjust Verona 138/69-kV transformer setting
3	Southwest Verona 69-kV bus		90.4%		90.6%		--	Verona-Southwest Verona 69-kV line	Potential Mount Horeb capacitor bank upgrade or addition
3	Muscoda, Lone Rock, Avoca, and Blue River 69-kV buses		90.3 - 91.8%		--		--	Lone Rock - Spring Green 69-kV line Spring Green 138/69-kV transformer #31	Install 1-8.16 MVAR capacitor bank at Boscobel 69-kV Substation and upgrade existing 5.4 MVAR bank with an 8.16 MVAR bank
3	Reiner, Burke 69-kV buses		91.9%		91.8 - 91.9%		--	Reiner 138/69-kV transformer #31 Reiner - Burke Tap 69-kV line	Install 2-16.33 Mvar 69-kV capacitor banks at Sun Prairie

Table ZS-3a
2009 10-Year Assessment - 2019 Futures Constraints

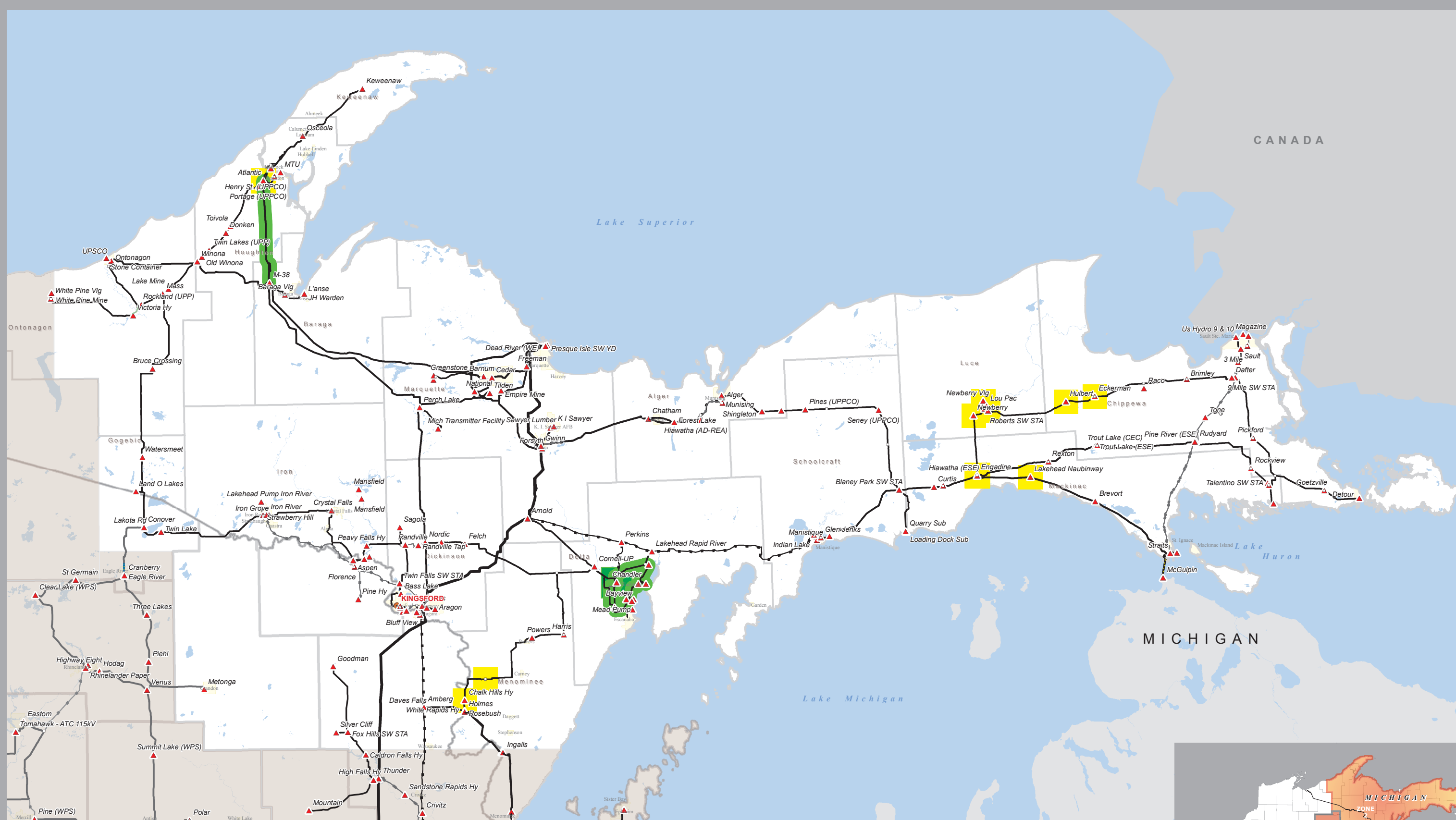
Planning Zone	Criteria Exceeded/Need	2019 Summer Peak Case		2019 DOE 20% Wind Future		2019 Slow Growth Future		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage		
3	AGA and Pflaum 69-kV buses		90.5 - 90.7%		--		--	Royster - AGA Tap 69-kV line	Uprate Fitchburg-Nine Springs line, uprate Pflaum - Royster line, install 2-16.33 MVAR 69 kV capacitor banks at Nine Springs and move the AGA load onto Femrite - Royster line
3	Lancaster and Eden 138-kV buses		90.9 - 91.9%		90.2 - 90.8%		--	Nelson Dewey - Lancaster 138-kV line Lancaster - Eden 138-kV line	Install 2-16.33 Mvar 69-kV capacitor banks at Eden Substation
3	Pleasant View and Hawk 138-kV buses		91.5 - 91.9%		91.8%		--	West Middleton - Pleasant View 138-kV line	Verona 1-16.33 Mvar 69-kV cap bank and potential 2-49 Mvar 138-kV capacitor banks at Oak Ridge
3	Lone Rock - Pine River - Brewer - Richland Center 69-kV line and Lone Rock phase shifter	--		121.0 -193.0%		177.9 - 113.7%		System intact	Adjust Lone Rock phase shifter to 0 deg
3	Gran Grae - Hillside 69-kV line	--		103.4%		95.3%		Seneca - Bell Center 161-kV line	Adjust Lone Rock phase shifter to 0 deg
3	Sun Valley - Oregon 69-kV line	--		97.0%		--		Kegonsa - Stoughton North 69-kV line	Potential Oregon substation uprate
3	Stoughton - Sheepskin 69-kV line	--		113.6 - 109.5%		--		McCue - Harmony 69-kV line Harmony - Lamar 69-kV line	2017 Construct double-circuit line between McCue and Lamar substations
