Zones & study results

Introduction

For system planning purposes, we have defined five planning zones representing distinct geographic areas within our overall service territory. Within each zone, we compile and assess the transmission system needs. This zone-level planning is one of four levels at which transmission system needs are assessed and potential solutions developed. ATC's five planning zones are shown in Figure ZS-16.

For each zone, we have compiled recent information on:

- ❑ demographics,
- ❑ future population and employment projections,
- ❑ environmental considerations,
- ❑ electricity demand and generation,
- ❑ transmission system issues,
- ❑ 2007 study results,
- ❑ 2011 study results and
- ❑ 2015 study results.

About the study results

For each zone, system performance criteria limits that are exceeded (overloads, low voltages, etc.) are identified from the results of each base model and associated contingency models along with their causes. In addition, system constraints (known transmission service/import limiters) also are identified. The identified needs and exceeded limits are categorized by ATC planning zone. Tables ZS-1 through ZS-3 list the combined limitations and instances where performance criteria limits are exceeded that were identified in the 2007, 2011 and 2015 analyses. The same information is shown graphically in Figures ZS-1 through ZS-15.

Note: The results for each zone in many cases are similar to the results presented in our Update of the 2005 10-Year Assessment issued in March 2006. Where new results or changes have been found, the new information is identified as such.

Beginning in April, 2005, the Midwest Independent System Operator began to monitor market constraints in both the Real Time and the Day Ahead markets. These market constraints may be lines, transformers or other equipment whose ratings would be exceeded when generation is dispatched in the most economic manner possible. These constraints are taken into consideration when developing solutions to the limits and needs identified above.

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A summary of the top 20 constraints that occurred in the Real Time and the Day Ahead markets on the ATC system during the first year of market operation is provided in Tables ZS-4 and ZS-5, respectively. From a planning perspective, we are concerned about market constraints that occur repeatedly as these constraints drive locational marginal pricing (LMP). In the LMP system, potential transmission equipment overloads are identified as constraints and are "bound" by the market in order to alleviate high loading levels. The binding of constraints results in a market-based redispatch of generation that is less than ideal from an economic standpoint.

Constraints that occur in the Real Time market facilitate the ability to recognize where our system may require reinforcements. These limitations, found in Table ZS-4, were taken into account when developing alternative solutions for other needs identified in the analyses. The Day Ahead market constraints found in Table ZS-5 can be the result of virtual transactions and are the basis of the Financial Transmission Rights (FTR) market. Day Ahead constraints may point out potential problems but must be investigated further in order to determine if there are cost effective solutions to mitigate the constraints in the future.

The primary (currently preferred) solution and the alternative solutions to the system performance criteria limits exceeded in the analyses are described for each zone. For limits exceeded in the 2007 model where the limit must be resolved in the near term and the preferred solution or a potential solution can reasonably be expected to be completed by 2011, such solutions are included in the 2011 model. For criteria limits exceeded in the 2007 analysis where the preferred or potential solutions require further verification or more analysis, such solutions are not included in the 2011 model, but the need is further investigated in the 2011 analysis. In instances where the need is further verified by the 2011 analyses, primary and alternative solutions are listed as part of the plan, with in-service dates based on reasonably likely completion dates. The same type of analyses was conducted for 2015, with planned and several proposed projects being included in the 2015 model. This linking of results across the three study years allows us to begin to optimize the solutions to problems within a zone and also within the entire ATC system. As a result, the specific discussion of results for each study year will sometimes include discussion of issues identified in a future study year because of the need to utilize an optimized solution in the earlier study year.

The solutions ultimately selected to address the needs and limitations identified will reflect the input of transmission planning process stakeholders, including customers, state and local officials, the public, and coordination with other planning processes to the extent possible. Please refer to Methodology & assumptions for a better understanding of the basis for the results discussed by zone

We continue to focus more attention on dealing with unexpected conditions. For instance, it is important to have appropriate reactive power reserves to manage system conditions that

differ from the norm. While many capacitor bank installations are proposed in each zone to meet specific system needs, it should be noted that these additions also increase our flexibility to deal with extreme system conditions. See the reactive power analysis and multiple outage studies discussions for more information about the ability of the ATC system to manage unexpected conditions.

In the multiple outage studies section, we summarize the status of the studies that we have been conducting. This includes a summary of stability analyses reviewed or recently completed, providing insights into current stability margins of major generating stations on our system.

MISO planning studies and regional study groups
Within the Midwest ISO (MISO) Planning Department, there are three Regional Study Groups (RSGs): the Western, Central and Eastern RSGs. ATC's footprint falls within the Western RSG that covers a large geographic territory including Wisconsin, Minnesota, North Dakota, South Dakota, Nebraska and Manitoba.

Each RSG contributes its portion to the MISO Transmission Expansion Planning (MTEP) process, particularly to the steady-state (thermal and steady-state voltage) analysis of each region. The scope of steady-state analysis is large and therefore it is divided into three sub-tasks. Some other MTEP studies, such as transient/dynamic stability analysis, voltage stability analysis and LOLE analysis are performed under a single initiative without being divided into three sub-tasks. In addition to these annual or biannual MTEP studies, each RSG also performs certain special studies upon request of the stakeholders, or under the joint initiative of MISO and its stakeholders. The conclusions of these studies are also included in the MTEP reports.

Western RSG has been active with a number of special studies. Most notably since the beginning of this year are the Combined Western Region Exploratory (CWRE) Study and the Eastern Iowa Transmission Reliability (EITR) Study.

The Combined Western Region Exploratory Study
The CWRE study is a PROMOD type of study. It includes information of the region's major transmission projects, generation addition and load growth 15 years into the future, as provided by individual stakeholders. Prior to this combined exploratory study, a number of individual studies in the region identified needs for major transmission additions due to load growth, generation delivery, reliability and economic consideration.

These individual studies include CapX 2020, NW Exploratory study, Buffalo Ridge Incremental Generation Outlet (BRIGO) study, Southwest Minnesota to Twin Cities EHV Development study, Southeastern Minnesota to Southwestern Wisconsin Reliability Enhancement study, Iowa-Southern Minnesota Exploratory study and American Transmission Company (ATC) Access study.

The goal of this combined study is to evaluate the combined effectiveness of the transmission projects identified previously in the individual studies. It is not necessarily for the purpose of justifying any project in terms of the economics computed by PROMOD, but more for the purpose of evaluating the effectiveness of additional transmission projects in eliminating congestion to support generation delivery and load growth in the MISO Western region.

The Eastern Iowa Transmission Reliability Study
This study addresses transmission reliability concerns in the eastern Iowa area within the footprint of ALTW. Beginning in the latter part of the 1990's with the advent of open access to the energy market, this area experienced increased power flows from the south and southeast to the north and northwest. These flow patterns have caused additional stress to the transmission system in the area. Numerous TLRs were called in summer 2003.

The goal of the EITR study is to identify the reliability concerns about the known stressful power flow patterns and consider load growth in 5 and 10 years. It will also identify the potential needs for bulk transmission (>100kV) projects that will support the underlining system, resolve the reliability concerns in long term planning and resolve the short-term operation issues that have been seen.

In respect to this study, ATC intends to find out if the additional bulk transmission projects identified will stress our transmission system. We have requested that MISO compare the steady-state system performance before and after the addition of the potential transmission projects. This study is expected to be completed by summer 2006.

CapX2020
The CapX 2020 utilities – an alliance of electric cooperatives, municipals and investor-owned utilities – took the first step in the regulatory process for three new 345-kilovolt transmission lines. A preliminary filing for one of the three lines, which lays out plans for notifying local governments, landowners and residents was made with the Minnesota Public Utilities Commission.

"CapX 2020 is a collaborative effort that aims to support customers' growing demand for electricity by upgrading and expanding the backbone transmission system in Minnesota and neighboring states," said Terry Grove of Great River Energy, a co-leader of the CapX 2020 effort. CapX 2020 is short for Capacity Expansion needed by 2020.

The approximate lengths and general locations of the proposed lines are as follows:

- A 200-mile, 345-kilovolt line between Brookings, S.D., and the southeast Twin Cities, plus a related 30-mile, 345-kilovolt line between Marshall, Minn., and Granite Falls, Minn.;

- A 200-mile, 345-kilovolt line between Fargo, N.D., and the St. Cloud/Monticello, Minn., area;
- A 150-mile, 345-kilovolt line between the southeast Twin Cities, Rochester, Minn., and La Crosse, Wis.

Great River Energy filed a proposed public notice plan for the CapX Brookings, S.D.-southeast Twin Cities transmission line with the Minnesota commission today. Xcel Energy plans to file similar notice plans for the CapX Twin Cities-Rochester-La Crosse line and the CapX Fargo-St. Cloud/Monticello area line in the next few weeks.

While Great River Energy and Xcel Energy are taking the lead on the three 345-kilovolt lines, other utilities also will be involved in permitting, building and financing them. A fourth line – a 230-kilovolt, 70-mile line in the Bemidji area of north central Minnesota – also is among the CapX 2020 Group 1 projects.

The first four projects represent a combined investment of approximately $1.3 billion. Xcel Energy, Great River Energy and Otter Tail Power Company are committed to financing a majority of the cost. The balance will be covered by other project participants in various amounts. Group 2 and Group 3 project phases are planned through 2020.

“These transmission capacity upgrades are needed to deliver new electricity generation to support economic, job and population growth in the future,” Grove said. “Additionally, key sections of the proposed lines are needed to deliver the rapidly expanding wind energy from this region to our customers.”

The utilities expect to file a single request for a Certificate of Need for the three 345-kilovolt lines and associated system interconnections with the Minnesota commission late this year. Following a rigorous public process, the commission is expected to decide on the need for the lines sometime in 2008. If the commission certifies need, it then will determine routes for the new lines in subsequent separate proceedings. As soon as routing decisions are complete in 2009 or 2010, construction will get under way, and the lines are expected to be completed three or four years later.

“We are just beginning a lengthy journey and are committed to working with landowners, local officials and other interested parties at every step of the process,” said Laura McCarten of Xcel Energy, a co-leader of the CapX 2020 effort. “Anyone interested is invited to comment on our notice plans.”

After Minnesota commission approval of the plans, Great River Energy and Xcel Energy will mail letters to potentially affected people in each of the broadly defined transmission line corridors to let them know how they can learn more and get involved in the state’s decision-making process, McCarten said.

"Public meetings will be held in the potentially affected communities to describe the projects and answer questions," she said. "We will post information about the projects and updates on the CapX 2020 Web site at www.capx2020.com, and we will begin building mailing lists to keep people informed as the long regulatory process unfolds."

Portions of the lines also will require approvals by federal officials and by regulators in North Dakota, South Dakota and Wisconsin.

Along with Great River Energy, Elk River, Minn.; Otter Tail Power Company, Fergus Falls, Minn.; and Xcel Energy, Minneapolis, utilities or groups that expect to participate in one or more of the CapX 2020 projects are: Dairyland Power Cooperative, La Crosse, Wis.; Midwest Municipal Transmission Group, Des Moines, Iowa; Minnesota Power, Duluth, Minn.; Minnkota Power Cooperative, Grand Forks, N.D.; Missouri River Energy Services, Sioux Falls, S.D.; Rochester Public Utilities, Rochester, Minn.; Southern Minnesota Municipal Power Agency, Rochester, Minn., and Wisconsin Public Power Inc., Sun Prairie, Wis.

The Minnesota Legislature adopted a new law in 2005 that encourages investment in strengthening power delivery systems by, among other things, allowing investor-owned utilities to recover costs as lines are being built.

It is expected that ATC involvement will begin in July 2006.

ATC-RPU -DPC Study
In the summer of 2005, Rochester Public Utilities (RPU) and Dairyland Power Cooperative (DPC) released a draft study detailing a plan to build a 345 kV line from the Prairie Island Substation south to Rochester, MN and then east to La Crosse, WI. This study also included potential future plans to continue the line from La Crosse into the Madison, WI area.

This plan has been subsequently rolled into the CapX 2020 effort. The CapX 2020 projects have been split into four separate groups dependent on timeframe for implementation. The portion of the project between Prairie Island and La Crosse has been included in the CapX 2020 Project Group 1 with a potential in-service date of 2011, while the portion between La Crosse and Madison has been added to Project Group 3 with no projected in-service date at this time.

A June 9, 2006 press release from the CapX participants stated that Xcel Energy plans to file a proposed public notice plan for the Twin Cities – Rochester – La Crosse line in the next few weeks and that the CapX utilities are planning to file a joint Certificate of Need filing for all of the Group 1 projects late this year.

Preliminary Results

Preliminary analysis has begun to determine the potential implications of continuing this line into the Madison area. Four different alternatives are currently being evaluated. They include:

- ❑ North La Crosse – Columbia 345-kV line
- ❑ North La Crosse – Hilltop – Columbia 345-kV line
  *Council Creek – Hilltop – Birchwood 138-kV line
- ❑ North La Crosse – West Middleton 345-kV line
- ❑ North La Crosse – Spring Green – West Middleton 345-kV line
  *Spring Green – West Middleton 138-kV line

At this point, the results of this analysis are inconclusive in regards to which options perform the best. Each of the alternatives will be studied further and more in-depth to help determine which of these options could have the most potential benefit to ATC and the region.

State of Michigan - Capacity Need Forum and 21st Century Plan
On Oct. 14, 2004 the Michigan Public Service Commission issued its own motion, *Case No. U-14231,* to begin an investigation into future Michigan generation capacity requirements. The policy docket is designed to identify any needed modifications to the Michigan Commission polices or processes needed to facilitate construction of needed electric infrastructure.

The Capacity Need Forum (CNF) was created as a collaborative industry-wide process to assess the projected need for electrical generating capacity in Michigan over the short-, intermediate-, and long-term future.

ATC participated in the Transmission and Distribution work group, which was responsible for compiling information on the existing transmission capacity. The group was also responsible for identifying any plans for immediate increase in capacity and to identify potential transmission investment options that could be used if additional electric capacity is needed.

The final CNF Staff report was issued at to the Michigan Commission on Jan. 1, 2006.

On April 6, 2006, Governor Granholm issued Executive Directive No. 2006-2, "21st Century Plan", calling for the development of a comprehensive plan for meeting the state's electric power needs. The directive asks for recommendations to ensure the state can both reliably meet its growing electric needs and keep electric costs competitive. The plan will encourage the use of new technologies and explore ways to continue the growth of the alternative energy industry in Michigan.

The plan will be developed in cooperation with representatives from the public and private sectors, including the directors of the Michigan Department of Environmental Quality and other appropriate state departments.

ATC participates in the Transmission work group and again will be responsible for identifying any plans needed for any additional electric capacity. The final report is due December 31, 2006.

Reactive power analysis
Appropriate availability of Reactive Power (VArs) is necessary to keep a transmission system operating robustly. Many of the VArs on the ATC system are provided by generators that are interconnected with ATC. Our computer load flow models list a minimum and maximum VAr output for each machine connected to the system. The goal of this analysis was to do a cursory determination of the adequacy of VAr reserves for the ATC system considering normal and first contingency conditions. Adequacy would be estimated by monitoring changes in system voltages and flows between the full VAr capability results and the impact on results of a 10 percent reduction in VAr capabilities for all generators in the ATC footprint.

The 10 percent reduction test was chosen because the reactive power capabilities of some generators connected to the ATC system may not have been tested due to safety or system conditions. In lieu of testing the generators, the maximum reactive capability values are calculated by the generation owners. Midwest Reliability Organization (MRO) and Reliability First Corporation (RFC), in order to comply with NERC reliability standard MOD-025-1 (Verification of Reactive Power Capability) require their generation owners to verify reactive capability of all generators over a period of five years. Other factors which may affect the maximum reactive capabilities of the generators, such as actual hydrogen pressure used, add to the uncertainty of the maximum reactive capabilities of the generators.

To account for uncertainty in maximum reactive power capability, the impact of a 10 percent simultaneous reduction in the maximum reactive capabilities of all generators connected to the ATC system was studied using the 2011 summer peak model developed for this Assessment. Using this model the impacts of no outages, single transmission facility contingencies, and single generator contingencies were evaluated zone with respect to the previous analysis in this assessment that was based on full VAr capability. The results of the comparison are summarized below.

Zone 1:
Reducing the maximum VAr output of Zone 1 generators for the 2011 summer peak model essentially had no impact within Zone 1. A major reason for this is that the model assumed

the completion of the new Weston Power Plant 550-MW generator. As a result of the new generation, reducing the maximum MVAR output of the generators in Zone 1 did not create any new constraints under single contingency conditions.

Zone 2:
The 10 percent reduction in the maximum generator reactive power capabilities had a negligible impact in Zone 2. For those contingencies which resulted in low voltages in the original study case, the reduction in generator reactive power only slightly lowered the voltages. No new contingencies were observed which resulted in inadequate voltages. With the proposed addition of capacitor banks in Zone 2 by 2011, the reduction in generator reactive power should not create any new voltage issues.

Zone 3:
For the 2011 summer peak time period, the 10 percent reduction in maximum generation reactive power capabilities had a slight impact in Zone 3. With most of the generation online and dispatched according to economic order, reactive capability of the units is not a serious constraint for line and transformer first contingency conditions throughout Zone 3. It is important to note that if one of the two Columbia Power Plant units is offline at the time of summer peak, the remaining Columbia unit reaches its maximum reactive capabilities and cannot supply enough reactive power to the northern, central and western portions of Zone 3. Large-scale capacitor bank additions are planned at Kilbourn and Artesian substations to provide additional reactive power support and reactive power margins for importing real power into these areas which would mitigate the impacts of one of the Columbia Power Plant units being offline during the summer peak. It is also important to note that the Sheepskin Substation generating unit can reach its maximum reactive capability and will be unable to supply enough reactive power to the Milton area under first contingency conditions. The Bass Creek 138/69-kV transformer project in 2010 will mitigate this issue. See Zone 3 - 2011 study results for more information.

Zone 4:
The 10 percent reduction in maximum generation reactive power capabilities had almost no impact in Zone 4 for the 2011 summer peak time period. Although there are no generation additions planned in Zone 4, there are some changes in the adjacent zones which may provide additional reactive power support to the west and south of Zone 4. Those changes include new generators at Weston Power Plant (550 MW) in Zone 1 and Port Washington Power Plant (600 MW). With most of the generation online and dispatched according to economic order, the 10 percent reduction in reactive power capability of the units is not a serious constraint under first contingency conditions for lines, transformers and generators throughout Zone 4.

Zone 5:

Reducing the maximum reactive power output of Zone 5 generators for the 2011 summer peak time period had essentially no impact in Zone 5. The model assumed the second block of combined-cycle generation (600 MW) at Port Washington Power Plant and the first two new units at Oak Creek Power Plant (1300 MW) were available and online. As a result of the new generation, reducing the maximum reactive output of the generators in Zone 5 did not create any new constraints under first contingency conditions.

In summary, we conclude that from the results of this analysis and from 2005 Assessment results that the reinforcement plans discussed in this Assessment will provide sufficient reactive power resources to robustly serve our customers under normal and first contingency conditions.

Multiple outage analysis

Introduction

The North American Electric Reliability Council (NERC) has established standards for transmission system planning. ATC strives to adhere to NERC's criteria, which calls for transmission facility ratings and system voltages to be within prescribed limits for loss of a single transmission element (line, transformer, or generator). While most of our system studies involve single contingency analysis, multiple outages are also reviewed. The major concern with multiple outages, even if a system can handle single contingencies, is the possibility of cascading outages or system instability occurring. NERC standards allows for interruption of service to firm contracts for loss of multiple elements, as long as the loss of load can be contained; that is, it does not cause cascading outages or system instability. ATC conducts steady-state and dynamic stability studies to ensure the transmission system meets multiple contingency criteria as the following discussion shows. In addition, ATC participates in appropriate NERC Region and MISO studies to facilitate coordination of planning for multiple outage conditions.

Steady-state analysis

ATC's steady-state multiple outage assessment started with Commonwealth Associates (CAI) performing more extensive analysis of our transmission system in 2004 to identify NERC Category C type contingencies that potentially could lead to cascading. ATC has taken this initial screening and enhanced our review in succeeding years.

NERC Category C contingencies are specific sets of multiple outages including lines, transformers and generators. In 2005, ATC revisited Category C event analysis. Based on the 2004 work, a set of critical outages consisting of 130 multiple contingencies and four breaker failure contingencies were selected for restudy. ATC determined that cascading could be reasonably ruled out for Category C contingencies on our 2006 system through the use of load shedding and generation redispatch. This critical contingency review was repeated on the 2010 model with similar results.

As part of our efforts to continue to be aware of multiple outage impacts on our system, in 2006 we performed additional Category C analysis and assessments. In 2006, ATC used the 2007 summer peak model including all projects identified in the 10-Year Assessment for additional steady state multiple outage analysis. Physical Operational Margin (POM)-Optimal Mitigation Measure (OPM) software was used to determine the amount of load that needed to be shed to avoid cascading. In this 2006 analysis, in addition to the critical contingencies selected in 2005, we evaluated additional Category C events by screening Zone 3 100 KV and above facilities and ATC 345-kV transmission facilities with the All Projects 2007 model. The total number of events tested in this initial study of the 2007 model was 24,044 which included:

- 98 multiple outages selected and tested in 2005
- 18,693 multiple outages associated with Zone 3 which includes the combinations of transmission facilities with 100-kV above and the generation (100 MW and above) in Zone 3
- 5,253 multiple outages associated with ATC 345-kV transmission facilities

Of the 24,044 events analyzed, 1,086 resulted in potential voltage problems or thermal overloads in 2007. The most severe 107 events among 1,086 potential were reviewed in more detail to determine if cascading was likely. As a result, 53 events would require load shedding, 45 events would require other remedial actions such as generation redispatch, and 9 turned out to be invalid outages. As in 2005, we found through the use of specific load shedding and generation redispatch that cascading could be ruled out for Category C contingencies on our 2007 system. Three breaker failure events involving Columbia Substation and a single breaker failure event involving Rocky Run Substation were tested by POM-OPM using the 2007 model. No system problems were identified for the breaker failures. The top 5 Category C events for the 2007 system are:

- Arpin-Eau Claire 345-kV line and North Appleton-Werner West 345-kV line
- Arcadian 345/138-kV #1 and #2 transformers
- North Appleton 345/138-kV #1 and #2 transformers
- Arpin-Rocky Run 345-kV line and North Appleton-Werner West 345-kV line
- Granville 345-kV bus tie 1-2 and Cedarsauk 345/138-kV transformer

To reassess the long-term planning horizon, the 53 Category C events resulting in load shedding to mitigate potential voltage or overloads in 2007 were repeated using the 2011 summer peak model including all projects identified for this 10-Year Assessment. Of the 53 events analyzed, 29 Category C events had no system problems and 24 Category C events had potential thermal overloads or low voltages in 2011. Ten of the 24 events resulted in overloads or low voltage problems that were more severe in 2011 than in 2007. Following are the 10 Category C contingencies that became worse in 2011 and the additional load that needed to be shed compared to 2007:

Category C contingencies	*MW loads shed in 2007*	*MW load shed in 2011*	*Difference in MW*
Arcadian 345/138-kV #1 and #2 transformers (open high side of #2)	236.8	273.5	36.7
Arcadian 345/138-kV #1 and #2 transformers (open low side of #2)	192.0	216.4	24.4
Granville 345-kV bus tie 1-2 and Cedarsauk 345/138-kV transformer (open high side)	154.9	257.6	102.7
Granville 345-kV bus tie 1-2 and Cedarsauk 345/138-kV transformer (open low side)	154.3	263.1	108.8
Woodenshoe (Quarry Run)-Neevin 138-kV line and Fitzgerald 345/138-kV transformer	108.0	154.6	46.6
Werner-White Lake 138-kV line and Whiting Ave-Rocky Run 115-kV line	26.0	70.3	44.3
Waupaca-White Lake 138-kV line and Whiting Ave-Rocky Run 115-kV line	9.6	34.5	24.9
Kelly-Gardner Park and Hilltop-Maine 115–kV lines	85.7	98.8	13.1
Kelly-Gardner Park and Pine-Maine 115-kV lines	76.2	90.3	14.1
Kelly-Gardner Park and Blackbrook-Gardner Park 115-kV lines	34.2	37.6	3.4

Although it is estimated that cascading could be ruled out for Category C contingencies on our 2007 and 2011 systems through the use of specific load shedding and generation redispatch, the study results are subject to further review by ATC Planning and System Operations to develop or confirm appropriate and more specific operating procedures.

