Zone 3 overview

Zone 3 includes the Wisconsin counties of:

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

The physical boundaries of Zone 3 and transmission facilities located in Zone 3 are shown in Figure ZS-24.

Land use in Zone 3 is a mix of rural, urban and agricultural.

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

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

Demographics
The population of the counties in Zone 3 grew at an annual rate of 1.0 percent from 2000 to 2010. The highest growth rate of 1.5 percent per year and the largest increase in population of 70,100 occurred in Dane County.

Population in Zone 3 is projected to grow at 1.1 percent annually for the 2010 to 2020 period. From 2010 to 2020, Dane County is projected to realize the largest increase in population (82,300) and is projected to have the highest growth rate of 1.5 percent.

During the same period, the annual employment growth rate was 0.9 percent. The highest growth rate (1.4 percent) and the largest increase in employment (51,000) occurred in Dane County.

Employment in Zone 3 is projected to grow at 1.3 percent annually between 2010 and 2020. Dane County is projected to realize the largest increase in employment of over 62,000 and Sauk County the highest growth rate of 1.6 percent.

Employment			
Annual Growth Rate			
	2000-2010		2010-2020
Zone 3	0.9	Zone 3	1.3
Dane, WI	1.4	Sauk, WI	1.6

Population			
Annual Growth Rate			
	2000-2010		2010-2020
Zone 3	1.0	Zone 3	1.1
Dane, WI	1.5	Dane, WI	1.5

Total Increase			
	2000-2010		2010-2020
Zone 3	72,091	Zone 3	111,444
Dane, WI	51,051	Dane, WI	62,192

Total Increase			
	2000-2010		2010-2020
Zone 3	112,076	Zone 3	138,157
Dane, WI	70,187	Dane, WI	82,362

Zone 3 environmental considerations

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

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

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

Zone 3 electricity demand and generation

The coincident peak load forecasts for Zone 3 for 2011, 2015, 2020 and 2025 are shown in Table ZS-10. Existing generation, along with proposed generation based on projected in-service year, also are shown. The resultant capacity margins, with or without the proposed generation, are shown as well.

The table shows that load is projected to grow at roughly 2.2 percent annually from 2011 through 2020. Comparing load with generation (at maximum output) within the zone indicates that Zone 3 has more generation than peak load during peak load periods. However, actual operating experience indicates that during most load periods, Zone 3 is a net importer of power.

Zone 3 transmission system issues

Key transmission facilities in Zone 3 include:

- Columbia-North Madison 345-kV lines,
- Columbia-Rockdale 345-kV line,
- Paddock-Rockdale 345-kV line (in-service spring 2010),
- Paddock-Wempletown 345-kV line,
- Rockdale – Wempletown 345-kV line, and
- 138-kV facilities from the Nelson Dewey Power Plant, around the Madison area, and in the northwest and southeast portions of Zone 3.

Key system performance issues in Zone 3 include:

- Existing contingency thermal overloads on the Fitchburg-Royster 69-kV line,
- Low voltages and line overloads on the 69-kV system in Monroe area in 2011,
- Contingency low voltage issues on the Sheepskin-Bass Creek-Brodhead 69-kV line in the 2013 timeframe,
- The 2013 Rockdale-Cardinal 345-kV line project is planned to address thermal constraints and low voltage issues in Madison area,
- The West Middleton-Stage Coach 69-kV line requires higher capacity under contingency conditions in 2015,
- Intact system 138- and 69-kV low voltages in Jefferson and Dane Counties are an emerging issue in 2015 and beyond,
- Insufficient 69-kV line capacity in Walworth County in 2016,
- Low voltages and line overloads on the 69-kV system in the Dam Heights area,
- The existing Hillman 138/69-kV transformer potentially overloads in 2018 under single contingency in the Dairyland Power system, and
- Even with some new 138-kV capacitor bank installation in 2011, the North Madison-Columbia 345-kV double circuit line outage could cause severe low voltage limitations in 2020 timeframe.

Zone 3 - 2011 study results

Refer to Table ZS-1 and Figure ZS-9

Summary of key findings

- Short term operation procedures are required to address the Fitchburg-Royster 69-kV line overload problems before a permanent transmission project can be implemented,
- Maintaining reliability of service to load in and around the Madison area requires that system reinforcements be implemented in the near term. Longer term, a 345-kV source on the west side of Madison will be required,
- With little or no generation running at Concord Substation, low voltages are observed under both system intact and single-contingency conditions. Economic benefit analysis may be performed to evaluate whether new transmission projects can be justified, and
- Significant load growth in the Rock and Green Counties, along with the mismatch of load to generation in the area, could result in the Monroe area 69-kV network being subjected to unacceptably low voltages and thermal overloads under both normal and contingency conditions in the summer of 2011. Rebuilding the 69-kV line Y-33 from Brodhead to South Monroe will address these issues.

In response to some single contingency low voltage problems in Zone 3, a total of 63 MVAR of capacitor banks distributed among the Sheepskin, Lamar, and Spring Green substations was deemed to be the most feasible solutions in the 2010-2011 timeframe.

There were a number of facility overloads and several facilities near their emergency ratings in Zone 3 in 2010-2011 timeframe. Many projects are either planned or proposed to address these near-term thermal problems by 2010-2011. As a result, ATC proposes to uprate four 69-kV lines and two 69-kV substation terminals.

Historically, import capability from Illinois has been severely limited for loss of the Wempletown-Paddock 345-kV line (ATC/Commonwealth Edison facility). This limitation has been addressed to some degree by installing a second 345-kV line between Illinois (Wempletown Substation) and south central Wisconsin (Paddock Substation). However, the underlying 138-kV transmission system in the Janesville area and to the north still poses limitations for transfers into the Madison area. To help address this, ATC proposed the first transmission project within the Midwest Independent System Operator (MISO) footprint driven by economics. This project, the Paddock-Rockdale 345-kV transmission line, significantly reduces congestion and enhances import capability into Zone 3 and ATC as a whole. In spring 2010, this project was successfully implemented.

Two other major 138-kV line projects in Zone 3 are in-service. One is the North Madison-Huiskamp 138-kV line project; the other is the Oak Ridge-Verona 138-kV line project. The North Madison-Huiskamp 138-kV line project addresses thermal overloads for outages of the Dane-Waunakee, Blount-Ruskin or West Middleton-Pheasant Branch 69-kV lines or the North Madison 138/69-kV transformer. The Oak Ridge-Verona project also addresses several line overloads and low voltages in southern Dane and Green counties. Along with the Oak Ridge-Verona 138-kV line project, the Verona-Sun Valley tap portion of the Y-119 69-kV line will be rebuilt due to existing condition issues and the potential of thermal overload.

The Concord 138-kV bus voltage is approaching the voltage limit under intact system conditions. Additionally, an outage of the Hartford – St. Lawrence 138-kV line causes marginal bus voltages at Rubicon and Butler Ridge. An outage of the Jefferson – Crawfish River 138-kV line causes marginal bus voltages at Crawfish River and Concord. Redispatching generation at Concord does improve the area voltage. An economic benefits analysis found it was more economical to run Concord generation than to install capacitors for voltage support. This was true until 2016 when capacitor banks and/or generation would be necessary to provide voltage support.

Studies have indicated the potential for severe low voltage limitations in Dane County area for the loss of North Madison-Columbia double-circuit tower. To address these issues in the near term, one-32.66 MVAR 138-kV Femrite capacitor bank and one-32.66 MVAR 138-kV Kegonsa capacitor bank have been proposed. Also in Dane County, the Fitchburg, Cross County, Oak Ridge and Pleasant View 138-kV buses have marginal system intact voltages. The Femrite and Kegonsa capacitor bank projects will also improve these system intact low voltage limitations.

The Fitchburg to Royster 69-kV line is susceptible to thermal overloads and the area experiences low voltages at Syene, Nine Springs, and Pflaum for loss of either end of the line. A package of projects was proposed to address these issues. It includes uprating the Fitchburg-Nine Springs 69-kV and Royster-Pflaum 69-kV lines, moving the AGA load to the Royster-Femrite 69-kV line and installing two 16.33 MVAR, 69-kV capacitor banks at the Nine Springs Substation. Prior to the implementation of these projects, a short-term operation procedure including potential load bridging is available. The short-term operation procedure will be evaluated each year until the transmission projects are implemented.

ATC and the city of Madison have proposed to bury part of the two Blount-Ruskin 69-kV overhead lines underground. This project will be completed by 2011.

Significant load growth in the Rock and Green Counties, along with the mismatch of load to generation in the area, will result in unacceptably low voltages in the Monroe area. Under several single contingency conditions, thermal overloads also arise on the Y-33 69-kV line

sections Brodhead-Spring Grove-Blacksmith-South Monroe. The planned solution to address these issues is to rebuild the Brodhead-South Monroe 69-kV line (Y-33) using 138-kV construction standards and initially operate the line at 69-kV.

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

We currently mitigate several of the identified 138-kV low voltages through remote control of the 138/69-kV transformers in the affected areas. In certain instances, transformer load tap changers are adjusted to bring the 138-kV contingency voltages above the planning criteria limits while maintaining the 69-kV bus voltages above criteria limits. This is a balancing act, and as loads continue to grow the process will no longer be effective.

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

Uprate McCue-Lamar 69-kV line
The potential for single-contingency low voltage problems in the Lamar area and an overload of the McCue-Lamar 69-kV line were observed in the 2009 summer peak model. Considering reasonable project lead times, the 2010 in-service date was chosen for this provisional project of uprating the McCue-Lamar line and installing capacitor banks at Lamar. In the interim, dispatching Sheepskin generation could be one possible mitigation to address these constraints.

Projects whose "In-service date" precedes the "Need date"
As a result of in-service date flexibility and corresponding alignment/synergies with other ATC non-planning project needs, the following projects will be in service prior to the need date. Additionally, the projects listed below are asterisked in the Annual Project Tables.

- ❑ Uprate X-23 Colley Road-Marine 138-kV terminals
  - This project only requires terminal upgrades at Colley Road substation. It has been included in the 2010 ATC System Protection and Maintenance upgrade project at Colley Road.
- ❑ Uprate Y-61 Sheepskin-Dana 69-kV line to 95 MVA
  - This project only requires terminal upgrades at Sheepskin substation. It has been included in the 2010 ATC System Protection and Maintenance upgrade project at Sheepskin.

- Uprate Y-40 Gran Grae-Boscobel 69-kV line to achieve a 99 MVA summer emergency rating
  - Asset Renewal initially identified 116 structures on the Gran Grae-Boscobel line to be replaced due to various maintenance issues. Based on the Y-40 thermal rating analysis, it was determined that the additional scope for uprating the line from 200 degrees F to 300 degrees F would be to replace an additional 19 structures. It makes sense to combine this uprate with the previously identified maintenance project because these structures are very close to the previously identified poles. There are significant cost savings that can be obtained from performing the additional work as part of the maintenance project rather than completing the work as a separate future project.
- Y-8 Dane-Lodi 69-kV line rebuild
  - A portion of the 69-kV Dane-Dam Heights line will be rebuilt in the year 2012 as a part of an asset renewal project that addresses first contingency overloads in the year 2015.

Zone 3 - 2015 study results

Refer to Table ZS-2 and Figure ZS-10

Summary of key findings

- Numerous low voltages and line overloads along with the potential for voltage collapse in the Madison area signal the need for another new 345-kV source on the west side of Madison,
- The Brick Church-North Lake Geneva 69-kV line faces both thermal and low voltage issues,
- Load growth in Green County, west of Rock County and south of Dane County requires one additional 69-kV source into the area. Adding the Bass Creek 138/69-kV transformation will address a number of potential low voltage issues and transformer overloads.
- Due to 69-kV system load growth in Verona and Spring Green areas, the West Middleton-Stage Coach 69-kV line requires higher capacity, and
- As load grows there is a potential for single-contingency thermal overloads on the Dane-Lodi 69-kV line.

There were a number of facility overloads and several facilities near their emergency ratings in Zone 3 based on the 2015 analysis. Several projects are either planned or proposed to address these near-term thermal problems. As a result, ATC proposes to uprate three 69-kV lines and one 138-kV line. In addition, the remainder of Y-119 69-kV line from Sun Valley Tap to Oregon should be rebuilt due to pending condition concerns and future loading concerns dependent on clearances and load growth.

In 2009, ATC received the regulatory CPCN approval for the Rockdale-West Middleton (Cardinal) 345-kV line project. This project will address line overloads and low voltage issues in Dane County and is planned to be in-service in 2013.

Certain issues in southeastern Zone 3 are related to the 69-kV loop between North Lake Geneva and Brick Church. If one of the sources is out of service, low voltage will exist on that end of the line and thermal issues will exist on the other end. The 2015 analysis found the Lake Geneva, South Lake Geneva, Katzenberg, and Twin Lakes 69-kV buses experienced unacceptable bus voltages with the North Lake Geneva – Lake Geneva 69-kV line out of service. Likewise, an outage of the Brick Church – Cobblestone 69-kV line will result in the Cobblestone 69-kV bus voltage dropping to near unacceptable levels. Thermal issues will occur on the same loop. The Cobblestone – Zenda tap will exceed its summer emergency rating for an outage of North Lake Geneva – Lake Geneva 69-kV line. The Katzenberg – Zenda tap will approach its summer emergency rating for the same outage. The project to construct a 138-kV line between North Lake Geneva and South Lake Geneva and install a 138/69-kV transformer at South Lake Geneva can provide thermal

and voltage relief in the Lake Geneva area. The preliminary in-service date is 2016; however, it could be delayed if the study area load forecast change justifies such action.

The Colley Road 138/69-kV transformer will approach its summer emergency rating for an outage of the Paddock 138/69-kV transformer by 2015. The proposed project to install a 138/69-kV transformer at Bass Creek will resolve the thermal issues in the area for the foreseeable future.

The Evansville and Brodhead areas are facing unacceptably low voltages under single contingency conditions. In addition, the North Monroe 138/69-kV transformer loading is approaching its summer normal rating under system intact conditions. In conjunction with the rebuild of line Y-33 from Brodhead to South Monroe (2011), a new Bass Creek 138/69-kV transformer and the Townline Road–Bass Creek 138-kV line uprate in 2013 will address these problems and provide an additional 69-kV source into Green and Rock Counties. These projects will also allow the delay of a new Brooklyn to Evansville 69-kV line project outside of ATC's 10-year planning horizon.

A new project is created to uprate the West Middleton-Stage Coach 69-kV line by 2015. It will address potential line overload problems under several single contingency conditions. A LiDar survey and a thermal rating analysis will be conducted to determine the final scope of the project.

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

Rebuild the Y-119 Verona-Oregon 69-kV line
The need year is listed as 2008. The in-service year is 2014. Distribution load shifting at Stoughton will eliminate potential system limitations in the 2008-2014 timeframe.

Bass Creek transformer and uprate Town Line Road-Bass Creek 138-kV line X-12
The need year is listed as 2010. The in-service year is 2013. Mitigation measures for the potential 2010-2012 system limitations include installing a 5.7 MVAR distribution capacitor bank at the Union Townline 69-kV Substation (2009) and upgrading the existing Sheepskin capacitor bank from 10.8 MVAR to 16.2 MVAR (2010).

Uprate Fitchburg-Nine Springs and Royster-Pflaum 69-kV lines, move AGA to the Femrite-Royster 69-kV line and install Nine Springs capacitor bank
The need year is listed as 2006. The in-service year is 2013. Post-contingency distribution load bridging will be utilized as an interim mitigation measure to alleviate potential single-contingency thermal and voltage issues.

Zone 3 - 2020 study results

Refer to Table ZS-3 and Figure ZS-11

Summary of key findings

- Additional reactive power is needed throughout the Zone 3,
- Load growth in the Lake Geneva area continues to cause severe single-contingency thermal overloads and low voltages,
- Potential single-contingency thermal overloads on the Kirkwood-Artesian 138-kV line,
- The existing Hillman 138/69-kV transformer overloads under single contingency in the Dairyland Power system,
- The West Middleton (Cardinal) - Blount 138-kV project is delayed from 2017 to 2020; the primary need driver is the outage of North Madison-Columbia 345-kV double circuit line,
- Potential single-contingency thermal overloads on the Gran Grae-Boscobel 69-kV line will require system reinforcements,
- Thermal overloads call for reinforcement on the Y-32 Colley Road-Brick Church 69-kV line,
- Due to 69-kV system load growth in Green County, the North Monroe-South Monroe 69-kV line requires higher capacity,
- Several projects were delayed due to lower load forecast in certain local area, and
- The new in-service dates were determined considering not only the need dates identified in the 2010 10-Year Assessment, but also the need dates identified in both the 2008 and the 2009 Assessments.

In response to low voltages throughout Zone 3, a significant amount of capacitor banks distributed at the Eden, Mazomanie, Concord, Brick Church, Sun Prairie, Dam Heights, North Monroe and Boscobel substations in the 2016-2020 timeframe were deemed to be the preliminary solutions.

There were a number of facility overloads and several facilities near their emergency ratings in Zone 3 based on the 2020 analysis. Two 69-kV line uprate projects and two new 138/69-kV transformer projects (Hillman and Spring Green Substations) have been proposed to address these thermal problems.

A new project was created to uprate the North Monroe-South Monroe 69-kV line by 2018. It will address potential line overload problems under several single contingency conditions. A LiDar survey and a thermal rating analysis will be conducted to determine the final scope of the project.

Potential Kirkwood to Artesian line overloads and serious post-contingency low voltages around the Reedsburg loop call for additional transmission reinforcements. The Lake Delton-Birchwood 138-kV project in 2020 will not only interconnect a new T-D substation, but also address impending low voltages and overloads identified on the transmission system.

In the 2008 Assessment, the West Middleton 138/69-kV transformers and West Middleton-Blackhawk 69-kV line were observed to be overloaded under single-contingency conditions in the 2017 timeframe. To address these thermal overloads, a Cardinal to Blount 138-kV line project was being considered. In conjunction with the Rockdale-West Middleton (Cardinal) 345-kV line project (2013), the Cardinal-Blount 138-kV line could eliminate the thermal overload issues in the long term and provide additional transfer capability into downtown Madison. The status of this project was provisional for several reasons.

- The West Middleton 138/69-kV transformer ratings need to be validated.
- The in-service date driver needs to be confirmed to determine whether the summer normal overloads can be mitigated by other means.
- Project alternatives have not been thoroughly developed and evaluated.

In 2013, the existing West Middleton Substation will be divided into two separate adjacent substations behind the same fence as follows:

- West Middleton will remain as 69 kV, and
- Cardinal Substation will encompass 138 and 345-kV portions of the substation.

Since the 2008 Assessment, the West Middleton (Cardinal) 138/69-kV transformer ratings have been validated with higher ratings. In addition, with the new load forecasts utilized in the 2009 and 2010 Assessments, the original needs for the Cardinal-Blount 138-kV project are sliding out of 10-year planning horizon. However, considering the potential severe low voltage problem under the Columbia-North Madison 345 kV double circuit tower outage condition, as a potential long term solution, it was decided to keep the project in the project table as a provisional 2020 project. It is provisional because the justification of the project needs to be confirmed and a project scope needs to be developed. Please note, due to a potential large T-D project development in Madison area, the in-service date for this project could be advanced.

Significant load growth near the Lamar area causes numerous system constraints. Near term solutions have been developed:

1. Uprating Stoughton Substation terminal equipment to achieve a 169 MVA summer emergency rating on Y-46 in 2009.
2. Uprating the McCue-Lamar section of the Y-61 to a minimum summer emergency rating of 115 MVA in 2010.
3. Installing 2-12.45 MVAR 69-kV capacitor banks at Lamar Substation in 2010.

However, these near-term solutions will not be sufficient after approximately six years. Subsequently, a longer term plan will be developed and implemented before 2017 to address the emerging McCue-Lamar and Bass Creek-Footville thermal overloads and voltage limitations at the Lamar Substation under single-contingency conditions. A second 69-kV line from McCue to Lamar is currently being considered as a placeholder to resolve the issues in this area.

The Y-32, Colley Road-Brick Church 69-kV line faces both contingency thermal overloads and age and condition issues. With the proposed 2016 North Lake Geneva-South Lake Geneva 138-kV line project, the need for rebuilding Y-32 can be delayed to the 2018 timeframe. The delay provides planners additional time to develop the provisional Spring Valley-Lake Geneva 138-kV project which may delay the Y-32 project even further in time. Depending on the final scope of the Spring Valley-Lake Geneva 138-kV project, ATC will revisit the in-service date for the Y-32 line rebuild project.

Many of the issues in southeastern Zone 3 continue to be related to the 69-kV loop between North Lake Geneva and Brick Church. With one of the sources out of service, low voltage will exist on one end of the line and thermal issues on the other end. The 2020 analysis found the Lake Geneva, South Lake Geneva, Katzenberg, and Twin Lakes 69-kV buses experienced low voltages under different contingency conditions. Likewise, an outage of the Brick Church – Cobblestone 69-kV line will result in the Cobblestone, Zenda, Twin Lakes, and Katzenberg 69-kV buses to experience low voltages. The Brick Church transformer can expect to be heavily loaded for two contingencies. An outage of the North Lake Geneva 138/69-kV transformer or the North Lake Geneva – Lake Geneva 69-kV line will cause the Brick Church transformer to load to exceed or approach its summer emergency rating. The proposed North Lake Geneva – South Lake Geneva project will resolve most of the voltage and thermal issues. As suggested above, a provisional project to construct a Spring Valley – Lake Geneva 138-kV line is being considered to further strengthen this area in addition to providing network service to We Energies' Spring Valley Substation.

The Brick Church 138-kV bus can experience low voltages under various contingencies. The provisional project of 2-24.5 MVAR 138-kV capacitor banks and 1-18 MVAR 69-kV capacitor bank at Brick Church will address these issues. The Brick Church capacitors will be placed in service in 2017.

The Colley Road 138/69-kV transformer will exceed its summer emergency rating for an outage of the Paddock 138/69-kV transformer. The installation of a 138/69-kV transformer at Bass Creek should provide relief.

Zone 3 - 2025 study results

Refer to Table ZS-4 and Figure ZS-12

Summary of key findings

- ❑ Load growth in the Green, Grant, Dane and Rock County areas will drive the need for additional 138/69-kV transformer capacity and 69-kV line uprate,
- ❑ Several 69-kV lines in the West Middleton, Waunakee, East Towne and Sycamore area are approaching their summer emergency ratings under single contingency conditions,
- ❑ Many potential terminal, line uprates or line rebuild projects will be needed in the 2020-2025 timeframe,
- ❑ System intact low voltages exist on the 138-kV system in Dane County and on the 138-kV system from Nelson Dewey to Kilbourn,
- ❑ Numerous low voltage limitations exist under single-contingency conditions throughout Zone 3, and
- ❑ Potential single-contingency thermal overloads on the Columbia-Portage 138-kV lines.

The 2025 results suggest that further study of Zone 3, particularly around Dane, Green and Grant Counties, is needed to identify an appropriate long-term solution for this area that may be required beyond the year 2020.