3	West Middleton - West Towne 69-kV line	--		101.1%		--		West Middleton - Pleasant View 138-kV line	Potential ~2 mile line uprate from 83 MVA to 106 MVA
3	Lone Rock - Pine River - Brewer - Richland Center 69-kV line and Lone Rock phase shifter	--		224.6 -103.4%		203.5 - 95.2%		Gran Grae - Wauzeka 69-kV line Wauzeka - Boscobel 69-kV line Boscobel - Blue River 69-kV line Blue River - Muscoda 69-kV line Muscoda - Avoca 69-kV line	Adjust Lone Rock phase shifter to -10 deg
3	Lone Rock, Pine River, Brewer, Richland Center 69-kV buses		--		84.1 - 87%		87.2 - 89.5%	System intact	Adjust Lone Rock phase shifter to 0 deg
3	Eden 138-kV bus		--		95.8%		--	System intact	Install 2-16.33 Mvar 69-kV capacitor banks at Eden Substation
3	Miner, Shullsburg and Benton 69-kV buses		--		89.4 - 91.6%		--	DPC Galena - Pilot 69-kV line Pilot -Terr Tap 69-kV line	DPC outage. Potential capacitor bank on Y130
3	Brodhead Muni 3, Brodhead Muni 2, Brodhead Muni 1, Brodhead, RCEC Orfordville, Bass Creek, Footville, Center, Union Townline and Evansville 69-kV buses		--		87.4 - 91.9%		--	Brodhead Switching Station - Brodhead Muni 3 69-kV line Brodhead Muni 3 - Brodhead Muni 2 69-kV line	Install a 138/69-kV transformer at Bass Creek Substation
3	Wauzeka, Boscobel, Blue River, Muscoda, Avoca 69-kV buses		--		88.2 - 91.8%		91.3 - 91.7%	Gran Grae - Wauzeka 69-kV line Wauzeka - Boscobel 69-kV line Spring Green 138/69-kV transformer #31	Install 1-8.16 MVAR capacitor bank at Boscobel 69-kV Substation and upgrade existing 5.4 MVAR bank with an 8.16 MVAR bank
3	Spring Green, Wyoming Valley and Eden 138-kV buses		--		91.5 - 91.7%		--	Lake Delton - Trienda 138-kV	Install 2-16.33 Mvar 69-kV capacitor banks at Eden Substation
3	Gays Mills 69-kV bus		--		90.9%		--	Seneca - Bell Center 161-kV line	Adjust Lone Rock phase shifter to 0 deg
3	Lone Rock Phase shifter	--		--		120.4 - 119.3%		Nelson Dewey - Lancaster 138-kV line Lancaster - Eden 138-kV line	Adjust Lone Rock phase shifter to 0 deg
5	Arcadian 345/138-kV transformer #3	108.7%		111.4%		98.2%		Arcadian 345/138-kV transformer #1	Replace Arcadian