System stability analysis

Introduction

ATC also designs its system to meet stability criteria that are more stringent than NERC Standards. In the Planning Criteria section of this report, the Transient and dynamic stability performance assessment discussion gives details about the ATC's criteria for assessing system stability.

Reviewing compliance with NERC Standards and ATC stability criteria is a continuous process. Each year ATC adds to its library of studies. There are two components to consider in assessing system stability. One component is the angular stability of the system or often more generally referred to as generator stability. The second component is the system's voltage stability. Our approach to assessing both of the system stability components is described below.

Generator Stability

For each year 10-Year Assessment, generator stability is screened or assessed at all major generator stations connected to the ATC system. Numerous generator interconnection studies add to our knowledge of the ATC system stability response to Category C and D outages. A MAIN on-site review completed in January 2006 determined that ATC was complying with NERC Standards for multiple outages (Category C), including standards for the system's stability response to multiple outages.

In the 2006 10-Year Assessment, we have revisited a select list of generator stations as described below. As generator stability concerns arise they are evaluated and appropriate corrective actions are developed and implemented. Generator stations with total net output above 100 MW and associated transmission lines operating above 100 kV are generally selected to assess system angular stabilities.

Comparing 2006 10-Year Assessment models with 2005 models, no significant change has occurred near the generator stations, other than the local load growth. Therefore, generator stability results from the existing studies are still applicable and are acceptable in the following years with proposed system upgrades. If significant changes have occurred near the generator station, the generator stability is screened or restudied.

As shown in Table ZS-6 - ATC System Angular Stability Assessment, all assessed generators in the ATC area meet NERC Category C criteria.

Several generators still do not meet the more stringent ATC criteria under 2007 conditions. We are implementing specific projects that will allow some of these generators to meet ATC criteria and are evaluating the other generators to determine what protective relay adjustments, operation guides, special protection systems (SPS), or transmission system upgrades may be necessary to meet ATC criteria.

Voltage Stability
ATC is still developing a rigorous process for assessing voltage stability across the system. Currently we monitor single and multiple contingency voltages throughout the ATC system to screen for indications of where voltage stability may be an issue. Based on this screening, more detailed voltage stability analysis has been performed in the Rhinelander area of Zone 1 and several areas of Zone 2. In the Rhinelander area, solutions were developed and implemented to address the voltage stability concerns that were found. In Zone 2, we found only one situation that may be a potential concern and it is receiving further review. Later in 2006 we expect to select another portion of the ATC system to screen and investigate for voltage stability in more detail. We hope to report on these results in a future Assessment.

The MAIN on-site review completed in January 2006 determined that ATC was compliant with the voltage stability assessment requirements in the NERC.

Conclusion
Based on these assessments and numerous other studies, the ATC network will meet NERC System Stability Standards assuming reinforcements contemplated in this 10-Year Assessment, operating procedures, and special protection systems are implemented.

Planned system reinforcement analysis

The zone analyses discussions presented in this Assessment provide a list of reinforcements that are beginning to optimize our reinforcement plans, at least at the one- or maybe two-zone level. Three important questions regarding this plan include the following:

- ❑ How do the reinforcements for all the zones perform together?
- ❑ Does applying a solution in one zone create a problem that was not seen before in another zone?
- ❑ Are some zone solutions redundant when all the solutions are applied to the system?

This year we have taken another step to more adequately address the first two questions. We have built year 2011 and year 2015 models that include reinforcements reflecting our best thoughts on all of the most likely planned, proposed, and provisional projects to deal with the identified issues. First contingency analysis was performed on these two new models, including selected outages on neighboring systems. This analysis showed that the reinforcements in total did indeed deal with the issues identified and did not create any new issues to be resolved.

We recognize that we need to continue to develop our reinforcement optimization processes. The analyses described are not the only methods we use to optimize our plans and do not begin to address the third question. Also, access-driven reinforcements were

not included in this analysis as we await more definition of the most likely projects. However, our project development process, including development of the access projects, does look to optimize the projects that are finally built.

Project delayability

In general, our project list is based on expected load, generation, and equipment condition. However, not all projects developed for the project list may have the same urgency. If ATC is able to build and customers are able to pay for all projects regardless of their urgency, then the relative urgency of projects is not an issue. However, ATC is acutely aware that there may not be resources to support building everything that could be put in the ATC project list.

In the 2005 10-Year Assessment, we summarized the prioritization process we are developing to help us choose the most important projects when resources are constrained. Our development of projects for the 2006 Assessment has included a review that helps us assess their urgency. The urgency issue is being addressed from the perspective of whether specific tools could be applied to delay a project if resources are not available. Applying these tools will not necessarily lead to the optimum system development that could happen if resources were unconstrained, but with either some sub-optimization or reasonable increase in risk these tools would allow ATC to avoid resource constraints. For this Assessment we specifically considered the following tools:

- ❑ Shifting distribution load to a less critical part of the transmission system
- ❑ Changing generation dispatch
- ❑ Modifying transformer fixed taps and LTC settings
- ❑ Distribution capacitors
- ❑ Adjusting generator voltage schedules
- ❑ Operating guides
- ❑ Temporary equipment rating changes

The preliminary and final scopes for each project are attempting to address whether the projects have delayability that can be used for resource management. Note that the actual ability to delay these projects will have to be confirmed by considering the additional risks and costs of delay, including seeking input from our customers. In reality, ATC will find that not all of these projects can be delayed even with reasonable increases in cost and risk. ATC will continue to enhance its project prioritization process using this tool. This will allow ATC to better manage its budget when unexpected events make unanticipated projects critical.

All Projects model analysis

The load flow models built for the10-Year Assessment are specially built models used exclusively for the Assessment. Projects are purposely left out of these models in order to verify system problems exist and which ones get worse over time. After the 10-Year

Assessment analysis is completed, models are built that include all planned, proposed, and some provisional projects. These new models are called “All Projects” models and are more indicative of the expected system configurations for 2007, 2011 and 2015 study years. These models are more appropriate for internal planning studies performed throughout the year. As part of the 10-Year Assessment, the zone planners perform a contingency analysis on each of the “All Projects” models. The contingency analysis includes systematically removing each line, generator, transformer, and modeled bus ties individually to determine the affect on the transmission system. The analysis will verify whether all of the planned, proposed, and provisional projects will resolve issues revealed in the Assessment process.

The zone analysis discussions presented in this Assessment provides a list of reinforcements that are beginning to optimize our reinforcement plans, at least at the one- or maybe two-zone level. Three important questions regarding this plan include the following:

- ❑ How do the reinforcements for all the zones perform together?
- ❑ Does applying a solution in one zone create a problem that was not seen before in another zone?
- ❑ Are some zone solutions redundant when all the solutions are applied to the system?

As we did in the 2005 Assessment, this year we have tried to address the first two questions. We have built year 2011 and year 2015 models that include reinforcements reflecting our best thoughts on all of the most likely planned, proposed, and provisional projects to deal with the identified issues. These projects are those identified in the project tables for this Assessment with specific in-service dates. First contingency analysis was performed on these two new models, including selected outages on neighboring systems. This analysis showed that the reinforcements in total did indeed deal with the issues identified and did not create any new issues to be resolved. Some details for each zone are summarized below.

Zone 1

A contingency analysis was performed on the 2007, 2011, and 2015 “All Projects” models. With all of the planned, proposed, and some provisional projects modeled, no new Zone 1 facility overloads or voltage problems occurred.

Zone 2

With all projects in the 2007, 2011 and 2015 summer peak models, most of the system overloads and low voltages in Zone 2 are addressed, although several system problems still exist under single contingency conditions in 2007 and 2015. The system issues remaining in the 2007 and 2015 all project models are:

- ❑ Atlantic-Osceola #1 69-kV overload for the outage of the Atlantic-Osceola #2 69-kV line (2007)

- There is no operating procedure to avoid this overload if the critical contingency occurs during peak loading conditions. The transmission solution for this overload is the uprate of Atlantic-Osceola #1 in 2008.

- ❑ L'Anse 69-kV Substation low bus voltage for the outage of the M-38 138/69-kV transformer (2007)
  - The addition of a 5.4 MVAR 69-kV capacitor bank at L'Anse Substation (2008) will solve this issue, which only occurs during peak conditions. The low voltage at L'Anse is borderline inadequate (89.9 percent of nominal), and a low level of generation at Warden could be used to improve this voltage if necessary.
- ❑ Low 69-kV voltage at Sawyer Substation for the outage of the Forsyth-Gwinn 69-kV line (2007)
  - This low voltage is primarily due to a very poor power factor at Sawyer Substation. ATC and UPPCo are working on a best value plan to address this issue, and may likely include power factor correction in this area.
- ❑ Low 69-kV voltages at Engadine, Newberry, and Roberts substations for the outage of the Hiawatha-Engadine 69-kV line (2007)
  - The addition of a 5.4 MVAR capacitor bank at the Roberts 69-kV bus (2008) will address this issue. This bank was originally projected for an in-service date of 2009, but a project to move load at Engadine Substation to a radial line from Hiawatha Substation was cancelled due to design and cost issues, resulting in more load on the Newberry-Hiawatha 69-kV line and therefore lower voltages. The critical outage, Hiawatha-Engadine, is part of a multi-terminal line where a fault on any portion of this line will remove all loads on this line from service and the low voltages would not occur. The low voltage scenario will only occur for a rare single-ended trip of this line at Hiawatha Substation.
- ❑ Low voltages throughout the Copper Country (northwest portion of Zone 2) for the loss of the M38-Perch Lake 138-kV line (2015)
  - Previous 10-Year Assessments included capacitor bank additions subsequent to 2010 in this area. The additions of these banks would certainly help address these issues. A complete review of the future reactive compensation requirements for this area of Zone 2 will be performed in the near future to ensure the most efficient solutions are identified.

Zone 3

With all projects in the 2007, 2011 and 2015 summer peak models, most of the system overloads and low voltages in Zone 3 are addressed, although several system problems still exist under single contingency conditions in 2007 and 2015. The system issues remaining in the 2007 and 2015 all project models are:

- ❑ Low 69-kV voltages at New Glarus Substation for the loss of North Monroe – Monticello Tap 69-kV line (2007)

- There is no operating procedure to avoid this low voltage problem if the critical contingency occurs during peak loading conditions. The transmission solution for this problem is the Oak Ridge-Verona 138-kV line project in 2009.
- Potential distribution cap bank installations are still under investigation.

- ❑ Low 69-kV voltages in the South Monroe area for several N-1 outages. (2007)
  - Possible operating procedure to avoid this low voltage problem is under investigation. The transmission solution for this problem is two-16.33 MVAR capacitor banks at South Monroe Substation in the fall of 2007.
- ❑ The South Monroe-Brodhead 69-kV line overloads under several N-1 outages. (2007)
  - Possible operating procedure to avoid this overload is still under investigation. The transmission solution for this problem is to rebuild this line in 2008.
- ❑ The Colley Road-Brick Church 69-kV line overloads for the loss of Colley Road-Brick Church 138-kV line. (2007)
  - An existing operating procedure can address this issue. A potential maintenance and reliability project to rebuild the Colley Road-Brick Church 69-kV line in 2010 timeframe is still under study.
- ❑ The Verona-Oregon 69-kV line overloads for the loss of Stoughton-Aaker Road 69-kV line. (2007)
  - Load bridging capability between Stoughton and Aaker Road substations can address this overload. The transmission solution for this problem is to rebuild the Verona-Oregon 69-kV line in 2008.
- ❑ The Rock River transformer and Rock River-Turtle 69-kV line overload for the loss of Colley Road-Brick Church 138-kV line. (2007)
  - There is no operating procedure to avoid these overloads if the critical contingency occurs during peak loading conditions. The transmission solution for this problem is Rock River-Elkhorn138-kV line conversion project in 2009.
- ❑ The North Randolph-North Beaver Dam 138-kV line overloads under the Jefferson-Crawfish River 138-kV line outage (2015)
  - The issue is primarily due to the provisional North Randolph 345/138-kV transformation project and provisional Horicon-East Beaver Dam 138-kV project. Further investigation is underway to determine the best solution to address this potential overload.

Zone 4

In the 2007, 2011 and 2015 summer peak “All Projects” models, most of the system overloads or low voltages in Zone 4 are addressed although a few issues still exist under single contingency conditions in our 2007 and 2015 models. Currently, those issues are under further investigation which includes communicating with our customers to confirm the local area load and to come up with a best value plan. The system issues remaining in the 2007 and 2015 “All Projects” models are:

- ❑ The Ellington-Hintz-Werner 138-kV line overloads under the North Appleton-Werner West 345 kV line outage (2007).

- The issue can be addressed by redispatching generation in the Weston and Appleton areas until Weston Power Plant unit G4 is in service (2008).

- ❑ West Marinette 138/69-kV transformer #1 overloads under the Roosevelt 138/69-kV transformer outage or Roosevelt-Wells Street 69-kV line outage (2007)
  - A customer review of the area load has been requested to confirm the system issue. Until the Menominee 138/69-kV transformer project is in place (2008), it can be addressed by dispatching generation at West Marinette Substation unit G31.
- ❑ Low voltages near Bluestone and Wesmark 69-kV substations under the Finger Road-Bluestone 69-kV line outage (2015)
  - The issue is primarily due to the potential new load interconnection at the Bluestone 69-kV Substation in 2015. A detailed study needs to be performed by the customer and ATC in order to come up with a best value plan which will accommodate the new load interconnection while minimizing other concerns such as system impact, construction cost, public and environmental impact.

Zone 5
A contingency analysis was performed on the 2007, 2011, and 2015 "All Projects" models. With all of the planned, proposed, and some provisional projects modeled, no new Zone 5 facility overloads or voltage problems occurred.

Conclusion
We recognize that we need to continue to develop our reinforcement optimization processes. The analyses described are not the only methods we use to optimize our plans and do not begin to address the third question. Also, access-driven reinforcements, (with the exception of the second Paddock-Rockdale 345-kV line) were not included in this analysis as we await more definition of the most likely projects. However, our project development process, including development of the access projects, does look to optimize the projects that are finally built.

Load sensitivity analysis
The analysis that we perform for each 10-Year Assessment is based on power flow analysis using specific load forecast assumptions. The load forecast assumes there is some probability of exceeding the load forecast on the peak day. A traditional practice for generation and transmission planning in Wisconsin has been to use a load forecast probability of 50 percent (also known as a 50/50 forecast). This means that there is a 50 percent chance that the actual system peak load will exceed the forecasted value in any given year or, to state it another way, it is expected that on the average the forecast will be exceeded once every two years. The problem with analysis based on the traditional method is that it does not indicate the reliability risk of the actual system peak exceeding the forecasted value. The question then is, what is the risk to reliable system operation in

the ATC footprint if the forecast is exceeded and what, if anything, should be done to mitigate some or all of the risk?

One way to assess this risk is to increase the load forecast and determine whether or not ATC's proposed projects can reliably serve this increased electricity usage. To accomplish this purpose, some utilities use a 90/10 forecast[1], as opposed to the 50/50 forecast. ATC has relied on its customers to provide the load forecasts for our analysis, so we currently do not have a 90/10 forecast available for this risk assessment in the 2006 Assessment. However, general discussions have found that a 5 percent increase in certain peak loads may be a reasonable assumption for a 90/10 versus a 50/50 forecast. Therefore, for the 2006 Assessment, ATC has used a 5 percent increase in certain peak loads as a proxy for the higher 90/10 forecast.

ATC applied a 5 percent increase to certain peak hour loads in the power flow models representing the years 2007 and 2011. In general, ATC found that the increased load generally did not have a significant impact on the need for proposed projects. While we did not see that the increased load had a major impact on voltages, we did see areas where voltage is expected be marginal for the 50/50 forecast. These voltages will need to be considered more carefully to determine if any mitigation should be considered for higher than expected load. We also saw some additional areas where voltage became marginal as loadings increased or overloads were aggravated. Tables ZS-1 and ZS-2 compare the results of the 50/50 and proxy 90/10 analyses for 2007 and 2011, respectively. At this time ATC is not proposing to advance any project timings to anticipate higher loads or load growth. However, we will continue to evaluate these conditions for future assessments.

[1] A 90/10 forecast generally means that there is a 90 percent chance that the load will be less than the forecasted value. Thus, a load based on a 90/10 forecast load would be higher than a load based on a 50/50 forecast where there is only a 50 percent chance that the load will be less than the forecasted value

TABLE ZS-1
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2007 Peak and Hot Summer Case

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause	% of Facility Rating Hot Summer Case	% of Nominal Bus Voltage Hot Summer Case
1	Antigo, Aurora Street and Summit Lake 115-kV bus voltages		89 – 92%	Gardner Park-Blackbrook-Antigo 115-kV line outage		88 – 92%
1	Weston-Sherman Street 115-kV line	102%		Weston-Morrison 115-kV line outage	105%	
1	Weston-Morrison 115-kV line	104%		Weston-Sherman Street 115-kV line outage	107%	
1	Morrison-Sherman Street 115-kV line	112%		Weston-Sherman Street 115-kV line outage	115%	
1	Sigel, Lakehead Vesper & Port Edwards 138-kV bus voltages		87 – 91%	Arpin-Sigel 138-kV line outage Sigel-Lakehead Vesper 138-kV line outage Lkhd Vesper-Port Edwards 138-kV line outage		85 – 90%
1	Port Edwards, Hollywood, & Saratoga 138-kV bus voltages		88 – 92%	Arpin-Sigel 138-kV line outage Sigel-Lakehead Vesper 138-kV line outage Lkhd Vesper-Port Edwards 138-kV line outage		86 – 92%
1	Castle Rock – Quincy 69-kV line	95 - 102%		Various line outages	95 – 107%	
1	Council Creek 69-kV bus tie	97 – 100%		King-Eau Claire-Arpin 345-kV line outage Eau Claire-Arpin 345-kV line outage Hillsboro-Hillsboro tap 69-kV line outage	98 – 102%	
1	Council Creek and Petenwell 138-kV bus voltage		90 – 96%	Base Case Arpin-Sigel 138-kV line outage Sigel-Lakehead Vesper 138-kV line outage		91%
1	Necedah, Whistling Wings, Dellwood, Friendship, Houghton Rock 69-kV bus voltages		89 – 91%	Petenwell 138/69-kV transformer Petenwell-Big Pond 69-kV line outage Big Pond-Necedah tap 69-kV line outage		88 – 92%
1	Wautoma, Sand Lake and Roeder 138-kV bus voltages		88 – 95%	Base Case Various line outages		86 – 92%
1	Metomen 138/69-kV transformer	97 – 102%		North Fond Du Lac-Rosendale 69-kV line outage Rosendale-Metomen 69-kV line outage	96 – 107%	
1	Metomen-Ripon 69-kV line	98%		Winneconne-Sunset Point 69-kV line outage	97 – 104%	
1	NW Ripon - Ripon 69-kV line	96%		Winneconne-Sunset Point 69-kV line outage	102%	
1	Metomen-Rosendale 69-kV line	96%		Metomen 138/69-kV transformer outage	102%	
1	North Fond du Lac-Rosendale 69-kV line	105%		Metomen 138/69-kV transformer outage	112%	
1	Berlin area 69-kV bus voltages		88 – 92%	Various line outages		85 – 92%
1	Deer Trail-Polar Tap 69-kV line	98%		Gardner Pk-Blackbrook-Antigo 115 kV outage	96 – 102%	
1	Portage – Lakehead Portage 69-kV line	95 – 101%		Various line outages	95 – 107%	
1	Roslin, Endeavor and Lakehead Portage 69-kV bus voltages		84 – 91%	Portage-Lakehead Portage 69-kV line outage		84 – 92%
1	Coloma (ACEC) 69-kV bus voltage		91%	Chaffee Creek-Coloma tap 69-kV line outage		90%
1	Roslin – Lakehead Portage 69-kV line	-		Various line outages	98 – 100%	
1	Mckenna – Quincy 69-kV line	-		Winnebago-Quincy 69-kV line outage	98%	
1	Bunker Hill – Blackbrook 115-kV line	-		Gardner Park-Blackbrook 115-kV line outage	95%	
1	Wild Rose and Wild Rose (ACEC) 69-kV bus voltages		-	Harrison 138/69-kV transformer outage		91 – 92%
1	Hancock, Hancock (ACEC), Plainfield, Plainfield (ACEC), Coloma 69-kV bus voltages		-	Sand Lake 138/69-kV transformer outage		89 – 90%
1	Wisconsin Dells #2, Lyndon Station 69-kV bus voltages		-	Kilbourn-Wisc Dells #2 69-kV line outage		91 – 92%
1	Winnebago, Glen 69-kV bus voltages		-	Kilbourn-Winnebago 69-kV line outage		91 – 92%
2	Atlantic-Elevation Tap #1 69-kV	113%		Atlantic-Elevation Tap #1 69-kV line outage	119%	
2	Sawyer, Gwinn 69-kV bus voltages		89-91%	Forsyth-Gwinn 69-kV line outage		88-90%
2	Bruce Crossing, Watersmeet 69-kV bus voltages		90-91%	Mass-Bruce Crossing 69-kV line outage		88-89%
2	L'Anse, Baraga, M-38 69-kV bus voltages		89-91%	M-38 138/69-kV transformer outage		89-91%
2	Munising 69-kV bus voltage		91%	Munising 138/69-kV transformer, Munising-Forsyth 138-kV line outage		91%