The West Middleton-Timberlane 69-kV line will exceed its summer normal rating under system intact conditions. This issue may call for additional 138-kV outlet from West Middleton to its west.

Jennings Switching Station-DPC Gratiot Tap 69-kV line will exceed or approach its summer emergency rating for the loss of either North Monroe – Idle Hour 69-kV line or North Monroe 138/69-kV transformer.

The Boscobel – Blue River Tap 69-kV line is also overloaded for a number of outages. A potential line uprate project will address the problem.

To address thermal overloads, the rating of the Portage-Trienda 138-kV line will need to be increased in 2022.

The Paddock 138/69-kV transformer will exceed its summer normal rating of 93MVA with the transmission system intact. An outage of the Colley Road transformer or the Colley Road – Park Street / East Rockton 69-kV line causes the Paddock transformer to exceed or approach its summer emergency rating of 143 MVA. Similarly, an outage of the Paddock

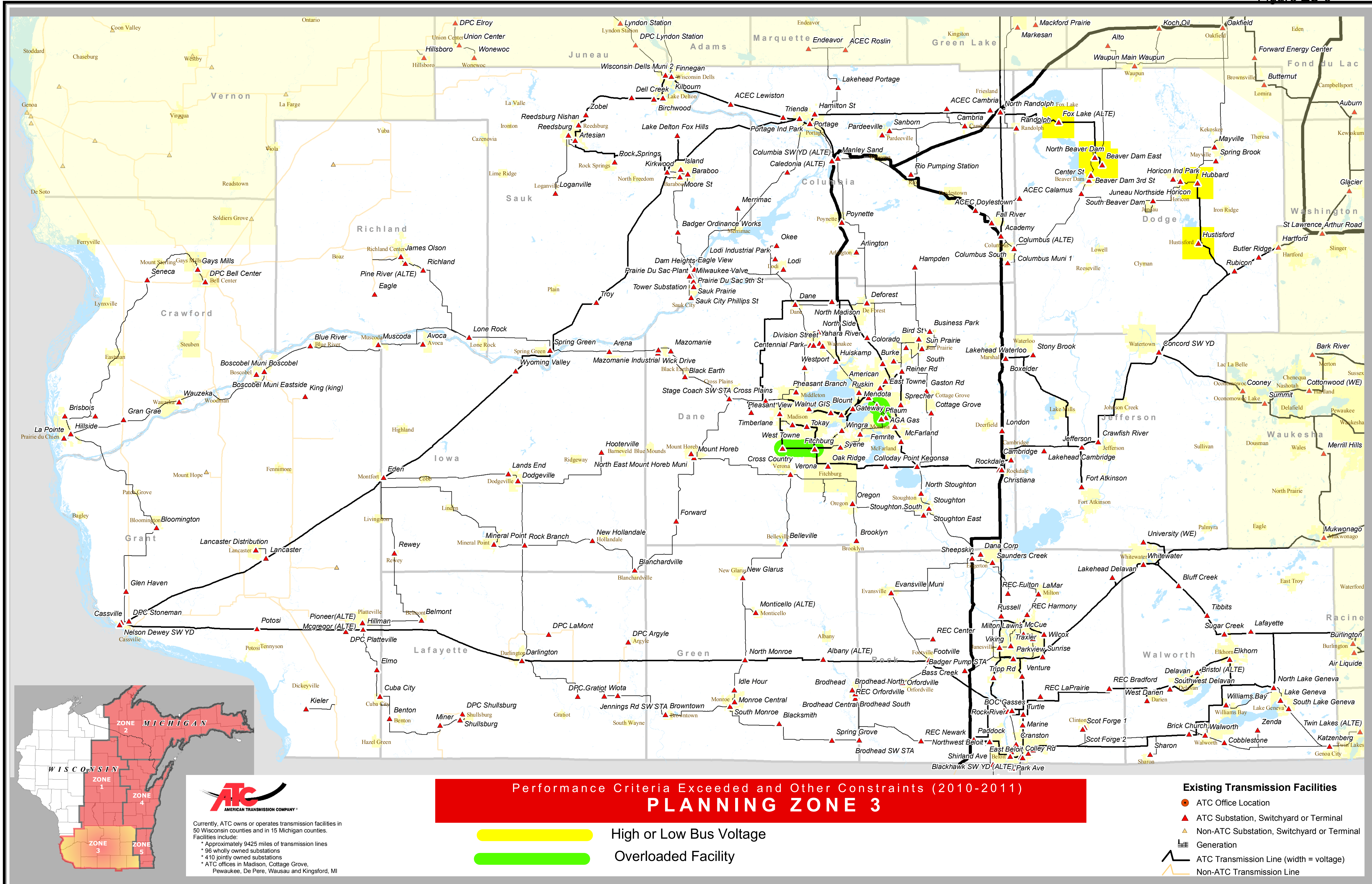
138/69-kV transformer causes the Shaw – East Rockton 69-kV line and Park Street – Colley Road 69-kV line to exceed their summer emergency ratings.

The Columbia-Portage 138-kV line is overloaded for the loss of the other Columbia to Portage 138-kV line by 2025. Adding a North Randolph 345/138-kV transformer is proposed to relieve these overloads. This project is also expected to provide needed voltage support for Dodge and Jefferson Counties.

The provisional project of constructing a Hubbard-East Beaver Dam 138-kV line will address not only several 69-kV thermal overloads, but also the low voltages in the Beaver Dam area for an outage of the North Randolph-North Beaver Dam 138-kV line. This project was delayed from 2016 to 2020 as a result of reduced load growth in the area.

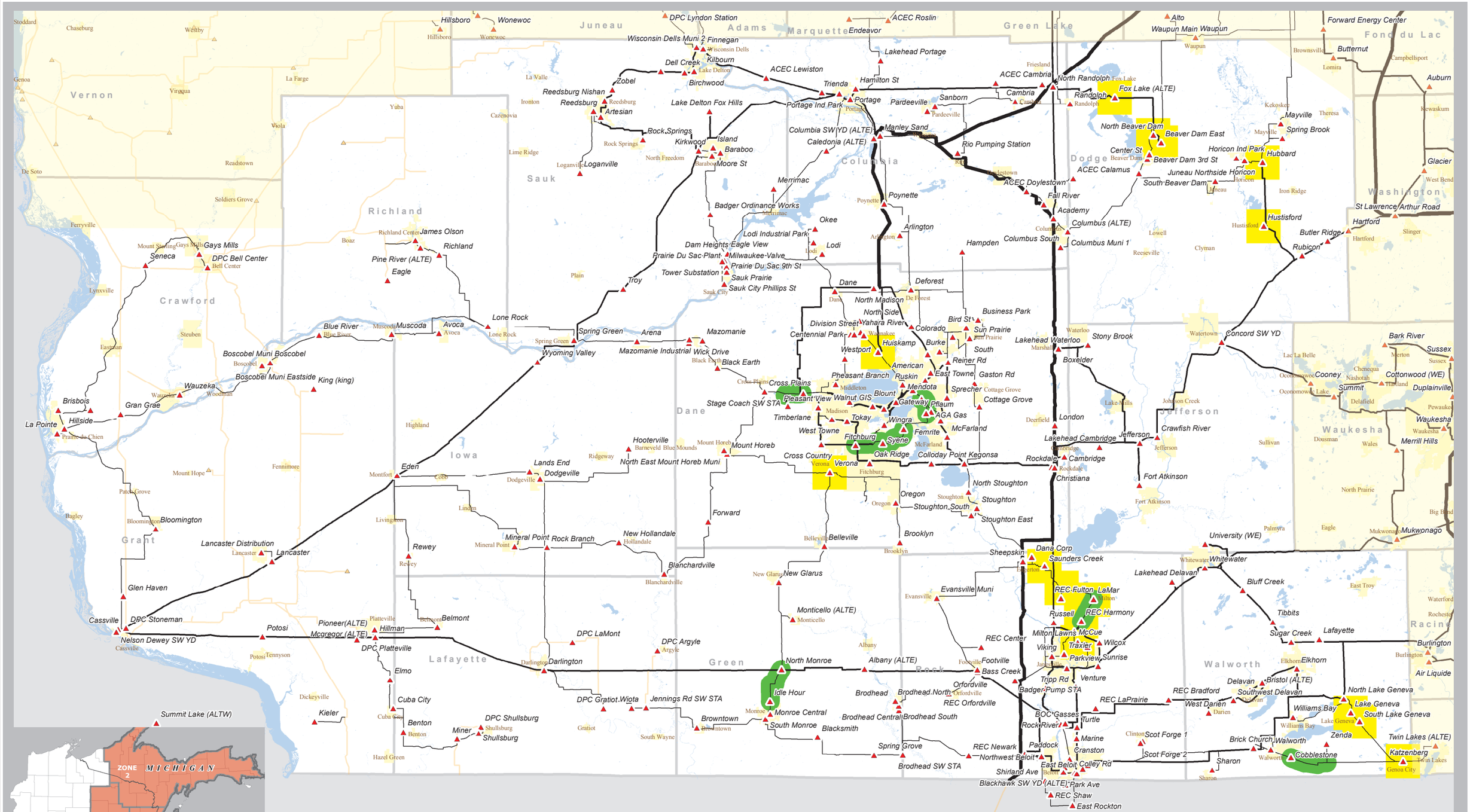
Assessment of Steady State Compliance with NERC Standards
The mitigation plans comprised of planned, proposed and provisional projects identified for Zone 3 in this Assessment will allow the ATC system in Zone 3 to meet the steady state portions of NERC standards TPL-001 and TPL-002 in each of the five years 2011-2015, and for the 2016-2020 planning horizon.

Figure ZS-9



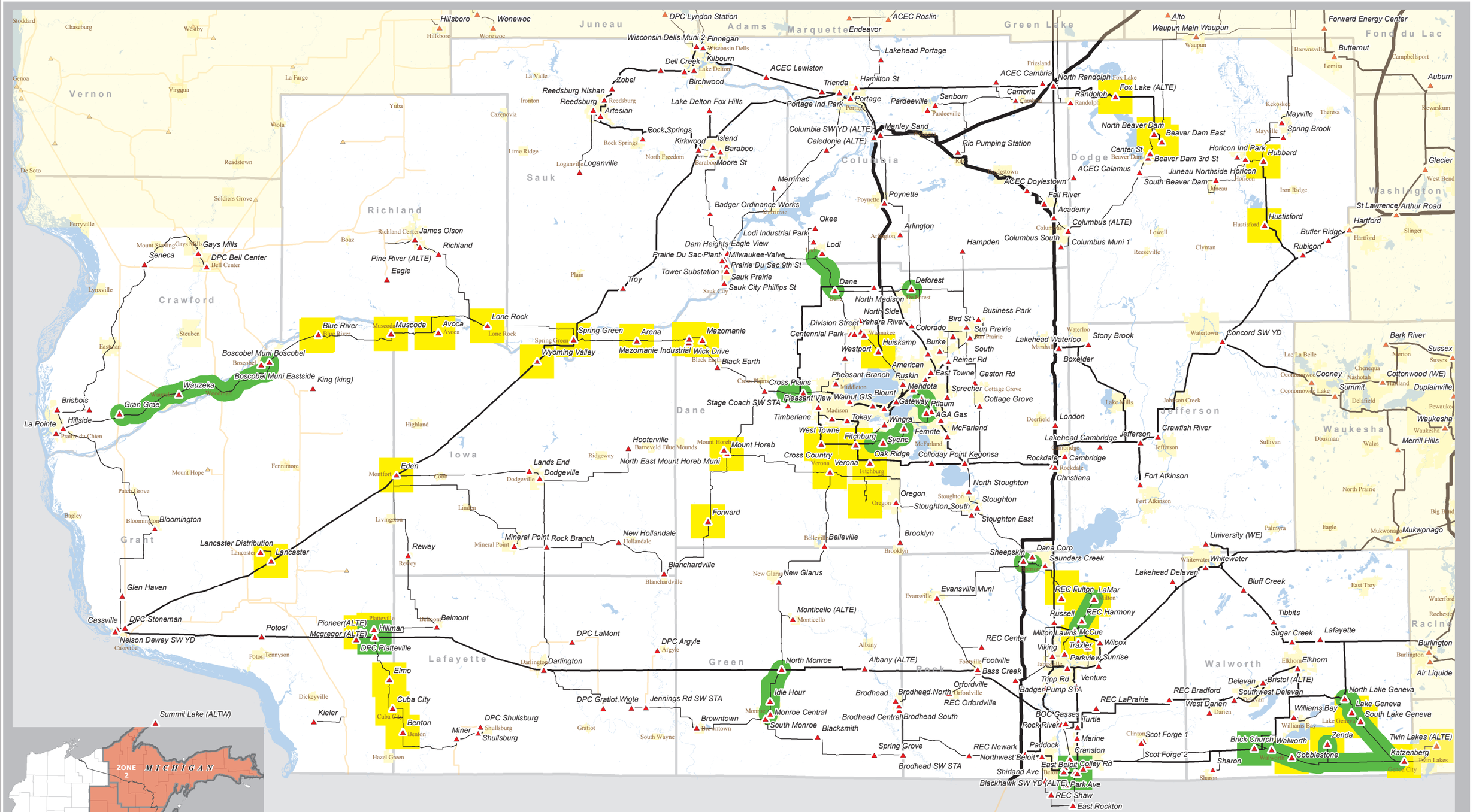
Modified: April 8, 2010

Figure ZS-10



Modified: April 27, 2010

Figure ZS-11



ATC
AMERICAN TRANSMISSION COMPANY®

Currently, ATC owns or operates transmission facilities in 50 Wisconsin counties and in 15 Michigan counties.
Facilities include:
* Approximately 9425 miles of transmission lines
* 96 wholly owned substations
* 410 jointly owned substations
* ATC offices in Madison, Cottage Grove, Pewaukee, De Pere, Wausau and Kingsford, MI

Performance Criteria Exceeded and Other Constraints (2015-2020)

PLANNING ZONE 3

High or Low Bus Voltage

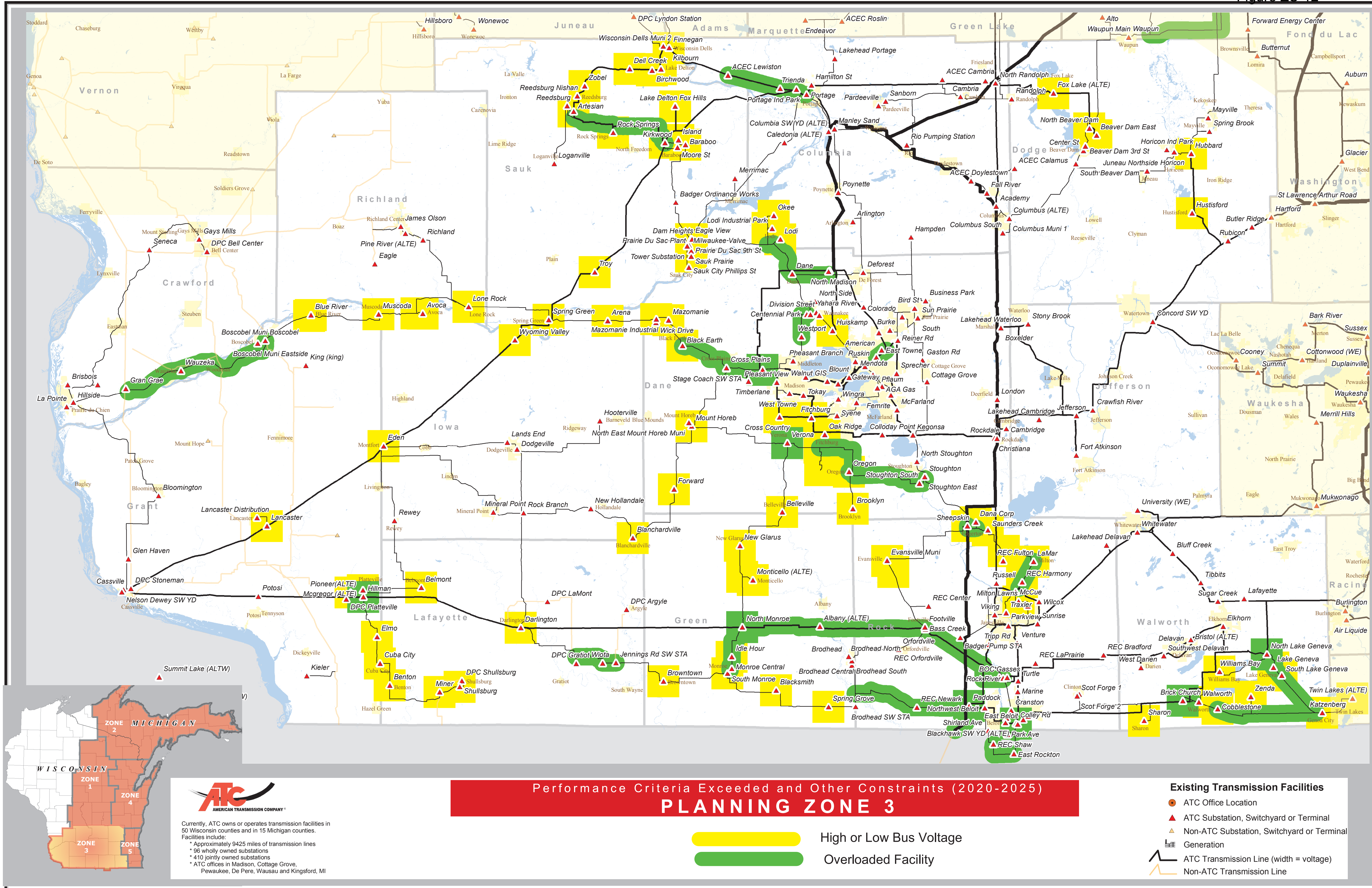
Overloaded Facility

Existing Transmission Facilities

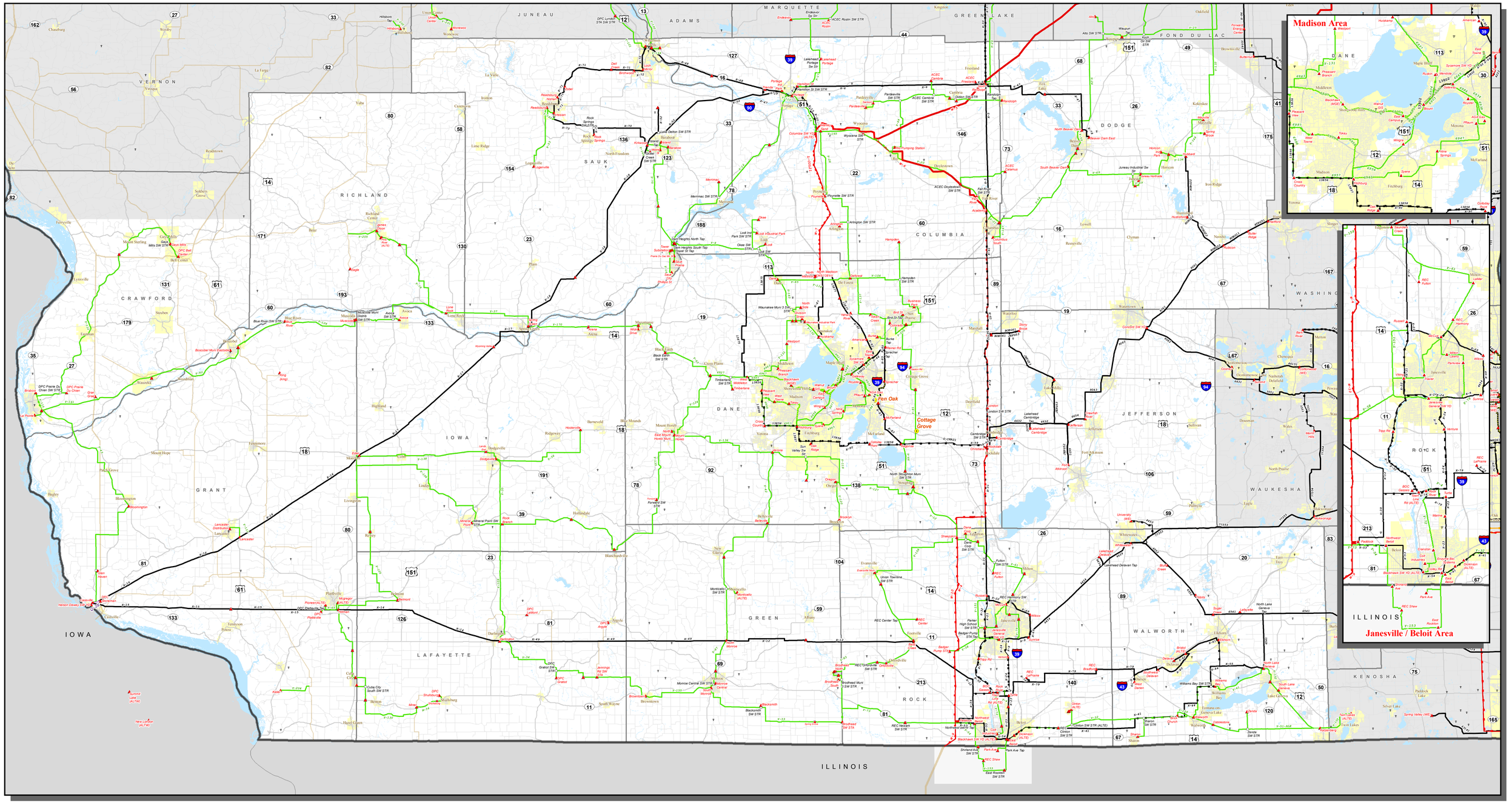
- ATC Office Location
- ATC Substation, Switchyard or Terminal
- Non-ATC Substation, Switchyard or Terminal
- Generation
- ATC Transmission Line (width = voltage)
- Non-ATC Transmission Line

Modified: April 27, 2010

Figure ZS-12



Modified: April 27, 2010



Electric Transmission and Related Facilities

Transmission Facilities

- Substation or Switching Yard
- Tap or Switching Structure
- Generation
- ATC Office Location
- Airport, Airfield or Helicopter Landing Area

Transmission Line Voltage and Type

- 69 kV
- 69 kV Double Circuit
- 69 kV Underground
- 115 kV
- 115 kV Double Circuit
- 138 kV
- 138 kV Double Circuit
- 138 kV Underground
- 161 kV
- 161 kV Double Circuit
- 230 kV
- 230 kV Double Circuit
- 345 kV
- 345 kV Double Circuit
- Non-Op Underground
- Mixed voltage double circuit lines drawn with each line color corresponding to the appropriate voltage.

Non-ATC

- < 50 kV
- 69 kV
- 88 kV
- 115 kV
- 161 kV
- 345 kV

Miles

5 0 5 10 15 20

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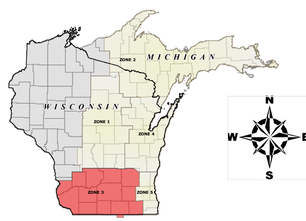
Transmission Network and Substations

PLANNING ZONE 3

Revised May 2010



AMERICAN TRANSMISSION COMPANY®

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, MI*

The information presented in this map document represent the most current and accurate georeferenced compilation of ATC owned and operated transmission facilities available - some facility locations may be approximate. This map is advisory and intended for reference purposes only. Please direct any revisions or corrections to ATC Asset Applications and GIS Group.