Table ZS-3a
2009 10-Year Assessment - 2019 Futures Constraints

Planning Zone	Criteria Exceeded/Need	2019 Summer Peak Case		2019 DOE 20% Wind Future		2019 Slow Growth Future		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage		
	Arcadian 345/138-kV transformer #2	97.6%		100.7%		95.2%			transformers or investigate
5	Branch – Kansas 138-kV line	100.5%		--		--		Oak Creek – Pennsylvania 138-kV line	Load shift – investigate future projects to resolve loading on the Branch - Kansas 138kV line.
5	Arcadian 6 – Waukesha3 138-kV line	112.6%		111.9%		103.1%		Arcadian4- Waukesha1 138-kV line	Upgrade Arcadian – Waukesha 138-kV lines or investigate other alternatives
5	Oak Creek - Elm Road 345/138-kV transformer #844	--		99.5%		98.4%		Bain - Kenosha 138-kV line	
5	Granville 345/138-kV transformer #3	--		97.5%		--		Granville 345-kV 1-2 bus tie	
5	Maple - Sauville 138-kV line	--		100.7%		--		Bark River – Sussex 138-kV line	
5	Kenosha - Lakeview 138-kV line	--		--		95.2%		Pleasant Prairie - Zion 345-kV line	
5	Bark River 138-kV bus		95.8%		95.6%		--	System Intact	Increase Germantown generation
			91.8%		90.3%			Bark River – Sussex 138-kV line	
			--		89.2%			Maple – Sauville 138-kV line	
5	Hartford 138-kV bus		--		--		91.6%	Hartford - St. Lawrence 138-kV line	
5	Tichigan 138-kV bus		91.4%		--		--	Burlington 138-kV 1-2 bus tie	Load shift – Investigate future projects for voltage support at Tichigan
5	Germantown 138-kV bus		95.5%		93.3%		95.5%	System Intact	Increase Germantown generation
			88.7%		--		88.7%	Maple – Sauville 138-kV line	
			--		89.8%		--	Bark River -Germantown 138-kV line	
			--		89.6%		--	Bark River -Sussex 138-kV line	
			--		88.8%		--	Germantown - Maple 138-kV line	
			--		80.0%		--	Maple – Sauville 138-kV line	
5	Maple 138-kV bus		95.7%		93.7%		95.7%	System Intact	Increase Germantown generation
			--		90.5%		--	Bark River - Sussex 138-kV line	
			--		90.8%		--	Bark River - Germantown 138-kV line	
			88.2%		79.3%		88.3%	Maple – Sauville 138-kV line	
5	Cottonwood 138-kV bus		95.3%		95.3%		--	System Intact	
					91.1%		--	Bark River - Sussex 138-kV line	