TABLE ZS-1
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2007 Peak and Hot Summer Case (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause	% of Facility Rating Hot Summer Case	% of Nominal Bus Voltage Hot Summer Case
2	L'Anse and Baraga 69-kV bus voltages, M-38 and Atlantic 138-kV bus voltages		90-91%	M38-Perch Lake 138-kV line outage		
2	Hiawatha, Lakehead, Brevort 138-kV bus voltages		90%	Hiawatha-Lakehead 138-kV line outage, Lakehead-Brevort 138-kV line outage, Brevort-Straits 138-kV line outage		89%
2	Engadine, Newberry Village, Newberry Hospital, Louisiana Pacific and Roberts 69-kV bus voltages		89-91%	Engadine-Hiawatha 69-kV line outage		87-88%
2	St. Ignace and Straits 69-kV bus voltages		91%	Straits 138-69-kV transformer		89-90%
3	Rock River 138/69-kV transformer	109%		Colley Road-Brick Church 138-kV line outage Op Guide, Colley Road-Brick Church 138-kV line outage, Black Hawk-Colt Industries 69-kV line outage.	111%	
3	Rock River-Turtle 69-kV line	128%		Colley Road-Brick Church 138-kV line outage Op Guide, Colley Road-Brick Church 138-kV line outage	131%	
3	Colley Road-Brick Church 69-kV line	111%		Colley Road-Brick Church 138-kV line outage	115%	
3	Paddock-Shirland Ave 69-kV line	104%		Colley Road 138/69-kV transformer outage	108%	
3	Colley Road-Park Ave Tap 69-kV line	110%		Paddock 138/69-kV transformer outage	116%	
3	Colley Road 138/69-kV transformer	96%		Paddock 138/69-kV transformer outage	100%	
3	North Lake Geneva-Lake Geneva 69-kV line	109%		Brick Church-Cobblestone 69-kV line outage	114%	
3	Brick Church-Cobblestone 69-kV line	114%		North Lake Geneva-Lake Geneva 69-kV line outage	119%	
3	Janesville-Parkview 69-kV line	113%		McCue 138/69-kV transformer outage	120%	
3	Royster-Pflaum 69-kV line	104%		Fitchburg-Syene 69-kV line outage	109%	
3	Blount-Ruskin 69-kV line	106%		Second Blount-Ruskin 69-kV line outage	119%	
3	Fitchburg-Syene 69-kV line	111%		Royster-Pflaum Tap 69-kV line outage	117%	
3	Stage Coach-Black Earth 69-kV line	102%		Spring Green 138/69-kV transformer outage	109%	
3	Verona-Oregon 69-kV line	121%		Stoughton-Aaker Road 69-kV line outage, Stoughton-Sheepskin 69-kV line outage	131%	
3	North Monroe-Monticello 69-kV line	95%		Stoughton-Aaker Road 69-kV line outage	99%	
3	Brodhead-Blacksmith 69-kV line	111%		North Monroe 138/69-kV transformer outage, Town line Road-Albany 138-kV line outage, Albany-North Monroe 138-kV line outage	116%	
3	Hillman-Belmont 69-kV line	97%		Nelson Dewey-Lancaster 138-kV line outage	97%	
3	Hillman 138/69-kV transformer	115%		Various DPC 69-kV line outages	121%	
3	Darlington-Rock Branch 69-kV line	97%		Nelson Dewey-Lancaster 138-kV line outage	98%	
3	Kilbourn 47 MVA 138/69-kV transformer	144%		Kilbourn 93 MVA 138/69-kV transformer outage	152%	
3	Portage-Columbia 69-kV line	113%		Portage 138/69-kV transformer outage	118%	
3	Columbia 138/69-kV transformer	105%		Portage 138/69-kV transformer outage, North Madison 138/69-kV transformer outage	109%	
3	Portage-Trienda 138-kV line	98%		Second Portage-Trienda 138-kV line outage	104%	
3	Columbia 345/138-kV transformer #2	98%		Columbia 345/138-kV transformer #1 and #3 outage	103%	
3	Academy-Columbus 69-kV line	110%		North Randolph-Fox Lake 138-kV line outage, Fox Lake-North Beaver Dam 138-kV line outage,	117%	
3	Concord-Cooney 138-kV line	102%		Concord 138-kV bus 4-5 outage	111%	
3	Cobblestone-Zenda Tap 69-kV line			North Lake Geneva-Lake Geneva 69-kV line outage	98%	
3	North Monroe-Monticello 69-kV line			Stoughton-Sheepskin 69-kV line outage	95%	
3	Black Hawk 138/69-kV transformer			Rock River 138/69-kV transformer outage	96%	

TABLE ZS-1
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2007 Peak and Hot Summer Case (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause	% of Facility Rating Hot Summer Case	% of Nominal Bus Voltage Hot Summer Case
3	Janesville 138/69-kV transformer			McCue 138/69-kV transformer outage	96%	
3	McCue-Harmony 69-kV line			Sheepskin-Sheepskin Peak Unit 69-kV line outage, Paddock-Newark 69-kV line outage, Brodhead Switching Station-Brodhead Muni 3 69-kV line outage	98%	
3	Columbia 138/69-kV transformer			Deforest-North Madison 69-kV line outage	96%	
3	Pheasant Branch-Westport 69-kV line			West Middleton-Pheasant Branch 69-kV line outage	98%	
3	Town Line-Albany 138-kV line			Nelson Dewey-Potosi 138-kV line outage, Potosi-Hillman 138-kV line outage	97%	
3	Portage-Columbia 138-kV line			Second Portage-Columbia 138-kV line outage	95%	
3	Both of the Blount-Ruskin 69-kV lines			North Madison 138/69-kV transformer outage, North Madison-Dane 69-kV line outage	98%	
3	Concord-Cooney 138-kV line			Concord-Rubicon 138-kV line outage	97%	
3	Syene-Nine Springs 69-kV line			Royster-Pflaum Tap 69-kV line outage	99%	
3	Koch Oil Tap-South Fond Du Lac 69-kV line			North Randolph-Fox Lake 138-kV line outage	98%	
3	Lake Geneva, South Lake Geneva, Twin Lake, Katzenberg 69-kV bus voltages		88-90%	North Lake Geneva-Lake Geneva 69-kV line outage		88-91%
3	Brodhead Muni 3, Brodhead Muni 2, Brodhead, Brodhead Muni 1, RCEC Orfordville 69-kV bus voltages			Brodhead Switching Station-Brodhead Muni 3 69-kV line outage, Brodhead Muni 3-Brodhead Muni 2 69-kV line outage		92%
3	Evansville, RCEC center 69-kV bus voltages		90-92%	Evansville-Sheepskin 69-kV line outage		89-91%
3	North Monroe, Idle Hour, Monroe, Monroe Tap, South Monroe, Monticello, Monticello Tap, New Glarus, Belleville, Blacksmith, Browntown, Verona, Oregon, Green Wind 69-kV bus voltages		85-92%	North Monroe 138/69-kV transformer, North Monroe-Idle Hour 69-kV line outage, Idle Hour-Monroe 69-kV line outage		83-90%
3	Monticello, Monticello Tap, New Glarus, Belleville, Verona, Oregon, Brooklyn 69-kV bus voltages		83-91%	North Monroe-Monticello Tap 69-kV line outage, Monticello Tap-New Glarus 69-kV line outage, New Glarus-Belleville 69-kV line outage		81-90%
3	Pine River, Richland Center, Richland, Lone Rock 69-kV bus voltages		91-92%	Pine River-Richland 69-kV line outage, Lone Rock-Richland 69-kV line outage, Lone Rock 69 kV phase shifter outage		90-91%
3	Spring Green 69-kV bus voltage		92%	Spring Green 138/69-kV transformer outage		91%
3	Brooklyn, Oregon, Aaker Road, Verona, Belleville 69-kV bus voltages		83-90%	Stoughton-Aaker Road 69-kV line outage		80-90%
3	Brooklyn, Oregon 69-kV bus voltages		90%	Oregon-Aaker Road 69-kV line outage		88%
3	North Beaver Dam, Beaver Dam East 138-kV bus voltages		93%	Base case, various line outages		92%
3	North Beaver Dam, Beaver Dam East, Fox Lake, Cambridge, Cambridge Tap, London, Boxelder, Lakehead Waterloo, Stony Brook 138-kV bus voltages		89-91%	Boxelder to London 138-kV line outage, Rockdale to Cambridge Tap 138-kV line outage, Cambridge Tap to London 138-kV line outage		88-89%
3	Pflaum, Pflaum Tap , AGA Gas 69-kV bus voltages		91%	Royster-Pflaum Tap 69-kV line outage		90%
3	Concord 5 138-kV bus voltage		92%	Concord 138-kV bus 4-5 outage		89%
3	Dickinson, Brick Church, Williams Bay, Elkhorn 138-kV bus voltages		90-92%	Colley Road-Brick Church 138-kV line outage		89-91%
3	North Lake Geneva 138-kV bus voltage		92%	North Lake Geneva-North Lake Geneva Tap 138-kV line outage		91%
3	Lewiston, Kilbourn, Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan 138-kV bus voltages		90-92%	Trienda-Lewiston 138-kV line outage		88-90%
3	Kilbourn, Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan 138-kV bus voltages		90-92%	Lewiston-Kilbourn 138-kV line outage		88-90%

TABLE ZS-1
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2007 Peak and Hot Summer Case (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause	% of Facility Rating Hot Summer Case	% of Nominal Bus Voltage Hot Summer Case
3	North Beaver Dam, Beaver Dam East, Fox Lake 138-kV bus voltages		80%	North Randolph-Fox Lake 138-kV line outage, Fox Lake-North Beaver Dam 138-kV line outage		78%
3	Avoca, Muscoda, Lone Rock, Arena, Mazomanie, Mazomanie Industrial 69-kV bus voltages			Spring Green 138/69-kV transformer outage		92%
3	Burke 69-kV bus voltage			Reiner Road-Burke Tap 69-kV line outage, Reiner Road 138/69-kV transformer outage		91%
3	North Lake Geneva Tap, North Lake Geneva 138-kV bus voltages			Burlington 138-kV bus 1-2 outage		92%
3	Albany 138-kV bus voltage			Town Line-Albany 138-kV line outage		92%
3	Hustiford, Spring Brook, Mayville, Oakfield, Horicon Industrial Park 69-kV bus voltages			Oakfield-South Fond Du Lac 69-kV line outage		91-92%
3	Fox Lake 138-kV bus voltage			Base case		94%
3	Footville, Bass Creek 69-kV bus voltages			Evansville-Sheepskin 69-kV line outage		91-92%
3	Nine Springs 69-kV bus voltage			Royster-Pflaum Tap 69-kV line outage		92%
3	Third Street, Center Street, Alto 69-kV bus voltages			North Randolph-Fox Lake 138-kV line outage		91-92%
4	Pioneer-Sandstone 69-kV line	95.3%		Crivitz-High Falls 69-kV line outage	100%	
4	High Falls-Crivitz 69-kV line	<95%		Pioneer-Sandstone 69-kV line outage	95%	
4	Goodman 69-kV bus		92.6%	Base Case		93%
4	Mountain 69-kV bus		91%	Crivitz-High Falls 69-kV line outage		89%
4	Thunder, High Falls, Caldron Falls 69-kV buses		>92%	Crivitz-High Falls 69-kV line outage		91-92%
4	Woodenshoe, Mears Corners 138-kV buses		>92%	Neevin-Woodenshoe 138-kV line outage		91%
4	Ellington-Hintz 138-kV line	107.6%		North Appleton-Werner West 345-kV line outage	115%	
4	Hintz-Werner 138-kV line	105.9%		North Appleton-Werner West 345-kV line outage	113%	
4	Werner-Werner West 138-kV line	<95%		North Appleton-Werner West 345-kV line outage	99%	
5	Bain 345/138-kV transformer #5	161%		Splitting Pleasant Prairie 345-kV bus sections 3 & 4	164%	
5	Oak Creek 345/230-kV transformer T884	101-108%		Various Oak Creek 230-kV bus outages	106–111%	
5	Pleasant Valley – Saukville 138-kV line	123%		Various outages	98–133%	
5	Pleasant Valley – Arthur Road 138-kV line			Various outages	98%	
5	Cooney – Concord 138-kV line	102%		Splitting Concord 345-kV bus sections 3 & 4	107%	
5	St. Martins – Raymond 138-kV line			Pleasant Prairie – Racine 345-kV line	98%	
5	Germantown – Maple 138-kV line			Bark River - Germantown	101%	

TABLE ZS-2
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2011 Peak, Hot Summer and Shoulder Cases

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause	% of Facility Rating Hot Summer Case	% of Nominal Bus Voltage Hot Summer Case	% of Facility Rating Shoulder Case	% of Nominal Bus Voltage Shoulder Case
1	Antigo, Aurora Street, Summit Lake, Venus, Three Lakes, Cranberry, St. Germain, Clear Lake, Highway 8, Hodag, Eastom, Tomahawk and Pine 115-kV bus voltages		82 – 92%	Maine-Pine 115-kV line outage Blackbrook-Antigo 115-kV line outage Antigo-Aurora Street 115-kV line outage Gardner Park-Blackbrook-Antigo 115 kV outage		80 – 92%		--
1	Bunker Hill – Blackbrook 115-kV line	108%		Gardner Park-Blackbrook 115-kV line outage	113%		--	
1	Gardner Park – Blackbrook 115-kV line	97 – 108%		Maine-Pine 115-kV line outage Maine-Hilltop 115-kV line outage	99 – 113%		--	
1	Kelly – Bunker Hill 115-kV line	95%		Maine-Pine 115-kV line outage	105%		--	
1	Highway 8 – Clear Lake 115-kV line	--		Three Lakes-Venus 115-kV line outage	98%		--	
1	Sigel, Lakehead Vesper and Port Edwards 138-kV bus voltages		89 – 90%	Arpin-Sigel 138-kV line outage		89 – 90%		91 – 92%
1	Port Edwards, Hollywood, and Saratoga 138-kV bus voltages		90 – 91%	Arpin-Sigel 138-kV line outage		90 – 91%		91 – 92%
1	Castle Rock – Quincy 69-kV line	98%		Petenwell 138/69-kV transformer outages Petenwell-Big Pond 69-kV line outage Necedah tap-Big Pond 69-kV line outage	101%		96 – 107%	
1	Council Creek 69-kV bus tie	--		Hillsboro-Hillsboro tap 69-kV line outage	96%		95 – 113%	
1	Council Creek and Petenwell 138-kV bus voltage		90 – 95%	Base Case Arpin-Sigel 138-kV line outage Sigel-Lakehead Vesper 138-kV line outage Council Creek-Petenwell 138-kV line outage Petenwell-Saratoga 138-kV line outage		90 – 95%		--
1	Necedah, Whistling Wings, Dellwood, Friendship, Houghton Rock 69-kV bus voltages		89 – 92%	Petenwell 138/69-kV transformer Petenwell-Big Pond 69-kV line outage Big Pond-Necedah tap 69-kV line outage Necedah tap-Whistling Wings tap 69 kV outage		87 – 92%		91 – 92%
1	Hilltop, Lyndon Station, Wisconsin Dells 69-kV bus voltages		90 – 92%	Kilbourn-Wisc. Dells 69-kV line outage		89 – 91%		--
1	Wautoma, Sand Lake and Roeder 138-kV bus voltages		91 – 96%	Base Case Sigel-Arpin 138-kV line outage		90 – 95%		--
1	Sand Lake 138/69-kV transformer	95 – 101%		Wautoma 138/69-kV transformer outage Winnebago-Kilbourn 69-kV line outage Trienda-Lewiston 138-kV line outage E. Dells-Lewiston 138-kV line outage	95 – 107%		--	
1	Hancock, Hancock (ACEC), Plainfield and Plainfield (ACEC) 69-kV bus voltages		91 – 92%	Sand Lake 138/69-kV transformer outage		89 – 92%		--
1	Metomen 138/69-kV transformer	95 – 111%		Base Case Various line outages	95 – 117%		--	
1	Metomen – Ripon 69-kV line	96 – 103%		Winneconne-Sunset Point 69-kV line outage Omro-Winneconne 69-kV line outage Markesan tap-North Randolph 69-kV line outage	97 – 112%		--	
1	NW Ripon – Ripon 69-kV line	102%		Winneconne-Sunset Point 69-kV line outage	98 – 109%		--	
1	Winneconne – Sunset Point 69-kV line	95%		NW Ripon - Ripon 69-kV line outage	102%		--	
1	Omro – Winneconne 69-kV line	--		NW Ripon - Ripon 69-kV line outage	98%		--	
1	Berlin area 69-kV bus voltages		88 – 92%	Various line outages		85 – 92%		--
1	Roslin, Endeavor and Lakehead Portage 69-kV bus voltages		87 – 92%	Portage-Lakehead Portage 69-kV line outage Endeavor tap-Lkhd Portage 69-kV line outage		84 – 90%		--
1	Whitcomb 115/69-kV transformer	99%		Antigo-Blackbrook 115-kV line outage	97 – 112%		--	
1	Caroline 115/69-kV transformer	--		Whitcomb 115/69-kV transformer	96%		--	
1	Deer Trail – Polar tap 69-kV line	98 - 105%		Gardner Park-Blackbrook-Antigo 115 kV outage Gardner Park-Blackbrook 115-kV line outage Blackbrook-Antigo 115-kV line outage	99 – 113%		--	

TABLE ZS-2
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2011 Peak, Hot Summer and Shoulder Cases (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause	% of Facility Rating Hot Summer Case	% of Nominal Bus Voltage Hot Summer Case	% of Facility Rating Shoulder Case	% of Nominal Bus Voltage Shoulder Case
1	Brooks Corners – Deer Trail 69-kV line	--		Gardner Park-Blackbrook-Antigo 115 kV outage Gardner Park-Blackbrook 115-kV line outage Blackbrook-Antigo 115-kV line outage	95 –97%		--	
1	Coloma (ACEC), Lincoln Pumping Station, Brooks (ACEC) and Grand Marsh 69-kV bus voltages		90 – 92%	Chaffee Creek-Coloma tap 69-kV line outage		89 – 91%		90 – 91%
1	White Lake 138-kV bus voltage		91%	Werner West-White Lake 138-kV line outage		91%		--
1	Plover – Coyne 115-kV line	--		Rocky Run-Coyne 115 kV line outage	--		97%	
2	Indian Lake 138-kV bus voltage		95%	Intact System		94%		
2	Atlantic-Elevation Tap #1 69-kV	115%		Atlantic-Elevation Tap #1 69-kV line outage	122%			
2	Sawyer, Gwinn, Chatham, Forest Lake 69-kV bus voltages		--	Forsyth-Gwinn 69-kV line outage		84-91%		
2	Sawyer, Gwinn 69-kV bus voltages		87-88%	Forsyth-Gwinn 69-kV line outage		--		
2	Bruce Crossing, Watersmeet, Land O' Lakes, Conover, and Twin Lakes 69-kV bus voltages		--	Mass-Bruce Crossing 69-kV line outage		84-89%		
2	Bruce Crossing, Watersmeet, Land O Lakes, Conover 69-kV bus voltages		87-91%	Mass-Bruce Crossing 69-kV line outage		--		
2	L'Anse, Baraga, M-38 69-kV bus voltages		89-91%	M-38 138/69-kV transformer outage		88-90%		
2	Munising and Alger 69-kV bus voltages		91%	Munising 138/69-kV transformer, Munising-Forsyth 138-kV line outage		90-91%		
2	L'Anse 69-kV bus voltage and Atlantic 138-kV bus voltage		91%	M38-Perch Lake 138-kV line outage		--		
2	L'Anse and Baraga 69-kV bus voltages, and M38 and Atlantic 138-kV bus voltages		--	M38-Perch Lake 138-kV line outage		89-91%		
2	Hiawatha, Lakehead and Brevort 138-kV bus voltages		90%	Hiawatha-Lakehead 138-kV line outage, Lakehead-Brevort 138-kV line outage, Brevort-Straits 138-kV line outage		--		
2	Hiawatha, Lakehead, Brevort, and Indian Lake 138-kV bus voltages		--	Hiawatha-Lakehead 138-kV line outage, Lakehead-Brevort 138-kV line outage, Brevort-Straits 138-kV line outage		89-91%		
2	Engadine, Newberry Village, Newberry Hospital, Louisiana Pacific, Roberts, Hulbert, and Eckerman 69-kV bus voltages		--	Engadine-Hiawatha 69-kV line outage, Engadine-Newberry 69-kV line outage		85-90%		
2	Engadine, Newberry Village, Newberry Hospital, Louisiana Pacific, Roberts, Hulbert 69-kV bus voltages		88-91%	Engadine-Hiawatha 69-kV line outage, Engadine-Newberry 69-kV line outage		--		
2	St. Ignace, Straits, Evergreen, Michigan Limestone, Talentino, and Rockview 69-kV bus voltages		--	Straits 138-69-kV transformer		88-90%		
2	St. Ignace, Straits, Evergreen, Michigan Limestone 69-kV bus voltages		90-91%	Straits 138-69-kV transformer		--		
2	Keweenaw, Osceola, MTU, Henry St. 69-kV bus voltages			Atlantic 138/69-kV transformer outage, Atlantic-M38 138-kV line outage		89-91%		
2	Indian Lake 138-kV bus voltage			Plains-Arnold 138-kV line outage		91%		
3	Brodhead-Blacksmith 69-kV line	106%		North Monroe 138/69-kV transformer outage, Town line Road-Albany 138-kV line outage, Albany-North Monroe 138-kV line outage, North Monroe-Idle Hour 69-kV line outage	111.5%			
3	Brick Church-Cobblestone-Zenda Tap 69-kV line	139%		North Lake Geneva-Lake Geneva 69-kV line outage, Lake Geneva-South Lake Geneva 69-kV line outage	150%		98%	
3	Brick Church-North Lake Geneva 69-kV line	114%		North Lake Geneva 138/69-kV transformer outage	122%			
3	Hillman 138/69-kV transformer	126%		Various DPC 69-kV line outages	136%		98%	
3	Hillman-Belmont 69-kV line	96%		Nelson Dewey-Lancaster 138-kV line outage, Lancaster-Eden 138-kV line outage	107%		117%	
3	Darlington-Darlington North-Rock Branch 69-kV line	102%		Nelson Dewey-Lancaster 138-kV line outage, Lancaster-Eden 138-kV line outage	109%			
3	Colley Road-Park Ave Tap 69-kV line	103%		Paddock 138/69-kV transformer outage	102%			