Base Map Information: ATC, PSCW, MiDNR, WDNR

Table ZS-1
2011 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2011 Summer Peak Case		2011 90% Load Case		2011 70% Load Case		2011 Minimum Load Case		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	% of Facility Rating	% of Nominal Bus Voltage		
1	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact	
1	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	FALSE	--	TRUE	System Intact	
1	Dartford 69-kV bus	--	91.7%	--	--	--	--	--	--	Metomen – Ripon 69-kV line	Marginal voltage, no mitigation needed within this timeframe
1	Petenwell and Council Creek 138-kV buses	--	89.2% 89.2 – 89.8%	--	90.3 – 96.7% 90.1 – 91.2%	--	--	--	--	ACEC Badger West – Saratoga 138-kV line ACEC Badger West – Petenwell 138-kV line	Adjust Council Creek 138/69-kV transformer LTC
1	ACEC Badger West 138-kV bus	--	89.2%	--	90.3%	--	--	--	--	ACEC Badger West – Saratoga 138-kV line	Adjust Council Creek 138/69-kV transformer LTC
1	Necedah, ACEC Dellwood, Friendship, ACEC Friendship and Houghton Rock 69-kV buses	--	87.9 – 91.9% 87.9 – 91.9% 88.9 – 91.9% 90.9 – 91.4%	--	87.9 – 91.9% 88.7 – 91.5% 88.7 – 91.5% 90.0 – 91.4%	--	--	--	--	Petenwell 138/69-kV transformer Petenwell – Big Pond 69-kV line Necedah Tap – Big Pond 69-kV line Necedah Tap – Whistling Wings Tap 69-kV line	Mitigated by generation adjustments
1	Brooks Corner 69-kV bus	--	87.5%	--	88.2%	--	90.2%	--	91.5%	Whitcomb – Deer Trail 69-kV line[4]	Adjust Brooks Corners 69/34.5-kV transformer LTC
1	Arpin 345-kV bus	--	--	--	--	--	--	--	105.4% 110.0%	System Intact Arpin – Rocky Run 345-kV line[1]	Switch Port Edwards 69-kV and McMillan 115-kV capacitors offline
1	Harrison 69-kV bus	--	--	--	--	--	--	--	106.4%	System Intact	Switch Harrison 69-kV capacitor offline
1	Caroline 115-kV bus	--	--	--	--	--	--	--	106.3%	System Intact	Switch area capacitor banks offline and adjust area transformer LTCs
1	Whitcomb 115-kV bus	--	--	--	--	--	--	--	106.0%	System Intact	Switch Birnamwood 69-kV capacitor bank offline and/or corrected Whitcomb transformer modeling
1	Petenwell 138/69-kV transformer	99.0% 95.6%	--	--	--	--	--	--	--	McKenna – Houghton Rock 69-kV line Castle Rock – Quincy ACEC 69-kV line	Mitigated by generation adjustments
1	Vulcan – Port Edwards 138-kV line #1 Vulcan – Port Edwards 138-kV line #2	123.0% 122.8%	--	123.0% 122.8%	--	123.0% 122.8%	--	123.0% 122.8%	--	Port Edwards – Vulcan Chemical 138-kV #2 line Port Edwards – Vulcan Chemical 138-kV #1 line	Change tap on free standing CT's at Port Edwards
2	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact	
2	Base case voltage criteria exceeded	--	TRUE	--	TRUE	--	TRUE	--	TRUE	System Intact	
2	M38 – Atlantic 69-kV line	116.8 – 121.6%	--	105.0% 105.0% 110.9%	--	--	--	-- --	-- --	M38 – Atlantic 138-kV line Atlantic 138/69-kV transformer M38 – Atlantic 138-kV line[5]	Mitigated by generation adjustments or uprate line
2	Nordic – Mountain 69-kV line	--	--	--	--	96.8% 98.8%	--	--	--	Plains – Arnold 138-kV line Chandler 138/69-kV transformer	Targeted for mitigation by Escanaba area reinforcements

Table ZS-1
2011 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2011 Summer Peak Case		2011 90% Load Case		2011 70% Load Case		2011 Minimum Load Case		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	% of Facility Rating	% of Nominal Bus Voltage		
2	Plains – Arnold 138-kV line	--	--	--	--	95.2%	--	--	--	Dead River 345/138-kV transformers[2]	Targeted for mitigation by Escanaba area reinforcements
2	Straits – McGulpin 138-kV line 9903	97.6%	--	97.6%	--	--	--	--	--	Straits – McGulpin 138-kV line 9901	Targeted for mitigation by Eastern U.P. area reinforcements
2	Pine River – Straits 69-kV line Pine River – Evergreen 69-kV line Evergreen – Straits 69-kV line	--	--	102.4 – 108.8% 102.1 – 108.4% 107.1 – 113.8% 106.7 – 111.9% 105.7 – 111.0%	--	--	--	--	--	Straits – Hiawatha 138-kV line 9902 Straits 138/69-kV transformer Straits – Brevort 138-kV line Brevort – Lakehead 138-kV line Hiawatha – Lakehead 138-kV line	Targeted for mitigation by Eastern U.P. area reinforcements
2	Engadine, Newberry, Newberry Hospital, Roberts, LouPac, Newberry Village, Hulbert and Eckerman 69-kV buses	--	82.9 – 90.7%	--	--	--	--	--	--	Hiawatha – Engadine 69-kV line Engadine – Newberry 69-kV line	Mitigated by generation adjustments
2	Engadine, Newberry, LouPac, Newberry Hospital, Newberry Village, Roberts 69-kV buses	--	--	--	89.4 – 89.9%	--	--	--	--	Hiawatha – Engadine 69-kV line	Mitigated by generation adjustments
2	Engadine, Newberry, Newberry Hospital, Roberts, LouPac, Newberry Village 69-kV buses	--	--	--	89.1 – 89.6%	--	--	--	--	Hiawatha – Engadine 69-kV line[6]	Mitigated by generation adjustments
2	Brevort, Hiawatha and Lakehead 138-kV buses	--	--	--	91.2 – 91.4%	--	--	--	--	Brevort – Straits 138-kV line	Targeted for mitigation by Eastern U.P. area reinforcements
2	Brevort and Lakehead 138-kV buses	--	--	--	91.6 – 91.7%	--	--	--	--	Brevort – Lakehead 138-kV line	Targeted for mitigation by Eastern U.P. area reinforcements
2	Hiawatha 138-kV bus	--	--	--	91.4%	--	--	--	--	Hiawatha – Lakehead 138-kV line	Targeted for mitigation by Eastern U.P. area reinforcements
2	North Bluff, Bay View, Mead, Gladstone, Masonville and Lakehead 69-kV buses	--	90.8 – 91.6%	--	--	--	--	--	--	Chandler 138/69-kV transformer	Mitigated by generation adjustments
2	Chandler, Delta, Escanaba, Masonville, Mead, Gladstone, West, Lakehead, North Bluff, Bay View, Cornell, Harris 69-kV buses	--	--	--	--	--	88.4 – 91.1%	--	--	Chandler 138/69-kV transformer	Mitigated by generation adjustments
2	Ontonagon, Stone Container and Winona 138-kV buses	--	91.3 – 91.7%	--	--	--	91.5 – 91.9%	--	--	M38 – Winona 138-kV line	Mitigated by generation adjustments
2	Straits, St. Ignace, Indian Lake, Evergreen, Valley, Glen Jenks, Manistique, Engadine, Hiawatha, Gould City, Curtis, Rexton, and Blaney Park 69-kV buses and Straits 138-kV bus	--	104.1 – 105.7%	--	--	--	104.2 – 108.0%	--	104.6 – 106.2%	System Intact	Adjust transformer tap settings at Hiawatha, Indian Lake, Straits
2	Hiawatha and Lakehead 138-kV buses	--	--	--	94.2 – 95.2%	--	--	--	105.9 – 106.0%	System Intact	Mitigated by generation adjustments
2	Alger Delta Hiawatha, Sault, Eckerman, Goetzville, Pickford, Rudyard, Newberry Hospital, Newberry Village, Three Mile, Magazine, Kinchloe, Trout Lake, Munising, Alger, Hulbert, Brimley, Dafter, Detour, Engadine, Newberry, Raco, LouPac, Roberts, ESE Hydro, Nine Mile, Pine River, Rockview, Pine Grove, Tone, Talentino 69-kV buses and Brevort 138-kV bus	--	--	--	--	--	--	--	105.0 – 106.5%	System Intact	Mitigated by generation adjustments
2	Lakota Road 69-kV bus	--	--	--	--	--	--	--	119.1%	Lakota Road – Conover 69-kV line	Resolved by transformer model adjustments
2	Lakota Road 115-kV bus	--	--	--	--	--	--	--	110.4%	Eagle River – Cranberry 115-kV line	Mitigated by generation adjustments
2	Atlantic 138-kV bus	--	--	--	--	--	--	--	113.0%	Atlantic – M38 138-kV line	Mitigated by generation adjustments
3	Base Case Loading Criteria Exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact	
3	Base Case Voltage Criteria Exceeded	--	FALSE	--	FALSE	--	FALSE	--	FALSE	System Intact	

Table ZS-1
2011 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2011 Summer Peak Case		2011 90% Load Case		2011 70% Load Case		2011 Minimum Load Case		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	% of Facility Rating	% of Nominal Bus Voltage		
3	Concord 138-kV bus	--	95.5%	--	--	--	--	--	--	System Intact	Mitigated by generation adjustments
3	Concord, Butler Ridge, and Rubicon 138-kV buses	--	--	--	95.2 – 95.9%	--	--	--	--	System Intact	Mitigated by generation adjustments
3	Butler Ridge and Rubicon 138-kV buses	--	90.9 – 91.4%	--	--	--	--	--	--	Hartford – St. Lawrence 138-kV line	Mitigated by generation adjustments
3	Crawfish River 138-kV bus	--	--	--	91.1%	--	--	--	--	Jefferson – Crawfish River 138-kV line	Mitigated by generation adjustments
3	Crawfish River and Concord 138-kV buses	--	90.5 – 91.7%	--	--	--	--	--	--	Jefferson – Crawfish River 138-kV line	Mitigated by generation adjustments
3	Paddock – Townline 138kV line	--	--	--	--	99.0% 97.1%	--	--	--	NW Beloit – Paddock 138-kV line Blackhawk – NW Beloit 138kV	Mitigated by generation adjustments
3	Hubbard and Hustisford 138-kV buses	--	96% 86.5% 87.1% 87.1% 90.7 – 90.9%	--	95.9% 87.2% 87.7% 87.% --	--	-- -- 87.2% 87.3% --	--	--	System Intact Rubicon – Hustisford 138-kV line Hustisford – Hubbard 138-kV line Rubicon – Hustisford – Hubbard 138-kV line Hartford – St. Lawrence 138-kV line	Adjust Hubbard 138/69-kV transformer LTC
3	Fox Lake, North Beaver Dam and Beaver Dam East 138-kV buses	--	89.2 – 89.3%	--	--	--	--	--	--	North Randolph – Fox Lake 138-kV line	Adjust North Beaver Dam 138/69-kV transformer LTC
3	Fitchburg 138-kV bus	--	--	--	--	--	96.0%	--	--	System Intact	Femrite and Kegonsa 138-kV capacitor banks
3	Huiskamp 138-kV bus	--	--	--	88.6%	--	88.4%	--	--	Huiskamp – North Madison 138-kV line	Adjust Huiskamp 138/69-kV transformer LTC
3	Verona and Fitchburg 138-kV buses	--	--	--	--	--	91.8 – 91.9%	--	--	Columbia generator #1	Femrite and Kegonsa 138-kV capacitor banks
3	Nelson Dewey 161/138-kV transformer	--	--	--	--	95.6% 95.4%	--	--	--	CE Byron generator #1 CE Byron generator #2	Mitigated by generation adjustments
3	Nelson Dewey – Cassville 161-kV line	--	--	--	--	99.6% 95.8%	--	--	--	DPC Genoa generator #3 Columbia generator #2	DPC line limitation / further study needed
3	Fitchburg – Syene 69-kV line	104.9%	--	95.3%	--	--	--	--	--	Royster – AGA Tap 69-kV line	Short term Operating Guide / Nine Springs, Pflaum area project
3	Royster – AGA Gas Tap 69-kV line	103.0%	--	--	--	--	--	--	--	Fitchburg – Syene 69-kV line	Short term Operating Guide / Nine Springs, Pflaum area project
3	Verona 138-kV bus	--	95.7% 90.2%	--	-- 90.2%	--	--	--	-- 114.8%	System Intact Verona – Oak Ridge 138-kV line	Adjust Verona 138/69-kV transformer LTC / Verona 69-kV capacitor bank project
3	Fitchburg, Cross County, Oak Ridge and Pleasant View 138-kV buses	--	95.3 – 95.9%	--	--	--	--	--	--	System Intact	Femrite and Kegonsa 138-kV capacitor banks
3	Verona, Oak Ridge, Pleasant View, Cross Country, Pleasant View, and Fitchburg 138-kV buses	--	--	--	95.0 – 95.9%	--	--	--	--	System Intact	Femrite and Kegonsa 138-kV capacitor banks
3	REC Harmony, Milton Tap and Milton 69-kV buses	--	91.9 – 92.0%	--	--	--	--	--	--	McCue – Harmony 69-kV line	Lamar 69-kV capacitor bank project
4	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact	
4	Base case voltage criteria exceeded	--	TRUE	--	FALSE	--	FALSE	--	TRUE	System Intact	
4	Badger & Belle Plaine 115-kV buses	--	105.0%	--	--	--	--	--	106.4%	System Intact	Switch Badger 138-kV capacitor banks offline
4	East Krok 138/69-kV transformer	103.2%	--	103.1%	--	98.1%	--	--	--	Canal – East Krok 138-kV line	No project needed Investigation into limiting facility resulted in higher facility ratings
4	Sunset Point – Pearl Avenue 69-kV line	108.2% 107.8%	--	97.1% 97.0%	--	--	--	--	--	Ellinwood 138/69-kV transformer[3] Ellinwood – 12th Avenue 69-kV line	Rebuild line
4	Morgan – Falls 138-kV line	--	--	--	--	105.7%	--	--	--	Morgan – Plains 345-kV line	Mitigated by generation adjustments
4	White Clay 138-kV 1-2 bus tie	--	--	--	--	96.0%	--	--	--	Morgan – Highway 22 345-kV line	Further study needed
4	North Appleton, Apple Hills, Maes, Combined Locks tap & City Limits 138-kV buses	--	--	--	--	--	--	--	104.1 – 105.3%	System Intact	Switch off area capacitor banks

Table ZS-1
2011 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2011 Summer Peak Case		2011 90% Load Case		2011 70% Load Case		2011 Minimum Load Case		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	% of Facility Rating	% of Nominal Bus Voltage		
4	Werner West, Werner & Hintz 138-kV buses	--	--	--	--	--	--	--	105.4 – 105.5%	System Intact	Switch off area capacitor banks
4	City Limits, Lake Park & Forest Junction 138-kV buses	--	--	--	--	--	--	--	104.1 – 105.1%	System Intact	Switch off area capacitor banks
4	Butte des Morts, Northside, Tayco, Melissa, Meadows Kaukauna Central tap & Forest Junction 138-kV buses	--	--	--	--	--	--	--	104.2 – 105.1%	System Intact	Switch off area capacitor banks
4	Kaukauna Central tap, Kaukauna Central, Kaukauna North & North Appleton 138-kV buses	--	--	--	--	--	--	--	104.9 – 105.3%	System Intact	Switch off area capacitor banks
4	Glenview 138-kV bus	--	--	--	--	--	--	--	105.1%	System Intact	Switch off area capacitor banks
5	Base Case Loading Criteria Exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact	
5	Base Case Voltage Criteria Exceeded	--	TRUE	--	TRUE	--	FALSE	--	TRUE	System Intact	
5	Bluemound 230-kV bus, Allerton, Bark River, Brookdale, Cooney, Cottonwood, Germantown, Hartford, Maple and Summit 138-kV buses	--	94.5 – 96.0%	--	--	--	--	--	--	System Intact	Mitigated by generation adjustments
5	Bluemound 230-kV bus, Bark River, Cooney, Cottonwood, Germantown, Hartford, Mukwonago, Maple and Summit 138-kV buses	--	--	--	94.5 – 95.9%	--	--	--	--	System Intact	Mitigated by generation adjustments
5	Montana, Barland, Valley, Racine, Dewey, Albers, Allerton, Branch, Center, Everett, Fiebrantz, Hayes, Harbor, Haymarket, Kansas, Kenosha, Lincoln, Nicholson, Norwich, Oak Creek, Parkhill, Pennsylvania, Racine, Ramsey, St. Rita, 28th St, and Somers 138-kV buses	--	--	--	--	--	--	--	105.0 – 105.8%	System Intact	Mitigated by generation adjustments
5	Germantown 138-kV bus	--	91.3%	--	--	--	--	--	--	Germantown – Maple 138-kV line	Mitigated by generation adjustments
5	Bark River and Germantown 138-kV buses	--	91.6 – 91.7%	--	--	--	--	--	--	Bark River – Sussex 138-kV line	Mitigated by generation adjustments
5	Bark River, Cottonwood and Germantown 138-kV buses	--	--	--	91.5 – 91.9%	--	--	--	--	Bark River – Sussex 138-kV line	Mitigated by generation adjustments
5	Hartford 138-kV bus	--	90.4%	--	91.9%	--	--	--	--	Hartford – St. Lawrence 138-kV line	Mitigated by generation adjustments
5	Maple, Germantown, Bark River, and Cottonwood 138-kV buses	--	85.8 – 91.6%	--	--	--	--	--	--	Maple – Saukville 138-kV line	Mitigated by generation adjustments
5	Maple and Germantown 138-kV buses	--	--	--	88.7 – 89.1%	--	--	--	--	Maple – Saukville 138-kV line	Mitigated by generation adjustments
5	Bain 345/138-kV transformer #5	159.5% 113.6%	--	159.2% --	--	146.9% --	--	146% --	--	Split Pleasant Prairie 345-kV bus 34 Split Pleasant Prairie 345-kV bus 23	Mitigated by generation adjustments
5	Oak Creek 345/230-kV transformer T895	104.7% 103.4%	--	104.7%	--	--	--	--	--	Split Oak Creek 230-kV bus 78 Split Oak Creek 230-kV bus 67	Mitigated by generation adjustments
5	Arcadian4 – Waukesha1 138-kV line	107.1%	--	131.1%	--	115.0%	--	--	--	Arcadian6 – Waukesha3 138-kV line	Rebuild line
5	Arcadian6 – Waukesha3 138-kV line	110.8%	--	126.7% 111.3%	--	111.2% 99.8%	--	--	--	Arcadian4 – Waukesha1 138-kV line Split Waukesha 138-kV bus 12	Rebuild line
5	Arcadian 345/138-kV transformer #3	101.5%	--	109.9% 105.8%	--	100.3%	--	--	--	Arcadian 345/138-kV transformer #1 Split Arcadian 345-kV bus 12	Replace transformer
5	Arcadian 345/138-kV transformer #2	--	--	101.8% 97.5%	--	--	--	--	--	Arcadian 345/138-kV transformer #1 Split Arcadian 345-kV bus 12	Replace transformer
5	Albers – Kenosha 138-kV line	--	--	102.5%	--	116.0%	--	--	--	Albers – Bain 138-kV line	Mitigated by generation adjustments
5	Waukesha 138-kV bus 12	--	--	98.2%	--	--	--	--	--	Arcadian6 – Waukesha3 138-kV line	Mitigated by generation adjustments
5	Harbor – Kansas 138-kV line	--	--	102.1% 97.4% 97.3% -- -- --	--	108.7% 99.4% 106.3% 106.4% 105.4% 102.4%	--	--	--	Kansas – Norwich 138-kV line Harbor – Norwich 138-kV line Split Dewey 138-kV bus Dewey – Norwich 138-kV line Montana – Dewey 138-kV line Montana – Valley 138-kV line	Mitigated by generation adjustments
5	Granville – Rangeline 138-kV line	--	--	101.2%	--	--	--	--	--	Cornell – Granville 138-kV line	Mitigated by generation adjustments

Table ZS-1
2011 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2011 Summer Peak Case		2011 90% Load Case		2011 70% Load Case		2011 Minimum Load Case		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	% of Facility Rating	% of Nominal Bus Voltage		
5	Oak Creek – Ramsey 138-kV line	--	--	102.1% 101.3% 100.5% 100.0% 97.4%	--	--	--	--	--	Valley generator #1 Edgewater generator #5 Oak Creek – Pennsylvania 138-kV line Edgewater generator #4 System Intact	Mitigated by generation adjustments
5	Edgewood – St. Martins 138-kV line	--	--	--	--	99.9%	--	--	--	Merrill Hills – Waukesha 138-kV line	Mitigated by generation adjustments

Table ZS-1_2011 constraints

Definition of Event Based Contingencies to be included in Appendix:	
1	Arpin - Rocky Run 345-kV line + Port Edwards - Sand Lake 138-kV line + Port Edwards - Hollywood 138-kV line + Council Creek - Council Creek DPC 69-kV line
2	Dead River 345/138-kV xfmr #1 and Dead River 345/138-kV xfmr 1A
3	Ellinwood 138/69 kV xfmr #1 + Ellinwood - Twelfth Ave 69 kV circuit + Ellinwood - Fitzgerald 138 kV circuit +Ellinwood 138 kV bus tie 1-2
4	Whitcomb - CWEC Wittenberg Tap - Wittenberg Tap - Birnamwood Tap - Brooks Corner - Deer Trail 69-kV line
5	M38 – Atlantic 138-kV line + Atlantic 138/69-kV transformer
6	Hiawatha-Engadine 69-kV line + Hiawatha 138/69-kV transformer