*Table ZS-9
Zone 2 Load and Generation*

Zone 2	2010	2014	2019	2024
Peak Forecast (megawatts)	841.4	862.3	888.9	914.7
Average Peak Load Growth	N/A	0.62%	0.61%	0.57%
Existing Generation Capacity (megawatts)	992.4	992.4	992.4	992.4
Existing Capacity Less Load	151	130.1	103.5	77.7
Existing Generation Capacity plus Modeled Generating Capacity Additions (megawatts)	992.4	992.4	992.4	992.4
Modeled Capacity Less Load (megawatts)	151	130.1	103.5	77.7



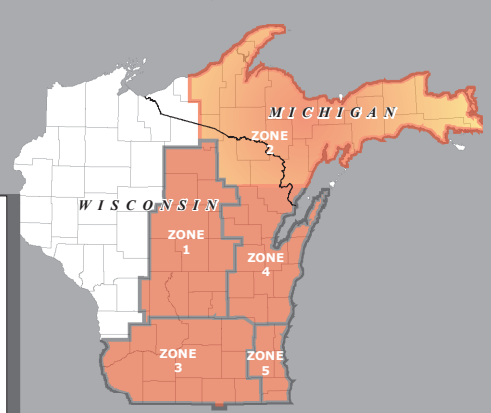
Performance Criteria Limits Exceeded and Other Constraints 2009-2010
PLANNING ZONE 2

Currently, ATC owns or operates transmission facilities in 50 Wisconsin counties and in 15 Michigan counties. Facilities include:
 * Approximately 9350 miles of transmission lines
 * 96 wholly owned substations
 * 410 jointly owned substations
 * ATC offices in Madison, Cottage Grove, Pewaukee, De Pere, Wausau and Kingsford, WI

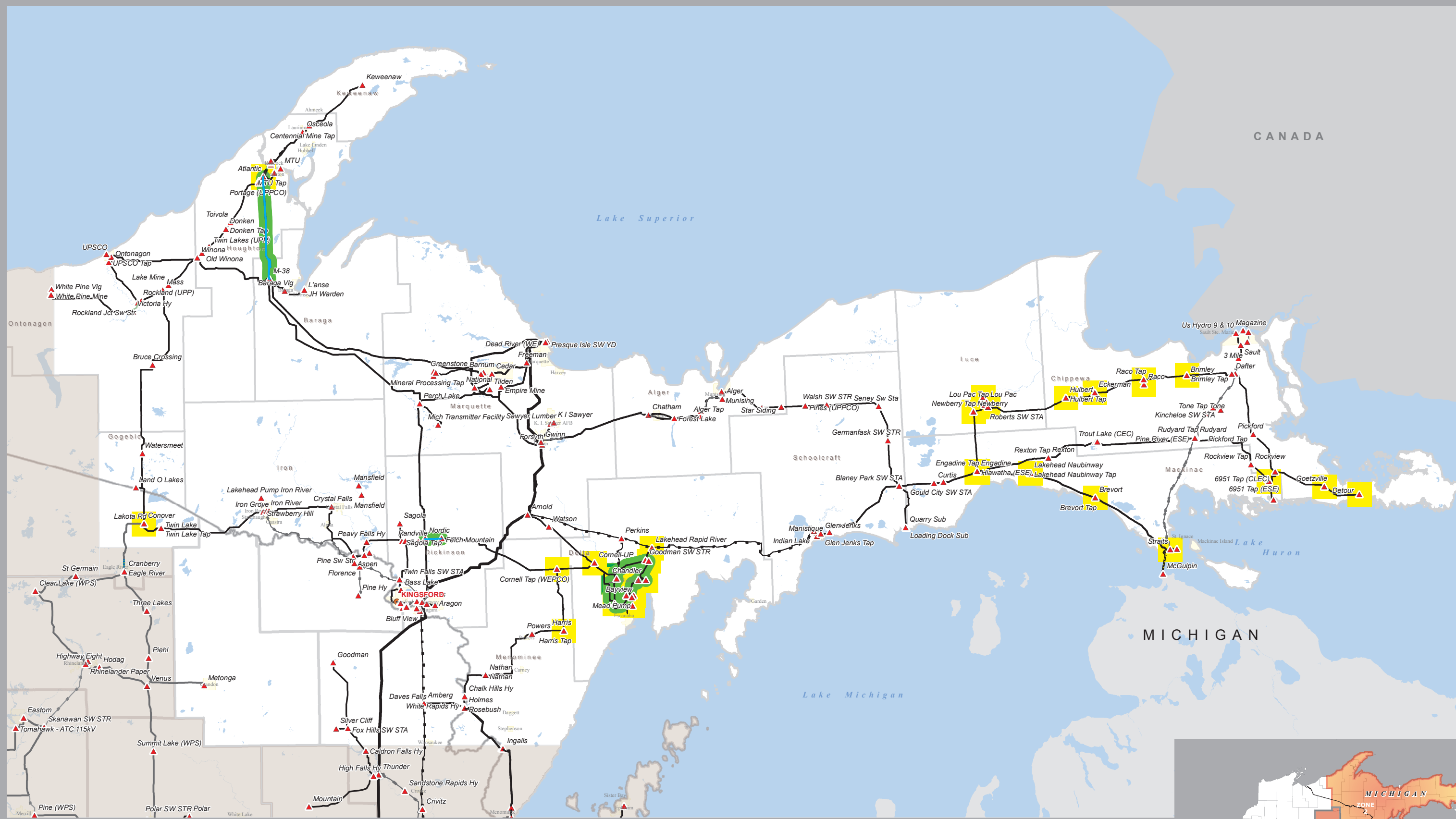
- Low/High Voltages
- Overloaded Facility
- Transmission Service Limiter