TABLE ZS-2
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2011 Peak, Hot Summer and Shoulder Cases (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause	% of Facility Rating Hot Summer Case	% of Nominal Bus Voltage Hot Summer Case	% of Facility Rating Shoulder Case	% of Nominal Bus Voltage Shoulder Case
3	Paddock 138/69-kV transformer			Rockdale-Wempletown 345-kV line outage			106%	
3	Ruskin 1 and 2 bus tie			North Madison-Vienna 138-kV line outage, Vienna-Yahara River 138-kV line outage, American Center – Yahara River 138-kV line outage, American Center-Sycamore 138-kV line outage			110%	
3	Bio Enzyme Systems-RCEC Clinton-Clinton 69-kV line	98%		Brick Church 138/69-kV transformer outage	103%			
3	North Lake Geneva-Lake Geneva 69-kV line	110%		Brick Church-Cobblestone 69-kV line outage	117%			
3	Janesville-Parkview 69-kV line	122%		McCue 138/69-kV transformer outage	126%		109%	
3	Janesville 138/69-kV transformer	97%		McCue 138/69-kV transformer outage	102%			
3	McCue-Milton Lawns 69-kV line	100%		Janesville 138/69-kV transformer outage	106%			
3	Black Earth-Cross Plains-Stagecoach-Timberlane 69-kV line	135%		Spring Green 138/69-kV transformer outage	145%			
3	Portage-Columbia 69-kV line	113%		Portage 138/69-kV transformer outage	116%		102%	
3	Columbia 138/69-kV transformer	109%		Portage 138/69-kV transformer outage, Deforest-North Madison 69-kV line outage	112%			
3	Kilbourn 47 MVA 138/69-kV transformer	133%		Kilbourn 93 MVA 138/69-kV transformer outage	132%		107%	
3	Huiskamp-Ruskin 69-kV line	115%		North Madison-Vienna 138-kV line outage, Vienna-Yahara River 138-kV line outage, American Center-Sycamore 138-kV line outage, Martinsville-North Madison 138-kV line outage, Martinsville-West Middleton 138-kV line outage	117%		129%	
3	Royster-Pflaum 69-kV line	98%		Fitchburg-Syene 69-kV line outage	103%			
3	Ruskin 69-kV 1-2 bus tie	107-98%		North Madison-Vienna 138-kV line outage, Vienna-Yahara River 138-kV line outage, American Center – Yahara River 138-kV line outage	118-105%			
3	Portage-Trienda 138-kV line	113%		Second Portage-Trienda 138-kV line outage	115%			
3	Portage-Columbia 138-kV line	96%		Second Portage-Columbia 138-kV line outage	99%			
3	Columbia 345/138-kV transformer #2	103%		Columbia 345/138-kV transformer #1 and #3 outage	106%			
3	Fitchburg-Syene 69-kV line	107%		Royster-Pflaum Tap 69-kV line outage	111%			
3	Brick Church-Cobblestone-Zenda Tap 69-kV line			North Lake Geneva 138/69-kV transformer outage	96%			
3	Zenda Tap-Katzenberg 69-kV line			North Lake Geneva-Lake Geneva 69-kV line outage	101%			
3	Janesville-Parkview 69-kV line			Russell 138/69-kV transformer outage	96%			
3	West Middleton-Timberlane 69-kV line			Spring Green 138/69-kV transformer outage	96%			
3	Rock Springs Tap-Artesian 138-kV line			Trienda-Lewiston 138-kV line outage	96%			
3	Academy-Columbus 69-kV line			North Randolph-Fox Lake 138-kV line outage	95%			
3	Koch Oil Tap-South Fond Du Lac 69-kV line			North Randolph-Fox Lake 138-kV line outage	98%			
3	Nine Springs-Syene 69-kV line			Royster- Pflaum Tap 69-kV line outage	97%			
3	Portage-Trienda 138-kV line			Second Portage-Trienda 138-kV line outage	96%			
3	Waunakee Switching Station-Waunakee #2 69-kV line			Martinsville-North Madison 138-kV line outage	96%			
3	Pheasant Branch-West Port 69-kV line			Martinsville-North Madison 138-kV line outage Martinsville-West Middleton 138-kV line outage	102%			
3	Kegonsa-Christiana 138-kV line			Second Kegonsa-Christiana 138-kV line outage	101%			
3	Idle Hour, Monroe, Monroe Tap, South Monroe, Blacksmith 69-kV bus voltages		89-92%	North Monroe-Idle Hour 69-kV line outage		87-91%		
3	Idle Hour, Monroe, Monroe Tap, South Monroe, North Monroe, Monticello, Monticello Tap, New Glarus 69-kV bus voltages		91-92%	North Monroe 138/69-kV transformer		88-92%		
3	Brodhead Muni 3, Brodhead Muni 2, Brodhead, Brodhead Muni 1, RCEC Orfordville, Orfordville, Bass Creek, Footville, RCEC Center 69-kV bus voltages		90-92%	Brodhead Switching Station-Brodhead Muni 3 69-kV line outage		88-92%		90-92%
3	Brodhead Muni 2, Brodhead, Brodhead Muni 1 69-kV bus voltages			Brodhead Muni 2 -Brodhead Muni 3 69-kV line outage		92%		92%

TABLE ZS-2
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2011 Peak, Hot Summer and Shoulder Cases (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause	% of Facility Rating Hot Summer Case	% of Nominal Bus Voltage Hot Summer Case	% of Facility Rating Shoulder Case	% of Nominal Bus Voltage Shoulder Case
3	Orfordville, Bass Creek, Footville, RCEC Center, Evansville 69-kV bus voltages		88-92%	Evansville-Sheepskin 69-kV line outage		87-92%		
3	Lake Geneva, South Lake Geneva, Twin Lake, Richmond, Katzenberg 69-kV bus voltages		84-86%	North Lake Geneva-Lake Geneva 69-kV line outage		81-91%		90-92%
3	South Lake Geneva, Twin Lake, Richmond, Katzenberg 69-kV bus voltages		90-91%	Lake-Geneva-South Lake Geneva 69-kV line outage		89-90%		
3	Harmony, Lamar, Fulton, Saunders Creek 69-kV bus voltages		92%	McCue-Harmony 69-kV line outage		89-92%		
3	Harmony, Lamar, Fulton, Saunders Creek, Dana Cooperation, RCEC Edgerton, Sheepskin 69-kV bus voltages			McCue-Harmony 69-kV line outage				89-92%
3	Lamar, Fulton 69-kV bus voltages			Harmony-Lamar 69-kV line outage		90-91%		
3	Lamar, Fulton, Saunders Creek, Dana Cooperation, Sheepskin, 69-kV bus voltages			Harmony-Lamar 69-kV line outage				89-92%
3	Pine River, Richland Center, Richland, Lone Rock 69-kV bus voltages		90%	Pine River-Richland 69-kV line outage, Lone Rock-Richland 69-kV line outage, Lone Rock 69 kV phase shifter outage		89-90%		
3	Avoca, Muscoda, Lone Rock, Blue River 69-kV bus voltages		91-92%	Lone Rock-Spring Green 69-kV line outage		89-91%		
3	Arena 69-kV bus voltage		92%	Spring Green-Arena 69-kV line outage				
3	Spring Green, Avoca, Muscoda, Lone Rock, Arena, Mazomanie, Mazomanie Industrial, Blue River, Pine River, Richland Center 69-kV bus voltages		88-92%	Spring Green 138/69-kV transformer outage		88-92%		
3	Spring Green, Arena 69-kV bus voltages			Spring Green 138/69-kV transformer outage				92%
3	McFarland, Femrite 138-kV bus voltages		91%	McFarland-Kegonsa 138-kV line outage		91%		
3	Femrite 138-kV bus voltage		92%	McFarland-Femrite 138-kV line outage		92%		
3	Burke, Colorado 69-kV bus voltages		87-91%	Reiner-Burke Tap 69-kV line outage		86-90%		
3	Burke, Colorado, Reiner 69-kV bus voltages		87-91%	Reiner 138/ 69-kV transformer outage		86-90%		
3	Burke 69-kV bus voltage			Reiner-Burke Tap 69-kV line outage, Reiner 138/ 69-kV transformer outage				92%
3	Hubbard 138-kV bus voltage		90%	Hustiford-Hubbard 138-kV line outage		90%		89%
3	Hustisford, Hubbard 138-kV bus voltages		90%	Hustiford-Rubicon 138-kV line outage		90%		89%
3	Pflaum, Pflaum Tap , AGA Gas, Nine Springs 69-kV bus voltages		90-91%	Royster-Pflaum Tap 69-kV line outage		90-91%		
3	Pflaum, Pflaum Tap , AGA Gas 69-kV bus voltages			Royster-Pflaum Tap 69-kV line outage				92%
3	Pflaum 69-kV bus voltage		92%	Pflaum-Pflaum Tap 69-kV line outage		92%		
3	Kilbourn, Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan, Artesian, Rock Springs 138-kV bus voltages, Artesian, Loganville, Reedsburg 69-kV bus voltages		86-90%	East Dells-Lewiston 138-kV line outage		85-91%		
3	Kilbourn, Loch Mirror, Birchwood, Dell Creek 138-kV bus voltages			East Dells-Lewiston 138-kV line outage				91-92%
3	Kilbourn, Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan, Artesian, Rock Springs 138-kV bus voltages, Artesian, Loganville, Reedsburg 69-kV bus voltages		86-90%	East Dells-Kilbourn 138-kV line outage		85-92%		
3	Kilbourn, Loch Mirror, Birchwood 138-kV bus voltages			East Dells-Kilbourn 138-kV line outage				91-92%
3	Lancaster, Eden, Wyoming Valley, Spring Green, Troy 138-kV bus voltages		90-92%	Nelson Dewey-Lancaster 138-kV line outage		88-92%		
3	Eden, Wyoming Valley 138-kV bus voltages		92%	Lancaster-Eden 138-kV line outage		91-92%		
3	Lake Delton, City View, Kirkwood, Spring Green Troy, Zobel, Nishan, Artesian, Rock Springs 138-kV bus voltages, Artesian, Reedsburg 69-kV bus voltages		90-92%	Lake Delton-Trienda 138-kV line outage		89-92%		
3	Lewiston, East Dells, Kilbourn, Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan, Artesian, Rock Springs 138-kV bus voltages, Artesian, Loganville, Reedsburg 69-kV bus voltages		90-92%	Lewiston-Trienda 138-kV line outage		84-91%		

TABLE ZS-2
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2011 Peak, Hot Summer and Shoulder Cases (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause	% of Facility Rating Hot Summer Case	% of Nominal Bus Voltage Hot Summer Case	% of Facility Rating Shoulder Case	% of Nominal Bus Voltage Shoulder Case
3	Lewiston, East Dells, Kilbourn, Loch Mirror, Birchwood, Dell Creek 138-kV bus voltages			Lewiston-Trienda 138-kV line outage				91-92%
3	Richland Center, Pine River 69-kV bus voltages		91-92%	DPC Dayton-T RC 69-kV line outage		89-90%		
3	Richland Center, Pine River, Gays Mills 69-kV bus voltages		90-91%	DPC Seneca-Bell Center 161-kV line outage		89-90%		
3	Verona 138-kV bus voltage		85%	Verona-Oak Ridge 138-kV line outage		84%		87%
3	Cobblestone, Zenda 69-kV bus voltage		92%	Cobblestone-Brick Church 69-kV line outage		90-92%		
3	City View, Kirkwood, Rock Springs, Artesian 138-kV bus voltages		92%	City View- Lake Delton 138-kV line outage		91-92%		
3	Monroe, South Monroe 69-kV bus voltages			Monroe Tap-South Monroe 69-kV line outage		91%		
3	South Lake Geneva, Twin Lake, Richmond, Katzenberg 69-kV bus voltages			North Lake Geneva 138/69-kV transformer outage		91-92%		
3	Richland Center, Pine River 69-kV bus voltage			Richland Center-T RC 69-kV line outage		90-91%		
3	South, Sun Prairie, Bird St.69-kV bus voltages			Reiner-Burke Tap 69-kV line outage		92%		
3	South, Sun Prairie, Bird St.69-kV bus voltages			Reiner 138/ 69-kV transformer outage		92%		
3	Artesian, Nishan, Zobel 138-kV bus voltages, Artesian, Reedsburg 69-kV bus voltages			Rock Springs Tap-Artesian 138-kV line outage		92%		
3	Rock Springs, Dell Creek, Artesian, Nishan, Zobel 138-kV bus voltages, Artesian, Reedsburg 69-kV bus voltages			Rock Springs Tap-Kirkwood 138-kV line outage		91-92%		
3	Loch Mirror, Birchwood 138-kV bus voltages			Kilbourn-Loch Mirror 138-kV line outage		92%		
3	Concord 138-kV bus 4 and 5 voltages			Jefferson-Crawfish River 138-kV line outage		91%		
3	Concord, Hubbard, Hustiford 138-kV bus voltages			Concord bus 4 and 5 outage		91-92%		
3	Concord 138-kV bus 4 and 5 voltages			Concord bus G and 5 outage		91%		
3	Wyoming Valley, Spring Green, Troy 138-kV bus voltages			Eden-Wyoming Valley 138-kV line outage		92%		
3	Dickinson 138-kV bus voltage			Colley Road-Dickinson 138-kV line outage		91%		
3	Spring Green 138-kV bus voltage			Spring Green-Wyoming Valley 138-kV line outage		92%		
3	North Beaver Dam, Beaver Dam East, Fox Lake 138-kV bus voltages			North Randolph-Fox Lake 138-kV line outage		91%		
3	Kirkwood, Rock Springs, Artesian, Nishan, Zobel 138-kV bus voltages			City View-Kirkwood 138-kV line outage		91-92%		
4	West Marinette 138/69-kV transformer #1	95-111%		Wells St-Roosevelt Rd 69-kV line outage, Roosevelt Rd 138/69-kV transformer outage, West Marinette 138/69-kV transformer #2 outage	98-116%			
4	West Marinette 138/69-kV transformer #2	97-100 %		Wells St-Roosevelt Rd 69-kV line outage, Roosevelt Rd 138/69-kV transformer outage	102-104%			
4	Sunset Point-Pearl Ave 69-kV line	97%		Ellinwood-12th Ave 69-kV line outage	102%			
4	Henry St-Danz Ave 69-kV line	<95%		Pulliam-Van Buren 69-kV line outage	97%			
4	Sunset Point 138/69-kV transformer #1	<95%		Sunset Point 138/69-kV transformer #2 outage	99%			
4	Mirro-North East 69-kV line	<95%		Shoto-Manrap 69-kV line outage			98%	
4	Glenview 138/69-kV transformer #1	<95%		Glenview 138/69-kV transformer #2 outage			97%	
4	Glenview 138/69-kV transformer #2	<95%		Glenview 138/69-kV transformer #1 outage			96%	
4	Quarry Run, Woodenshoe, Mears Corners 138-kV bus voltages		91%	Neevin-Quarry Run 138-kV line outage, Quarry Run-Woodenshoe 138-kV line outage		90-92%		
4	Sunset Point 138-kV bus voltage		>92%	Neevin-Quarry Run 138-kV line outage		92%		
4	East Krok 69-kV bus voltage		>92%	East Krok 138/69-kV transformer outage		92%		
4	Hickory, Butternut, Forward Energy Center 138-kV bus voltages		>92%	Hickory-South Fond du Lac 138-kV line outage		92%		
5	Germantown 138-kV bus		-----	Base Case		92%		
5	Country Aire 138-kV bus		-----	Base Case		91%		
5	Bain 345/138-kV transformer #5	156%		Splitting Pleasant Prairie 345-kV bus sections 3 and 4	157%		158%	
5	Albers – Bain	98%		Bain – Kenosha 138-kV line	105%			
5	Oak Creek – Pennsylvania 138-kV line	100 – 108%		Various Contingencies	113%		95 – 100%	

TABLE ZS-2
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2011 Peak, Hot Summer and Shoulder Cases (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause	% of Facility Rating Hot Summer Case	% of Nominal Bus Voltage Hot Summer Case	% of Facility Rating Shoulder Case	% of Nominal Bus Voltage Shoulder Case
5	Arcadian4 – Waukesha 1 138-kV line	114%		Arcadian6 – Waukesha 3	125%		117%	
5	Arcadian 345/138-kV transformer #3	110%		Arcadian 345/138-kV transformer #1 outage	118%		103%	
5	Oak Creek 345/138-kV transformer #1	96%		Oak Creek 345/138-kV transformer #2 outage	100%			
5	Nicholson – Ramsey 138-kV line	95%		Oak Creek – Pennsylvania 138-kV line outage	98%		96%	
5	Oak Creek – Ramsey 138-kV line	94%		Oak Creek – Pennsylvania 138-kV line outage	97%		95%	
5	Arcadian6 – Waukesha3 138-kV line	115%		Arcadian4 – Waukesha 1 138-kV line outage	126%		118%	
5	Bluemound – Brookdale W 138-kV line			Bluemound – 96th St 2 138-kV line outage	104%			
5	Bark River – Sussex 138-kV line			Maple – Saukville 138-kV line outage	104%			
5	Maple – Saukville 138-kV line			Bark River – Sussex 138-kV line outage	104%			
5	Bluemound5 – Butler 138-kV line			Various Contingencies			107 -109%	
5	Bluemound6 – Butler 138-kV line			Various Contingencies			99 – 101%	
5	Harbor – Kansas 183-kV line			Various Contingencies			97 – 99%	
5	Albers – Kenosha 138-kV line			Albers – Bain 138-kV line outage			102%	
5	Granville – Rangeline 138-kV line			Cornell – Granville 138-kV line outage			102%	

TABLE ZS-3
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2015 Peak Summer Case

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause
1	Antigo, Aurora Street, Cranberry and St. Germain 115-kV bus voltages		89 – 92%	Gardner Park-Blackbrook-Antigo-Aurora St. 115-kV outage Gardner Park-Blackbrook-Antigo 115-kV line outage Blackbrook-Antigo 115-kV line outage Eagle River-Cranberry 115-kV line outage
1	Bunker Hill – Blackbrook 115-kV line	103%		Gardner Park-Blackbrook 115-kV line outage
1	Gardner Park – Blackbrook 115-kV line	97%		Maine-Pine 115-kV line outage
1	Sigel, Young Road, Lakehead Vesper and Port Edwards 138-kV bus voltages		88 – 91%	Arpin-Sigel 138-kV line outage Young Road-Sigel 138-kV line outage Young Road-Lakehead Vesper 138-kV line outage Port Edwards-Lakehead Vesper 138-kV line outage
1	Port Edwards, Vulcan, Hollywood and Saratoga 138-kV bus voltages		89 – 92%	Arpin-Sigel 138-kV line outage Young Road-Sigel 138-kV line outage Young Road-Lakehead Vesper 138-kV line outage Port Edwards-Lakehead Vesper 138-kV line outage
1	Castle Rock – Quincy 69-kV line	96 - 112%		Petenwell 138/69-kV transformer outages Petenwell-Big Pond 69-kV line outage Necedah Tap-Big Pond 69-kV line outage Various other line outages
1	McKenna – Quincy 69-kV line	100%		Petenwell 138/69-kV transformer outages Petenwell-Big Pond 69-kV line outage Necedah tap-Big Pond 69-kV line outage
1	Council Creek 69-kV bus tie (ATC-DPC)	95 – 121%		Hillsboro-Hillsboro tap 69-kV line outage King-Eau Claire-Arpin 345-kV line outage Eau Claire-Arpin 345-kV line outage Various other line outages
1	Council Creek and Petenwell 138-kV bus voltage		90 – 95%	Base Case Arpin-Sigel 138-kV line outage Young Road-Sigel 138-kV line outage Council Creek-Petenwell 138-kV line outage
1	Necedah, Whistling Wings, Dellwood, Friendship, Houghton Rock 69-kV bus voltages		85 – 92%	Petenwell 138/69-kV transformer Petenwell-Big Pond 69-kV line outage Big Pond-Necedah tap 69-kV line outage Various other 69-kV line outages
1	Hilltop, Mauston, West Mauston, Lyndon Station, Wisconsin Dells 69-kV bus voltages		88 – 92%	Kilbourn-Wisc. Dells 69-kV line outage E. Dells-Lewiston 138-kV line outage Trienda-Lewiston 138-kV line outage
1	Wautoma and Sand Lake 138-kV bus voltages		90 – 96%	Base Case Arpin-Sigel 138-kV line outage Young Road-Sigel 138-kV line outage Young Road-Lakehead Vesper 138-kV line outage
1	Sand Lake 138/69-kV transformer	95 – 109%		Wautoma 138/69-kV transformer outage Trienda-Lewiston 138-kV line outage E. Dells-Lewiston 138-kV line outage Various other line outages
1	Hancock, Hancock (ACEC), Plainfield and Plainfield (ACEC) 69-kV bus voltages		88 – 92%	Sand Lake 138/69-kV transformer outage Sand Lake-Plainfield Tap 69-kV line outage

TABLE ZS-3
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2015 Peak Summer Case (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause
1	Metomen 138/69-kV transformer	95 – 119%		Base Case North Fond du Lac-Rosendale 69-kV line outage Metomen-Rosendale 69-kV line outage Various other line outages
1	Metomen – Ripon 69-kV line	96 – 103%		Winneconne-Sunset Point 69-kV line outage Omro-Winneconne 69-kV line outage Markesan tap-North Randolph 69-kV line outage Wautoma-Silver Lake 69-kV line outage
1	NW Ripon – Ripon 69-kV line	96 – 106%		Winneconne-Sunset Point 69-kV line outage Omro-Winneconne 69-kV line outage
1	Winneconne – Sunset Point 69-kV line	95 – 103%		NW Ripon - Ripon 69-kV line outage Metomen-Ripon 69-kV line outage
1	Omro – Winneconne 69-kV line	98%		NW Ripon - Ripon 69-kV line outage
1	Berlin area 69-kV bus voltages		85 – 92%	NW Ripon - Ripon 69-kV line outage Metomen-Ripon 69-kV line outage Winneconne-Sunset Point 69-kV line outage Wautoma-Silver Lake 69-kV line outage Various other line outages
1	Montello, Roslin, Endeavor and Lakehead Portage 69-kV bus voltages		89 – 92%	Portage-Lakehead Portage 69-kV line outage Endeavor Tap-Lakehead Portage 69-kV line outage
1	Whitcomb 115/69-kV transformer	95 – 98%		Gardner Park-Blackbrook-Antigo 115-kV line outage Antigo-Blackbrook 115-kV line outage Werner West-White Lake 138-kV line outage
1	Caroline 115/69-kV transformer	95%		Whitcomb 115/69-kV transformer
1	Coloma (ACEC), Lincoln Pumping Station, Brooks (ACEC) and Grand Marsh 69-kV bus voltages		88 – 92%	Chaffee Creek-Coloma tap 69-kV line outage Lincoln Pumping Station-Coloma Tap 69-kV line outage Sand Lake 138/69-kV transformer outage Petenwell 138/69-kV transformer outage
1	White Lake, Waupaca, Harrison and Hartman Creek 138-kV bus voltages		90 – 92%	Werner West-White Lake 138-kV line outage
1	Hillsboro, Wonewoc and Union Center 69 kV bus voltages		90 – 91%	Hillsboro-Hillsboro tap 69-kV line outage
2	Indian Lake 138-kV bus voltage		95%	Base Case
2	St. Ignace, Straits, Evergreen, Michigan Limestone, and Talentino 69-kV bus voltages		90-91%	Straits 138/69-kV transformer
2	Engadine, Newberry Village, Newberry Hospital and Louisiana Pacific bus voltages		91%	Engadine-Hiawatha 69-kV line outage
3	McCue 138/69-kV transformer	101%		Base Case
3	North Monroe 138/69-kV transformer	104%		Base Case
3	Kirkwood-Skillet Creek 69-kV line	110%		Base Case
3	Brodhead-Blacksmith 69-kV line	134-95%		North Monroe 138/69-kV transformer outage, Town Line Road-Albany 138-kV line outage, Albany-North Monroe 138-kV line outage, North Monroe-Idle Hour 69-kV line outage, Brodhead-Brodhead Muni 3 69-kV line outage, North Monroe – Idle Hour 69-kV line outage
3	Hillman-Elmo 69-kV line	99%		Pilot NB-Galena 69-kV line outage
3	North Monroe-Monticello Tap 69-kV line	95%		Wempletown-Rockdale 345-kV line outage
3	North Monroe 138/69-kV transformer	97-95%		Darlington 138/69-kV transformer outage, Paddock-Newark 69-kV line outage
3	Janesville-Park View 69-kV line	99%		McCue 138/69-kV transformer outage
3	Janesville 138/69-kV transformer	104%		McCue 138/69-kV transformer outage
3	Milton-Lawns-McCue 69-kV line	110%		Janesville 138/69-kV transformer outage