Table ZS-2
2015 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2015 Summer Peak Case		2015 70% Load Case		2015 90% Load Case		2015 105% Load Case		2015 High Wind		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	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage		
1	Base case loading criteria exceeded	TRUE	--	FALSE	--	FALSE	--	TRUE	--	FALSE	--	System Intact	
1	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	TRUE	--	FALSE	--	FALSE	System Intact	
1	Silver Lake, ACEC Spring Lake, Redgranite, Fountain Valley and River Run 69-kV buses	--	89.5 – 91.6% 91.3 – 91.7% -- --	--	--	--	--	--	88.2 – 91.5% 90.0 – 91.7% 91.1 – 91.9% 91.2 – 91.4%	--	--	Wautoma – Silver Lake Tap 69-kV line Silver Lake – ACEC Spring Lake 69-kV line ACEC Spring Lake – Redgranite 69-kV line Metomen – Ripon 69-kV line	Adjust Sunset Point 138/69-kV transformer LTCs
1	Dartford,Ripon Industrial Park, Northwest Ripon and Ripon 69-kV buses	--	89.0 – 89.7% 90.3 – 91.4%	--	--	--	--	--	87.9 – 89.5% 89.4 – 91.0% 91.2% 91.4% 92.0%	--	--	Metomen – Ripon 69-kV line Ripon – Northwest Ripon Tap 69-kV line Wautoma – Silver Lake Tap 69-kV line Northwest Ripon Tap – Dartford Tap 69-KV line Silver Lake – ACEC Spring Lake 69-KV line	Ripon Capacitor Expansion Project
1	Winneconne, Omro and Omro Industrial Park 69-kV buses	--	91.1 – 91.6%	--	--	--	--	--	90.0% – 90.6%	--	--	Winneconne – Sunset Point 69-kV line	Marginal voltage, no mitigation needed within this timeframe
1	ACEC Brooks and Grand Marsh (PP&L) 69-kV buses	--	--	--	--	--	--	--	91.9% – 92.0% 92.0%	--	--	Necedah Tap – Big Pond 69-kV line Petenwell – Big Pond 69-kV line	Marginal voltage, no mitigation needed within this timeframe
1	Petenwell and Council Creek 138-kV buses	--	95.7% 88.2 – 89.4% 88.2 – 89.4% 88.3 – 89.5% 90.6 – 90.7%	--	91.6% 91.6% 91.7%	--	89.6 – 90.8% 89.5 – 90.8% 89.6 – 90.8%	--	95.8 – 95.9% 87.7 – 88.9% 87.7 – 88.9% 87.8 – 89.0% 90.4 – 90.6%	--	--	System Intact ACEC Badger West – Petenwell 138-kV line Saratoga – Petenwell 138-kV line[1] ACEC Badger West – Saratoga 138-kV line Arpin – Rocky Run 345-kV line[2]	Adjust Council Creek 138/69-kV transformer LTC
1	Necedah, Petenwell, Big Pond, ACEC Dellwood, Friendship, Houghton Rock and McKenna 69-kV buses	--	84.9 – 91.1% 84.9 – 91.1% 85.2 – 91.3% 88.8 – 91.8%	--	90.8% – 91.6% 90.8% – 91.6% 90.7% – 91.6%	--	86.8% – 91.0% 86.8% – 91.0% 86.7% – 91.0% 89.9% – 91.7%	--	84.1 – 90.5% 84.0 – 90.5% 84.0 – 90.4% 88.2 – 91.2%	--	91.5% – 91.6% 91.5% – 91.6% 91.5% – 91.6%	Petenwell 138/69-kV transformer Petenwell – Big Pond 69-kV line Necedah Tap – Big Pond 69-kV line Necedah Tap – Whistling Wings Tap 69-kV line	McKenna Capacitor Expansion Project
1	Okee 69-kV bus	--	--	--	--	--	--	--	91.7%	--	--	Dane – Lodi Tap 69 kV line	Marginal voltage, no mitigation needed within this timeframe
1	ACEC Coloma 69-kV bus	--	--	--	--	--	--	--	91.6%	--	--	Chaffee Creek – Coloma Tap 69-kV line	Marginal voltage, no mitigation needed within this timeframe
1	Brooks Corner 69-kV bus	--	87.4%	--	89.5%	--	87.8%	--	87.5%	--	89.7%	Whitcomb – Deer Trail 69-kV line[3]	Adjust Brooks Corners 69/34.5-kV transformer LTC
1	Badger West 138-kV bus	--	88.3%	--	91.7%	--	89.6%	--	87.7%	--	--	ACEC Badger West – Saratoga 138-kV line	Adjust Council Creek 138/69-kV transformer LTC
1	Arrowhead 345-kV bus	--	--	--	--	--	105.0%	--	--	--	--	System Intact	Switch Arrowhead 230-kV capacitor bank offline
1	Petenwell 138/69-kV transformer	103.3% 111.4% 108.7% 107.0% 105.9% 104.8 – 98.2%	--	--	--	100.9%	--	105.5% 116.7% 111.1% 107.5% 107.6% 108.0 – 102.6%	--	--	--	System Intact McKenna – Houghton Rock 69-kV line Castle Rock – Quincy ACEC 69-kV line McKenna – Quincy ACEC 69-kV line Castle Rock – McKenna 69-kV line Plus other less severe contingencies	Replace Petenwell transformer
1	Castle Rock – ACEC Quincy 69-kV line	104.8% 104.7% 104.6%	--	--	--	--	--	107.9% 107.9% 107.9%	--	--	--	Petenwell 138/69-kV transformer Petenwell – Big Pond 69-kV line Necedah Tap – Big Pond 69-kV line	Uprate Castle Rock – McKenna 69-kV line

Table ZS-2
2015 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2015 Summer Peak Case		2015 70% Load Case		2015 90% Load Case		2015 105% Load Case		2015 High Wind		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	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage		
1	ACEC Quincy – McKenna 69-kV line	98.3% 98.2% 98.2%	--	--	--	96.0% 96.0% 96.0%	--	101.1% 101.1% 101.1%	--	--	--	Petenwell 138/69-kV transformer Petenwell – Big Pond 69-kV line Necedah Tap – Big Pond 69-kV line	Uprate Castle Rock – McKenna 69-kV line
1	Mauston – Hilltop 69-kV line	--	--	--	--	--	--	--	--	99.3%	--	Arpin – Rocky Run 345-kV line[2]	Marginal issue, no mitigation needed within this timeframe
1	Saratoga – ACEC Badger West 138-kV line	--	--	--	--	--	--	96.9% 96.5% 96.4%	--	--	--	Eau Claire – Arpin 345 kV line[4] King – Arpin 345-kV line[22] King – Eau Claire 345 kV line[5]	Marginal issue, no mitigation needed within this timeframe
1	Caroline 115/69-kV transformer	95.9%	--	--	--	--	--	101.2%	--	--	--	Whitcomb 115/69-kV transformer	Marginal issue, no mitigation needed within this timeframe
1	Chaffee Creek – Coloma Tap 69-kV line	95.0%	--	--	--	--	--	100.7%	--	--	--	Petenwell 138/69-kV transformer	Marginal issue, no mitigation needed within this timeframe
1	Harrison 138/69-kV transformer	99.8%	--	--	--	--	--	102.7%	--	--	--	System Intact	Replace Harrison transformer
1	Metomen 138/69-kV transformer	96.3%	--	--	--	--	--	106.1% 104.6%	--	--	--	System Intact North Fond du Lac 138/69-kV transformer #3[6]	Adjust Metomen 138/69-kV transformer LTC
1	Northwest Ripon – Ripon 69-KV line	--	--	--	--	--	--	95.9%	--	--	--	Winneconne – Sunset Point 69-kV line	Marginal issue, no mitigation needed within this timeframe
1	Sigel – Auburndale 69-kV line	95.4%	--	--	--	--	--	101.1%	--	--	--	System Intact	Higher ratings -- validated
1	Vulcan – Port Edwards 138-kV line #2 Vulcan – Port Edwards 138-kV line #1	123.2% 123.0%	--	123.2% 123.0%	--	122.9% 122.9%	--	123.1% 122.9%	--	123.1% 122.9%	--	Port Edwards – Vulcan Chemical 138-kV #1 line Port Edwards – Vulcan Chemical 138-kV #2 line	Change tap on free standing CT's at Port Edwards
2	Base case loading criteria exceeded	TRUE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact	
2	Base case voltage criteria exceeded	--	TRUE	--	TRUE	--	TRUE	--	TRUE	--	TRUE	System Intact	
2	M38-Atlantic 69-kV line	115.0% – 119.8%	--	--	--	-- -- 108.6%	--	122.2% 122.2% 122.4%	--	--	--	M38 – Atlantic 138-kV line Atlantic 138/69-kV transformer M38 – Atlantic 69-kV line[23]	Mitigated by generation adjustments or uprate line
2	Straits – McGulpin 138-kV line 9901 Straits – McGulpin 138-kV line 9903	--	--	--	--	97.7%	--	--	--	--	--	Straits – McGulpin 138-kV line 9903 Straits – McGulpin 138-kV line 9901	Targeted for mitigation by Eastern U.P. area reinforcements
2	Lakota Road 69-kV bus	--	--	--	--	--	118.1%	--	--	--	118.1%	Lakota Road – Conover 69-kV line	Resolved by transformer model adjustments
2	Brevort, Hiawatha and Lakehead 138-kV buses	--	--	--	--	--	90.8 – 91.0%	--	--	--	--	Straits 138/69-kV transformer	Targeted for mitigation by Eastern U.P. area reinforcements
2	Engadine, Newberry, Newberry Hospital, Roberts, LouPac, Newberry Village, Hulbert and Eckerman 69-kV buses	--	74.6 – 91.9%	--	--	--	84.8 – 90.4%	--	61.9 – 73.3% 80.9 – 86.9%	--	--	Hiawatha – Engadine 69-kV line Engadine – Newberry 69-kV line	Mitigated by generation adjustments
2	Brimley, Goetzville, Pickford, Raco, Magazine and Talentino 69-kV buses	--	--	--	--	--	--	--	79.0 – 89.9% 79.1 – 89.1%	--	--	Hiawatha – Engadine 69-kV line Engadine – Newberry 69-kV line	Mitigated by generation adjustments
2	North Bluff, Bay View, Mead, Gladstone, Masonville, Lakehead, West Side, Escanaba, Delta, Harris and Chandler 69-kV buses	--	89.6 – 91.8%	--	88.0 – 90.7%	--	--	--	87.5 – 89.8%	--	--	Chandler 138/69-kV transformer	Mitigated by generation adjustments
2	Hulbert, Eckerman, LouPac, Newberry Hospital, Newberry Village and Roberts 69-kV buses	--	--	--	--	--	--	--	87.7 – 91.8%	--	--	Newberry – Newberry Hospital 69-kV line	Targeted for mitigation by Eastern U.P. area reinforcements
2	LouPac, Newberry Village, Roberts 69-kV buses	--	--	--	--	--	--	--	89.7 – 90.1% 89.7 – 90.1%	--	--	Hiawatha – Roberts[24] 69-kV line Newberry Hospital – Roberts 69-kV line	Targeted for mitigation by Eastern U.P. area reinforcements
2	Ontonagon, Stone Container and Winona 138-kV buses	--	91.3 – 91.7%	--	--	--	--	--	--	--	--	M38 – Winona 138-kV line	Mitigated by generation adjustments

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Planning Zone	Criteria Exceeded/Need	2015 Summer Peak Case		2015 70% Load Case		2015 90% Load Case		2015 105% Load Case		2015 High Wind		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	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage		
2	Straits, St. Ignace, Indian Lake, Evergreen, Valley, Glen Jenks, Manistique, Engadine, Hiawatha, Gould City and Curtis 69-kV buses	--	104.0 – 105.3%	--	105.1 – 105.8%	--	--	--	--	--	104.7 – 105.6%	System Intact	Adjust transformer tap settings at Hiawatha, Indian Lake, Straits
2	Nordic – Mountain 69-kV line	--	--	99.7 – 101.3%	--	--	--	100.9% --	--	--	--	Chandler 138/69-kV transformer Plains – Arnold 138-kV line	Mitigated by generation adjustments
2	Rudyard – Pine River 69-kV line Rudyard – Tone 69-kV line Kinchloe – Tone 69-kV line	--	--	--	--	--	--	100.0 – 100.1% 103.3 – 103.4% 97.2 – 97.3%	--	--	--	Hiawatha – Engadine 69-kV line Engadine – Newberry 69-kV line	Mitigated by generation adjustments
2	Hiawatha 138-kV bus	--	--	--	--	--	94.5%	--	--	--	--	System Intact	Targeted for mitigation by Eastern U.P. area reinforcements
2	Straits 69-kV bus	--	--	--	--			--	105.1%	--	--	System Intact	Targeted for mitigation by Eastern U.P. area reinforcements
2	Pine River – Straits 69-kV line Pine River – Evergreen 69-kV line Straits – Evergreen 69-kV line	--	--	--	--	101.4 – 105.2% 101.0 – 104.8% 106.5 -110.5%	--	--	--	--	--	Hiawatha – Straits[25] 138-kV line Straits 138/69-kV transformer	Targeted for mitigation by Eastern U.P. area reinforcements
3	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact	
3	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	System Intact	
3	Dane – Lodi Tap 69-kV line	--	--	--	--	--	--	98.6%	--	--	--	Island Street – Kirkwood 69-KV line	Marginal issue, no mitigation needed within this timeframe
3	Lake Geneva, Katzenberg, Twin Lakes, and South Lake Geneva 69-kV buses	--	88.6 – 90.2%	--	--	--	--	--	--	--	--	North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Cobblestone 69-kV bus	--	91.4%	--	--	--	--	--	91.2%	--	--	Cobblestone – Brick Church 69-kV line	North Lake Geneva – South Lake Geneva 138-kv line
3	Concord, Brick Church, Williams Bay and Fort Atkinson 138-kV buses+B73	--	--	--	95.6 – 95.9%	--	95.9%	--	--	--	--	System Intact	Marginal voltage, no mitigation needed within this timeframe
3	Lake Geneva 69-kV bus	--	--	--	--	--	91.8%	--	86.6%	--	--	North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kv line
3	Beloit Gateway 138-kV bus	--	--	--	--	--	91.6%	--	--	--	--	Beloit Gateway – Dickinson 138-kV line	Marginal voltage, no mitigation needed within this timeframe
3	Katzenberg, Twin Lakes, and South Lake Geneva 69-kV buses	--	--	--	--	--	--	--	87.6 – 88.3%	--	--	North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Concord 138-kV bus	--	--	--	95.9% --	--	95.4% 91.7%	--	--	--	--	System Intact Jefferson – Crawfish River 138-kV line	Marginal voltage, no mitigation needed within this timeframe
3	Brick Church 138-kV bus	--	--	--	95.6% --	--	95.6% 91.9%	--	--	--	--	System Intact Beloit Gateway – Dickinson 138-kV line	Marginal voltage, no mitigation needed within this timeframe
3	Crawfish River 138-kV bus	--	--	--	--	--	90.7%	--	--	--	--	Jefferson – Crawfish River 138-kV line	Marginal voltage, no mitigation needed within this timeframe
3	Butler Ridge 138-kV bus	--	--	--	--	--	95.9% 91.8%	--	--	--	--	System Intact Hartford – St. Lawrence 138-kV line	Marginal voltage, no mitigation needed within this timeframe
3	Williams Bay, Bristol, Delavan, SW Delavan, Brick Church and Elkhorn 138-kV buses	--	--		91.3 – 91.9%	--	--	--	--	--	--	Wempletown – Paddock 345-kV line	Marginal voltage, no mitigation needed within this timeframe

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Planning Zone	Criteria Exceeded/Need	2015 Summer Peak Case		2015 70% Load Case		2015 90% Load Case		2015 105% Load Case		2015 High Wind		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	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage		
3	Beloit Gateway, BOC Gas, NW Beloit, RC9, Williams Bay, Bristol, Delavan, West Darien, RC2, Sunrise, Venture, Tichigan, EL&W, Sugar Creek, Burlington, Whitewater, SW Delavan, Rock River, Blackhawk, Paddock, Colley Road, Dickinson, Marine, Brick Church, North Lake Geneva, Elkhorn, Janesville, Russell, McCue, Viking, Townline, Wilcox, Kennedy, Tripp, Air Liquide, University, Bluff Creek, Lakehead-Delavan 138-kV buses	--	--	--	87.8 – 91.8%	--	--	--	--	--	--	Paddock 345/138-kV transformer	Further study needed
3	Beloit Gateway, BOC Gas, NW Beloit, RC9, Williams Bay, Bristol, Delavan, West Darien, RC2, Venture, SW Delavan, Rock River, Blackhawk, Paddock, Colley Road, Dickinson, Marine, Brick Church, Townline 138-kV buses	--	--	--	--	--	--	--	--	--	90.9 – 91.9%	Paddock 345/138-kV transformer	Marginal voltage, no mitigation needed within this timeframe
3	Cobblestone – Zenda Tap 69-kV line	105.0%	--	--	--	--	--	112.7%	--	--	--	North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Colley Road 138/69-kV transformer	96.9%	--	--	--	--	--	100.2%	--	--	--	Paddock 138/69-kV transformer	Marginal issue, no mitigation needed within this timeframe
3	Katzenberg – Zenda Tap 69-kV line	95.3%	--	--	--	--	--	102.2%	--	--	--	North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Paddock – Townline 138-kV line	--	--	102.4% 100.9% 99.9%	--	--	--	--	--	--	--	NW Beloit – Paddock 138-kV line Blackhawk – NW Beloit – Paddock 138-kV line Blackhawk – NW Beloit 138-kv	Mitigated by generation adjustments
3	NW Beloit – Paddock 138-kV line	--	--	97.6%	--	--	--	--	--	--	--	Paddock – Townline 138-kV line	Marginal issue, no mitigation needed within this timeframe
3	Lake Geneva – South Lake Geneva 69-kV line	--	--	--	--	--	--	97.7%	--	--	--	Cobblestone – Brick Church 69-kV line	Marginal issue, no mitigation needed within this timeframe
3	North Monroe – Idle Hour 69-kV line	103.9 – 96.1%	--	--	--	95.4% -- -- -- -- --	--	109.1 – 96.2%	--	--	--	Paddock – Newark 69-kV line Paddock – Brodhead Switching Station 69-kV line[7] Brodhead – Newark 69-kV line Darlington – Gratiot 69-kV line Wiota – Gratiot 69-kV line Darlington 138/69-kV transformer	Bass Creek transformer project
3	McCue – REC Harmony – Milton Tap – Lamar 69-kV line	103.3 – 95.4%	--	--	--	--	--	109.1 – 97.7%	--	--	--	Kegonsa – Stoughton North Tap2 69-kV line Kegonsa 138/69-kV transformer Stoughton North Tap1 – Stoughton North Tap2 69-kV line Stoughton East – Stoughton North 69-kV line	McCue to Lamar line uprate project
3	Sheepskin – Dana 69-kV line	--	--	--	--	--	--	99.9%	--	--	--	McCue – Lamar 69-kV line	Sheepskin terminal upgrade
3	Boscobel – Wauzeka – Gran Grae 69-kV line	--	--	--	--	--	--	98.0 – 96.4%	--	--	--	Spring Green 138/69-kV transformer Spring Green – Lone Rock 69-kV line	Gran Grae line uprate project
3	Wauzeka – Gran Grae 69-kV line	95.3%	--	--	--	--	--	--	--	--	--	Spring Green 138/69-kV transformer	Gran Grae line uprate project
3	Timberlane Tap – West Middleton 69-kV line	101.4%	--	--	--	96.9%	--	108.0%	--	--	--	Spring Green 138/69-kV transformer	West Middleton to Stagecoach line uprate
3	Royster – AGA Gas Tap – Pflaum 69-kV line	111.8 – 95.2%	--	--	--	--	--	117.8 – 99.1%	--	--	--	Fitchburg – Syene 69-kV line Nine Springs – Syene 69-kV line Fitchburg – Nine Springs 69-kV line[8]	Nine Springs, Pflaum area project
3	Royster – AGA Gas Tap	--	--	--	--	101.5%	--	--	--	--	--	Fitchburg – Syene 69-kV line	Nine Springs, Pflaum area project
3	Fitchburg – Syene – Nine Springs 69-kV line	113.4 – 97.3%	--	--	--	--	--	119.3 – 102.4%	--	--	--	Royster – AGA tap 69-kV line Pflaum – AGA tap 69-kV line Royster – AGA tap 69-kV line[9]	Nine Springs, Pflaum area project
3	Fitchburg – Syene 69-kV line	--	--	--	--	102.8%	--	--	--	--	--	Royster – AGA tap 69-kV line	Nine Springs, Pflaum area project

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Planning Zone	Criteria Exceeded/Need	2015 Summer Peak Case		2015 70% Load Case		2015 90% Load Case		2015 105% Load Case		2015 High Wind		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	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage		
3	Verona 138-kV bus	--	95.4% 87.2%	--	-- 90.05%	--	-- 88.4%	--	95.1% 86.5%	--	-- 91.4%	System Intact Verona – Oak Ridge 138-kV line	Adjust Verona 138/69-kV transformer LTC / Verona 69-kV capacitor bank project
3	Fitchburg 138-kV bus	--	95.9%	--	--	--	--	--	--	--	--	System Intact	Verona 69-kV capacitor bank project
3	Fitchburg and Oak Ridge 138-kV buses	--	--	--	--	--	--	--	95.8 – 95.9%	--	--	System Intact	Verona 69-kV capacitor bank project
3	Southwest Verona 69-kV bus	--	89.6%	--	--	--	91.2%	--	88.5%	--	--	Verona – Southwest Verona 69-kV line	Further study needed
3	Huiskamp 138-kV bus	--	88.9%	--	88.2%	--	87.7%	--	87.8%	--	--	Huiskamp – North Madison 138-kV line	Adjust Huiskamp 138/69-kV transformer LTC
3	Brodhead Muni2, Brodhead Muni3, Brodhead and Brodhead Muni1 69-kV buses	--	91.6 – 91.8%	--	--	--	--	--	--	--	--	Brodhead Switching Station – Brodhead Muni3 69-kV line	Bass Creek transformer project
3	Brodhead Muni2, Brodhead Muni3, Brodhead, Brodhead Muni1, REC Orfordville, Orfordville, Bass Creek and Footville 69-kV buses	--	--	--	--	--	--	--	90.1 – 91.7%	--	--	Brodhead Switching Station – Brodhead Muni3 69-kV line Brodhead Muni 2 – Brodhead Muni3 69-kV line	Bass Creek transformer project
3	REC Harmony, Milton, Milton Tap, Lamar, Fulton and Saunders Creek 69-kV buses	--	88.5 – 91.9%	--	--	--	--	--	86.5 – 91.9%	--	--	McCue – Harmony 69-kV line Milton Tap – Harmony 69-kV line McCue – Lamar 69-kV line[10]	Lamar 69-kV capacitor bank project
3	AGA Gas 69-kV bus	--	--	--	--	--	--	--	92.0%	--	--	Royster – AGA tap 69-kV line	Nine Springs, Pflaum area project
3	McFarland, Femrite and Sprecher 138-kV buses	--	--	--	--	--	--	--	91.2 – 91.5%	--	--	Kegonsa – McFarland 138-kV line Femrite – McFarland 138-kV line Kegonsa – Femrite 138-kV line[11]	Dane County Corrective Plan
3	REC Harmony, Milton, Milton Tap, Lamar, Fulton 69-kV buses	--	--	--	--	--	91.3 – 91.9%	--	--	--	--	McCue – Harmony 69-kV line	Lamar capacitor bank
3	Hubbard and Hustisford 138-kV buses	--	-- 86.2% 86.8% 86.8% --	--	--	--	96.0% 86.8% 87.3% 87.3% 91.8%	--	-- 85.8% 86.5% 86.5% --	--	-- -- 87.4% 87.4% --	System Intact Rubicon – Hustisford 138-kV line Hustisford – Hubbard 138-kV line Rubicon – Hustisford – Hubbard 138-kV line Hartford – Saint Lawrence 138-kV line	Adjust Hubbard 138/69-kV transformer LTC
3	Fox Lake, North Beaver Dam and Beaver Dam East 138-kV buses	--	88.2 – 88.3% 88.9% 88.9%	--	--	--	89.4 – 89.5% -- --	--	87.4 – 87.5% 88.2 – 88.3% 88.2 – 88.3%	--	--	North Randolph – Fox Lake 138-kV line Fox Lake – North Beaver Dam 138-kV line North Randolph – North Beaver Dam 138-kV line[12]	Adjust North Beaver Dam 138/69-kV transformer LTC
3	Nelson Dewey – DPC Cassville 161-kV line	--	--	98.2 – 95.2%	--	--	--	--	--	--	--	Paddock 345/138-kV transformer DPC Genoa generator #3 Columbia generator #1 Columbia generator #2	Mitigation by potential generation adjustments / Futher study needed
3	Nelson Dewey – DPC Cassville 161-kV line	--	--	--	--	--	--	--	--	111.2 – 109.2%	--	DPC Seneca – DPC Genoa 161-kV line Genoa 161/69-kV transformer[13]	DPC line limitation / further study needed
3	Darlington – North Monroe 138-kV line	--	--	--	--	--	--	--	--	109.3 – 95.2%	--	Paddock 345/138-kV transformer Darlington 138/69-kV transformer	Mitigation by potential generation adjustments / Futher study needed
3	Nelson Dewey 161/138-kV transformer	--	--	--	--	--	--	--	--	100.5 – 95.5%	--	ComEd Byron generator #1 ComEd Braidwood generator #1 ComEd Braidwood generator #2 Point Beach generator #1 Point Beach generator #2 Kewaunee generator #1	Mitigation by potential generation adjustments / Futher study needed
3	West Middleton – Black Hawk 69-kV line	--	--	98.5 – 96.3%	--	--	--	--	--			North Madison – Vienna 138-kV line Vienna – Yahara River 138-kV line North Madison – Yahara River 138-kV line[14]	Mitigated by generation adjustments/ Potential Cardinal – Blount 138-kV line
3	Verona, Oak Ridge, and Fitchburg 138-kV buses	--	--	--	95.5 – 95.7%	--	--	--	--	--	--	System Intact	Femrite and Kegonsa 138-kV capacitor banks
4	Base case loading criteria exceeded	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	System Intact	
4	Base case voltage criteria exceeded	--	FALSE	--	FALSE	--	FALSE	--	FALSE	--	FALSE	System Intact	
4	Non Converged Solution	--	--	Applies	--	--	--	--	--	Applies	--	Morgan – Plains 345-kV line[15] Morgan – Plains 345-kV line	Mitigated by generation adjustments
4	Morgan – Falls 138-kV line	--	--	103.4% 103.4%	--	--	--	--	--	96.0% 95.9%	--	Morgan – Plains 345-kV line[15] Morgan – Plains 345-kV line	Mitigated by generation adjustments