Transmission Related Facilities

- ▲ Substation, Switchyard or Terminal
- ATC Office Location
- Proposed/Design/Construction
- Generation
- Other Facility



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Performance Criteria Limits Exceeded and Other Constraints 2010-2014
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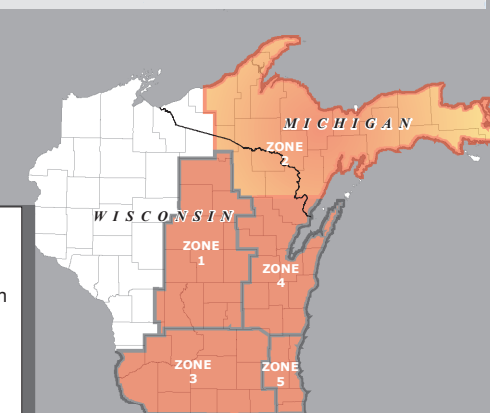
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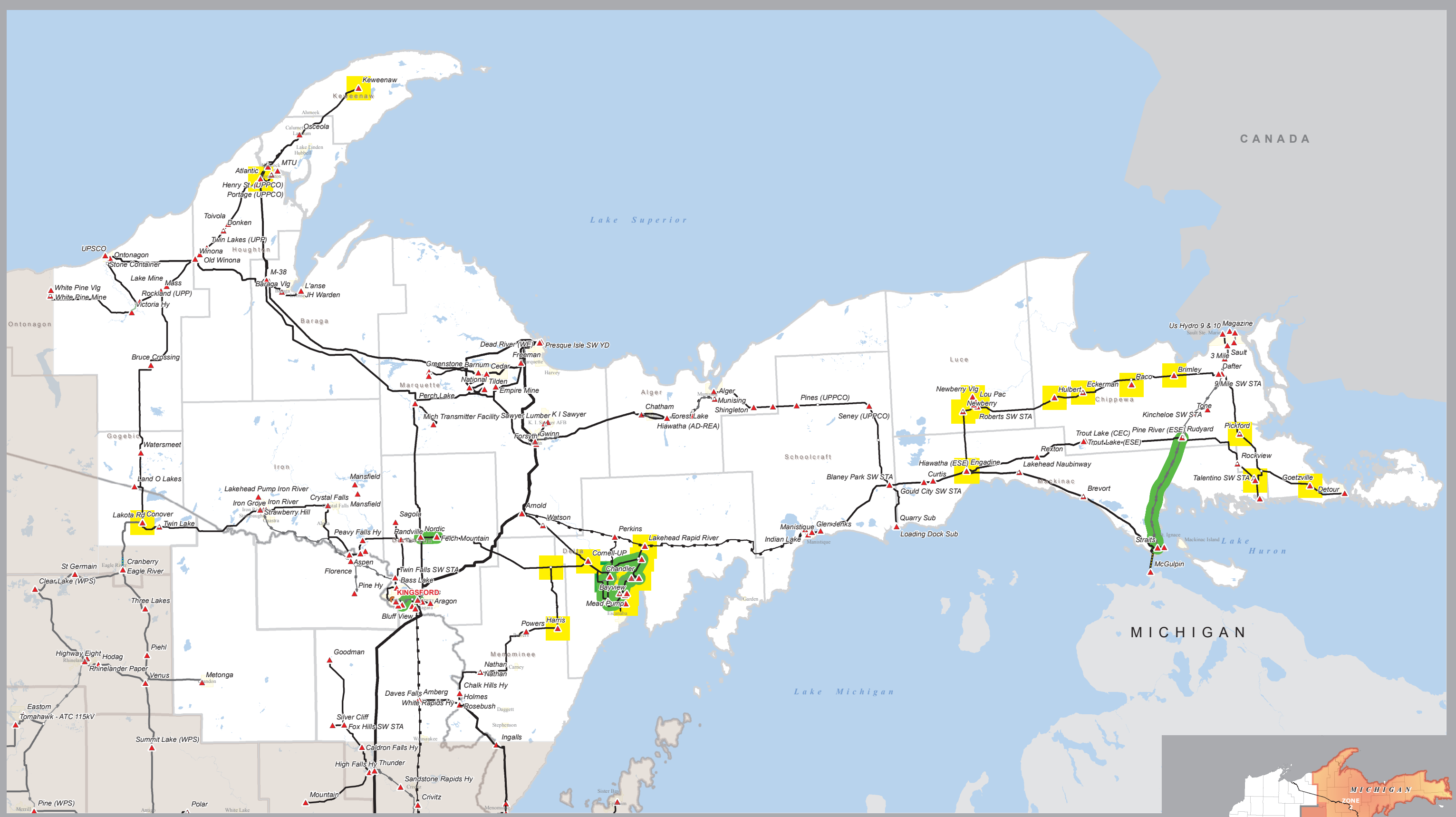
- Low/High Voltages
- Overloaded Facility
- Transmission Service Limiter

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- Other Facility

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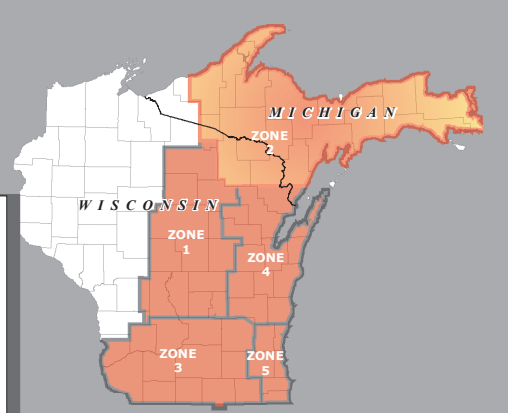
Performance Criteria Limits Exceeded and Other Constraints 2015-2019
PLANNING ZONE 2

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- Low/High Voltages
- Overloaded Facility
- Transmission Service Limiter

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Table PR-15
Zone 2 Transmission System Additions