TABLE ZS-3
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2015 Peak Summer Case (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause
3	Dana Corporation Tap – Sheepskin 69-kV line	103%		McCue-Harmony 69-kV line outage
3	Black Earth - Cross Plain - Stage Coach - Timberlane - West Middleton 69-kV line	115%		Spring Green 138/69-kV transformer outage
3	North Stoughton-Stoughton Muni 69-kV line	100-95%		McCue-Harmony 69-kV line outage, Harmony-Lamar 69-kV line outage
3	Stoughton-Aaker 69-kV line	95%		Verona 138/69-kV transformer outage, Verona-Oak Ridge 138-kV line outage
3	Kegonsa – Cottage Grove 69-kV line	99%		Deforest-North Madison 69-kV line outage
3	Deforest-Arlington Tap 69-kV line	102%		Deforest-North Madison 69-kV line outage
3	Arlington Tap – Poynette 69-kV line	115%		Deforest-North Madison 69-kV line outage
3	Waunakee Industrial Park – Huiskamp 69-kV line	96%		North Madison 138/69-kV transformer outage
3	Rock Springs Tap – Artesian 138-kV line	113-108%		Trienda-Lewiston 138-kV line outage, East Dells-Lewiston 138-kV line outage, East Dells-Lewiston 138-kV line outage
3	Academy-Columbus Muni 2 Tap 69-kV line	100%		North Randolph-Fox Lake 138-kV line outage
3	Columbus Muni 2 Tap- Columbus 69-kV line	96%		North Randolph-Fox Lake 138-kV line outage
3	Waupun – Koch Oil Tap 69-kV line	97%		North Randolph-Fox Lake 138-kV line outage
3	Koch Oil Tap – South Fond Du Lac 69-kV line	101-96%		North Randolph-Fox Lake 138-kV line outage, Fox Lake-North Beaver Dam 138-kV line outage
3	47 MVA Kilbourn 138/69-kV transformer	120%		93 MVA Kilbourn 138/69-kV transformer outage
3	Huiskamp-Ruskin 69-kV line	132-108%		North Madison-Vienna 138-kV line outage, Vienna-Yahara River 138-kV line outage, Yahara River-American Center 138-kV line outage, American Center-Sycamore 138-kV line outage
3	East Dells-Kilbourn 138-kV line	96%		Lake Delton-Trienda 138-kV line outage
3	East Dells-Lewiston 138-kV line	98%		Lake Delton-Trienda 138-kV line outage
3	X-19 Portage-Trienda 138-kV line	126%		X-67 Portage-Trienda 138-kV line
3	X-67 Portage-Trienda 138-kV line	105%		X-19 Portage-Trienda 138-kV line
3	Portage-Columbia 138-kV line	105%		Second Portage-Columbia 138-kV line outage
3	Trienda-Lewiston 138-kV line	99-95%		Lake Delton-Trienda 138-kV line outage, Rock Springs Tap-Kirkwood 138-kV line outage
3	Columbia 345/138 transformer T21	99%		Columbia 345/138 transformer T22 outage
3	Columbia 345/138 transformer T23	99%		Columbia 345/138 transformer T22 outage
3	Ruskin 69-kV bus tie	104-98%		North Madison-Vienna 138-kV line outage, Vienna-Yahara 138-kV line outage
3	Idle Hour, Monroe, Monroe Tap, South Monroe, Blacksmith, Browntown, Green Wind, Jennings Road, Wiota 69-kV bus voltages		85-92%	North Monroe-Idle Hour 69-kV line outage
3	Idle Hour, Monroe, Monroe Tap, South Monroe, North Monroe, Monticello, Monticello Tap, New Glarus, Belleville, Montrose, Brooklyn, Sun Valley, Oregon, Verona 69-kV bus voltages		85-92%	North Monroe 138/69-kV transformer
3	Monticello, Monticello Tap, New Glarus, Belleville, Montrose, Brooklyn, Sun Valley, Oregon, Verona, Jennings South Monroe, Blacksmith, Browntown, Green Wind, Aakar Road, Wiota 69-kV bus voltages, Verona 138-kV bus voltage		87-92%	North Monroe-Monticello Tap 69-kV line outage
3	South Monroe, Monroe, Blacksmith, Browntown 69-kV bus voltages		88-91%	Idle Hour-Monroe Tap 69-kV line outage
3	New Glarus, Belleville, Montrose, Brooklyn, Sun Valley, Oregon 69-kV bus voltages, Verona 138-kV bus voltage		88-91%	Monticello Tap-New Glarus 69-kV line outage
3	Brodhead Muni 3, Brodhead Muni 2, Brodhead, Brodhead Muni 1, RCEC Orfordville, Orfordville, Bass Creek, Footville, RCEC Center, Evansville 69-kV bus voltages		88-91%	Brodhead Switching Station-Brodhead Muni 3 69-kV line outage

TABLE ZS-3
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2015 Peak Summer Case (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause
3	Brodhead Muni 2, Brodhead, Brodhead Muni 1, RCEC Orfordville, Orfordville, Bass Creek, Footville, RCEC Center 69-kV bus voltages		90-91%	Brodhead Muni 2 -Brodhead Muni 3 69-kV line outage
3	Orfordville, Bass Creek, Footville, RCEC Center, Evansville 69-kV bus voltages		87-92%	Evansville-Sheepskin 69-kV line outage
3	Brodhead Switching Station, Brodhead Muni 3, Brodhead Muni 2, Brodhead, Brodhead Muni 1 69-kV bus voltages		92%	Paddock-Newark 69-kV line
3	Bradford, West Darien, SW Delavan, North Shore, Delavan, Bristol, Elkhorn, Como, Williams Bay, North Lake Geneva, White River, South Lake Geneva, Brick Church 138-kV bus voltages		90-92%	RCEC La Prairie-RCEC Bradford 138-kV line outage
3	La Prairie, Bradford, West Darien, SW Delavan, North Shore, Delavan, Bristol, Elkhorn, Como, Williams Bay, North Lake Geneva, White River, South Lake Geneva, Brick Church 138-kV bus voltages		90-92%	Rock River-RCEC La Prairie 138-kV line outage
3	Twin Lakes, Richmond, Katzenberg 69-kV bus voltages		90%	Katzenberg-South Lake Geneva 69-kV line outage
3	West Darien, SW Delavan, North Shore, Delavan, Bristol, Elkhorn, Como, Williams Bay, North Lake Geneva, White River, South Lake Geneva, Brick Church 138-kV bus voltages		90-92%	West Darien-West Darien Tap 138-kV line outage
3	West Darien Tap, West Darien, SW Delavan, North Shore, Delavan, Bristol, Elkhorn, Como, Williams Bay, North Lake Geneva, White River, South Lake Geneva, Brick Church 138-kV bus voltages		90-92%	RCEC Bradford-West Darien Tap 138-kV line outage
3	SW Delavan, North Shore, Delavan, Bristol, Elkhorn, Como, Williams Bay, North Lake Geneva, White River 138-kV bus voltages		91-92%	West Darien-SW Delavan 138-kV line outage
3	Harmony, Lamar, Fulton, Saunders Creek, Evansville, Dana Corporation, RCEC Center 69-kV bus voltages		85-92%	McCue-Harmony 69-kV line outage
3	Lamar, Fulton, Saunders Creek, Evansville 69-kV bus voltages		88-92%	Harmony-Lamar 69-kV line outage
3	Avoca, Avoca Tap, Muscoda 69-kV bus voltages		91-92%	Avoca Tap-Lone Rock 69-kV line outage
3	Pine River, Richland Center, Richland, Lone Rock 69-kV bus voltages		91-92%	Lone Rock 69-kV Phase Shifter outage, Lone Rock-Richland Center 69-kV line outage
3	Pine River, Richland Center, Richland, Lone Rock, Muscoda, Avoca, Blue River, Boscobel, Boscobel Muni 69-kV bus voltages		88-90%	Lone Rock-Spring Green 69-kV line outage
3	Arena, Mazomanie, Mazomanie Industrial, Black Earth 69-kV bus voltages		90-91%	Spring Green-Arena 69-kV line outage
3	Spring Green, Avoca, Muscoda, Lone Rock, Arena, Mazomanie, Mazomanie Industrial, Blue River, Pine River, Richland Center, Black Earth, Boscobel, Boscobel Muni 69-kV bus voltages		84-92%	Spring Green 138/69-kV transformer outage
3	Mazomanie, Mazomanie Industrial, Black Earth 69-kV bus voltages		91-92%	Arena-Mazomanie 69-kV line outage
3	Black Earth, Mazomanie, Mazomanie Industrial 69-kV bus voltages		92%	Black Earth-Cross Plains 69-kV line outage
3	Cross Plains, Black Earth, Mazomanie, Mazomanie Industrial 69-kV bus voltages		89-90%	Stage Coach-Cross Plains 69-kV line outage
3	Timberlane, Cross Plains, Stage Coach, Black Earth, Mazomanie, Mazomanie Industrial, Mount Horeb, Forward 69-kV bus voltages		88-92%	Timberlane-West Middleton 69-kV line outage
3	Asker Rd, Sun Valley, Oregon, Brooklyn 69-kV bus voltages		90-92%	Stoughton-Aakar 69-kV line outage
3	Cottage Grove, Gaston Road 69-kV bus voltages		90%	Kegonsa-Cottage Grove 69-kV line outage, Kegonsa 138/69-kV transformer outage
3	McFarland, Femrite, Sprecher, Reiner Road 138-kV bus voltages		88-91%	McFarland-Kegonsa 138-kV line outage
3	Femrite, Sprecher, Reiner Road 138-kV bus voltages		89-91%	McFarland-Femrite 138-kV line outage

TABLE ZS-3
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2015 Peak Summer Case (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause
3	Burke, Burke Tap, Colorado, Sun Prairie, South, Bird St., Business Park, Gaston Rd, Token Creek 69-kV bus voltages		85-91%	Reiner Road-Burke Tap 69-kV line outage
3	Reiner Rd, Burke, Burke Tap, Colorado, Sun Prairie, South, Bird St., Business Park, Gaston Rd, Token Creek, Cottage Grove, Hampden Tap, Hampden 69-kV bus voltages		82-92%	Reiner 138/69-kV transformer outage
3	Colorado 69-kV bus voltage		92%	Colorado-Burke Tap 69-kV line outage
3	Token Creek 69-kV bus voltage		92%	Deforest-Token Creek 69-kV line outage
3	Deforest, Sun Prairie, South, Bird St., Gaston Rd, Token Creek, Hampden Tap, Hampden 69-kV bus voltages		90-91%	Deforest-North Madison 69-kV line outage
3	Hubbard 138-kV bus voltage		89%	Hustiford-Hubbard 138-kV line outage
3	Hustiford, Hubbard 138-kV bus voltages		88%	Hustiford-Rubicon 138-kV line outage
3	Birchwood, Dell Creek, Zobel, Nishan 138-kV bus voltages		91-92%	Loch Mirror-Birchwood 138-kV line outage
3	Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan, Artesian, Rock Springs, Spring Green, Troy, Wyoming Valley, Kirkwood 138-kV bus voltages, Artesian, Loganville, Reedsburg 69-kV bus voltages		87-92%	Loch Mirror-Kilbourn 138-kV line outage
3	East Dells, Kilbourn, Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan, Artesian, Rock Springs, Spring Green, Troy, Wyoming Valley, Kirkwood, City View, Lake Delton, Eden 138-kV bus voltages, Artesian, Loganville, Reedsburg, Finnegan, Platte, Kilbourn 69-kV bus voltages		83-92%	East Dells-Lewiston 138-kV line outage
3	Kilbourn, Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan, Artesian, Rock Springs, Spring Green, Troy, Wyoming Valley, Kirkwood, City View, Lake Delton 138-kV bus voltages, Artesian, Loganville, Reedsburg, Finnegan, Platte, Kilbourn 69-kV bus voltages		83-92%	East Dells-Kilbourn 138-kV line outage
3	Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan, Artesian, Rock Springs, Spring Green, Troy, Wyoming Valley, Kirkwood, City View, Lake Delton, Eden 138-kV bus voltages, Artesian, Loganville, Reedsburg 69-kV bus voltages		88-91%	Lake Delton-Trienda 138-kV line outage
3	East Dells, Kilbourn, Loch Mirror, Birchwood, Dell Creek, Zobel, Nishan, Artesian, Rock Springs, Spring Green, Troy, Wyoming Valley, Kirkwood, City View, Lake Delton, Eden 138-kV bus voltages, Artesian, Loganville, Reedsburg, Finnegan, Platte, Kilbourn 69-kV bus voltages		82-92%	Trienda-Lewiston 138-kV line outage
3	Dell Creek, Zobel, Nishan, Artesian, Rock Springs, Spring Green, Troy, Wyoming Valley, Kirkwood, City View, Eden 138-kV bus voltages		90-92%	City View-Lake Delton 138-kV line outage
3	Spring Green, Troy, Wyoming Valley, Kirkwood 138-kV bus voltages		91-92%	City View-Kirkwood 138-kV line outage
3	Sugar Creek 138-kV bus voltage		92%	Sugar Creek-University 138-kV line
3	Fort Atkinson 138-kV bus voltage		91%	Jefferson 4-5 138-kV bus tie outage
3	Crawfish, Rockvale 138-kV bus voltages		91-92%	Jefferson-Crawfish River 138-kV line outage
3	Concord, Hubbard, Hustiford, Rubicon 138-kV bus voltages		90-92%	Concord 4-5 138-kV bus tie outage
3	Rockvale 138-kV bus voltage		90%	Rockvale-Concord 138-kV line outage
3	North Shore, Delavan, Bristol, Elkhorn, Como 138-kV bus voltages		91-92%	SW Delavan-North Shore 138-kV line outage
3	Lancaster, Eden, Wyoming Valley, Spring Green, Troy 138-kV bus voltages, Avoca, Blue River, Muscoda 69-kV bus voltages		88-92%	Nelson Dewey-Lancaster 138-kV line outage
3	Potosi, Hillman, Lafayette Wind, Darlington 138-kV bus voltages		90%	Nelson Dewey-Potosi 138-kV line outage
3	Hillman, Lafayette Wind, Darlington 138-kV bus voltages		90%	Potosi-Hillman 138-kV line outage
3	Darlington 138-kV bus voltage		92%	Darlington-Lafayette Wind 138-kV line outage

TABLE ZS-3
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2015 Peak Summer Case (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause
3	Eden, Wyoming Valley, Spring Green, Troy 138-kV bus voltages,		90-91%	Eden-Lancaster 138-kV line outage
3	Wyoming Valley, Spring Green, Troy 138-kV bus voltages, Avoca, Muscoda 69-kV bus voltages		91-92%	Eden-Wyoming Valley 138-kV line outage
3	North Monroe, Darlington 138-kV bus voltages		90-92%	North Monroe-Albany 138-kV line outage
3	Albany, North Monroe, Darlington, Lafayette Wind 138-kV bus voltages		88-92%	Town line Road-Albany 138-kV line outage
3	Dickinson, Brick Church, Williams Bay 138-kV bus voltages		89-91%	Colley Road-Dickinson 138-kV line outage
3	Brick Church, Williams Bay 138-kV bus voltages		91-92%	Dickinson-Brick Church 138-kV line outage
3	Spring Green, Troy 138-kV bus voltages		91-92%	Spring Green-Wyoming Valley 138-kV line outage
3	Fort Atkinson 138-kV bus voltage		92%	Rockdale-Lakehead Cambridge 138-kV line
3	Reiner Road, Sprecher 138-kV bus voltages		91-92%	Reiner Rd-Sycamore 138-kV line outage
3	Fox Lake, Beaver Dam East bus voltages		91-92%	North Randolph-Fox Lake 138-kV line outage
3	Rockvale 138-kV bus voltage		91-92%	Bark River-Cottonwood 138-kV line outage, Bark River-Sussex 138-kV line outage
3	LCI, Pflaum, Femrite, Nine Springs, Syene 69-kV bus voltages		90-92%	Femrite 138/69-kV transformer outage
3	Brisbois, Grangrae, Boscobel, Boscobel Muni, Wauzeka, Hillside, Lapointe 69-kV bus voltages		91-92%	Grangrae 138/69-kV transformer outage
3	Miner 69-kV bus voltage		92%	DPC Terr TP – Pilot NB 69-kV line outage
3	Miner, Shullsburg 69-kV bus voltages		91%	DPC Pilot NB-Galena 69-kV line outage
3	Boscobel, Muscoda, Blue River, Brisbois 69-kV bus voltages		91-92%	Seneca-Genoa 161-kV line outage
3	Vienna, Yahara River, American Center, Reiner Rd, Sprecher, Femrite, Sycamore, Blount 138-kV bus voltages		91-92%	North Madison-Vienna 138-kV line outage
3	Yahara River, American Center, Reiner Road, Sprecher, Femrite, Sycamore 138-kV bus voltages		91-92%	Yahara River-Vienna 138-kV line outage
3	Reiner Rd, Sprecher, Femrite, Sycamore 138-kV bus voltages		91-92%	Yahara River-American Center 138-kV line outage
3	Verona, Sun Valley, Brooklyn, Oregon, Montrose, Belleville, Aaker, Stoughton, Stoughton Muni, Mount Horeb, New Glarus, Forward, Monticello 69-kV bus voltages		86-91%	Verona-Oakridge 138-kV line outage
3	Verona, Sun Valley, Brooklyn, Oregon, Montrose, Belleville, Aaker, Stoughton, Stoughton Muni, Mount Horeb, New Glarus, Forward, Monticello 69-kV bus voltages		87-91%	Verona 138/69-kV transformer outage
3	Sun Valley, Oregon, Brooklyn 69-kV bus voltages		88-90%	Sun Valley-Verona 69-kV line outage
3	Cobble Stone, Lake Shore, Zenda Tap, Zenda, Katzenberg, Richmond, Twin Lakes 69-kV bus voltages		88-92%	Cobble Stone-Brick Church 69-kV line outage
4	Pulliam-Van Buren 69-kV line	97%		Pulliam-Danz Avenue 69-kV line outage
4	Henry-Danz Avenue 69-kV line	105%		Pulliam-Van Buren 69-kV line outage
4	Pulliam-Danz Avenue 69-kV line	102%		Pulliam-Van Buren 69-kV line outage
4	Sunset Point-Pearl Avenue 69-kV line	104%		Ellinwood-Twelfth Avenue 69-kV line outage
4	Sunset Point 138/69-kV transformer #1	101%		Sunset Point 138/69-kV transformer #2 outage
4	Sister Bay 69-kV bus voltage		95%	Base Case
4	Bluestone, Wesmark 69-kV bus voltages		86-88%	Finger Road-Bluestone 69-kV line outage
4	Booster, Barnett, Beardsley St, East Krok 69-kV bus voltages		90-91%	East Krok 138/69-kV transformer outage
4	Quarry Run, Woodenshoe, Mears Corners, Sunset Point 138-kV bus voltages		89-91%	Neevin-Quarry Run 138-kV line outage, Quarry Run-Woodenshoe 138-kV line outage
4	Hickory, Butternut, Forward Energy Center 138-kV bus voltages		92%	Hickory-South Fond du Lac 138-kV line outage
5	Oak Creek 345/230-kV transformer	100%		Splitting Oak Creek 230-kV bus 78
5	Granville 345/138-kV transformer	95%		Splitting Granville 345-kV bus 23
5	Tichigan and Burlington 138-kV bus voltages		89-90%	Spliiting Burlington 138-kV bus
5	Edgewood – St. Martins 138-kV line	102%		Walworth – Mukwonago 138-kV bus outage
5	Albers – Bain 345-kV line	110%		Bain – Kenosha 138-kV line outage

TABLE ZS-3

PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2015 Peak Summer Case (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating Peak Case	% of Nominal Bus Voltage Peak Case	Cause
5	Oak Creek – Pennsylvania 138-kV line	95 – 103%		Various Contingencies
5	Arcadian4 – Waukesha1 138-kV line	103 – 117%		Various Contingencies
5	Arcadian 345/138-kV transformer #3	111%		Arcadian 345/138-kV transformer #1 outage
5	Fredonia 138-kV bus voltage		91%	Cedarsauk – Fredonia 138-kV line outage
5	Bark River and Cottonwood 138-kV bus voltages		91-92%	Various Contingencies
5	Oak Creek 345/138-kV transformer	97%		Oak Creek 345/138-kV transformer outage
5	Arcadian6 – Waukesha3 138-kV line	118%		Arcadian4 – Waukesha1 138-kV line outage
5	Germantown, Maple 138-kV bus voltages		91-92%	Maple – Saukville 138-kV line outage

Table ZS-4

ATC Real Time Market Constraints (April 1, 2005 through March 31, 2006)

Occurrence hours*	Rank	Constraint (Common name)
1111	1	Eau Claire-Arpin 345-kV line
651	2	Flow south
650	3	Minnesota/Wisconsin stability interface
357	4	Paddock 345/138-kV Transformer T21 for loss of Wempletown-Rockdale 345 kV
264	5	Kelly-Whitcomb 115 kV for loss of Rocky Run-North Appleton 345 kV
240	6	Oak Creek 345/230-kV Transformer 895 for loss of Oak Creek 230/138-kV Transformer 851
234	7	Highway V-Preble 138 kV for loss of Lost Dauphin-Red Maple 138 kV
147	8	Weston 345/115-kV Transformer (no longer in-service) for loss of Weston Unit #3
127	9	Bain-Kenosha 138 kV for loss of Zion-Pleasant Prairie 345 kV
81	10	Oak Creek 345/230-kV Transformer 884 for loss of Oak Creek 230/138-kV Transformer 851 AND Oak Creek Transformer T56
54	11	Highway V - Preble 138 kV for loss of Depere - Glory Rd 138 kV
53	12	Kelly - Whitcomb 115 kV for loss of Weston – Rocky Run 345 kV
53	12	Pleasant Prairie - Racine 345-kV line
50	14	T-Corners-Wien 115 kV for loss of Eau Claire - Arpin 345 kV + Op. Guide
48	15	Forest Junction-Fox River 345 kV for loss of Point Beach - Forest Jct 345 kV
48	15	Pulliam-Maplewood 138 kV for loss of North Appleton-White Clay 138 kV
43	17	Paddock 345/138-kV Transformer T21 for loss of Paddock - Rockdale 345 kV**
40	18	Weston 345/115-kV Transformer (no longer in-service)
38	19	North Appleton-Rocky Run 345 kV for loss of Sherbourne Co. 3 (NSP)
37	20	Dewey (CW8)-Northpoint 115 kV for loss of Weston 345/115-kV Transformer (no longer in-service)
37	20	Stiles-Pulliam 138 kV (64451) for loss of Stiles-Pulliam 138 kV (64441)
37	20	Wien-T-Corners 115 kV
5328		**Total for all ATC Real-Time constraints, 4/1/05 - 3/31/06**

**Number of hours during which this constraint occurred, even if only for a portion of the hour.*

***Paddock-Rockdale is no longer in service (replaced by Wempletown-Rockdale in 2005)*

Table ZS-5

ATC Day Ahead Market Constraints (April 1, 2005 through March 31, 2006)

Occurrence Hours*	Rank	Constraint (Common Name)
1432	1	Flow south PTDF
1395	2	Minnesota/Wisconsin stability interface
1292	3	Paddock 345/138-kV Transformer T21
704	4	Eau Claire-Arpin 345-kV line
645	5	Way Dam Transformer
599	6	Highway V-Preble 138-kV line
438	7	Kelly-Whitcomb 115-kV line
412	8	Detour Transformer T2
387	9	Peavy Falls Transformer 1
382	10	Peavy Falls Transformer 2
357	11	Old Quinn Transformer 4
319	12	Stiles-Oconto 138-kV line
314	13	Old Quinn Transformer 5
305	14	Stiles-Pulliam 138-kV (64441) line
285	15	Stiles-Pioneer 138-kV (64442) line
261	16	Morgan-White Clay 138-kV line
253	17	Oak Creek 345/230-kV Transformer 895
222	18	Racine-Pleasant Prairie 345-kV line
187	19	Dewey(CW8)-Northpoint 115-kV line
182	20	Belle Plaine-Badger 115-kV line
13981		**Total for all ATC Day Ahead constraints, 4/1/05 - 3/31/06**

** Number of hours during which this constraint occurred, even if only for a portion of the hour.*

Table ZS-6: ATC System Angular Stability Assessment for 2006 10-Year Assessment

Facility studied	Response for Selected NERC Category C Outages (NERC Reliability Criteria)					SPS	Note
	2007	2008	2009	2010	Appropriate for 2011~2015		
Pleasant Prairie (1200.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (6)	Acceptable (6)	Yes	Yes	IPO Breakers
Paris (400.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	
Oak Creak (1135.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (6)	Acceptable (6)	Yes	No	
Valley (267.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	
Germantown (342.8 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	
Port Washington CC1 (600.0 MW)	Acceptable (1)(2)	Acceptable (3)	Acceptable (3)	Acceptable (3)	Yes	No	
Port Washington CC2 (600.0 MW)		Acceptable (3)	Acceptable (3)	Acceptable (3)	Yes	No	
Point Beach (557 MW & 559 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	Yes	
Kewaunee (579.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	Yes	
Edgewater (773.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	Yes	IPO Breakers
S. Fond du Lac (352.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	
Neevin (300.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	
Skygen (185.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	
Pulliam (459.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	
West Marinette (240.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	
Fox Energy (672.3 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	IPO Breakers
Sheboygan Energy (343.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	
Cypress (160.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	
Butternut (200.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	
Columbia (1050.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	IPO Breakers
Christiana (544.5 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	
Town Line Road (659.1 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	
Rock River (262.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	
Nelson Dewey (226.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	
University (236.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	
Concord (376.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	
Walnut (New 147.2 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	
Presque Isle (617.0 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	Yes	
Weston (552.6 MW)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Acceptable (1)(2)	Yes	No	IPO Breakers
Weston 4 (550)		Acceptable (4)	Acceptable (4)	Acceptable (4)	Yes	Yes(5)	IPO Breakers
Elm Road Phase I (650 MW)			Acceptable (6)	Acceptable (6)	Yes	No	IPO Breakers
Elm Road Phase II (1300 MW)				Acceptable (6)	Yes	No	IPO Breakers

(1). "American Transmission Company (ATCLLC) - 2005 10-Year Assessment" (http://www.atc10yearplan.com) dated September 2005 section "ZONE & STUDY RESULTS > Multiple outage analysis" under the heading "Generator Stability" and "Voltage Stability" stating the results of dynamics studies for catergory C.