Table ZS-2
2015 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2015 Summer Peak Case		2015 70% Load Case		2015 90% Load Case		2015 105% Load Case		2015 High Wind		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	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage		
4	East Krok 138/69-kV transformer	105.1% -- --	--	99.8% -- --	--	102.7% -- --	--	107.1% 96.5% 95.7%	--	--	--	Canal – East Krok 138-kV line Highway V 138/69-kV transformer #2[16] Highway V – East Krok 138-kV line	No project needed; Investigation into limiting facility resulted in higher facility ratings
4	Sunset Point – Pearl Avenue 69-kV line	116.3% 115.7%	--	--	--	104.6% 103.7%	--	122.6% 121.4%	--	--	--	Ellinwood 138/69-kV transformer[17] Ellinwood – 12th Avenue 69-kV line	Rebuild line
4	Highway V – Ontario 138-kV line	99% --	--	--	--	--	--	103.5% 98.7%	--	--	--	East Krok 138/69-kV transformer[18] Canal 138/69-kV transformer #1[19]	Uprate line
4	Dyckesville – Rosiere 69-kV line	95.0%	--		--	--	--	99.2%	--	--	--	East Krok 138/69-kV transformer[18]	Further study needed
4	White Clay 138-kV 1-2 bus tie	--	--	99.7%	--	--	--	--	--	--	--	Morgan – Highway 22 345-kV line	Further study needed
4	Highway V – Preble 138-kV line	--	--	97.5%	--	--	--	--	--	--	--	Morgan – Highway 22 345-kV line	Further study needed
4	Canal – East Krok 138-kV line	--	--	--	--	--	--	98.0%	--	--	--	Highway V 138/69-kV transformer #1[20]	Further study needed
4	Edgewater – Sauk Trail 138-kV line	--	--	--	--	--	--	96.8%	--	--	--	Edgewater – Huebner 138-kV line	Further study needed
4	East Krok – Kewaunee 138-kV line	--	--	--	--	96.0%	--	--	--	--	--	North Appleton 345/138 kV xfmr #1[21]	Further study needed
4	Manrap – Custer 69-kV line	--	--	--	--	--	--	97.2%	--	--	--	Dewey – Lakefront 69-kV line	Further study needed
5	Base Case Loading Criteria Exceeded	FALSE		FALSE		FALSE		FALSE		FALSE			
5	Base Case Voltage Criteria Exceeded		TRUE		FALSE		TRUE		TRUE		FALSE		
5	Bluemound 230-kV bus, Allerton, Brookdale, Cottonwood, Edgewood, and 28th St 138-kV buses	--	94.6 – 95.9%	--	--	--	--	--	--	--	--	System Intact	Shift Allerton load from T9 to T8
5	Bluemound 230-kV bus, Allerton, Brookdale, Cottonwood, and 28th St 138-kV buses	--	--	--	--	--	--	--	94.6 – 95.8%	--	--	System Intact	Shift Allerton load from T9 to T9
5	Burlington and Tichigan 138-kV buses	--	--	--	90.8 – 91.0%	--	--	--	--	--	--	Split Burlington 138-kV bus	Marginal voltage, no mitigation needed within this timeframe
5	Bark River 138-kV bus	--	--	--	--	--	95.6% 91.3%	--	--	--	--	System Intact Bark River – Sussex 138-kV line	Marginal voltage, no mitigation needed within this timeframe
5	Cottonwood 138-kV bus	--	--	--	--	--	95.3% 91.6%	--	--	--	--	System Intact Bark River – Sussex 138-kV line	Marginal voltage, no mitigation needed within this timeframe
5	Germantown 138-kV bus	--	--	--	-- -- -- 91.9%	--	94.6% 91.9% 91.5% 87.6%	--	--	--	--	System Intact Germantown – Maple 138-kV line Bark River – Sussex 138-kV line Maple – Saukville 138-kV line	Mitigated by generation adjustments
5	Hartford 138-kV bus	--	--	--	--	--	95.8% 91.4%	--	--	--	--	System Intact Hartford – St. Lawrence 138-kV line	Marginal voltage, no mitigation needed within this timeframe
5	Maple 138-kV bus	--	--	--	-- 91.7%	--	94.8% 87.3%	--	--	--	--	System Intact Maple – Saukville 138-kV line	Mitigated by generation adjustments
5	Summit, Cooney and Mukwonago 138-kV buses	--	--	--	--	--	95.5 – 95.8%	--	--	--	--	System Intact	Marginal voltage, no mitigation needed within this timeframe
5	Bain 345/138-kV transformer #5	159.7% 117.9%	--	147.3% --	--	159.3% --	--	159.2% 108.2%	--	147.5% 107.6%	--	Split Pleasant Prairie 345-kV bus 34 Split Pleasant Prairie 345-kV bus 23	Mitigated by generation adjustments
5	Oak Creek 345/230-kV transformer T895	105.0% 105.3%	--	95.3% --	--	104.7% --	--	104.9% 104.5%	--	95.1% --	--	Split Oak Creek 230-kV bus 78 Split Oak Creek 230-kV bus 67	Mitigated by generation adjustments
5	Arcadian4 – Waukesha1 138-kV line	104.8%	--	119.6%	--	134.2%	--	105.2%	--	--	--	Arcadian6 – Waukesha3 138-kV line	Rebuild line
5	Arcadian6 – Waukesha3 138-kV line	101.1% --	--	115.6% 103.5%	--	129.7% 113.6%	--	101.5% --	--	--	--	Arcadian4 – Waukesha1 138-kV line Split Waukesha 138-kV bus 12	Rebuild line
5	Arcadian 345/138-kV transformer #3	-- -- 99.8%	--	101.7% 99.7% 98.3%	--	105.6% 105.2% 110.9%	--	-- -- 101.8%	--	--	--	Split Arcadian 345-kV bus 12 Arcadian 345-kV bus outage Arcadian 345/138-kV transformer #1	Replace transformer
5	Arcadian 345/138-kV transformer #2	--	--	95.7% --	--	97.4% 102.4%	--	--	--	--	--	Split Arcadian 345-kV bus 12 Arcadian 345/138-kV transformer #2	Replace transformer
5	Bain – Kenosha 138-kV line	97.9%	--	--	--	--	--	--	--	--	--	Pleasant Prairie – Zion 345-kV line	Uprate Bain – Kenosha
5	Pleasant Prairie – Zion 345-kV line	95.7% -- -- -- --	--	--	--	--	--	98.1% 96.2% 100.2% 98.5% 95.4%	--	--	--	Zion – Arcadian 345-kV line Cherry Valley – Silver Lake 345-kV line Braidwood generator #1 or #2 Dresden generator #2 or #3 Zion Energy Ctr #1 or #2	Marginal issue, no mitigation needed within this timeframe
5	Granville 345/138-kV transformer #1	--	--	95.0%	--	107.2%	--	--	--	--	--	Split Granville 345-kV bus 23	Mitigated by generation adjustments

Table ZS-2
2015 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2015 Summer Peak Case		2015 70% Load Case		2015 90% Load Case		2015 105% Load Case		2015 High Wind		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	% of Facility Rating	% of Nominal Bus Voltage	% of Facility Rating	% of Nominal Bus Voltage		
5	Harbor – Kansas 138-kV line	--	--	109.5% 106.7% 106.6% 105.7% 99.6 – 102.5%	--	--	--	--	--	--	--	Kansas – Norwich 138-kV line Dewey – Norwich 138-kV line Split Dewey 138-kV bus Dewey – Montana 138-kV line Plus Other Less Severe Outages	Mitigated by generation adjustments
5	Albers – Kenosha 138-kV line	--	--	120.3%	--	103.3%	--	100.9%	--	--	--	Albers – Bain 138-kV line	Mitigated by generation adjustments
5	Edgewood – St. Martins 138-kV line	--	--	102.1% 98.8% 97.4% 96.5%	--	--	--	--	--	--	--	Merrill Hills – Waukesha 138-kV line Paris – Air Liquide 138-kV line Paris – Air Liquide – Burlington 138-kV line Burlington – Air Liquide 138-kV line	Mitigated by generation adjustments
5	Oak Creek – Ramsey 138-kV line	--	--	--	--	95.6%	--	--	--	--	--	Oak Creek – Pennsylvania 138-kV line	Marginal issue, no mitigation needed within this timeframe
5	Wauesha 138-kV bus 12	--	--	--	--	100.1%	--	--	--	--	--	Arcadian6 – Waukesha3 138-kV line	Mitigated by generation adjustments
5	Kenosha – Lakeview 138-kV line	--	--	--	--	--	--	100.7%	--	--	--	Pleasant Prairie – Zion 345-kV line	Rebuild line
5	Lakeview – Zion 138-kV line	--	--	--	--	--	--	96.7%	--	--	--	Pleasant Prairie – Zion 345-kV line	Further study needed

Event Based Contingency	Definition of Event Based Contingency
1	Saratoga – ACEC Badger West – Petenwell138-kV line
2	Arpin – Rocky Run 345-kV line + Port Edwards – Sand Lake 138-kV line + Port Edwards – Hollywood 138-kV line + Council Creek – Council Creek DPC 69-kV line
3	Whitcomb – CWEC Wittenberg Tap – Wittenberg Tap – Birnamwood Tap – Brooks Corner – Deer Trail 69-kV line
4	Eau Clare – Arpin 345-kV line + Council Creek DPC – Council Creek 69-kV line + Hilltop – Mauston 69-kV line
5	King – Eau Claire 345-kV line + Eau Clare – Arpin 345-kV line + Eau Clare 345/161-kV transformer + Council Creek DPC – Council Creek 69-kV line + Hilltop – Mauston 69-kV line + Lubin – Lakehead 69-kV line
6	North Fond du Lac 138/69-kV transformer #3 + North Fond du Lac – Hickory Street Tap 69-kV line + North Fond du Lac – Rosendale 69-kV line + North Fond du Lac 69-kV bus capacitor
7	Paddock – REC Newark – Brodhead Switching Station 69-kV line
8	Fitchburg – Syene – Nine Springs 69-kV line
9	Royster – AGA tap – LCI 69-kV line
10	McCue – Harmony – Milton Tap – Lamar 69-kV line
11	Kegonsa – McFarland – Femrite 138-kV line
12	North Randolph – Fox Lake – North Beaver Dam 138-kV line
13	Genoa 161/69-kV transformer + Genoa-Seneca 161-kV line + Genoa-Lansing W 161-kV line+ Genoa-Lac Tap 161-kV line
14	North Madison-Vienna-Yahara River 138-kV line
15	Morgan – Plains 345-kV line + Morgan 24.9 kV reactor + Plains 24.9 kV reactor
16	Highway V 138/69 kV xfmr #2 + Highway V - East Krok 138 kV circuit + Highway V - Mystery Hills 138 kV circuit + Highway V - Oak Street 69 kV circuit
17	Ellinwood 138/69 kV xfmr #1 + Ellinwood - Twelfth Ave 69 kV circuit + Ellinwood - Fitzgerald 138 kV circuit +Ellinwood 138 kV bus tie 1-2
18	East Krok 138/69 kV xfmr + Highway V - East Krok 138 kV circuit + East Krok - Canal 138 kV circuit + East Krok - Kewaunee 138 kV circuit + Beardsely - East Krok 69 kV circuit
19	Canal 138/69 kV xfmr #1 + Canal - East Krok 138 kV circuit + Canal - Sawyer 69 kV circuit + Canal - Algoma 69 kV circuit + Canal 69 kV cap banks, 2 x 16.3 MVAr
20	Highway V 138/69 kV xfmr #1 + Highway V - Ontario 138 kV circuit + Highway V - Preble 138 kV circuit + Highway V - Finger Road 69 kV circuit + Highway V - Rockland 138 kV circuit + Highway V 138 kV cap bank, 2 x 18.9 MVAr
21	North Appleton 345/138 kV xfmr #1 + North Appleton - Kewaunee 345 kV circuit
22	King – Eau Clare 345-kV line + Eau Clare – Arpin 345-kV line + Eau Clare 345/161-kV transformer + Council Creek DPC – Council Creek 69-kV line + Hilltop – Mauston 69-kV line
23	M38-Atlantic 69-kV line + Atlantic 138/69-kV transformer
24	Hiawatha-Engadine-Newberry-Newberry Hospital-Roberts 69-kV line
25	Hiawatha-Lakehead-Brevort-Straits 138-kV line

Table ZS-3
2020 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2020 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
1	Base case loading criteria exceeded	TRUE	--	System Intact	
1	Base case voltage criteria exceeded	--	TRUE	System Intact	
1	Silver Lake, ACEC Spring Lake, Redgranite, Fountain Valley, River Run and Berlin 69-kV buses	--	84.5 – 88.2% 86.6 – 89.6% 87.2 – 90.6% 88.0 – 90.6% 88.6 – 91.9%	Wautoma – Silver Lake Tap 69-kV line Silver Lake – ACEC Spring Lake 69-kV line Metomen – Ripon 69-kV line ACEC Spring Lake – Redgranite 69-kV line Plus other less severe contingencies	Ripon capacitor expansion and Install capacitors at Dartford
1	Dartford, Ripon Industrial Park, Northwest Ripon and Ripon 69-kV buses	--	94.8% 83.2 – 85.1% 85.0 – 86.9% 87.8 – 89.6% 87.9 – 91.6%	System Intact Metomen – Ripon 69-kV line Ripon – Northwest Ripon Tap 69-kV line Wautoma – Silver Lake Tap 69-kV line Plus other less severe contingencies	Ripon capacitor expansion and Install capacitors at Dartford
1	Winneconne, Omro and Omro Industrial Park 69-kV buses	--	84.2 – 85.0% 89.6 – 89.8% 90.5 – 91.2% 91.3 – 91.9% 91.3 – 91.9%	Winneconne – Sunset Point 69-kV line Winniconne – Omro Tap 69-kV line Metomen – Ripon 69-kV line Wautoma – Silver Lake Tap 69-kV line Plus other less severe contingencies	Ripon capacitor expansion and Install capacitors at Dartford
1	Mackford Prairie and Markesan 69-kV bus	--	91.7 – 91.9%	North Randolph – Markesan Tap 69-kV line	Ripon capacitor expansion
1	Metomen – Ripon 69-kV line	96.0% 104.9% 97.0% 95.9%	--	System Intact Winneconne – Sunset Point 69-kV line Winniconne – Omro Tap 69-kV line North Randolph – Markesan Tap 69-kV line	Second Metomen – Ripon 69-kV line
1	Metomen 138/69-kV transformer	109.4% 110.7% 109.2% 103.4% 103.2 – 95.9%	--	System Intact North Fond du Lac 138/69-kV transformer #3[2] North Fond du Lac – Rosendale Tap 69-kV line Metomen – North Fond du Lac 69-kV line[3] Plus other less severe contingencies	Replace Metomen 138/69-kV transformer
1	Northwest Ripon Tap – Ripon 69-kV line	106.8% 95.1%	--	Winneconne – Sunset Point 69-kV line Winneconne – Omro Tap 69-kV line	Uprate line
1	Omro – Winneconne 69-kV line	98.5% 95.1%	--	Ripon – Northwest Ripon Tap 69-kV line Harrison 138/69-kV transformer	Marginal issue, no mitigation needed within this timeframe
1	Winneconne – Sunset Point 69-kV line	103.5% 101.3%	--	Ripon – Northwest Ripon Tap 69-kV line Metomen – Ripon 69-kV line	Uprate line

Table ZS-3
2020 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2020 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
1	ACEC Brooks, Grand Marsh (PP&L) and Lincoln Pumping Station 69-kV buses	--	88.9 – 89.5% 91.2 – 91.6% 91.2 – 91.6%	Necedah Tap – Big Pond 69-kV line Chaffee Creek – Coloma Tap 69-kV line Necedah Tap – Whistling Wings Tap 69-kV line	McKenna capacitor expansion
1	Necedah, Petenwell, Big Pond, ACEC Dellwood, Friendship, ACEC Friendship, Houghton Rock and McKenna 69-kV buses	--	79.3 – 87.0% 84.8 – 89.8% 90.1 – 91.4% 90.3 – 91.5% 90.3 – 91.8%	Necedah Tap – Big Pond 69-kV line Necedah Tap – Whistling Wings Tap 69-kV line Dellwood ACEC – Whistling Wings Tap 69-kV line Petenwell – Big Pond 69-kV line Plus other less severe contingencies	McKenna capacitor expansion, Convert Necedah to 138 kV, redispatch Castle Rock generation
1	ACEC Winnebago, ACEC Glen and Neenah Creek 69-kV bus	--	90.1 – 92.0%	Kilbourn – Winnebago ACEC 69-kV line	Increase capacitance at Neenah Creek
1	ACEC Coloma, Plainfield, Sand Lake, Hancock and ACEC Hancock 69-kV buses	--	89.4 – 90.2% 90.9 – 91.9% 90.9 – 92.0% 90.9 – 92.0% 91.6%	Chaffee Creek – Coloma Tap 69-kV line Wautoma – Port Edwards 138-kV line Sand Lake Tap – Sand Lake 69-kV line Sand Lake 138/69-kV transformer Necedah Tap – Big Pond 69-kV line	McKenna capacitor expansion
1	ACEC Quincy and Castle Rock 69-kV bus	--	91.3 – 91.8%	Necedah Tap – Big Pond 69-kV line	McKenna capacitor expansion
1	Chaffee Creek – Coloma Tap 69-kV line	113.4% 96.3%	--	Necedah Tap – Big Pond 69-kV line Necedah Tap – Whistling Wings Tap 69-kV line	Uprate terminal equipment at Chaffee Creek
1	Castle Rock – ACEC Quincy 69-kV line	125.9% 112.1% 104.6% 104.6% 101.0%	--	Necedah Tap – Big Pond 69-kV line Necedah Tap – Whistling Wings Tap 69-kV line Petenwell – Big Pond 69-kV line Petenwell 138/69-kV Transformer Dellwood ACEC – Whistling Wings Tap 69-kV line	Uprate Castle Rock – McKenna 69-kV line
1	ACEC Quincy – McKenna 69-kV line	119.0% 105.3% 98.0% 98.0%	--	Necedah Tap – Big Pond 69-kV line Necedah Tap – Whistling Wings Tap 69-kV line Petenwell – Big Pond 69-kV line Petenwell 138/69-kV Transformer	Uprate Castle Rock – McKenna 69-kV line
1	Hilltop – Mauston 69kV line	100.3%	--	Arpin – Rocky Run 345-kV line[4]	Mitigated by generation adjustments

Table ZS-3
2020 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2020 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
1	Sigel, Lakehead Pipeline, Port Edwards and Vulcan 138-kV buses	--	90.7 – 91.9%	Sigel – Arpin 138-kV line	Marginal voltage, no mitigation needed in this timeframe
1	Sigel – Auburndale 69-kV line	114.2%	--	System Intact	Line validated with higher rating
1	Rozellville 69-kV bus	--	91.9%	Sigel 138/69-kV transformer	Marginal voltage, no mitigation needed in this timeframe
1	Vulcan – Port Edwards 138-kV line #2 Vulcan – Port Edwards 138-kV line #1	124.2% 123.9%	--	Port Edwards – Vulcan Chemical 138-kV #1 line Port Edwards – Vulcan Chemical 138-kV #2 line	Change tap on free standing CT's at Port Edwards
1	Petenwell and Council Creek 138-kV buses	--	94.7 – 94.9% 89.0 – 89.5% 89.0 – 89.6% 89.0 – 89.6% 89.6 – 91.6%	System Intact ACEC Badger West – Saratoga 138-kV line ACEC Badger West – Petenwell 138-kV line Saratoga – Petenwell 138-kV line[5] Plus other less severe contingencies	Expand capacitors at Council Creek and Adjust Council Creek 138/69-kV transformer LTC
1	Badger West 138-kV bus	--	95.8% 88.1% 91.7% 91.8%	System Intact ACEC Badger West – Saratoga 138-kV line Arpin – Rocky Run 345-kV line[4] Sigel – Arpin 138-kV line	Adjust Council Creek 138/69-kV transformer LTC
1	Petenwell 138/69-kV transformer	116.3% 122.7%	--	System Intact Castle Rock – Quincy ACEC 69-kV line	Replace Petenwell transformer
1	Lakehead Pipeline Portage, Endeavor and Roslin ACEC 69-kV buses	--	91.7 – 91.9%	Portage – Lakehead Pipeline Portage 69-kV line	Marginal voltage, no mitigation needed in this timeframe
1	Fairwater and Brandon 69-kV bus	--	91.2 – 91.5%	Metomen 138/69-kV transformer	Marginal voltage, no mitigation needed in this timeframe
1	Brooks Corner 69-kV bus	--	86.7%	Whitcomb – Deer Trail 69-kV line[6]	Adjust Brooks Corners 69/34.5-kV transformer LTC
1	Harrison 138/69-kV transformer	107.1%	--	System Intact	Replace Harrison 138/69-kV transformer
1	Rocky Run 345/115-kV transformer #3	95.7% 94.6%	--	Rocky Run 345/115-kV transformer #2 Rocky Run 345/115-kV transformer #1	Marginal issue, no mitigation needed within this timeframe