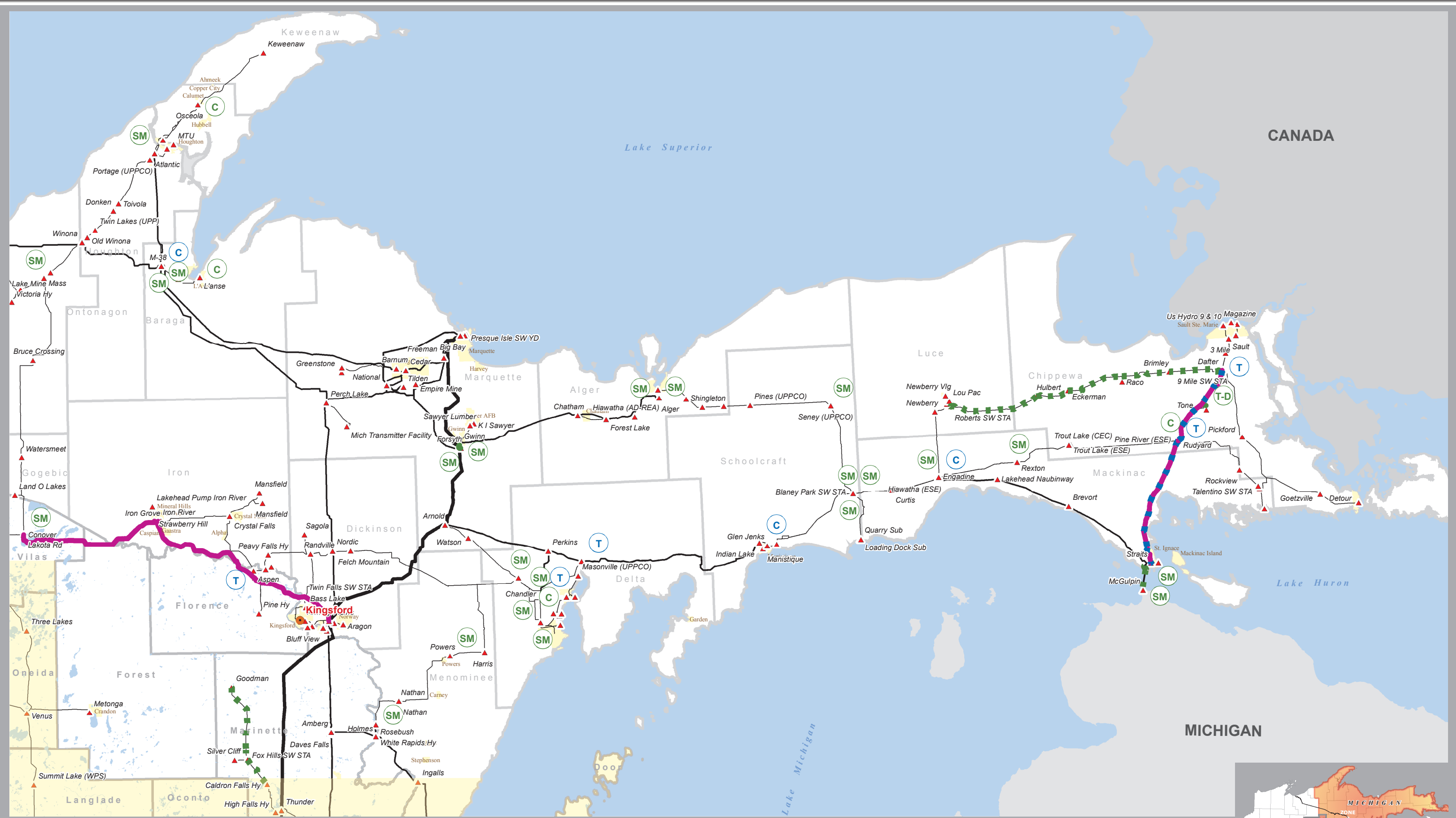
System Additions	System Need Year	Projected In-Service Year	Planning Zone	Need Category	Planned, Proposed or Provisional
Uprate the Chandler-Masonville 69-kV line summer normal and emergency ratings from 120 deg F to 167 deg F	2009	2009	2	reliability	Proposed
Install 1-4.08 MVAR capacitor bank at L'Anse 69 kV	2008	2009	2	reliability	Proposed
Construct ring bus at the Pine River 69-kV Substation and replace 1-5.4 MVAR capacitor bank with 2-4.08 MVAR banks	2008	2009	2	reliability, condition	Proposed
Install 1-8.16 MVAR capacitor banks at the M38 138-kV Substation	2009	2009	2	reliability	Proposed
Uprate Chandler-Cornell 69-kV line clearance from 120 to 167 deg F	2009	2009	2	reliability	Proposed
Install 1-8.2 MVAR capacitor bank at Hiawatha 138-kV Substation	2009	2009	2	reliability	Proposed
Install 1-4.08 MVAR capacitor banks at Osceola 69 kV	2009	2009	2	reliability	Proposed
Uprate the Chandler-Delta #1 69-kV line summer emergency rating from 120 deg F to 167 deg F	2009	2009	2	reliability	Proposed