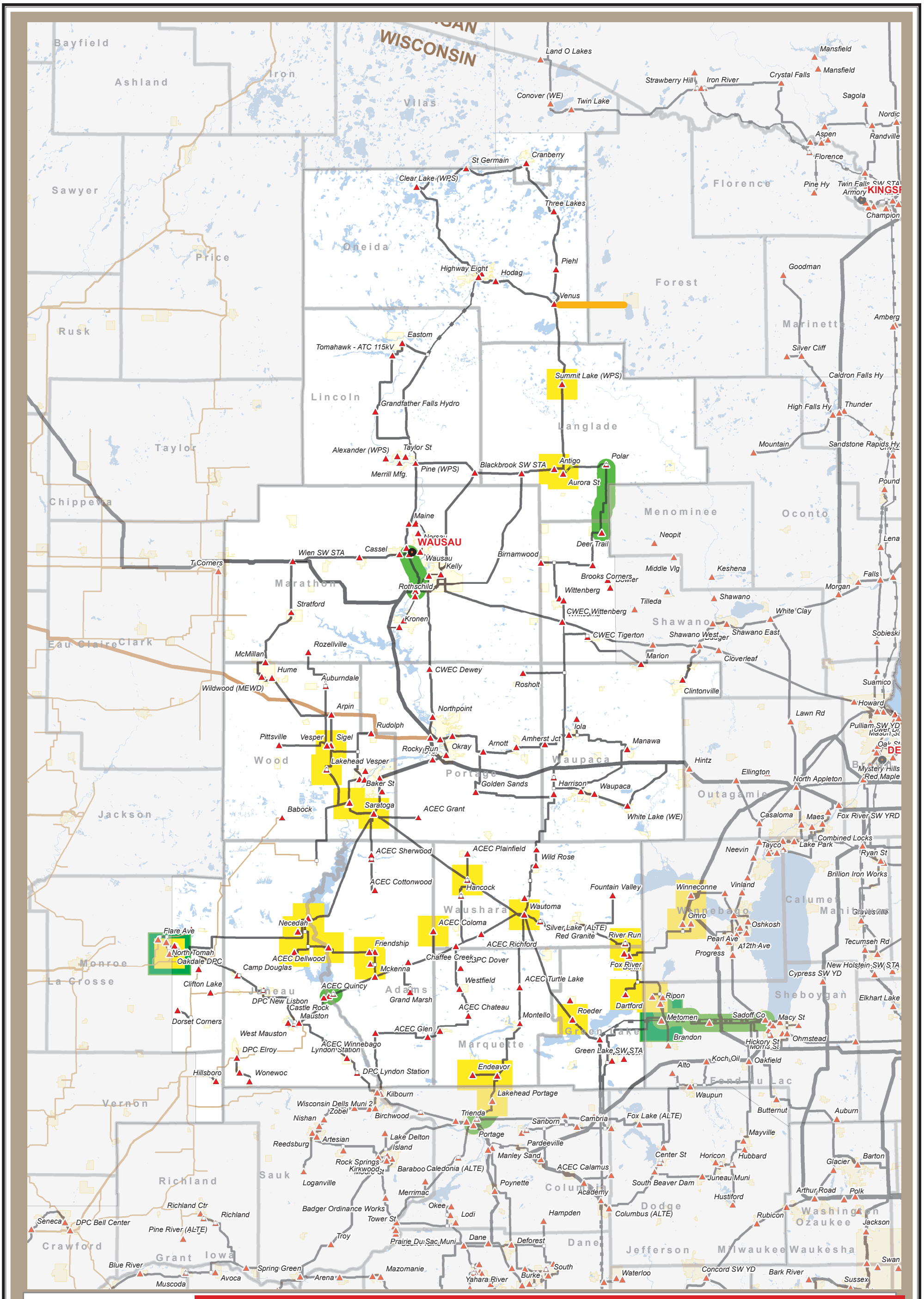
(2). Comparing 2006 models with 2005 models, no significant change has occurred near the generation station, other than the local load growth. Therefore, the stability results from the 2005 TYA are still applicable and are acceptable in the following years.

(3). "Generator Interconnection Facility Study Report for G093 - Revision #3, MISO #G093 (#37004-01)" dated May 13, 2003. \\atc.llc\atcdata\Knowledge Share\Planning and Service\Generator Requests\Study Reports\IC027\GIC027_Facility_Study_Report.pdf.

(4). "Generator Interconnection Facility Study Report for G144 - Addendum IV, MISO #G144 (#37187-02)" dated June 16, 2005. \\atc.llc\atcdata\Knowledge Share\Planning and Service\Generator Requests\Study Reports\IC044\GIC044_Facility_Study_Report.pdf.

(5). A temporary special protection system to trip Weston 4 and a temporary generation restriction on Weston 31 and 32 from June 1, 2008 to December 1, 2009 will be implemented to maintain angular stability until the completion of the following facilities: a) 345-kV Arrowhead-Stone Lake line (expected in service date is June 1, 2008), b) 345-kV Morgan-Central Wisconsin-Werner West line (December 1, 2009), and c) 345-kV Gardner Park-Central Wisconsion line (December 1, 2009).

(6). "Generator Interconnection Facility Study Report for G051 Phase I, II, and III - Restudy, MISO #G051 (#36760-01)" dated March 3, 2006. \\atc.llc\atcdata\Knowledge Share\Planning and Service\Generator Requests\Study Reports\IC012\G051_Facility_Study_Report_Rev1.pdf.



AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

Performance Criteria Limits Exceeded and Other Constraints 2006-2007

PLANNING ZONE 1

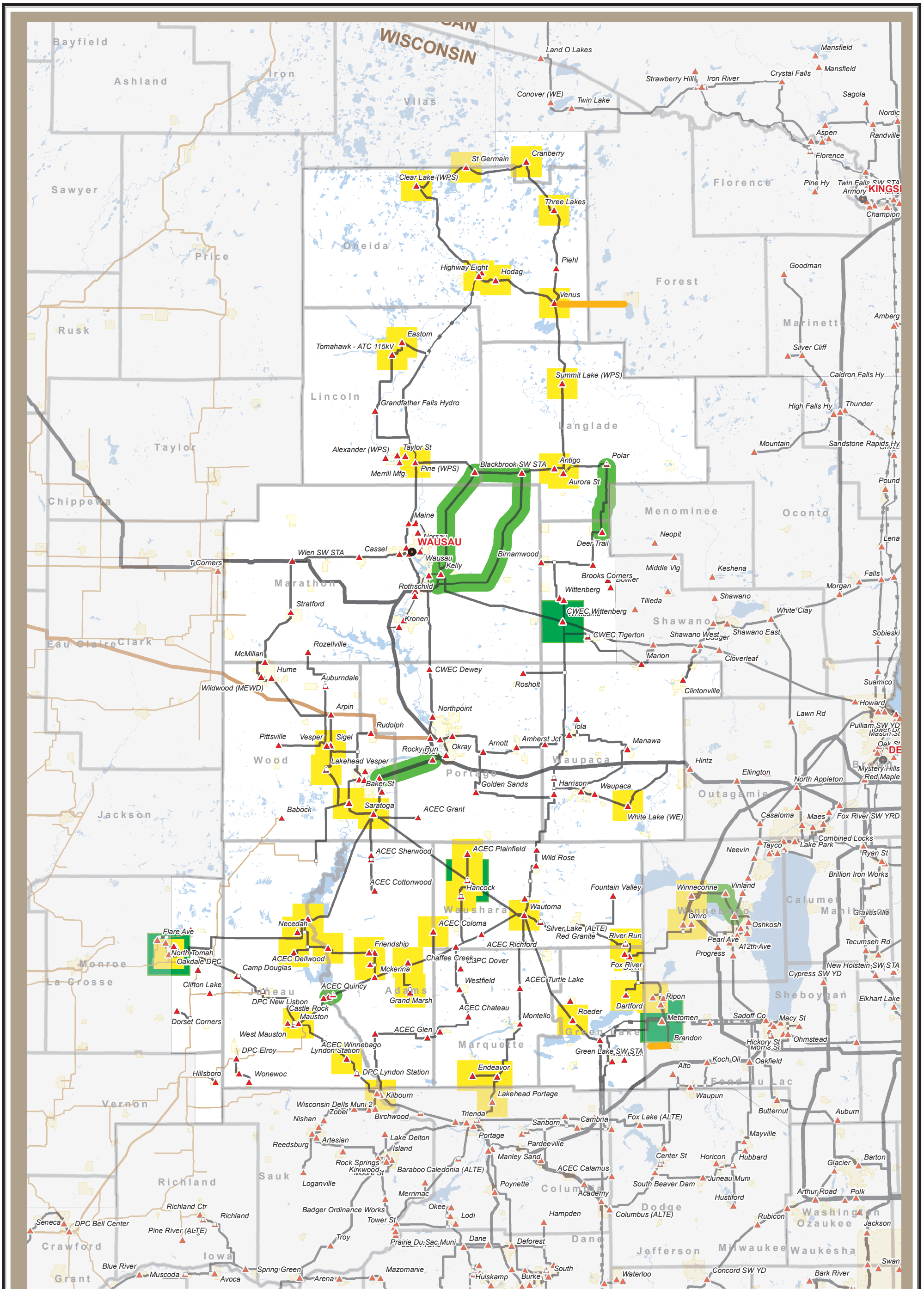
Currently, ATC owns or operates transmission facilities in 50 Wisconsin counties and in 15 Michigan counties. Facilities include:

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

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

Transmission Related Facilities

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



AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

Performance Criteria Limits Exceeded and Other Constraints 2008-2011

PLANNING ZONE 1

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

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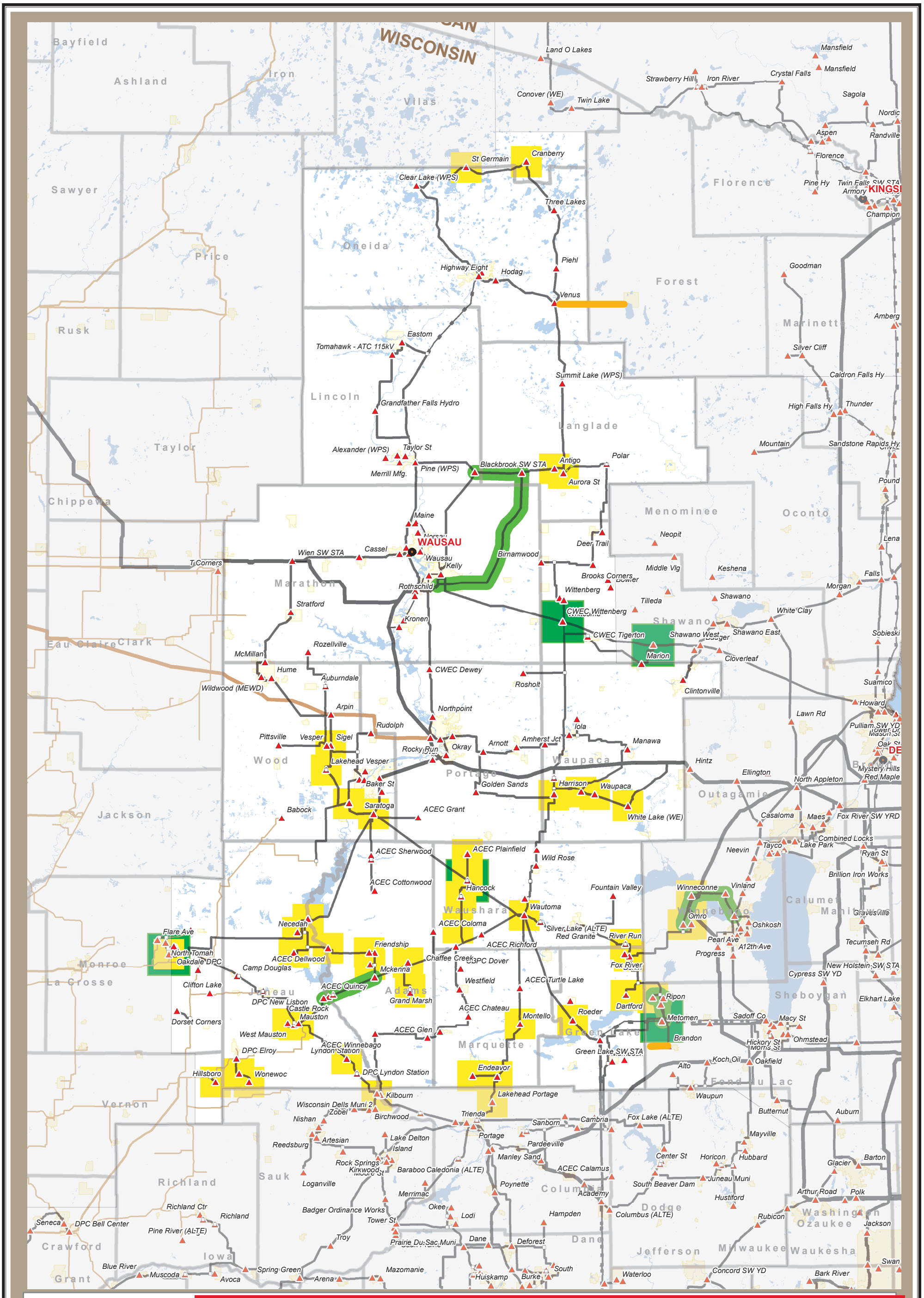
- *98 wholly owned substations*
- *358 jointly owned substations*
- *Offices in Madison (2), Cottage Grove, Pewaukee, De Pere Wausau and Kingsford, MI*

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

Transmission Related Facilities

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



AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

Performance Criteria Limits Exceeded and Other Constraints 2012-2015

PLANNING ZONE 1

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

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- *358 jointly owned substations*
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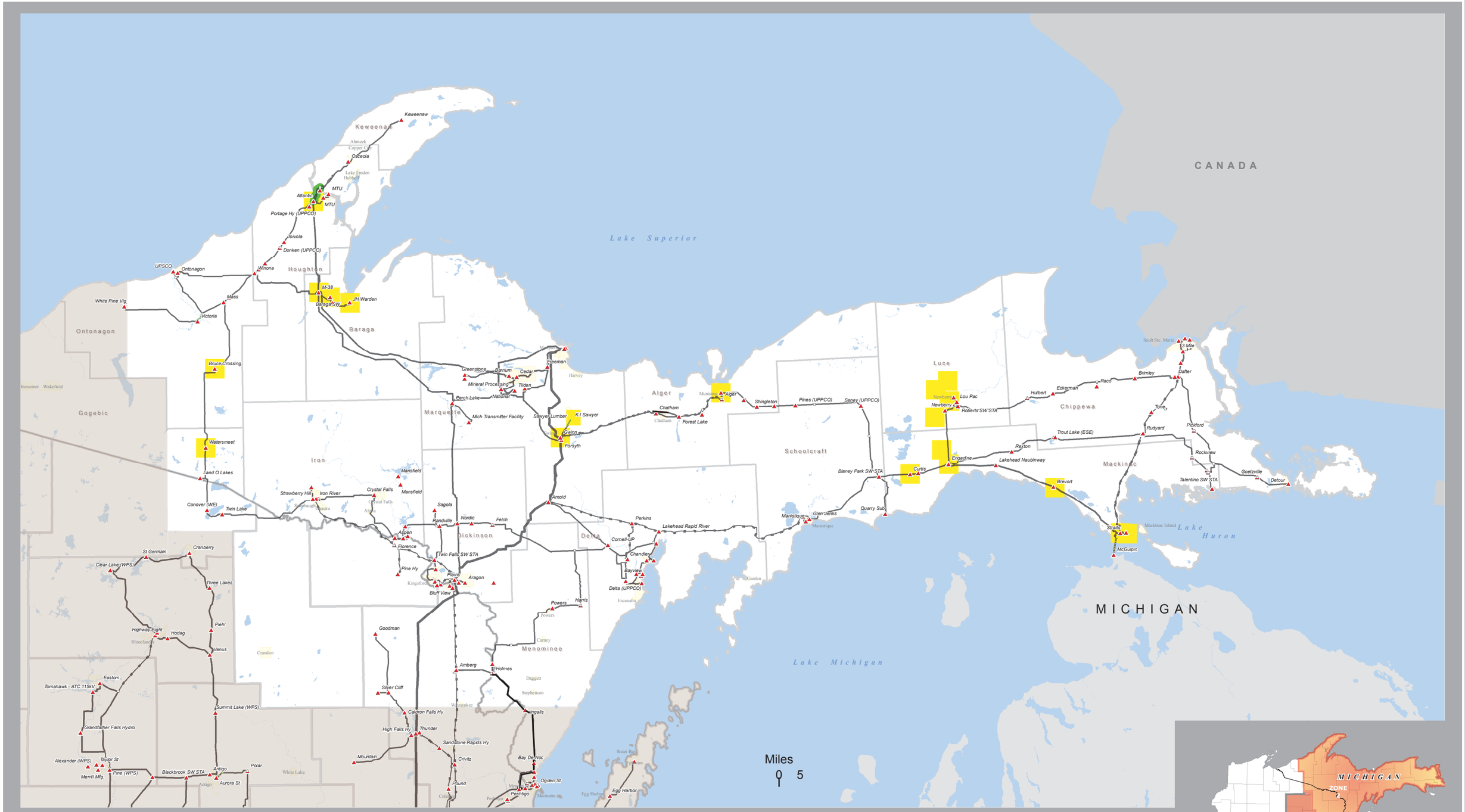
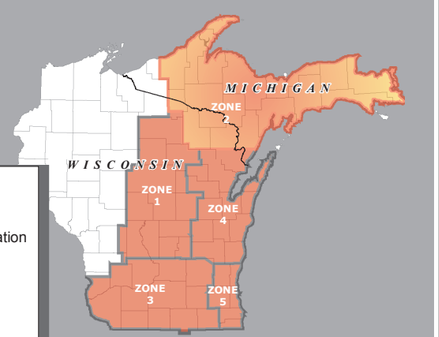
Low Voltages
Overloaded Facility
New Generation/Stability
Transmission Needed for Load Growth

Transmission Related Facilities

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





AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

Performance Criteria Limits Exceeded and Other Constraints 2006-2007

PLANNING ZONE 2

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

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

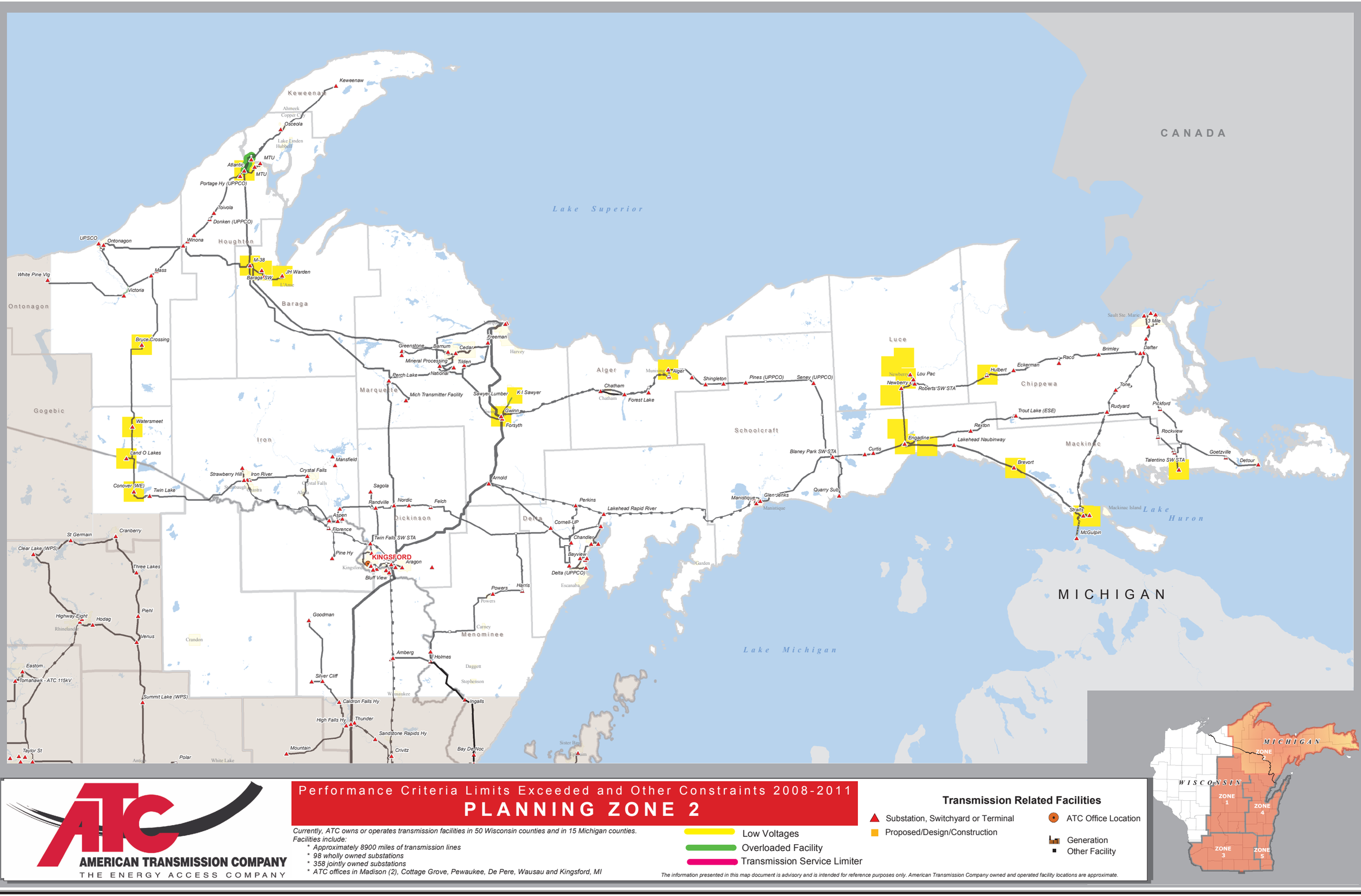
Low Voltages
Overloaded Facility
Transmission Service Limiter