Table ZS-3
2020 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2020 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
1	Caroline 115/69-kV transformer	104.9%	--	Whitcomb 115/69-kV transformer	Replace Caroline 115/69-kV transformer
1	Wautoma 138/69-kV transformer T31	109.5% 103.4% 103.4% 99.7% 98.2 – 95.0%	--	System Intact Sand Lake Tap – Sand Lake 69-kV line Sand Lake 138/69-kV transformer Portage – Lakehead Pipeline Portage 69-kV line Plus other less severe contingencies	Second 138/69-kV Transformer at Wautoma
2	M38 – Atlantic 69-kV line	117.9 – 121.7%	--	M38-Atlantic 138-kV line Atlantic 138/69-kV transformer M38-Atlantic 138-kV line[13]	Uprate M38-Atlantic 69-kV line or mitigated by generation adjustments
2	Engadine, Newberry, Newberry Hospital, Roberts, LouPac, Newberry Village, Hulbert, Eckerman 69-kV buses	--	55.6 – 89.7%	Hiawatha-Engadine 69-kV line Engadine-Newberry 69-kV line Newberry-Newberry Hospital Tap 69-kV line	Mitigated by generation adjustments
2	North Bluff, Bay View, Mead, Gladstone, Masonville, Lakehead, West Side, Escanaba, Harris, Chandler 69-kV buses	--	88.5 – 90.8%	Chandler 138/69-kV transformer	Mitigated by generation adjustments
2	Straits, St. Ignace, Indian Lake, Evergreen, Valley, Glen Jenks, Manistique, Engadine, Hiawatha, Gould City 69-kV buses	--	104.0 – 105.2%	System Intact	Adjust transformer tap settings at Hiawatha, Indian Lake, Straits
2	Straits, Brevort, Lakehead, Hiawatha 138-kV buses	--	90.9 – 91.1%	Livingstone-Emmet 138-kV line	Adjust transformer tap settings at Hiawatha, Straits
3	Base case loading criteria exceeded	FALSE	--	System Intact	
3	Base case voltage criteria exceeded	--	TRUE	System Intact	
3	Okee, Lodi Industrial Park and Lodi 69-kV buses	--	90.2 – 91.4% 92.0%	Dane – Lodi Tap 69-kV line Lodi Tap – Okee Tap 69-kV line	Marginal voltage, no mitigation needed in this timeframe
3	Dane – Lodi Tap 69-kV line	107.9% 95.3% 95.3%	--	Island Street – Kirkwood 69-kV line Baraboo Tap – Moore Street Tap 69-kV line Island Street – Moore Street Tap 69-kV line	Rebuild line
3	Eagle View 69-kV bus	--	91.8%	Island Street – Kirkwood 69-kV line	Marginal voltage, no mitigation needed in this timeframe
3	Island Street, Baraboo, Sauk Prairie, Prairie du Sac Muni, Tower Street, Dam Heights and Prairie du Sac Hydro 69-kV buses	--	90.4 – 91.8%	Island Street – Kirkwood 69-kV line	Marginal voltage, no mitigation needed in this timeframe
3	Stoughton Muni South Tap – Stoughton 69-kV line	98.4%	--	Verona – Oak Ridge 138-kV line Verona 138/69-kV transformer	Potential Y-127 line uprate/ further study needed

Table ZS-3
2020 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2020 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
3	North Monroe – Idle Hour 69-kV line Monroe Tap – Idle Hour 69-kV line	118.5 – 95.4%	--	Paddock – Newark 69-kV line Darlington – Gratiot 69-kV line Brodhead – Newark 69-kV line Paddock – Newark – Brodhead Switching Station 69-kV line Wiota – Gratiot 69-kV line plus other less severe contingencies	Bass Creek transformer project / potential Y-87 line uprate/ further study needed
3	McCue – REC Harmony 69-kV line	101.4 – 98.7%	--	Sheepskin generator Kegonsa – Stoughton North Tap2 69-kV line Kegonsa 138/69-kV transformer	Y-61 line uprate
3	REC Harmony – Milton Tap – Lamar 69-kV line	96.0%	--	Sheepskin generator	Y-61 line uprate
3	Dana Corporation Tap – Sheepskin 69-kV line	111.5 – 103.0%	--	McCue – Harmony 69-kV line Milton Tap – Lamar 69-kV line McCue – Harmony – Milton Tap – Lamar 69-kV line Milton Tap – Harmony 69-kV line	Sheepskin terminal upgrade
3	Wauzeka – Gran Grae 69-kV line Wauzeka – Boscobel 69-kV line	104.8 – 95.0%	--	Spring Green 138/69-kV transformer Nelson Dewey – Lancaster 138-kV line Nelson Dewey – Lancaster – Eden 138-kV line Eden – Lancaster 138-kV line Lone Rock – Spring Green 69-kV line plus other less severe contingencies	Y-40 line uprate
3	Timberlane Tap – West Middleton 69-kV line	112.9 – 95.3%	--	Spring Green 138/69-kV transformer Verona – Southwest Verona 69-kV line Nelson Dewey – Lancaster 138-kV line Verona – Oak Ridge 138-kV line Verona 138/69-kV transformer Eden – Lancaster 138-kV line	6927 line uprate
3	Royster – AGA Gas Tap 69-kV line Pflaum – AGA Gas Tap 69-kV line	125.9 – 105.6%	--	Fitchburg – Syene 69-kV line Nine Springs – Syene 69-kV line Fitchburg – Syene – Nine Springs 69-kV line	Nine Springs, Pflaum area project
3	Royster – Sycamore 69-kV line	99.1%	--	Femrite 138/69-kV transformer	6986 line uprate
3	Fitchburg – Syene 69-kV line Nine Springs – Syene 69-kV line	128.1 – 109.5%	--	Royster – AGA tap 69-kV line Pflaum – AGA tap 69-kV line Royster – AGA tap – Pflaum 69-kV line	Nine Springs, Pflaum area project
3	Verona, Oak Ridge, Hawk Alliant, Hawk, Cross Country, and Fitchburg 138-kV buses	--	94.0 – 96.0%	System Intact	Femrite and Kegonsa 138-kV capacitor banks
3	Southwest verona, Mount Horeb Muni1, Mount Horeb, Mount Horeb Northeast, and Forward 69-kV buses	--	83.4 – 91.7%	Verona – Southwest Verona 69-kV line	Further T-D BVP study needed
3	Idle Hour, Monroe, Monroe Tap, and South Monroe 69-kV buses	--	90.6 – 91.0%	North Monroe – Idle Hour 69-kV line	Further study needed
3	Brodhead Muni3, Brodhead Muni2, Brodhead, and Brodhead Muni1 69-kV buses	--	91.8 – 92.0 %	rodhead Switching Station – Brodhead Muni3 69-kV lin	Bass Creek transformer project

Table ZS-3
2020 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2020 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
3	REC Harmony, Milton, Milton Tap, Lamar, Fulton 69-kV buses	--	88.9 – 91.1%	McCue – Harmony 69-kV line Milton Tap – Harmony 69-kV line Milton Tap – Lamar 69-kV line McCue – Harmony – Milton Tap – Lamar 69-kV line	Lamar 69-kV capacitor bank
3	Reiner, Burke and Burke Tap 69-kV buses	--	91.7 – 91.9%	Reiner – Burke Tap 69-kV line Reiner 138/69-kV transformer	Sun Prairie capacitor bank
3	AGA Gas, Pflaum, AGA Gas Tap, and Pflaum Tap 69-kV buses	--	91.1 – 91.2%	Royster – AGA tap 69-kV line	Nine Springs, Pflaum area project
3	Lancaster, Eden, Wyoming Valley, and Spring Green 138-kV buses	--	87.6 – 91.9%	Nelson Dewey – Lancaster 138-kV line Eden – Lancaster 138-kV line Nelson Dewey – Lancaster – Eden 138-kV line	Eden capacitor bank
3	Wyoming Valley, Spring Green, Troy, and Eden 138-kV buses	--	90.6 – 91.1%	Lake Delton – Trienda 138-kV line	Eden capacitor bank
3	Pleasant View, Hawk Alliant, and Hawk 138-kV buses	--	91.8 – 92.0%	West Middleton – Pleasant View 138-kV line	Femrite and Kegonsa 138-kV capacitor banks
3	Darlington 138-kV bus	--	90.5%	Darlington – Lafayette Wind 138-kV line	North Monroe capacitor bank
3	Verona 138-kV bus, Southwest verona, Sun Valley , and Verona 69-kV buses	--	83.5 – 91.9%	Verona – Oak Ridge 138-kV line Verona 138/69-kV transformer	Further T-D BVP study needed / Verona 69-kV capacitor banks
3	Muscoda, Avoca, and Avoca Tap 69-kV buses	--	91.2%	Lone Rock – Spring Green 69-kV line	Boscobel capacitor bank
3	Pioneer, Mcgregor , Platteville tap, Hillman, Elmo, Cuba City, and Benton 69-kV buses	--	89.5%	Hillman 138/69-kV transformer	Second Hillman transformer
3	Avoca, Muscoda, Avoca Tap, Arena, Spring Green, Lone Rock , Mazomanie Industrial, Mazomanie West, Mazomanie, Blue River Tap, and Blue River 69-kV buses	--	89.8 – 91.7%	Spring Green 138/69-kV transformer	Second Spring Green transformer
3	McFarland, Femrite, Sprecher 138-kV buses	--	91.2 – 91.8%	Kegonsa – McFarland 138-kV line McFarland – Femrite 138-kV line Kegonsa – McFarland – Femrite 138-kV line	Femrite capacitor bank
3	Huiskamp 138-kV bus	--	88.0%	Huiskamp – North Madison 138-kV line	Adjust Huiskamp 138/69-kV transformer LTC
3	Verona, Fitchburg 138-kV buses	--	91.4 – 92.0%	Rockdale – West Middleton 345-kV line West Middleton 345/138-kV transformer	Femrite and Kegonsa 138-kV capacitor banks
3	Verona, Eden, and Wyoming Valley 138-kV buses	--	91.5 – 91.9%	Columbia Generator unit 1 Columbia Generator unit 2	Eden capacitor bank / Dane County corrective plan
3	South Fond du Lac – Koch Oil Tap 69-kV line	95.4%	--	North Randolph – Fox Lake 138-kV line	Further study needed
3	Hubbard and Hustisford 138-kV bus	--	85.7 – 85.8% 86.4% 86.4%	Rubicon – Hustisford 138-kV line Hustisford – Hubbard 138-kV line Rubicon – Hustisford – Hubbard 138-kV line	Adjust Hubbard 138/69-kV transformer LTC
3	Fox Lake, North Beaver Dam and Beaver Dam East 138-kV buses	--	86.1 – 86.2% 87.0 – 87.1% 87.2 – 87.3%	North Randolph – Fox Lake 138-kV line North Randolph – North Beaver Dam 138-kV line[7] Fox Lake – North Beaver Dam 138-kV line	Adjust North Beaver Dam 138/69-kV transformer LTC

Table ZS-3
2020 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2020 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
3	Cobblestone – Zenda Tap 69-kV line	162.3% 99.8% 99.1%	--	North Lake Geneva – Lake Geneva 69-kV line Lake Geneva – South Lake Geneva 69-kV line North Lake Geneva – Lake Geneva – South Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Colley Road 138/69-kV transformer	111.8% 97.4%	--	Paddock 138/69-kV transformer Paddock – Shirland 69-kV line	Bass Creek 138/69-kV transformer
3	Katzenberg – Zenda tap 69-kV line	149.6%	--	North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Katzenberg – South Lake Geneva 69-kV line	113.0%	--	Cobblestone – Brick Church 69-kV line	Third source into area, possibly from Spring Valley
3	North Lake Geneva – Lake Geneva 69-kV line	105.2%	--	Cobblestone – Brick Church 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Lake Geneva – South Lake Geneva 69-kV line	118.8% 95.8%	--	Cobblestone – Brick Church 69-kV line Cobblestone – Zenda tap 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Cobblestone – Brick Church 69-kV line	133.3%	--	North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Brick Church 138/69-kV transformer	105.6% 97.1%	--	North Lake Geneva 138/69-kV transformer North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Enzyme Bio – RC3 69-kV line	96.5%	--	Brick Church 138/69-kV transformer	Line Y-32 rebuild
3	Paddock 138/69-kV transformer	97.3%	--	Colley Road 138/69-kV transformer	Bass Creek 138/69-kV transformer
3	Lake Geneva, Katzenberg, Twin Lakes, and South Lake Geneva, and Zenda 69-kV buses	--	68.6 – 82.0%	North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Twin Lakes, Katzenberg, and South Lake Geneva 69-kV buses	--	90.6 – 91.7%	North Lake Geneva – Lake Geneva – South Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Brick Church 138-kV bus	--	91.6% 91.5% 90.8%	Beloit Gateway – Brick Church 138-kV line Colley Road – Dickinson – Beloit Gateway – Brick Church 138-kV line Dickinson – Beloit Gateway 138-kV line	Brick Church capacitors or third line into the area, possibly from Spring Valley
3	Twin Lakes, Katzenberg, and South Lake Geneva 69-kV buses	--	90.4 – 91.5%	Lake Geneva – South Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Cobblestone, Zenda, Twin Lakes, Katzenberg 69-kV buses	--	87.7 – 91.4%	Cobblestone – Brick Church 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Twin Lakes 69-kV bus	--	91.3%	Katzenberg – South Lake Geneva 69-kV line	Third source into area, possibly from Spring Valley

Table ZS-3
2020 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2020 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
4	Base case loading criteria exceeded	FALSE	--	System Intact	
4	Base case voltage criteria exceeded	--	FALSE	System Intact	
4	Highway V – Ontario 138-kV line	106.7% 102.1%	--	East Krok 138/69-kV transformer[8] Canal 138/69-kV transformer #1[9]	Uprate line
4	Canal – East Krok 138-kV line	101.9% 96.5%	--	Highway V 138/69-kV transformer #1[10] Highway V – Ontario 138-kV line	Uprate line
4	East Krok 138/69-kV transformer	109.4% 99.4% 99.1% 95.6%	--	Canal – East Krok 138-kV line Highway V 138/69-kV transformer #1[10] Highway V – East Krok 138-kV line Highway V 138/69-kV transformer #2[11]	No project needed Investigation into limiting facility resulted in higher facility ratings
4	Dyckesville – Rosiere 69-kV line	95.7%	--	East Krok 138/69-kV transformer[8]	Further study needed
4	Sunset Point – Pearl Avenue 69-kV line	119.1% 118.9%	--	Ellinwood 138/69-kV transformer[12] Ellinwood – 12th Avenue 69-kV line	Rebuild line
4	Edgewater – Sauk Trail 138-kV line	105.8%	--	Edgewater – Huebner 138-kV line	Uprate line
4	Sauk Trail – 20th Street 138-kV line	95.3%	--	Edgewater – Huebner 138-kV line	Uprate line
4	East Krok – Kewaunee 138-kV line	96.0%	--	North Appleton 345/138-kV transformer #1[1]	Further study needed
4	Manrap – Custer 69-kV line	95.4%	--	Dewey – Lakefront 69-kV line	Further study needed
5	Base Case Loading Criteria Exceeded	TRUE		System Intact	
5	Base Case Voltage Criteria Exceeded	--	FALSE	System Intact	
5	Bain 345/138-kV transformer #5	159.6% 108.8%	--	Split Pleasant Prairie 345-kV bus 34 Split Pleasant Prairie 345-kV bus 23	Mitigated by generation adjustments
5	Oak Creek 345/230-kV transformer T895	105.2% 104.9%	--	Split Oak Creek 230-kV bus 78 Split Oak Creek 230-kV bus 67	Mitigated by generation adjustments
5	Arcadian4 – Waukesha1 138-kV line	106.8%	--	Arcadian6 – Waukesha3 138-kV line	Rebuild line
5	Arcadian6 – Waukesha3 138-kV line	103.1%	--	Arcadian4 – Waukesha1 138-kV line	Rebuild line
5	Arcadian 345/138-kV transformer #3	101.9%	--	Arcadian 345/138-kV transformer #1	Replace transformer
5	Pleasant Prairie – Zion 345-kV line	95.6% 95.4%	--	Zion – Arcadian 345-kV line Cherry Valley – Silver Lake 345-kV line	Marginal issue, no mitigation needed within this timeframe
5	Kenosha – Lakeview 138-kV line	102.1%	--	Pleasant Prairie – Zion 345-kV line	Rebuild line. The existing conductor is 477 ACSR and is the limitation.
5	Lakeview – Zion 138-kV line	97.3%	--	Pleasant Prairie – Zion 345-kV line	No overload
5	Albers – Kenosha 138-kV line	106.0%	--	Bain – Kenosha 138-kV line	Uprate the 477 ACSR section of the Kenosha – Albers 138-kV line
5	Bluemound 230-kV bus, Allerton, Bark River, Brookdale, Edgewood, Cottonwood,Germantown, Mukwonago, Maple, O'Connor, and 28th St 138-kV buses	--	94.4 – 96.0%	System Intact	Shift Allerton load from T9 to T8 or connecting KK5063 to Brookdale 138-kV bus
5	Maple and Germantown 138-kV buses	--	90.4 – 90.9%	Saukville – Maple 138-kV line	Mitigated by generation adjustments

Table ZS-3_2020 constraints

Event Based Contingency Number	**Definition of Event Based Contingency**
1	North Appleton 345/138 kV xfmr #1 + North Appleton - Kewaunee 345 kV circuit
2	North Fond du Lac 138/69-kV transformer #3 + North Fond du Lac - Hickory Street Tap 69-kV line + North Fond du Lac - Rosendale 69-kV line + North Fond du Lac 69-kV bus capacitor
3	Metomen - Rosendale - North Fond du Lac 69-kV line
4	Arpin - Rocky run 345-kV line + Port Edwards - Sand Lake 138-kV line + Port Edwards - Hollywood 138-kV line + Council Creek - Council Creek DPC 69-kV line
5	Saratoga – ACEC Badger West - Petenwell 138-kV line
6	Whitcomb - CWEC Wittenberg Tap - Wittenberg Tap - Birnamwood Tap - Brooks Corner - Deer Trail 69-kV line
7	North Randolph – Fox Lake – North Beaver Dam 138-kV line
8	East Krok 138/69 kV xfmr + Highway V - East Krok 138 kV circuit + East Krok - Canal 138 kV circuit + East Krok - Kewaunee 138 kV circuit + Beardsely - East Krok 69 kV circuit
9	Canal 138/69 kV xfmr #1 + Canal - East Krok 138 kV circuit + Canal - Sawyer 69 kV circuit + Canal - Algoma 69 kV circuit + Canal 69 kV cap banks, 2 x 16.3 MVAr
10	Highway V 138/69 kV xfmr #1 + Highway V - Ontario 138 kV circuit + Highway V - Preble 138 kV circuit + Highway V - Finger Road 69 kV circuit + Highway V - Rockland 138 kV circuit + Highway V 138 kV cap bank, 2 x 18.9 MVAr
11	Highway V 138/69 kV xfmr #2 + Highway V - East Krok 138 kV circuit + Highway V - Mystery Hills 138 kV circuit + Highway V - Oak Street 69 kV circuit
12	Ellinwood 138/69 kV xfmr #1 + Ellinwood - Twelfth Ave 69 kV circuit + Ellinwood - Fitzgerald 138 kV circuit +Ellinwood 138 kV bus tie 1-2
13	M38-Atlantic 138-kV line + Atlantic 138/69-kV transformer

Table ZS-4
2025 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2025 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
1	Base case loading criteria exceeded	TRUE	--	System Intact	
1	Base case voltage criteria exceeded	--	FALSE	System Intact	
1	Silver Lake, ACEC Spring Lake, Redgranite, Fountain Valley, River Run, Berlin and Fox River 69-kV buses	--	84.6 – 88.8% 87.2 – 91.9% 87.5 – 90.8% 87.5 – 90.2% 88.8 – 91.9%	Wautoma – Silver Lake Tap 69-kV line Metomen – Ripon 69-kV line Silver Lake – ACEC Spring Lake 69-kV line Winneconne – Sunset Point 69-kV line Plus other less severe contingencies	Ripon capacitor expansion and Install capacitors at Dartford
1	Dartford,Ripon Industrial Park, Northwest Ripon and Ripon 69-kV buses	--	84.9 – 86.1% 87.1 – 88.1% 88.7 – 89.7% 91.1 – 91.9%	Metomen – Ripon 69-kV line Ripon – Northwest Ripon Tap 69-kV line Winneconne – Sunset Point 69-kV line Plus other less severe contingencies	Ripon capacitor expansion and Install capacitors at Dartford
1	Winneconne, Omro and Omro Industrial Park 69-kV buses	--	82.5 – 83.4% 89.6 – 89.9% 90.1 – 90.8% 90.8 – 91.5% 91.0 – 91.7%	Winneconne – Sunset Point 69-kV line Winneconne – Omro Tap 69-kV line Metomen – Ripon 69-kV line Ripon – Northwest Ripon Tap 69-kV line Wautoma – Silver Lake Tap 69-kV line	Ripon capacitor expansion and Install capacitors at Dartford
1	ACEC Brooks, Grand Marsh (PP&L) and Lincoln Pumping Station 69-kV buses	--	85.6 – 86.2% 85.6 – 86.1% 88.6 – 89.1% 90.2 – 90.5% 90.5 – 91.9%	Necedah Tap – Big Pond 69-kV line Chaffee Creek – Coloma Tap 69-kV line Necedah Tap – Whistling Wings Tap 69-kV line Wautoma – Port Edwards 138-kV line Plus other less severe contingencies	McKenna capacitor expansion
1	Sigel, Lakehead Pipeline, Port Edwards, Vulcan and Hollywood 138-kV buses	--	89.8 – 91.8%	Sigel – Arpin 138-kV line	Further Study needed
1	Petenwell and Council Creek 138-kV buses	--	95.8 – 96.4% 90.2 – 91.0% 90.2 – 91.0% 90.3 – 90.8% 91.9%	System Intact King – Arpin 345-kV line[1] Eau Claire to Arpin 345 kV[2] Arpin – Rocky Run 345-kV line[3] Sigel – Arpin 138-kV line	Marginal voltage, no mitigation needed within this timeframe
1	Necedah, Petenwell, Big Pond, ACEC Dellwood, Friendship, ACEC Friendship, Houghton Rock and McKenna 69-kV buses	--	95.8 – 96.1% 74.5 – 83.3% 81.3 – 87.0% 87.0 – 89.9% 87.0 – 89.8% 87.0 – 92.0%	System Intact Necedah Tap – Big Pond 69-kV line Necedah Tap – Whistling Wings Tap 69-kV line Dellwood ACEC – Whistling Wings Tap 69-kV line Petenwell – Big Pond 69-kV line Plus other less severe contingencies	McKenna capacitor expansion, Convert Necedah to 138 kV, redispatch Castle Rock generation