Table PR-15 (continued)
Zone 2 Transmission System Additions

System Additions	System Need Year	Projected In-Service Year	Planning Zone	Need Category	Planned, Proposed or Provisional
Uprate the Chandler-Delta #2 69-kV line summer emergency rating to from 120 deg F 167 deg F	2009	2009	2	reliability	Proposed
Rebuild/convert Conover-Plains 69-kV line to 138 kV	2010	2010	2	reliability, transfer capability	Planned
Construct 138 kV bus and install a 138/69 kV, 60 MVA transformer at Aspen Substation	2010	2010	2	reliability	Planned
Install 1-16.33 MVAR capacitor bank at Indian Lake 138-kV Substation	2010	2010	2	reliability	Proposed
Install 1-4.08 MVAR capacitor bank at North Bluff 69-kV Substation	2010	2011	2	reliability	Provisional
Uprate overhead portions of Straits-McGulpin 138-kV circuits #1 & #3 to 230 F degree summer emergency ratings	2012	2012	2	reliability	Provisional
Rebuild/convert Straits-Pine River 138-kV lines 6904/5	2012	2012	2	reliability	Provisional
Install 138/69-kV 150 MVA transformer at Pine River	2012	2012	2	reliability	Provisional
Install 138/69-kV 150 MVA transformer at Nine Mile	2012	2012	2	reliability	Provisional
Install 138/69-kV 150 MVA transformer at Lakehead Rapid River	2012	2012	2	reliability	Provisional

Table PR-15 (continued)
Zone 2 Transmission System Additions

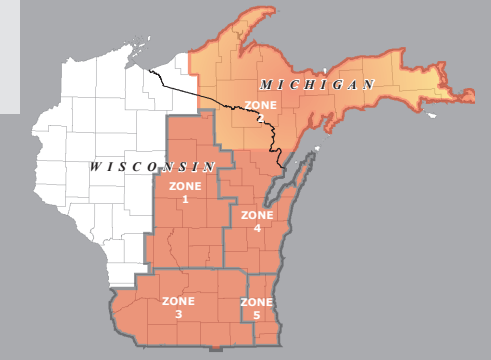
System Additions	System Need Year	Projected In-Service Year	Planning Zone	Need Category	Planned, Proposed or Provisional
Construct tap from the Kinross load to Pine River/Nine Mile 69-kV line	2012	2012	2	T-D interconnection, reliability	Provisional
Construct/convert Pine River-Nine Mile 138/69-kV double-circuit line	2012	2012	2	reliability	Provisional
Install second Chandler 138/69-kV transformer	2013	2013	2	reliability	Provisional
Increase ground clearance of M38-Atlantic 69-kV line from 120 to 167 degrees F	2009	2013	2	reliability	Provisional
Uprate Munising-Seney-Blaney Park 69-kV line to 167 degrees F	2014	2014	2	reliability	Provisional
Construct Gwinn-Forsyth second 69-kV line	2014	2014	2	reliability	Provisional



**2009 10-Year Assessment Projects
PLANNING ZONE 2**

- | | | | |
|--|--|--------------------------|---------------------|
| New 69kV Transmission Line | Rebuilt 69 kV Transmission Line | New Substation | T-D Interconnection |
| New 115, 138 or 161 kV Transmission Line | Rebuilt 115, 138 or 161 kV Transmission Line | Substation Modifications | Capacitor Bank |
| New 345 kV Transmission Line | Rebuilt 345 kV Transmission Line | Transformer | |
| Transmission Line Voltage Conversion | | | |

- Existing Transmission Facilities**
- ATC Office Location
 - ATC Substation, Switchyard or Terminal
 - Generation
 - ATC Transmission Line (width = voltage)



ATC
AMERICAN TRANSMISSION COMPANY

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