Transmission Related Facilities

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

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

Figure ZS-5



AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

Performance Criteria Limits Exceeded and Other Constraints 2008-2011
PLANNING ZONE 2

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

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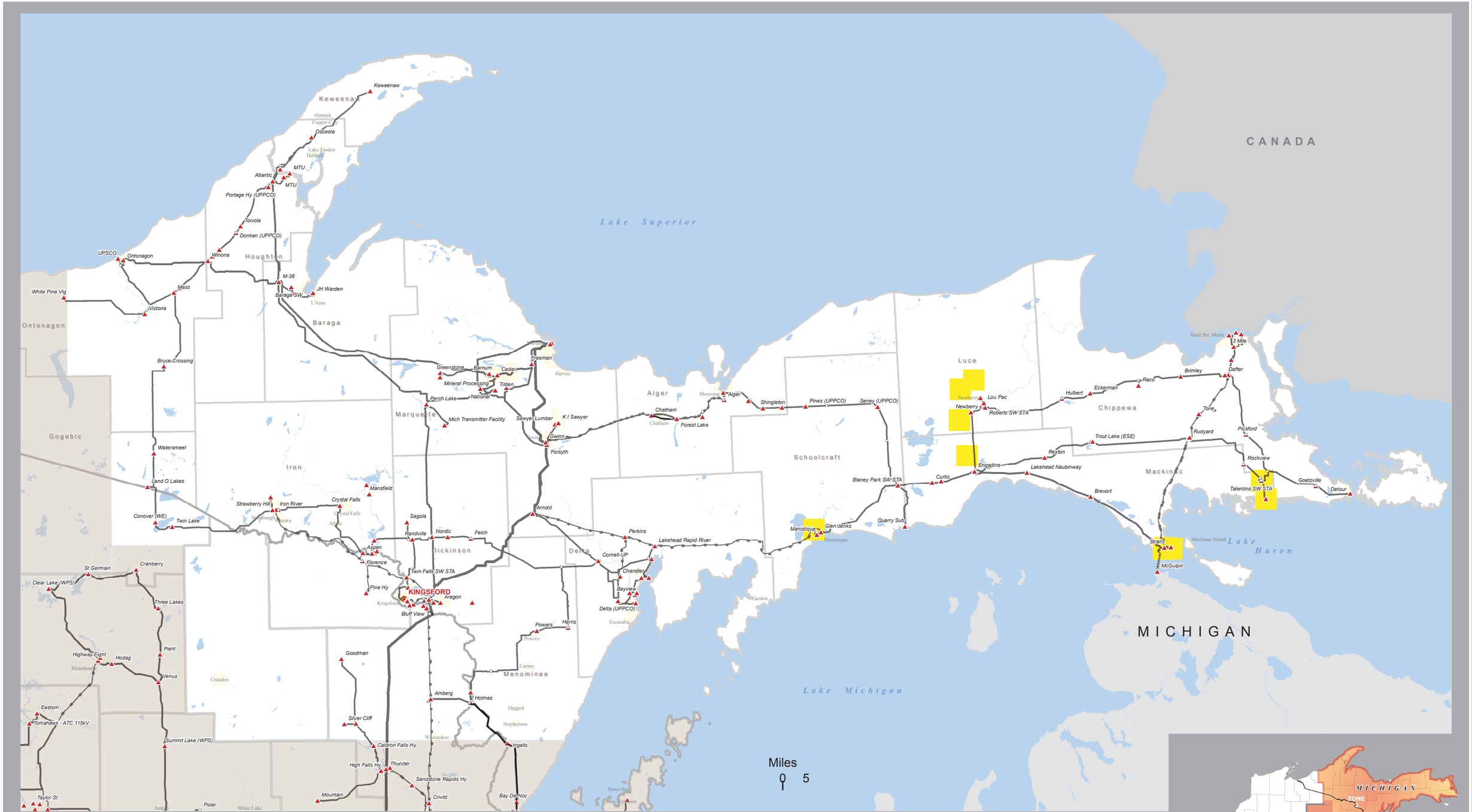
- *98 wholly owned substations*
- *358 jointly owned substations*
- *ATC offices in Madison (2), Cottage Grove, Pewaukee, De Pere, Wausau and Kingsford, MI*

Low Voltages
Overloaded Facility
Transmission Service Limiter

Transmission Related Facilities

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

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



AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

Performance Criteria Limits Exceeded and Other Constraints 2012-2015

PLANNING ZONE 2

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

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

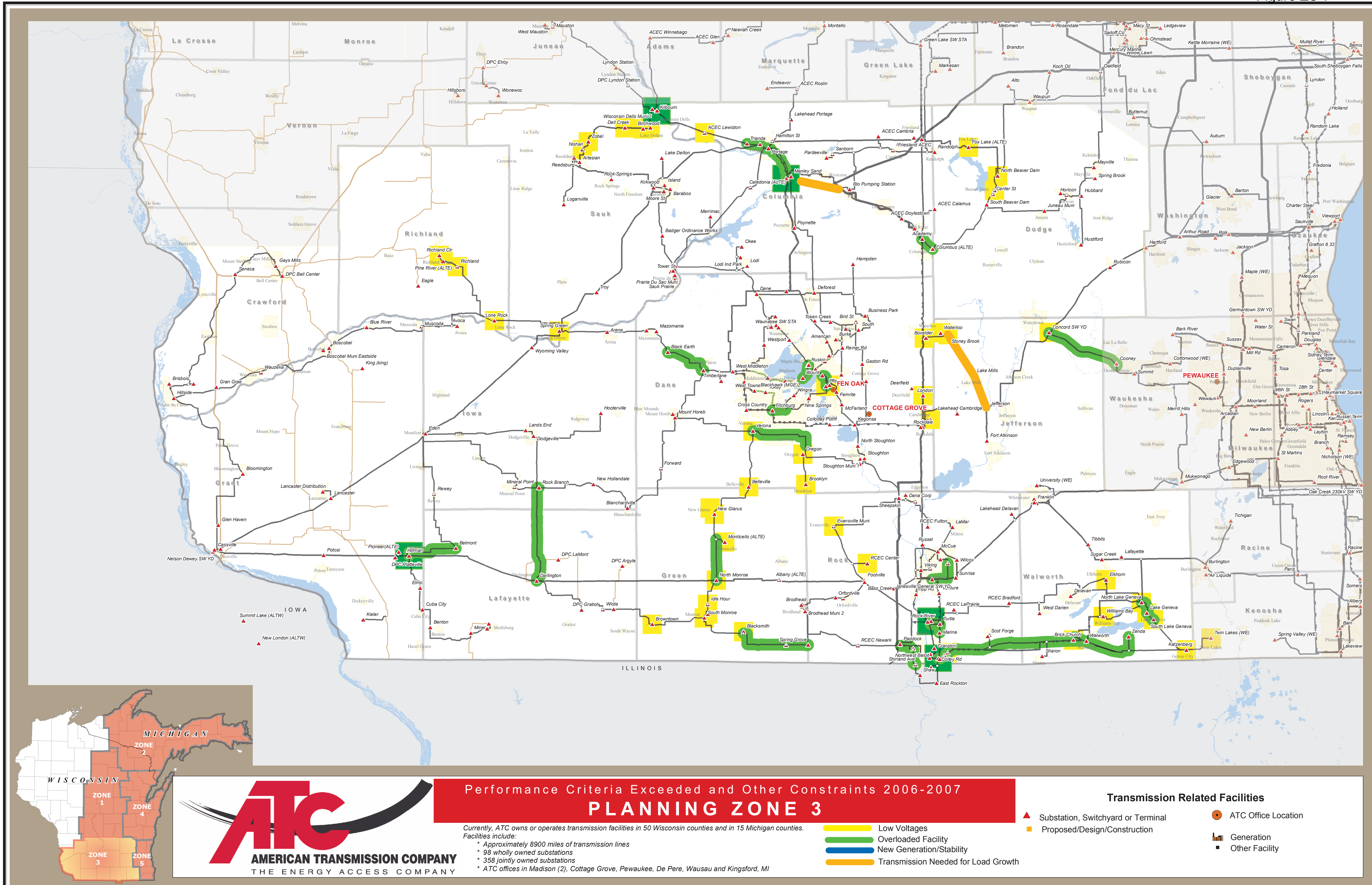
Low Voltages
Overloaded Facility
Transmission Service Limiter

Transmission Related Facilities

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

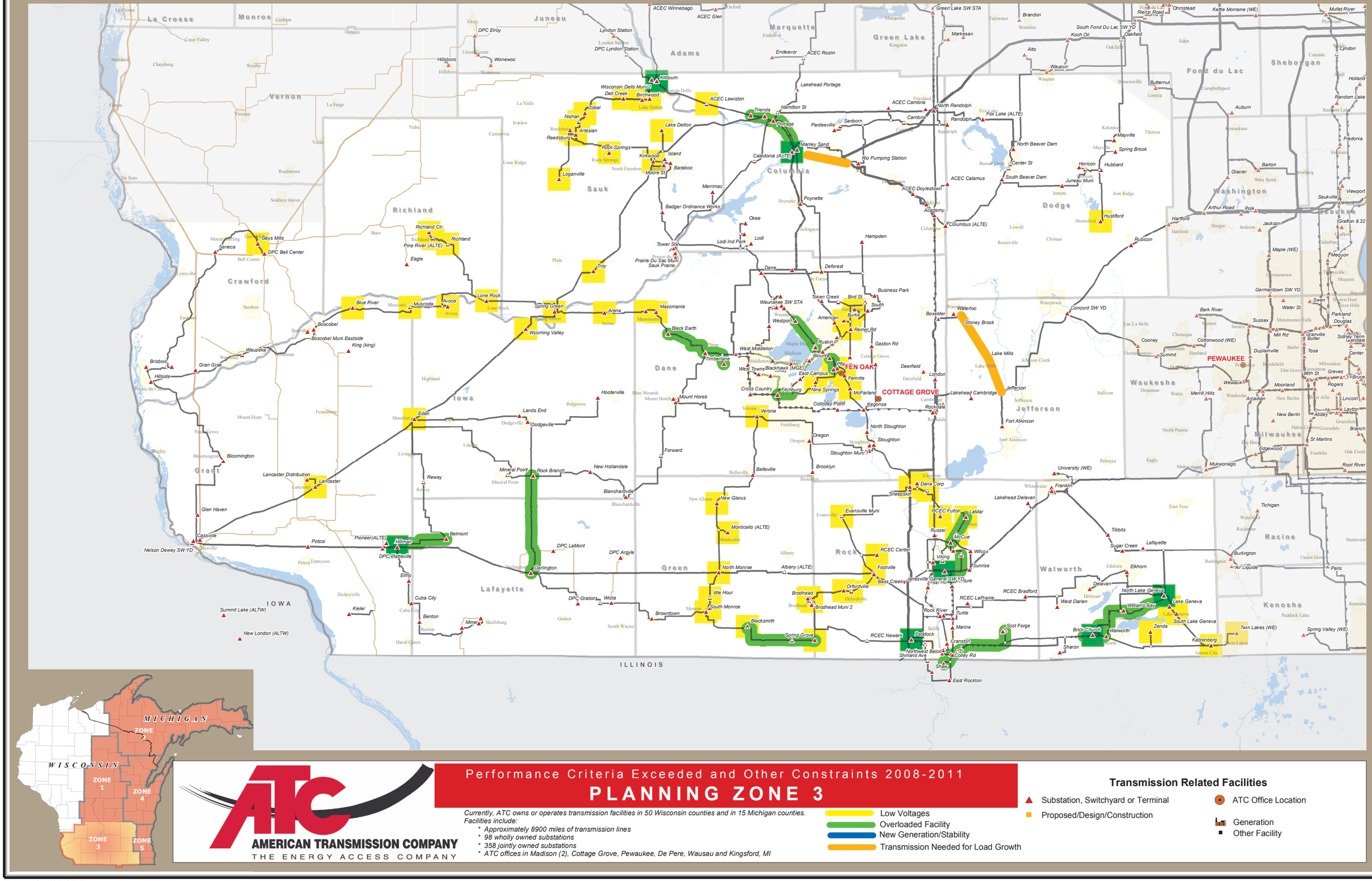
The information presented in this map document is advisory and is intended for reference purposes only. American Transmission Company owned and operated facility locations are approximate.

Figure ZS-7



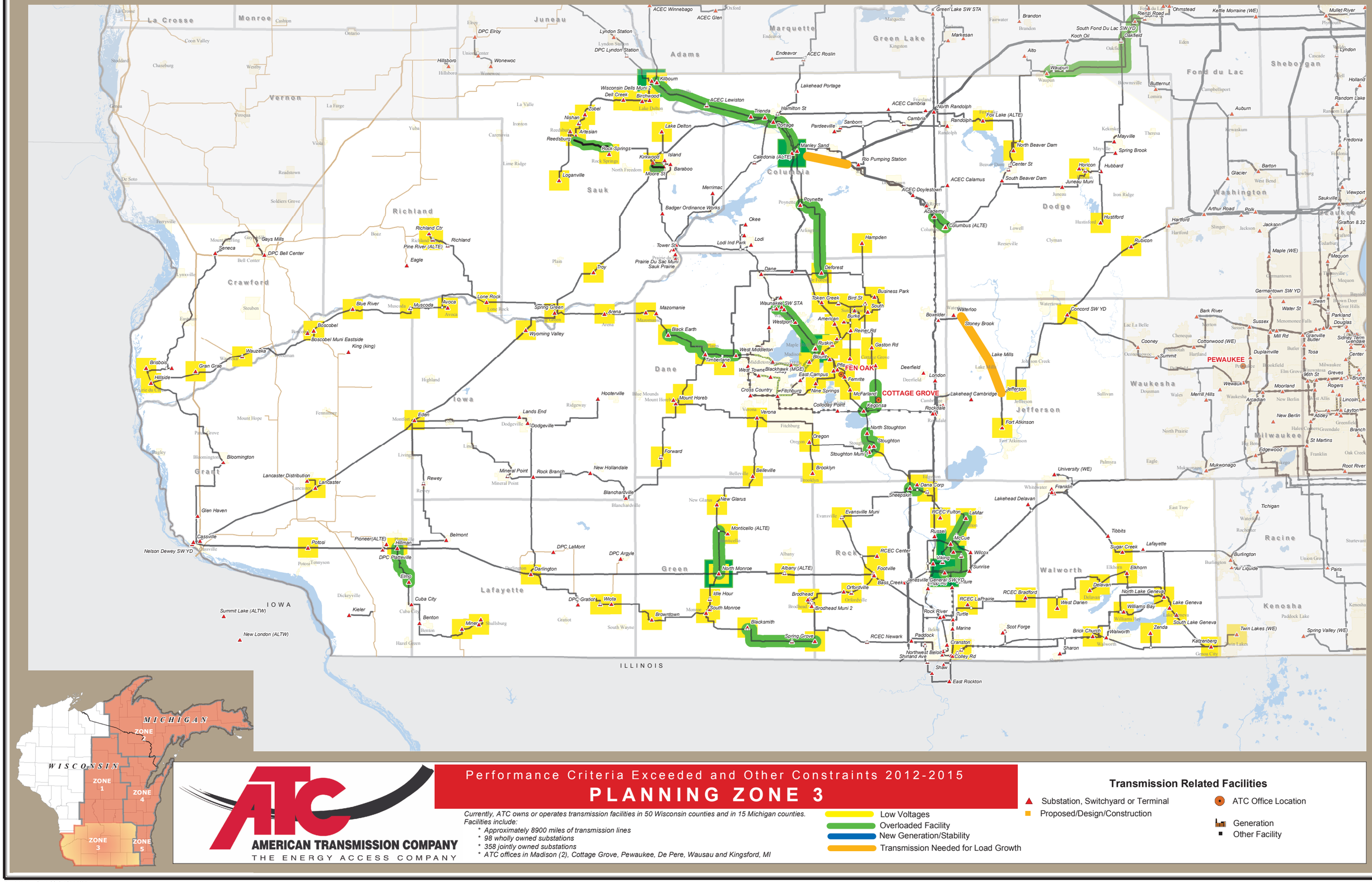
Performance Criteria Exceeded and Other Constraints 2006-2007
PLANNING ZONE 3
AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY
Currently, ATC owns or operates transmission facilities in 50 Wisconsin counties and in 15 Michigan counties.
Facilities include:
* Approximately 8900 miles of transmission lines
* 98 wholly owned substations
* 358 jointly owned substations
* ATC offices in Madison (2), Cottage Grove, Pewaukee, De Pere, Wausau and Kingsford, MI
Low Voltages
Overloaded Facility
New Generation/Stability
Transmission Needed for Load Growth
Transmission Related Facilities
Substation, Switchyard or Terminal
Proposed/Design/Construction
ATC Office Location
Generation
Other Facility
MICHIGAN
WISCONSIN
ZONE 1
ZONE 2
ZONE 3
ZONE 4
ZONE 5
IOWA
ILLINOIS
FEN OAK
COTTAGE GROVE
PEWAUKEE

Figure ZS-8



Zone3 11x17.mxd Modified: Jul 18, 2003

Figure ZS-9



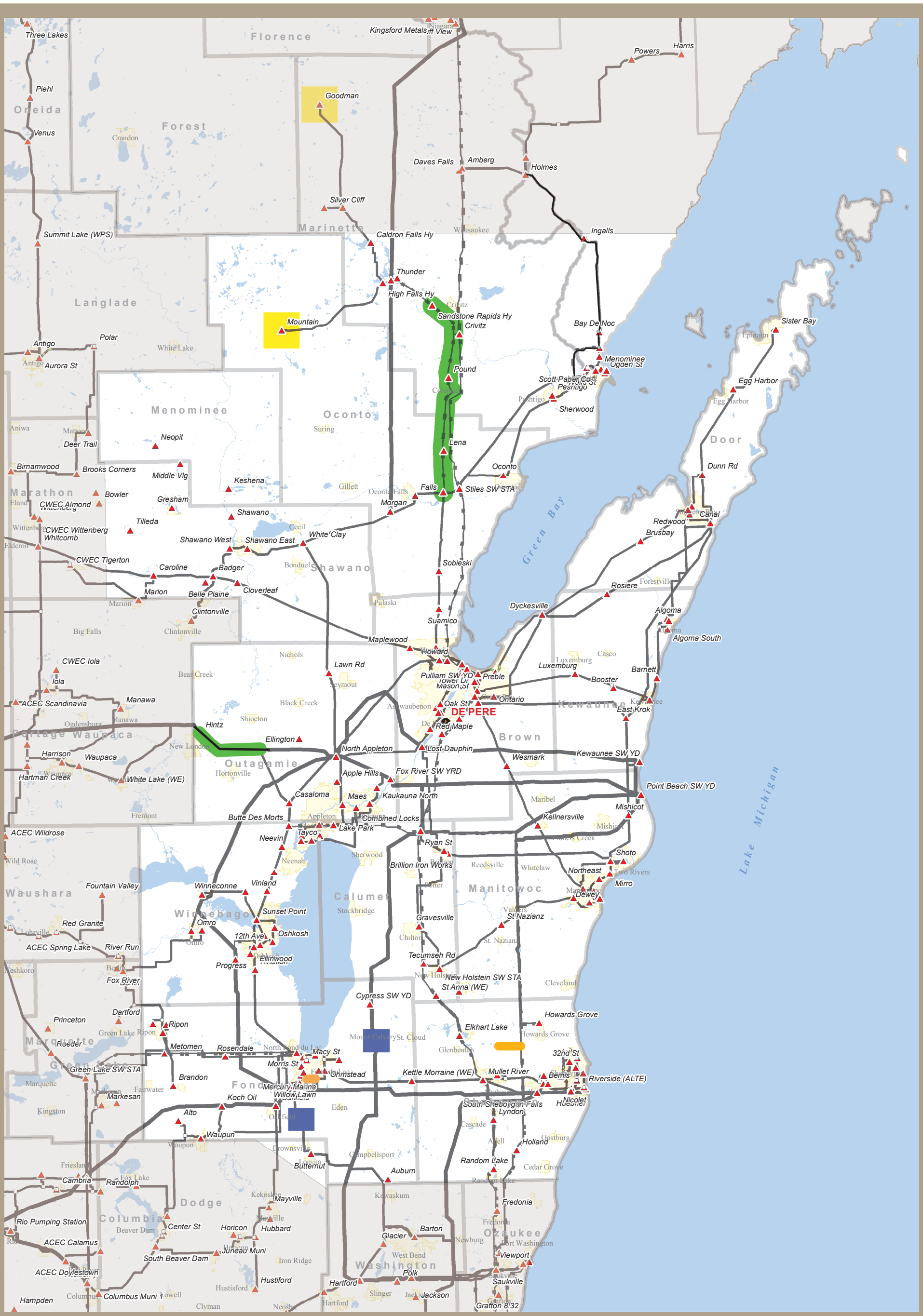
Performance Criteria Exceeded and Other Constraints 2012-2015

PLANNING ZONE 3

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

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

Zone3 11x17.mxd Modified: Jul 26, 2006



Performance Criteria Limits Exceeded and Other Constraints 2006-2007

PLANNING ZONE 4

AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

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

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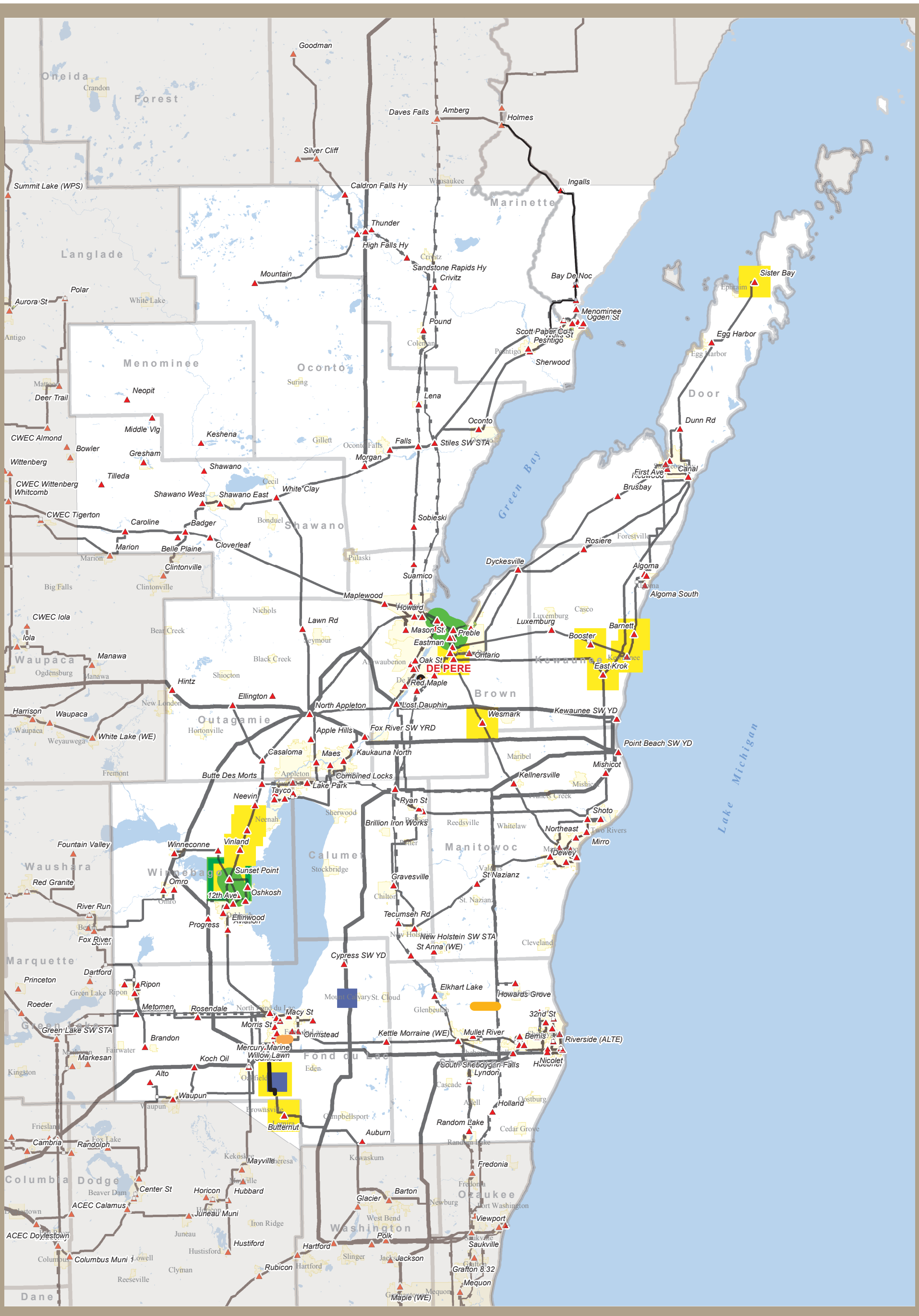
- *98 wholly owned substations*
- *358 jointly owned substations*
- *Offices in Madison (2), Cottage Grove, Pewaukee, De Pere Wausau and Kingsford, MI*