Table ZS-4
2025 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2025 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
1	Lakehead Pipeline Portage, Endeavor, Roslin ACEC and Montello ACEC 69-kV buses	--	89.5 – 90.8% 91.4 – 91.5%	Portage – Lakehead Pipeline Portage 69-kV line Endeavor – Lakehead Pipeline 69-kV line	Further Study needed
1	Sand Lake and Wautoma 138-kV buses	--	95.2 – 95.5% 90.7 – 92.0% 91.2% 92.0%	System Intact Arpin – Rocky Run 345-kV line[3] Sigel – Arpin 138-kV line Port Edwards – Sand Lake 138-kV line	Marginal voltage, no mitigation needed within this timeframe
1	ACEC Winnebago, ACEC Glen, Neenah Creek, ACEC Chateau and Westfield 69-kV buses	--	86.2 – 91.0% 91.2 – 91.8% 91.5% 91.5% 91.2 – 91.8%	Kilbourn – Winnebago ACEC 69-kV line Wautoma – Port Edwards 138-kV line Sand Lake Tap – Sand Lake 69-kV line Sand Lake 138/69-kV transformer Wautoma – Port Edwards 138-kV line	Increase capacitance at Neenah Creek
1	ACEC Coloma, Plainfield, Sand Lake, Hancock and ACEC Hancock 69-kV buses	--	83.4 – 84.5% 86.8 – 90.7% 87.3 – 91.1% 87.3 – 91.1% 88.6 – 89.6% 90.8 – 91.8%	Chaffee Creek – Coloma Tap 69-kV line Wautoma – Port Edwards 138-kV line Sand Lake Tap – Sand Lake 69-kV line Sand Lake 138/69-kV transformer Necedah Tap – Big Pond 69-kV line Plus other less severe contingencies	McKenna capacitor expansion
1	ACEC Quincy and Castle Rock 69-kV bus	--	88.6 – 89.2% 91.0 – 91.4%	Necedah Tap – Big Pond 69-kV line Necedah Tap – Whistling Wings Tap 69-kV line	McKenna capacitor expansion
1	Wittenburg 69-kV bus		92.0%	Whitcomb – Wittenberg CWEC 69 kV line	Marginal voltage, no mitigation needed within this timeframe
1	North Randolph – Markesan 69-kV line	96.6%	--	Metomen – Ripon 69-kV line	Marginal issue, no mitigation needed within this timeframe
1	Markesan – Mackford Pairie 69-kV line	98.4%	--	Metomen – Ripon 69-kV line	Marginal issue, no mitigation needed within this timeframe
1	Arnott 138/69 KV transformer #T31	100.9%	--	Harrison 138/69 kV transformer	Further Study needed
1	Caroline 115/69 KV transformer #T61	116.3%	--	Whitcomb 115/69-kV transformer	Replace Caroline 115/69-kV transformer
1	Chaffee Creek – Coloma Tap 69-kV line	136.3% 115.0% 106.4% 106.3% 106.2% -- 98.2%	--	Necedah Tap – Big Pond 69-kV line Necedah Tap – Whistling Wings Tap 69-kV line King – Eau Claire 345 kV tie line[1] King – Arpin 345-kV line[4] Plus other less severe contingencies	Uprate terminal equipment at Chaffee Creek

Table ZS-4
2025 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2025 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
1	Castle Rock – ACEC Quincy 69-kV line	138.6% 120.7% 112.9% 112.9% 108.1% 105.3% -- 99.5%	--	Necedah Tap – Big Pond 69-kV line Necedah Tap – Whistling Wings Tap 69-kV line Petenwell – Big Pond 69-kV line Petenwell 138/69-kV transformer Dellwood ACEC – Whistling Wings Tap 69-kV line Plus other less severe contingencies	Uprate Castle Rock – McKenna 69-kV line
1	ACEC Quincy – McKenna 69-kV line	131.4% 113.6% 105.9% 105.9% 101.1% 95.2%	--	Necedah Tap – Big Pond 69-kV line Necedah Tap – Whistling Wings Tap 69-kV line Petenwell – Big Pond 69-kV line Petenwell 138/69-kV transformer Dellwood ACEC – Whistling Wings Tap 69-kV line Chaffee Creek – Coloma Tap 69-kV line	Uprate Castle Rock – McKenna 69-kV line
1	Brooks Corners 69-kV bus	--	85.9%	Whitcomb – Deer Trail 69-kV line[22]	Adjust Brooks Corners 69/34.5-kV transformer LTC
1	Harrison – Harrison Tap 69-kV line	116.1% 108.6% 108.1% 106.0% 105.7 – 100.3%	--	Wautoma 138/69-kV transformer Winneconne – Sunset Point 69-kV line Portage – Lakehead Pipeline Portage 69-kV line Endeavor – Lakehead Pipeline 69-kV line Plus other less severe contingencies	Further Study needed
1	Harrison 138/69 KV transformer #T1	124.1% 104.8% 100.7% 100.7% 100.0 – 97.2%	--	System Intact Arnott 138/69-kV transformer Whitcomb – Rosholt Tap 69-kV line Arnott 69-kV bus Plus other less severe contingencies	Replace Harrison 138/69-kV transformer
1	Hilltop – Mauston 69-kV line	106.7%	--	Arpin – Rocky Run 345-kV line3	Further Study needed
1	Metomen – Ripon 69-kV line	106.5% 118.8% 109.7% 104.2% 103.9 -- 95.8%	--	System Intact Winneconne – Sunset Point 69-kV line Winneconne – Omro Tap 69-kV line North Randolph – Markesan Tap 69-kV line Plus other less severe contingencies	Second Metomen – Ripon 69-kV line

Table ZS-4
2025 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2025 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
1	Metomen 138/69 KV transformer #T31	109.8% 117.5% 115.7% 109.1% 108.9 – 97.0%	--	System Intact North Fond du Lac 138/69-kV transformer #3[5] North Fond du Lac – Rosendale Tap 69-kV line Metomen – North Fond du Lac 69 kV line[6] Plus other less severe contingencies	Replace Metomen 138/69-kV transformer
1	Northwest Ripon – Ripon 69-kV line	119.4% 105.2% 97.0%	--	Winneconne – Sunset Point 69-kV line Winneconne – Omro Tap 69-kV line Omro – Omro Industrial Tap 69-kV line	Uprate line
1	NW Ripon – Dartford 69-kV line	100.9%	--	Winneconne – Sunset Point 69-kV line	Further Study needed
1	Omro – Winneconne 69-kV line	102.2% 113.1% 112.4% 100.9%	--	System Intact Ripon – Northwest Ripon Tap 69-kV line Metomen – Ripon 69-kV line Northwest Ripon Tap – Dartford Tap 69-kV line	Further Study needed
1	Petenwell – ACEC Badger West 138-kV line	104.9% 104.9% 104.5% 104.4%	--	Eau Claire to Arpin 345 kV line[2] Eau Claire to Arpin 345 kV line[7] King – Arpin 345-kV line[1] King – Eau Claire 345-kV line[4]	Further Study needed
1	Petenwell 138/69-kV transformer	101.0% 107.6% 107.1% 104.9% 104.0% 104.0 – 97.1%	--	System Intact McKenna – Houghton Rock 69-kV line Castle Rock – Quincy ACEC 69-kV line Hilltop – Buckhorn Tap 69-kV line McKenna – Quincy ACEC 69-kV line Plus other less severe contingencies	Replace Petenwell transformer
1	Sand Lake 138/69-kV transformer	103.0% 99.9% 95.2%	--	System Intact Wautoma 138/69-kV transformer Necedah Tap – Big Pond 69-kV line	Further Study needed
1	Sand Lake – Sand Lake Tap 69-kV line	106.3% 112.5% 111.5% 107.6% 107.0 – 99.3%	--	System Intact Wautoma 138/69-kV Transformer Necedah Tap – Big Pond 69-kV line Trienda – Lewiston ACEC 138-kV line Plus other less severe contingencies	Further Study needed

Table ZS-4
2025 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2025 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
1	Saratoga – ACEC Badger West 138-kV line	109.3% 109.3% 108.9% 108.8%	--	Eau Claire to Arpin 345-kV tie line[2] Eau Claire to Arpin 345-kV line[2] King – Arpin 345-kV line[1] King – Eau Claire 345 kV tie line[4]	Further Study needed
1	Sigel – Auburndale 69-kV line	130.2%	--	System Intact	Line validated with higher rating
1	Vulcan – Port Edwards 1 138-kV line	123.8%	--	Vulcan – Port Edwards 138-kV line #2	Change tap on free standing CT's at Port Edwards
1	Vulcan – Port Edwards 2 138-kV line	123.8%	--	Vulcan – Port Edwards 138-kV line #1	Change tap on free standing CT's at Port Edwards
1	Rocky Run 345/115-kV transformer #T4	99.8% 99.6% 98.7% 95.2%	--	Rocky Run 345/115-kV transformer #T2 Sigel – Arpin 138-kV line Rocky Run 345/115-kV transformer #T1 Arpin 345/138-kV transformer	Marginal issue, no mitigation needed in this timeframe
1	Wautoma 138/69-kV transformer #T31	118.1% 113.9% 113.9% 105.8% 105.0 – 95.9%	--	System Intact Sand Lake Tap – Sand Lake 69-kV line Sand Lake 138/69-kV transformer Portage – Lakehead Pipeline Portage 69-kV line Plus other less severe contingencies	Second 138/69-kV Transformer at Wautoma
1	Whitcomb 115/69-kV transformer #T31	99.4%	--	System Intact	Marginal issue, no mitigatin needed in this timeframe
1	Winneconne – Sunset Point 69-kV line	118.6% 118.2% 107.2% 102.2% 97.1%	--	Ripon – Northwest Ripon Tap 69-kV line Metomen – Ripon 69-kV line Northwest Ripon Tap – Dartford Tap 69-kV line Wautoma – Silver Lake Tap 69-kV line Silver Lake – ACEC Spring Lake 69-kV line	Uprate line
2	Base case loading criteria exceeded	FALSE	--	System Intact	
2	Base case voltage criteria exceeded	--	FALSE	System Intact	
2	Atlantic – M38 69-kV line	121.7% 121.6% 117.9%	--	M38 – Atlantic 138-kV line[23] Atlantic 138/69-kV transformer Roberts – Newberry Hospital 69-kV line	Uprate line
2	Nordic – Mountain 69-kV line	102.4%	--	Chandler 138/69-kV transformer	Targeted for mitigation by Escanaba area reinforcements

Table ZS-4
2025 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2025 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
2	Rudyard – Pine River 69-kV line Rudyard – Tone 69-kV line Kinchloe – Tone 69-kV line	111.4% 114.7% 107.9%	--	Engadine – Newberry 69-kV line	Mitigated by generation adjustments
2	Hulbert, Brimley, Detour, Eckermann, Goetzville, Pickford, Raco, Lou-Pac, Newberry Village, Roberts, Talantino 69-kV buses	--	75.4 – 90.4%	Hiawatha – Roberts 69-kV line 6911[24]	Targeted for mitigation by Eastern U.P. area reinforcements
2	Lakota Road 69-kV bus	--	118.1%	Lakota – Conover 138/69-kV transformer	Resolved by transformer model adjustments
2	Chandler, Delta, Escanaba 1, Escanaba 2, Masonville, Mead, Gladstone, West, North Bluff, Lakehead, Bay View, Cornell, Harris 69-kV buses	--	87.1 – 90.2%	Chandler 138/69-kV transformer	Targeted for mitigation by Escanaba area reinforcements
2	Detour 69-kV bus, Brevort, Hiawatha, Lakehead 138-kV buses	--	90.9 – 91.9%	Straits 138/69-kV transformer	Targeted for mitigation by Eastern U.P. area reinforcements
2	Hulbert, Sault, Brimley, Dafter, Detour, Eckermann, Goetzville, Newberry, Pickford, Raco, Lou-Pac, Newberry Hospital, Newberry Village, Roberts, Three Mile, ESE Hydro, Magazine, Nine Mile, Kinchloe, Rockview, Michigan Limestone, Pine Grove, Tone, Talantino 69-kV buses	--	56.3 – 88.2%	Engadine – Newberry 69-kV line	Targeted for mitigation by Eastern U.P. area reinforcements
2	Hulbert, Brimley, Detour, Eckermann, Goetzville, Pickford, Raco, Lou-Pac, Newberry Hospital, Newberry Village, Roberts, Talantino 69-kV buses	--	72.9 -88.9%	Newberry – Newberry Hospital 69-kV line	Targeted for mitigation by Eastern U.P. area reinforcements
2	Hulbert, Brimley, Detour, Eckermann, Goetzville, Pickford, Raco, Lou-Pac, Newberry Village, Roberts, Three Mile, Magazine, Michigan Limestone, Pine Grove, Talantino 69-kV buses	--	71.6 – 90.2%	Newberry Hospital – Roberts 69-kV line	Targeted for mitigation by Eastern U.P. area reinforcements
3	Base case loading criteria exceeded	TRUE	--	System Intact	
3	Base case voltage criteria exceeded	--	TRUE	System Intact	
3	Kilbourn, Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan, Artesian, Rock Springs 138-kV bus	--	95.6 – 96.6% 86.3 – 89.0% 86.9 – 89.4% 86.9 – 89.4% 89.0 – 90.8% 91.1 – 92.0%	System Intact Trienda – Lewiston ACEC 138-kV line Kilbourn – Lewiston ACEC 138-kV line Trienda – Kilbourn 138-kV line Lake Delton – Trienda 138-kV line Plus other less severe contingencies	
3	Okee, Lodi Industrial Park and Lodi 69-kV buses	--	88.3 – 89.7% 90.2 – 91.6%	Dane – Lodi Tap 69-kV line Lodi Tap – Okee Tap 69-kV line	

Table ZS-4
2025 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2025 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
3	Kirkwood and Lake Delton 138-kV buses	--	95.0 – 95.1% 87.2 – 87.3% 90.0% 90.3 – 90.7% 90.4% 90.6 – 90.9% 90.6 – 90.9%	System Intact Lake Delton – Trienda 138-kV line Lake Delton – Kirkwood 138-kV line Trienda – Lewiston ACEC 138-kV line Trienda – Kirkwood 138-kV line8 Kilbourn – Lewiston ACEC 138-kV line Trienda – Kilbourn 138-kV line	
3	Island Street, Baraboo, Sauk Prairie, Prairie du Sac Muni, Tower Street, Dam Heights and Prairie du Sac Hydro 69-kV buses	--	88.2 – 90.2% 91.9% 91.9%	Island Street – Kirkwood 69-kV line Baraboo Tap – Moore Street Tap 69 kV line Island Street – Moore Street Tap 69-kV line	
3	Artesian – Rock Springs 138-KV line	101.9% 99.7% 99.7%	--	Trienda – Lewiston ACEC 138-kV line Kilbourn – Lewiston ACEC 138-kV line Trienda – Kilbourn 138-kV line	
3	Kirkwood – Rock Springs 138-KV line	105.4% 103.3% 103.2%	--	Trienda – Lewiston ACEC 138-kV line Trienda – Kilbourn 138-kV line Kilbourn – Lewiston ACEC 138-kV line	
3	Kilbourn – Lewiston 138-kV line	100.7%	--	Lake Delton – Trienda 138-kV line	
3	Trienda – Lewiston 138-kV line	102.6% 96.2% 95.0%	--	Lake Delton – Trienda 138-kV line Trienda – Kirkwood 138-kV line8 Lake Delton – Kirkwood 138-kV line	
3	Dane – Lodi Tap 69-kV line	122.5% 111.3% 108.7% 108.7% 102.9 – 96.5%	--	Island Street – Kirkwood 69-kV line Lake Delton – Trienda 138-kV line Baraboo Tap – Moore Street Tap 69-kV line Island Street – Moore Street Tap 69-kV line Plus other less severe contingencies	
3	Kilbourn 138/69-kV transformer #T32	99.3%	--	Kilbourn 138/69-kV transformer T31	
3	Portage – Columbia 1 138-kV line	100.5%	--	Portage – Columbia 2 138-kV line	
3	Portage – Columbia 2 138-kV line	100.5%	--	Portage – Columbia 1 138-kV line	
3	Portage – Trienda 1 138-kV line	97.5%	--	Portage – Trienda 2 138-kV line	
3	Portage – Trienda 2 138-kV line	107.4%	--	Portage – Trienda 1 138-kV line	
3	Cobblestone – Zenda Tap 69-kV line	218.6% 134.0% 132.3%	--	North Lake Geneva – Lake Geneva 69-kV line Lake Geneva – South Lake Geneva 69-kV line North Lake Geneva – Lake Geneva – South Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line

Table ZS-4
2025 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2025 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
3	Colley Road 138/69-kV transformer	127.8% 109.7% 106.4% 106.1% 103.3 – 98.5%	--	Paddock 138/69-kV transformer Paddock – Shirland 69-kV line System Intact Brick Church 138/69-kV transformer Plus other less severe outages	Bass Creek 138/69-kV transformer
3	Katzenberg – Zenda tap 69-kV line	201.5% 119.4% 117.8%	--	North Lake Geneva – Lake Geneva 69-kV line Lake Geneva – South Lake Geneva 69-kV line North Lake Geneva – Lake Geneva – South Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Katzenberg – South Lake Geneva 69-kV line	138.6% 104.3% 103.9%	--	Cobblestone – Brick Church 69-kV line North Lake Geneva – Lake Geneva 69-kV line Cobblestone – Zenda Tap 69-kV line	Third source into area, possibliy from Spring Valley
3	North Lake Geneva – Lake Geneva 69-kV line	126.7% 105.1%	--	Cobblestone – Brick Church 69-kV line Cobblestone – Zenda tap 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	North Lake Geneva 138/69-kV transformer	106.8%	--	Brick Church 138/69-kV transformer	North Lake Geneva – South Lake Geneva 138-kV line
3	Lake Geneva – South Lake Geneva 69-kV line	146.0% 116.9% 101.6%	--	Cobblestone – Brick Church 69-kV line Cobblestone – Zenda tap 69-kV line Katzenberg – Zenda tap 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Cobblestone – Brick Church 69-kV line	178.0% 114.7% 113.3%	--	North Lake Geneva – Lake Geneva 69-kV line Lake Geneva – South Lake Geneva 69-kV line North Lake Geneva – Lake Geneva – South Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Brick Church 138/69-kV transformer	126.8% 109.1% 97.0%	--	North Lake Geneva 138/69-kV transformer North Lake Geneva – Lake Geneva 69-kV line System Intact	North Lake Geneva – South Lake Geneva 138-kV line
3	Brick Church – Walworth 69-kV line	118.8%	--	North Lake Geneva 138/69-kV transformer	North Lake Geneva – South Lake Geneva 138-kV line
3	Enzyme Bio – RC3 69-kV line	104.1%	--	Brick Church 138/69-kV transformer	Line Y-32 rebuild
3	RC3 – Clinton Tap 69-kV line	97.2%	--	Brick Church 138/69-kV transformer	Line Y-32 rebuild
3	Paddock 138/69-kV transformer	112.5% 112.3% 104.2% 96.3%	--	Colley Road 138/69-kV transformer Intact System Colley Road – Park Street 69-kV line Park Street – East Rockton 69-kV line	Bass Creek 138/69-kV transformer
3	Walworth – Schofield tap 69-kV line	97.6%	--	North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Schofield tap – North Lake Geneva 69-kV line	96.9%	--	North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Paddock – Shirland Ave 69-kV line	105.2%	--	Colley Road 138/69-kV transformer	Further Study needed
3	Shaw – East Rockton 69-kV line	105.1%	--	Paddock 138/69-kV transformer	Bass Creek 138/69-kV transformer
3	East Rockton – Park St 69-kV line	98.5%	--	Paddock 138/69-kV transformer	Bass Creek 138/69-kV transformer

Table ZS-4
2025 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2025 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
3	Colley Road – Park St 69-kV line	109.4%	--	Paddock 138/69-kV transformer	Bass Creek 138/69-kV transformer
3	McCue – Milton Lawns 69-kV line	100.6%	--	Janesville 138/69-kV transformer	Further Study needed
3	Lake Geneva, South Lake Geneva, Twin Lakes, Katzenberg, Zenda, Cobblestone, Brick Church, Sharon, Walworth, Lakehead-Walworth 69-kV buses, Brick Church and Williams Bay 138-kV buses	--	47.1 – 92.0%	North Lake Geneva – Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Twin Lakes, Katzenberg, South Lake Geneva, and Zenda 69-kV buses	--	80.9 – 89.2%	North Lake Geneva – Lake Geneva – South Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Twin Lakes and Zenda 69-kV buses	--	91.3 – 91.8%	Cobblestone – Zenda tap 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Twin Lakes, Katzenberg, South Lake Geneva and Zenda 69-kV buses	--	79.9 – 88.3%	Lake Geneva – South Lake Geneva 69-kV line	North Lake Geneva – South Lake Geneva 138-kV line
3	Cobblestone, Zenda, Twin Lakes, Katzenberg 69-kV buses	--	84.4 – 88.8%	Cobblestone – Brick Church 69-kV line	North Lake Geneva – South Lake Geneva 138kV line
3	Twin Lakes and Katzenberg 138-kV buses	--	87.1 -88.3%	Katzenberg – South Lake Geneva 69-kV line	Third source into area, possibliy from Spring Valley
3	Twin Lakes, Katzenberg, South Lake Geneva, Lake Geneva, North Lake Geneva, Zenda, and Schofield 69-kV buses	--	83.9 – 90.4%	North Lake Geneva 138/69-kV transformer	North Lake Geneva – South Lake Geneva 138-kV line
3	Brick Church and Williams Bay 138-kV buses	--	90.3 – 91.6%	Colley Road – Dickinson – Beloit Gateway – Brick Church 138-kV line	Y-32 line rebuild
3	Brick Church, Dickinson and Williams Bay 138-kV buses	--	90.6 – 91.6%	Colley Road – Dickinson 138-kV line	Y-32 line rebuild
3	Concord 5 138-kV bus	--	91.6%	Split Concord 138-kV bus	Marginal voltage, no mitigation needed within this timeframe
3	RC9 , RC2, West Darien and SW Delavan 138-kV buses	--	91.6 – 91.9%	RC9 – Rock River 138-kV line	Y-32 line rebuild
3	Brick Church and Williams Bay 138-kV buses	--	89.3 – 90.7%	Beloit Gateway – Dickinson 138-kV line	Y-32 line rebuild
3	Brick Church and Williams Bay 138-kV buses	--	90.3 – 91.5%	Beloit Gateway – Brick Church 138-kV line	Y-32 line rebuild
3	South Fond du Lac – Koch Oil Tap 69-kV line	101.0% 96.5% 96.3%	--	North Randolph – Fox Lake 138-kV line Fox Lake – North Beaver Dam 138-kV line North Randolph – North Beaver Dam 138-kV line[9]	Further study needed
3	Kock Oil Tap – Waupun 69-kV line	96.8%	--	North Randolph – Fox Lake 138-kV line	Further study needed
3	Hubbard and Hustisford 138-kV bus	--	85.3% 86.1% 86.1%	Rubicon – Hustisford 138-kV line Hustisford – Hubbard 138-kV line Rubicon – Hustisford – Hubbard 138-kV line	Adjust Hubbard 138/69-kV transformer LTC