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

Transmission Related Facilities

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

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



Performance Criteria Limits Exceeded and Other Constraints 2012-2015

PLANNING ZONE 4

AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

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

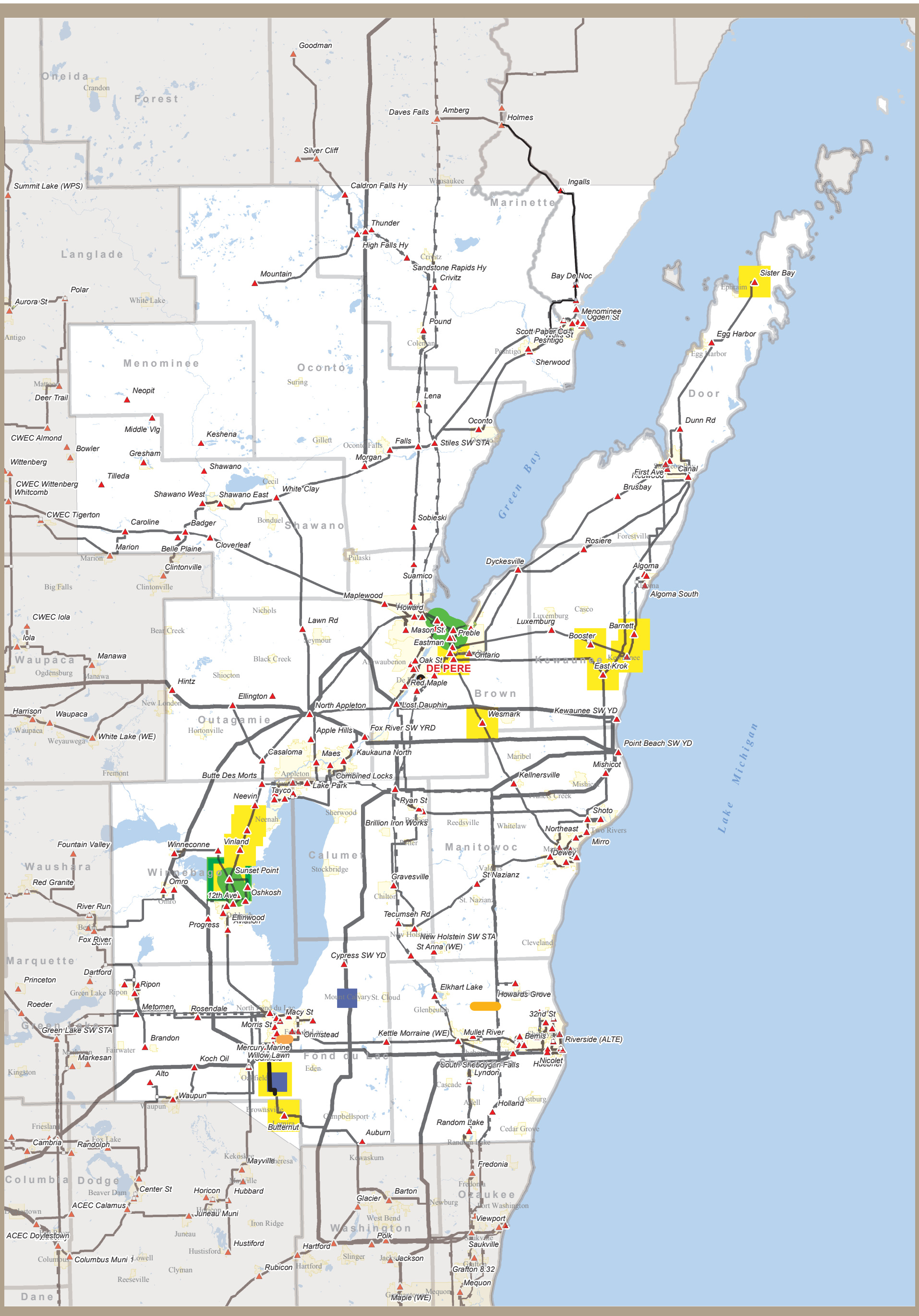
- *Approximately 8900 miles of transmission lines*
- *98 wholly owned substations*
- *358 jointly owned substations*
- *Offices in Madison (2), Cottage Grove, Pewaukee, De Pere Wausau and Kingsford, MI*

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

Transmission Related Facilities

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

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



AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

Performance Criteria Limits Exceeded and Other Constraints 2012-2015

PLANNING ZONE 4

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

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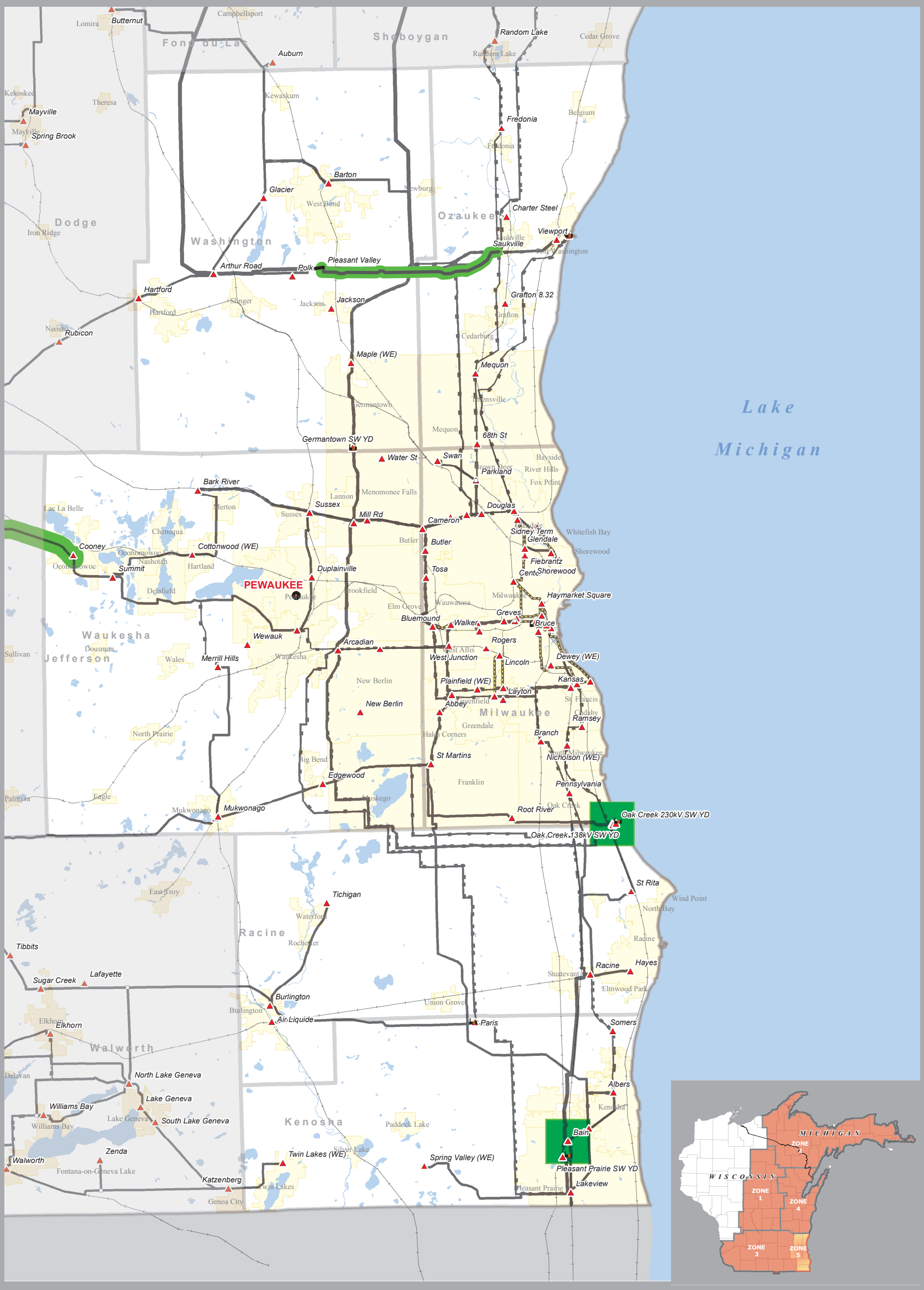
- *98 wholly owned substations*
- *358 jointly owned substations*
- *Offices in Madison (2), Cottage Grove, Pewaukee, De Pere Wausau and Kingsford, MI*

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

Transmission Related Facilities

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

Figure ZS-13



AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

Performance Criteria Limits Exceeded and Other Constraints 2006-2007

PLANNING ZONE 5

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

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- *358 jointly owned substations*
- *Offices in Madison (2), Cottage Grove, Pewaukee, De Pere Wausau and Kingsford, MI*

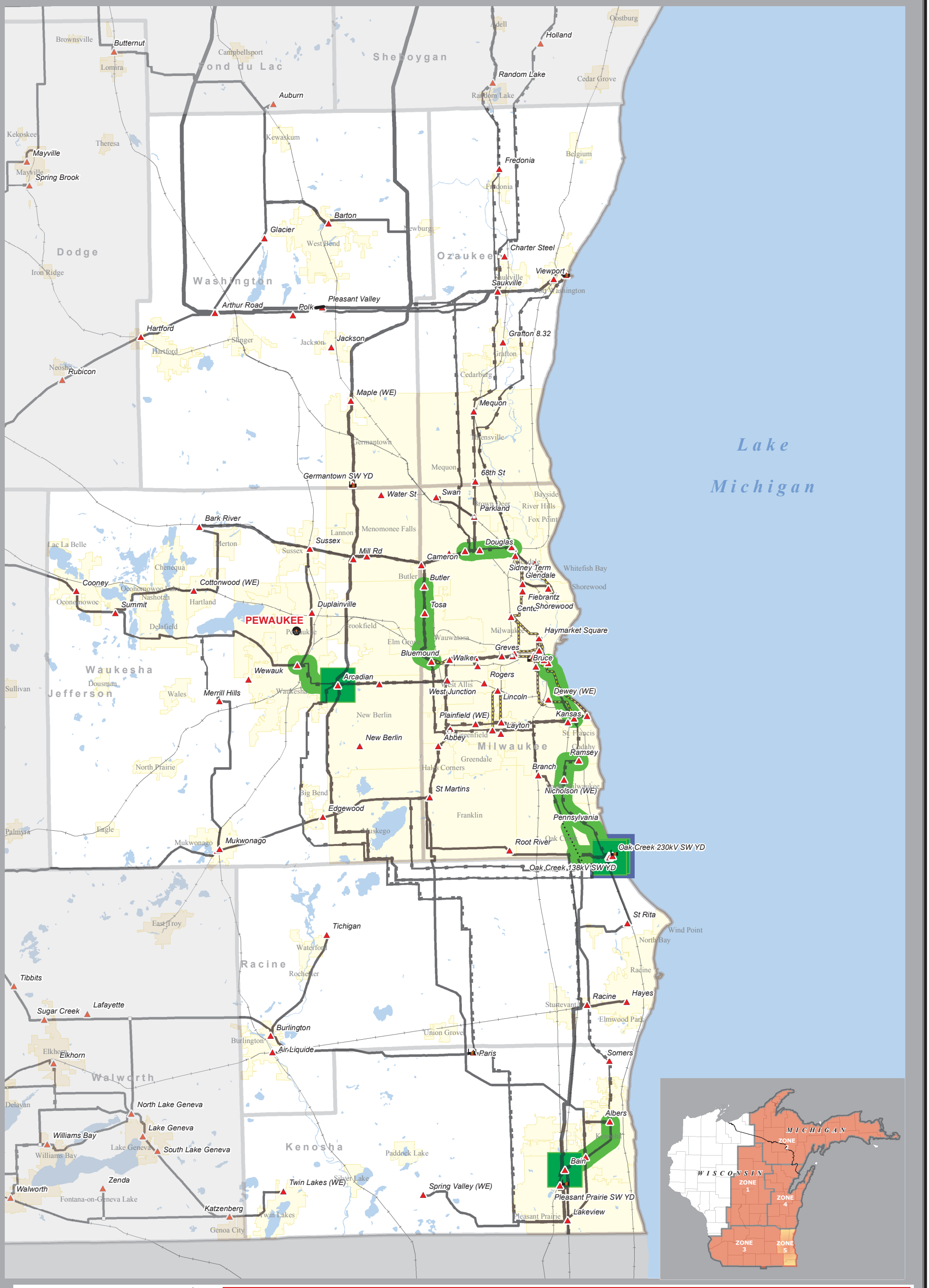
- Low Voltages
- Overloaded Facility
- New Generation/Stability
- Transmission Needed for Load Growth
- Transmission Service Limiter

Transmission Related Facilities

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

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

Figure ZS-14



AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

Performance Criteria Limits Exceeded and Other Constraints 2008-2011

PLANNING ZONE 5

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

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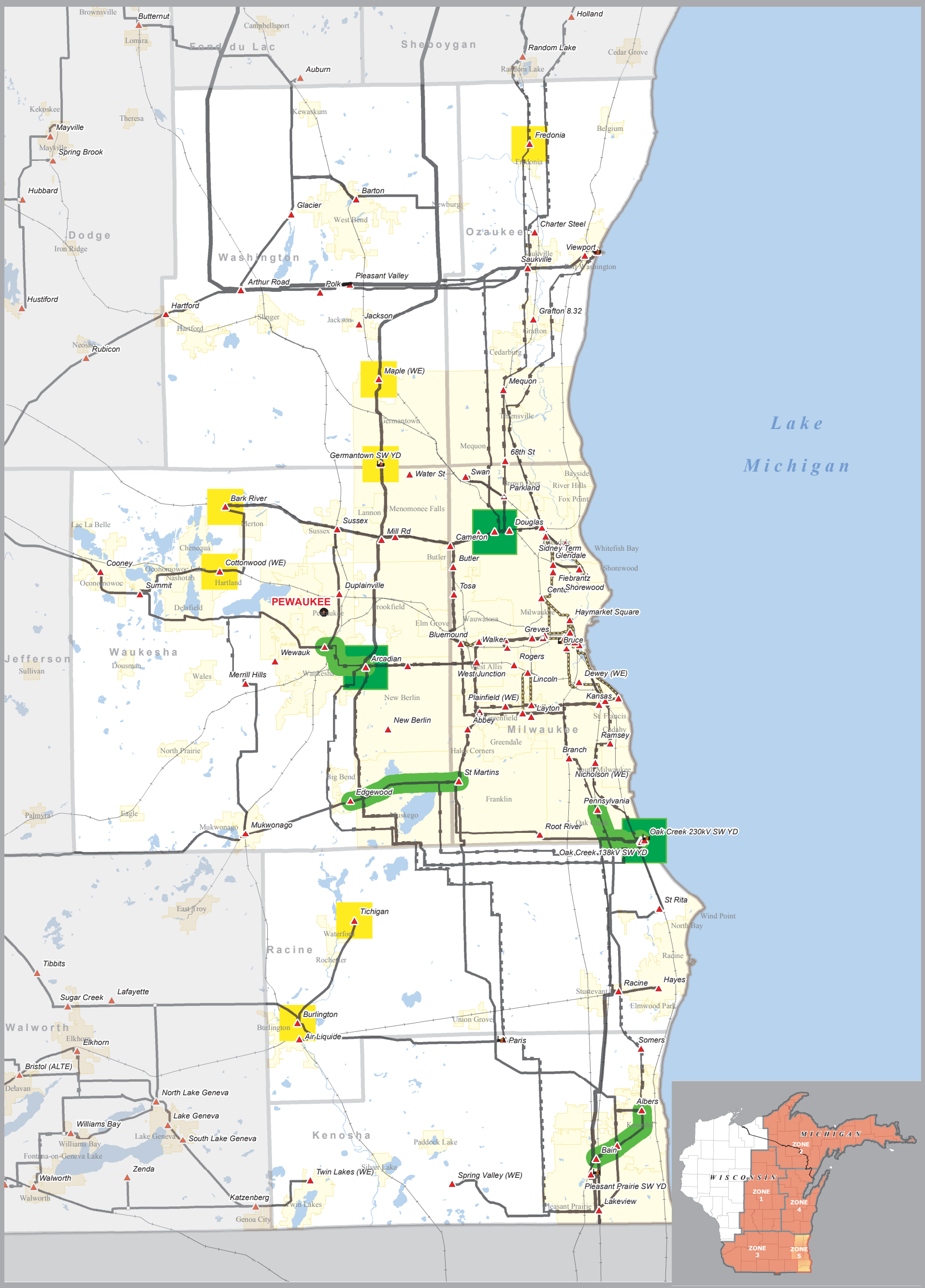
- Low Voltages
- Overloaded Facility
- New Generation/Stability
- Transmission Needed for Load Growth
- Transmission Service Limiter

Transmission Related Facilities

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

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



AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

Performance Criteria Limits Exceeded and Other Constraints 2012-2015

PLANNING ZONE 5

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

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- *98 wholly owned substations*
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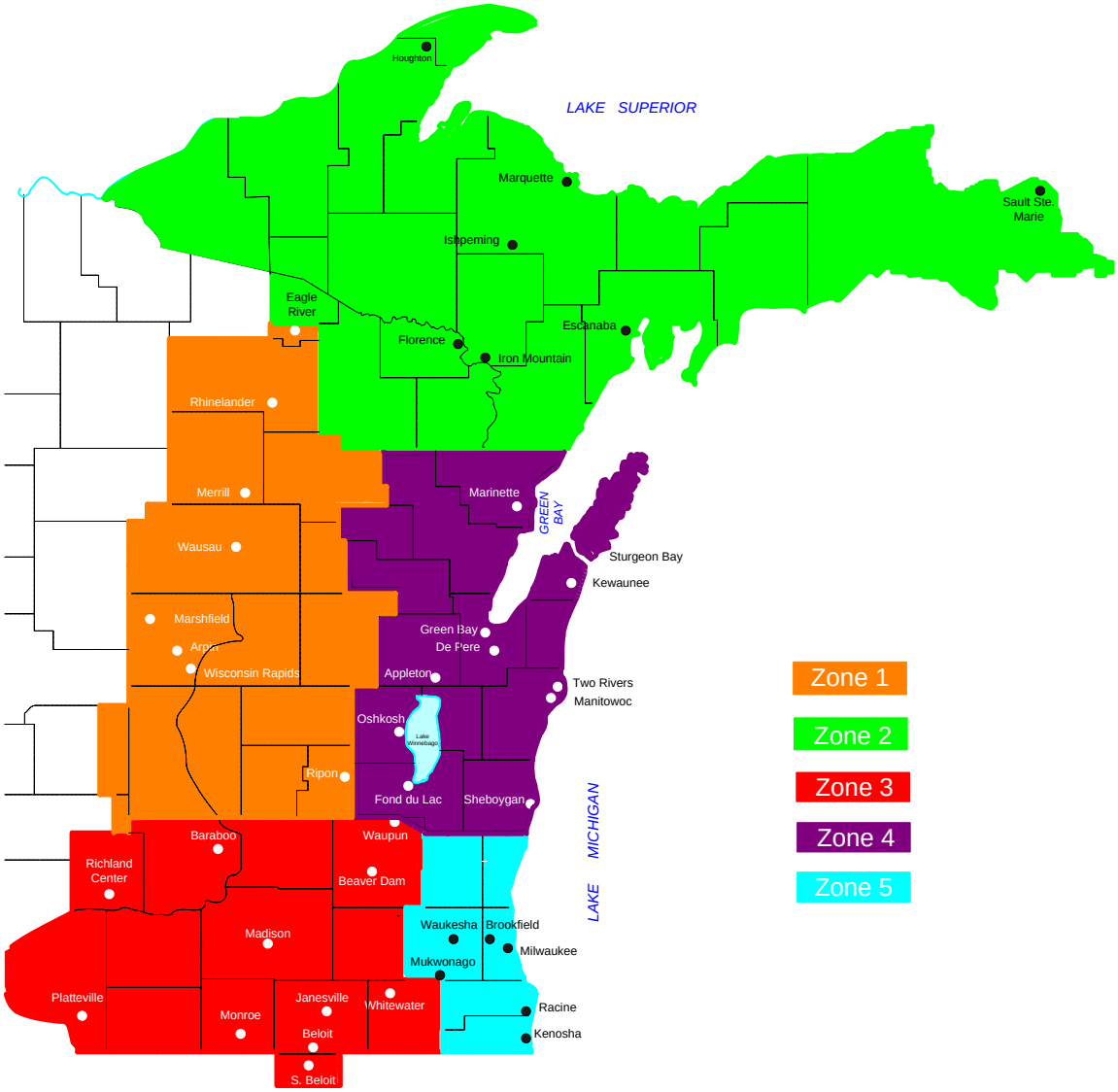
- Low Voltages
- Overloaded Facility
- New Generation/Stability
- Transmission Needed for Load Growth
- Transmission Service Limiter

Transmission Related Facilities

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

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

Figure ZS-16


LAKE SUPERIOR
Houghton
Marquette
Sault Ste. Marie
Ishpeming
Eagle River
Florence
Escanaba
Iron Mountain
Rhinelander
Merrill
Marinette
GREEN BAY
Wausau
Sturgeon Bay
Kewaunee
Marshfield
Green Bay
De Pere
Appleton
Wisconsin Rapids
Two Rivers
Manitowoc
Oshkosh
Lake Winnebago
Ripon
Fond du Lac
Sheboygan
LAKE MICHIGAN
Baraboo
Waupun
Richland Center
Beaver Dam
Waukesha
Brookfield
Madison
Milwaukee
Mukwonago
Platteville
Janesville
Whitewater
Racine
Monroe
Beloit
Kenosha
S. Beloit
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5