Table ZS-4
2025 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2025 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
3	Fox Lake, North Beaver Dam and Beaver Dam East 138-kV buses	--	95.9 – 96.1% 84.6 – 84.7% 85.6 – 85.7% 85.6 – 85.7% 90.4 – 92.0%	System Intact North Randolph – Fox Lake 138-kV line Fox Lake – North Beaver Dam 138-kV line North Randolph – North Beaver Dam 138-kV line[9] Plus other less severe contingencies	Adjust North Beaver Dam 138/69-kV transformer LTC
3	North Randolph and Academy 138-kV bus	--	95.8 – 95.9% 91.1%	System Intact Boxelder – Academy 138-kV line	Further study needed
3	Koch Oil, Waupun and Alto Dairy 69-kV bus	--	91.0 – 91.1% 91.7 – 91.8%	South Fond du Lac – Koch Oil Tap 69-kV line Waupan – Koch Oil Tap 69-kV line	Further study needed
3	Horicon Industrial Park, Horicon and Juneau 69-kV bus	--	91.2 – 91.4% 91.7 – 91.8%	Hubbard – Horicon Industrial Park 69-kV line South Fond du Lac – Waupun 69-kV line[10]	Further study needed
3	Randolph and Didion Ethanol 69-kV bus	--	91.5 – 91.7%	North Randolph – Randolph Tap 69-kV line	Further study needed
3	McCue – REC Harmony 69-kV line	95.9%	--	System Intact	Second McCue-Lamar line
3	Hillman 138/69-kV transformer	100.0%	--	System Intact	Second Hillman transformer
3	North Monroe 138/69-kV transformer	113.0%	--	System Intact	Bass Creek transformer
3	REC Newark – Paddock 69-kV line	97.0%	--	System Intact	Bass Creek transformer
3	Timberlane Tap – West Middleton 69-kV line	106.0%	--	System Intact	Further Study needed
3	Verona 138/69-kV transformer	112.7 – 96%	--	Stoughton South – Stoughton 69-kV line Oregon – Stoughton 69-kV line Stoughton South tap – Oregon 69-kV line North Monroe 138/69-kV transformer West Middleton – Timberlane 69-kV line plus other less severe contingencies	Bass Creek and potential second Verona transformer
3	Stoughton – Stoughton Muni South Tap – Oregon 69-kV line	122.8 – 106.9%	--	Verona – Oak Ridge 138-kV line Verona 138/69-kV transformer	Y127 line uprate
3	Mount Horeb Northeast – Stagecoach 69-kV line	98.2%	--	Verona – Southwest Verona 69-kV line	Further Study needed
3	Sun Valley Tap – Oregon 69-kV line	102.1%	--	Stoughton South – Stoughton 69-kV line	Y119 rebuild and potential Oregon terminal upgrade
3	Hillman 138/69-kV transformer	122.1 – 95.4%	--	DPC Galena – Pilot NB 69-kV line DPC Terr Tap – Pilot NB 69-kV line DPC LNGHLLW8 – Terr Tap 69-kV line DPC LNGHLLW8 – Galna T8 69-kV line DPC Galna – Guilford 69-kV line plus other less severe contingencies	Secnd Hillman transformer

Table ZS-4
2025 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2025 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
3	North Monroe – Idle Hour – Monroe Tap 69-kV line	139.3 – 95.9%	--	Paddock – Newark 69-kV line Brodhead – Newark 69-kV line Paddock – Brodhead Switching Station 69-kV line[12] Darlington – Gratiot 69-kV line Spring Grove – Brodhead Switching Station 69-kV line Plus other less severe outages	Bass Creek transformer and potential Y87 line uprate
3	North Monroe 138/69-kV transformer	114.7 – 95.3%	--	Columbia generator #1 Columbia generator #2 Darlington 138/69-kV transformer	Bass Creek transformer
3	Jennings Switching Station – Wiota – DPC Gratiot Tap 69-kV line	104.5 – 97.5%	--	North Monroe – Idle Hour 69-kV line North Monroe 138/69-kV transformer	Y34 line uprate
3	Brodhead Switching Station – REC Newark – Paddock 69-kV line	112.2 – 95.3%	--	North Monroe – Idle Hour 69-kV line North Monroe 138/69-kV transformer Idel Hour – Monroe Central tap 69-kV line Albany – Townline 138-kV line	Bass Creek transformer
3	McCue – REC Harmony – Milton Tap – Lamar 69-kV line	115.6 – 95.6%	--	Kegonsa – Stoughton North Tap2 69-kV line Kegonsa 138/69-kV transformer Stoughton North Tap1 – Stoughton North Tap2 69-kV line Stoughton East – Stoughton North 69-kV line Stoughton East – Stoughton 69-kV line plus other less severe contingencies	Second McCue-Lamar line
3	Dana Corporation Tap – Sheepskin 69-kV line	137.1 – 125.4%	--	McCue – Harmony 69-kV line Milton Tap – Lamar 69-kV line McCue – Lamar 69-kV line[13] Milton Tap – Harmony 69-kV line	Y62 line uprate and second McCue-Lamar line
3	Gran Grae – Wauzeka – Boscobel 69-kV line	110.2 – 95.1%	--	Spring Green 138/69-kV transformer Nelson Dewey – Lancaster 138-kV line Nelson Dewey – Eden 138-kV line Eden – Lancaster 138-kV line Eden – Wyoming Valley 138-kV line Columbia generator #1 plus other less severe contingencies	Y40 line uprate
3	Boscobel – Blue River Tap 69-kV line	99.0 – 96.3%	--	Nelson Dewey – Lancaster 138-kV line Spring Green 138/69-kV transformer Nelson Dewey – Eden 138-kV line[11] Eden – Lancaster 138-kV line	Y124 line uprate
3	Spring Green 138/69-kV transformer	95.7%	--	Gran Grae – Wauzeka 69-kV line	Second Spring Green transformer

Table ZS-4
2025 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2025 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
3	Black Earth – Stagecoach 69-kV line	103.2%	--	Spring Green 138/69-kV transformer	Second Spring Green transformer
3	Stagecoach – Timberlane Tap – West Middleton 69-kV line	132.2 – 95.7%	--	Spring Green 138/69-kV transformer Verona – Southwest Verona 69-kV line Verona – Oak Ridge 138-kV line Verona 138/69-kV transformer Nelson Dewey – Lancaster 138-kV line plus other less severe contingencies	Further Study needed
3	Dane – North Madison 69-kV line	102.8 – 95.4%	--	Huiskamp 138/69-kV transformer Huiskamp – North Madison 138-kV line North Madison – Huiscamp 138-kV line Waunakee Industrial Park – Huiskamp 69-kV line North Madison – Deforest 69-kV line	Potential Huiskamp-Blount 138-kV line
3	Waunakee Industrial Park – Huiskamp 69-kV line	97.7%	--	North Madison 138/69-kV transformer	Y132 GOAB uprate
3	West Middleton – Pheasant Branch 69-kV line	98.5%	--	Waunakee Switching – Waunakee Municipal 2 69-kV line	6963 line uprate
3	West Middleton 138/69-kV transformer	103.8%	--	West Middleton 138/69-kV transformer	Cardinal-Blount 138-kV line
3	Westport – Waunakee Muni2 69-kV line	102.3%	--	West Middleton – Pheasant Branch 69-kV line	Y131 line uprate
3	Royster – Sycamore 69-kV line	104.1%	--	Femrite 138/69-kV transformer	Royster – Sycamore line uprate or second Femrite transformer
3	East Towne – Sycamore 69-kV line 2	98.7%	--	East Towne – Sycamore 69-kV line 1	Potential line uprate
3	East Towne – Sycamore 69-kV line 1	98.7%	--	East Towne – Sycamore 69-kV line 2	Potential line uprate
3	Nelson Dewey – Cassville 161-kV line	102.9 – 100.8%	--	Genoa 161/69-kV transformer DPC Seneca – Genoa 161-kV line	Further study needed
3	North Monroe – Albany – Townline Road 138-kV line	101.3 – 95.3%	--	Darlington – Lafayette Wind 138-kV line Nelson Dewey – Potosi 138-kV line Potosi – Hillman 138-kV line Hillman – Nelson Dewey 138-kV line[14]	Potential X-12 rebuild
3	Verona, Oak Ridge, Hawk Alliant, Hawk, Cross Country and Fitchburg 138-kV buses	--	93.6 – 95.8%	System Intact	Potential Oak Ridge capacitor bank
3	North Monroe 138-kV bus	--	95.7%	System Intact	North Monroe capacitor bank
3	Spring Green, Wyoming Valley and Troy 138-kV buses	--	95.5 – 95.7%	System Intact	Further study needed
3	Miner, Shullsburg, Benton, Cuba City and Elmo 69-kV buses	--	85.8 – 91.8%	DPC Galena – Pilot NB 69-kV line DPC Terr Tap – Pilot NB 69-kV line DPC LNGHLLW8 – Terr Tap 69-kV line	Further Study needed

Table ZS-4
2025 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2025 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
3	Southwest verona, Mount Horeb Muni1, Mount Horeb, Mount Horeb Northeast, Forward and Blanchardville 69-kV buses	--	77.8 – 91.6%	Verona – Southwest Verona 69-kV line	SW Verona Unity Power factor correction and 1-16.33 Mvar 69-kV capacitor bank
3	Aaker Road, Stoughton Muni South Tap and Brooklyn 69-kV buses	--	91.7 – 91.8%	Stoughton South – Stoughton 69-kV line	SW Verona Unity Power factor correction and 1-16.33 Mvar 69-kV capacitor bank
3	Huiskamp 138-kV bus	--	88.2%	Huiskamp – North Madison 138-kV line	Adjust Huiskamp 138/69-kV transformer LTC
3	Rewey and Belmont 69-kV buses	--	90.6 – 91.4%	Eden – Rewey 69-kV line Belmont – Rewey 69-kV line	Further Study needed
3	Idle Hour, Monroe, Monroe Tap, South Monroe, Blacksmith, Blacksmith Tap, Browntown and Spring Grove 69-kV buses	--	85.5 – 91.6%	North Monroe – Idle Hour 69-kV line Idel Hour – Monroe Central tap 69-kV line	Further study needed
3	Brodhead Muni3, Brodhead Muni2, Brodhead, Brodhead Muni1, REC Orfordville, Orfordville, Bass Creek and Footville 69-kV buses	--	90.3 – 92%	Brodhead Switching Station – Brodhead Muni3 69-kV line Brodhead Muni3 – Brodhead Muni2 69-kV line	Bass Creek transformer
3	REC Newark and Brodhead Muni2 69-kV buses	--	91.9 – 92%	Paddock – Newark 69-kV line	Bass Creek transformer
3	REC Harmony, Milton, Milton Tap, Lamar, Fulton, Saunders Creek, Dana corporation, Dana Corporation Tap, REC Edgerton, Sheepskin, Evansville and Union Townline 69-kV buses	--	83.8 – 92%	McCue – Harmony 69-kV line Milton Tap – Harmony 69-kV line Milton Tap – Lamar 69-kV line McCue – Lamar 69-kV line[13]	Second McCue-Lamar line
3	Arena 69-kV bus	--	91.5%	Spring Green – Arena 69-kV line	Mazomanie capacitor bank
3	Cottage Grove and Gaston Road 69-kV buses	--	90.4%	Kegonsa – Cottage Grove 69-kV line	Sun Prairie capacitor bank
3	Lancaster, Eden, Wyoming Valley, Spring Green and Troy 138-kV buses	--	87.4 – 91.9%	Nelson Dewey – Lancaster 138-kV line Eden – Lancaster 138-kV line Nelson Dewey – Eden 138-kV line[11]	Potential Y105 conversion
3	Albany and North Monroe 138-kV buses	--	90.2 – 91%	Albany – Townline 138-kV line North Monroe – Albany 138-kV line Townline Road – North Monroe 138-kV line[15]	North Monroe capacitor bank
3	Pleasant View, Hawk Alliant and Hawk 138-kV buses	--	91.6 – 91.8%	West Middleton – Pleasant View 138-kV line	Further study needed
3	Verona, Fitchburg, Oak Ridge and Cross Country 138-kV buses	--	90.7 – 91.9%	Rockdale – West Middleton 345-kV line	Potential Oak Ridge capacitor bank
3	Darlington and North Monroe 138-kV buses	--	87.4 – 90.3%	Darlington – Lafayette Wind 138-kV line	North Monroe capacitor bank
3	Muscoda, Avoca and Avoca Tap 69-kV buses	--	91.1 – 91.3%	Lone Rock – Spring Green 69-kV line	Boscobel capacitor bank
3	Mcgregor, Pioneer, Platteville tap, Hillman, Elmo, Cuba City, Benton, Belmont, Miner and Shullsburg 69-kV buses	--	85.5 – 90.5%	Hillman 138/69-kV transformer	Second Hillman transformer

Table ZS-4
2025 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2025 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
3	Idle Hour, Monroe, Monroe Tap, South Monroe, North Monroe, Monticello, Monticello Tap, New Glarus, Blacksmith, Blacksmith Tap, Belleville, and Browntown 69-kV buses	--	88.2 – 91.9%	North Monroe 138/69-kV transformer	North Monroe capacitor bank
3	Burke, Reiner, Burke Tap and Colorado 69-kV buses	--	90.9 – 91.5%	Reiner 138/69-kV transformer Reiner – Burke Tap 69-kV line	Sun Prairie capacitor bank
3	Avoca, Muscoda, Avoca Tap, Spring Green, Arena, Lone Rock, Mazomanie Industrial, Mazomanie West, Mazomanie , Blue River Tap, Blue River and Black Earth 69-kV buses	--	87.7 – 91.4%	Spring Green 138/69-kV transformer	Second Spring Green transformer
3	Southwest verona, Sun Valley, Verona, Sun Valley Tap, Brooklyn, Belleville, Oregon, Mount Horeb Muni1 and Mount Horeb 69-kV buses	--	87.3 – 91.9%	Verona 138/69-kV transformer Verona – Oak Ridge 138-kV line	SW Verona Unity Power factor correction and 1-16.33 Mvar 69-kV capacitor bank
3	Verona, Fitchburg and Oak Ridge 138-kV buses	--	90.9 – 92.0%	West Middleton 138/69-kV transformer	Potential Oak Ridge capacitor bank
3	Verona, Eden, Spring Green, Troy and Wyoming Valley 138-kV buses	--	90.3 – 91.8%	Columbia Generator Unit 1 Columbia Generator Unit 2	Potential Oak Ridge capacitor bank
4	Base case loading criteria exceeded	TRUE	--	System Intact	
4	Base case voltage criteria exceeded	--	FALSE	System Intact	
4	Highway V – Ontario 138-kV line	115.2% 110.6% 102.8%	--	East Krok 138/69-kV transformer[16] Canal 138/69-kV transformer #1[17] Canal – East Krok 138-kV line	Uprate line
4	Canal – East Krok 138-kV line	106.9% 101.0%	--	Highway V 138/69-kV transformer #1[18] Highway V – Ontario 138-kV line	Uprate line
4	East Krok 138/69-kV transformer	109.5% 99.3% 98.2% 97.7%	--	Canal – East Krok 138-kV line Highway V 138/69-kV transformer #1[18] Highway V – East Krok 138-kV line Highway V 138/69-kV transformer #2[19]	No project needed Investigation into limiting facility resulted in higher facility ratings
4	Dyckesville – Rosiere 69-kV line	96.0%	--	East Krok 138/69-kV transformer[16]	Further study needed
4	Sunset Point – Pearl Avenue 69-kV line	122.1% 121.9%	--	Ellinwood 138/69-kV transformer[20] Ellinwood – 12th Avenue 69-kV line	Rebuild line
4	Sunset Point 138/69-kV transformer #1	105.1%	--	Sunset Point 138/69-kV transformer #2	Replace transformer
4	Sunset Point 138/69-kV transformer #2	95.7%	--	Sunset Point 138/69-kV transformer #1	Further study needed
4	Neevin – Woodenshoe 138-kV line	97.5%	--	Fitzgerald 345/138-kV transformer #1[21]	Further study needed
4	Edgewater 345/138-kV transformer #1	95.1%	--	Edgewater 345/138-kV transformer #2	Further study needed
4	Edgewater 138/69-kV transformer #1	102.0% 99.0%	--	System Intact Edgewater 138/69-kV transformer #2	Replace transformer
4	Edgewater 138/69-kV transformer #2	100.0%	--	System Intact	Replace transformer
4	Edgewater – Sauk Trail 138-kV line	118.4% 95.0%	--	Edgewater – Huebner 138-kV line Lodestar – Huebner 138-kV line	Uprate line
4	Sauk Trail – 20th Street 138-kV line	107.0%	--	Edgewater – Huebner 138-kV line	Further study needed

Table ZS-4
2025 Limitations and Performance Criteria Exceeded

Planning Zone	Criteria Exceeded/Need	2025 Summer Peak Case		Facility Outage(s)	Project/Mitigation
		% of Facility Rating	% of Nominal Bus Voltage		
4	Manrap – Custer 69-kV line	98.2%	--	Dewey – Lakefront 69-kV line	Further study needed
4	Bluestone 69-kV bus	--	90.5%	Finger Road – Bluestone 69-kV line	Further study needed
5	Base Case Loading Criteria Exceeded	FALSE		System Intact	
5	Base Case Voltage Criteria Exceeded	--	FALSE	System Intact	
5	Bain 345/138-kV transformer #5	159.4% 106.5%	--	Split Pleasant Prairie 345-kV bus 34 Split Pleasant Prairie 345-kV bus 23	Mitigated by generation adjustments
5	Oak Creek 345/230-kV transformer T895	105.0% 104.8%	--	Split Oak Creek 230-kV bus 67 Split Oak Creek 230-kV bus 78	Mitigated by generation adjustments
5	Arcadian 345/138-kV transformer #3	95.5%	--	Arcadian 345/138-kV transformer #1	Replace Arcadian transformer
5	Pleasant Prairie – Zion 345-kV line	101.9% 98.7% 95.4%	--	Zion – Arcadian 345-kV line Cherry Valley – Silver Lake 345-kV line Kenosha – Lakeview 138-kV line	Uprate line

Event Based Contingencies

Event Based Contingency Number	Definition of Event Based Contingency
1	King - Eau Claire 345-kV line + Eau Claire - Arpin 345-kV line + Eau Claire 345/161-kV transformer + Council Creek DPC - Council Creek 69-kV line + Hilltop - Mauston 69-kV line
2	Eau Claire - Arpin 345-kV line + Council Creek DPC - Council Creek 69-kV line + Hilltop - Mauston 69-kV line
3	Arpin - Rocky Run 345-kV line + Port Edwards - Sand Lake 138-kV line + Port Edwards - Hollywood 138-kV line + Council Creek - Council Creek DPC 69-kV line
4	King - Eau Claire 345-kV line + Eau Claire - Arpin 345-kV line + Eau Claire 345/161-kV transformer + Council Creek DPC - Council Creek 69-kV line + Hilltop - Mauston 69-kV line + Lubin - Lakehead 69-kV line
5	North Fond du Lac 138/69-kV transformer #3 + North Fond du Lac - Hickory Street Tap 69-kV line + North Fond du Lac - Rosendale 69-kV line + North Fond du Lac 69-kV bus capacitor
6	Metomen - Rosendale - North Fond du Lac 69-kV line
7	Eau Claire - Arpin 345-kV line + Council Creek DPC - Council Creek 69-kV line + Hilltop - Mauston 69-kV line + Lubin - Lakehead 69-kV line
8	Trienda - Lake Delton 138-kV line + Lake Delton - Kirkwood 138-kV line
9	North Randolph – Fox Lake – North Beaver Dam 138-kV line
10	South Fond du Lac - Koch Oil tap 69 kV circuit + Koch Oil tap - Waupun 69 kV circuit + Koch Oil tap - Koch Oil 69 kV circuit
11	Nelson Dewey – Lancaster – Eden 138-kV line
12	Paddock - Brodhead Switching Station 69-kV line
13	McCue – Harmony – Milton Tap – Lamar 69-kV line
14	Hillman – Potosi – Nelson Dewey 138-kV line
15	Townline Road – Albany – North Monroe 138-kV line
16	East Krok 138/69 kV xfmr + Highway V - East Krok 138 kV circuit + East Krok - Canal 138 kV circuit + East Krok - Kewaunee 138 kV circuit + Beardsely - East Krok 69 kV circuit
17	Canal 138/69 kV xfmr #1 + Canal - East Krok 138 kV circuit + Canal - Sawyer 69 kV circuit + Canal - Algoma 69 kV circuit + Canal 69 kV cap banks, 2 x 16.3 MVAr
18	Highway V 138/69 kV xfmr #1 + Highway V - Ontario 138 kV circuit + Highway V - Preble 138 kV circuit + Highway V - Finger Road 69 kV circuit + Highway V - Rockland 138 kV circuit + Highway V 138 kV cap bank, 2 x 18.9 MVAr
19	Highway V 138/69 kV xfmr #2 + Highway V - East Krok 138 kV circuit + Highway V - Mystery Hills 138 kV circuit + Highway V - Oak Street 69 kV circuit
20	Ellinwood 138/69 kV xfmr #1 + Ellinwood - Twelfth Ave 69 kV circuit + Ellinwood - Fitzgerald 138 kV circuit +Ellinwood 138 kV bus tie 1-2
21	Fitzgerald 345/138 kV xfmr + Fitzgerald - North Appleton 345 kV circuit + Fitzgerald - South Fond du Lac 345 kV circuit
22	Whitcomb - CWEC Wittenberg Tap - Wittenberg Tap - Birnamwood Tap - Brooks Corner - Deer Trail 69-kV line
23	Atlantic 138/69-kV transformer + M38 – Atlantic 138-kV line
24	Hiawatha – Engadine – Newberry – Roberts 69-kV line

Table ZS-10
Zone 3 Load and Generation

Zone 3	2011	2015	2020	2025
Peak Forecast (megawatts)	3242.2	3531.6	3948.1	4368.1
Average Peak Load Growth	N/A	2.16%	2.25%	2.04%
Existing Generation Capacity (megawatts)	3882.7	3882.7	3882.7	3882.7
Existing Capacity Less Load	640.5	351.1	-65.4	-485.4
Existing Generation Capacity plus Modeled Generating Capacity Additions (megawatts)	4185.4	4185.4	4185.4	4185.4
Modeled Capacity Less Load (megawatts)	943.2	653.8	237.3	-182.7