ZONE & STUDY RESULTS > Zone 5 overview

Zone 5 includes the Wisconsin counties of:

- Kenosha
- Milwaukee
- Ozaukee
- Racine
- Washington
- Waukesha

The physical boundaries of Zone 5 and transmission facilities located in Zone 5 are shown in Figure ZS-22.

Zone 5 encompasses southeast Wisconsin.

Land use in Zone 5 is largely urban, though some agricultural uses exist.

The major population center in Zone 5 is the metropolitan Milwaukee area.

Zone 5 typically experiences peak demands during the summer months. Large industrial loads in the Milwaukee metropolitan area (such as Charter Steel, Miller Brewing) are among the largest electricity users in the zone.

Zone 5 demographics

The population of the counties in Zone 5 grew at an annual rate of 0.4 percent from 1994 to 2004. The highest growth rate occurred in Washington County (more than 1.6 percent), while the largest increase in population occurred in Waukesha County, which increased by almost 50,000 people.

During the same period, the employment growth rate was 0.9 percent. The highest growth rate and the highest increase in employment occurred in Waukesha County.

Zone 5 future population and employment projections

Population in Zone 5 is projected to grow at 0.6 percent annually between 2000 and 2005 and at 0.5 percent from 2005 through 2010. Milwaukee County is projected to realize the largest increase in population, while Kenosha County is projected to have the highest growth rate.

Employment in Zone 5 is projected to grow at 0.2 percent annually between 2000 and 2005 and at 1.0 percent from 2005 through 2010. Waukesha County is projected to realize the largest increase in employment and to have the highest growth rate.

Zone 5 environmental considerations

Zone 5 encompasses the southeastern portion of the state and is the most densely populated of the zones. The area lies in the Southern Lake Michigan Coastal and Southeast Glacial Plains ecological landscape regions. Most of the zone lies in the drainage basins of the Milwaukee, Root or Fox rivers. The Kettle Moraine State Forest lies in the western portions of the zone, and Lake Michigan forms its eastern boundary. Pre-settlement vegetation varied from prairie and oak savanna in the south to southern mesic forest in the northern portions of the zone. Agricultural land uses are common throughout this zone.

Zone 5 electricity demand and generation

The coincident peak load forecasts for Zone 5 for 2006, 2010 and 2014 are shown in Table ZS-14. Existing generation, along with proposed generation based on projected in-service year, also are shown. The resultant capacity margins, with or without the proposed generation, are shown as well.

The table shows that load is projected to grow at roughly 1.6 percent annually from 2006 through 2014. Comparing load with generation (at maximum output) within the zone indicates that Zone 5 has less generation than load during peak load periods.

Zone 5 transmission system issues

Key transmission facilities in Zone 5 include:

- the southern portion of 345-kV lines from Point Beach and Edgewater,
- the Saukville, Arcadian, Granville and Racine 345/138-kV substations,
- the transmission lines emanating from the Pleasant Prairie and Oak Creek power plants and
- a significant 138-kV network in the Milwaukee area, a portion of which is underground.

Key system performance issues in Zone 5 include:

- heavy flows on aging facilities,
- new generation projects are being planned that likely will influence load-serving needs in the zone,
- heavy flows from the west (Zone 3) resulting in heavily loaded 138-kV facilities in the western portion of Zone 5,
- sagging voltage profile in portions of Washington, Waukesha and Jefferson counties and
- stability of existing and proposed generation in the southeast portion of Zone 5.

In addition, the Wisconsin Department of Transportation is reconstructing the Marquette Interchange in downtown Milwaukee and portions of the interstate system near the Marquette Interchange. This may require modification or relocation of some of our transmission facilities in the area including:

- a portion of Everett - 28th Street underground 138-kV circuit will need to be relocated in 2005.
- the Valley-Harbor and Valley-Dewey underground 138-kV circuits may need to be relocated in 2005 or 2006.
- the 138-kV switchyard at the Valley Power Plant will require various equipment modifications and a more extensive maintenance program.

Table PR-17
Transmission System Additions for Zone 5

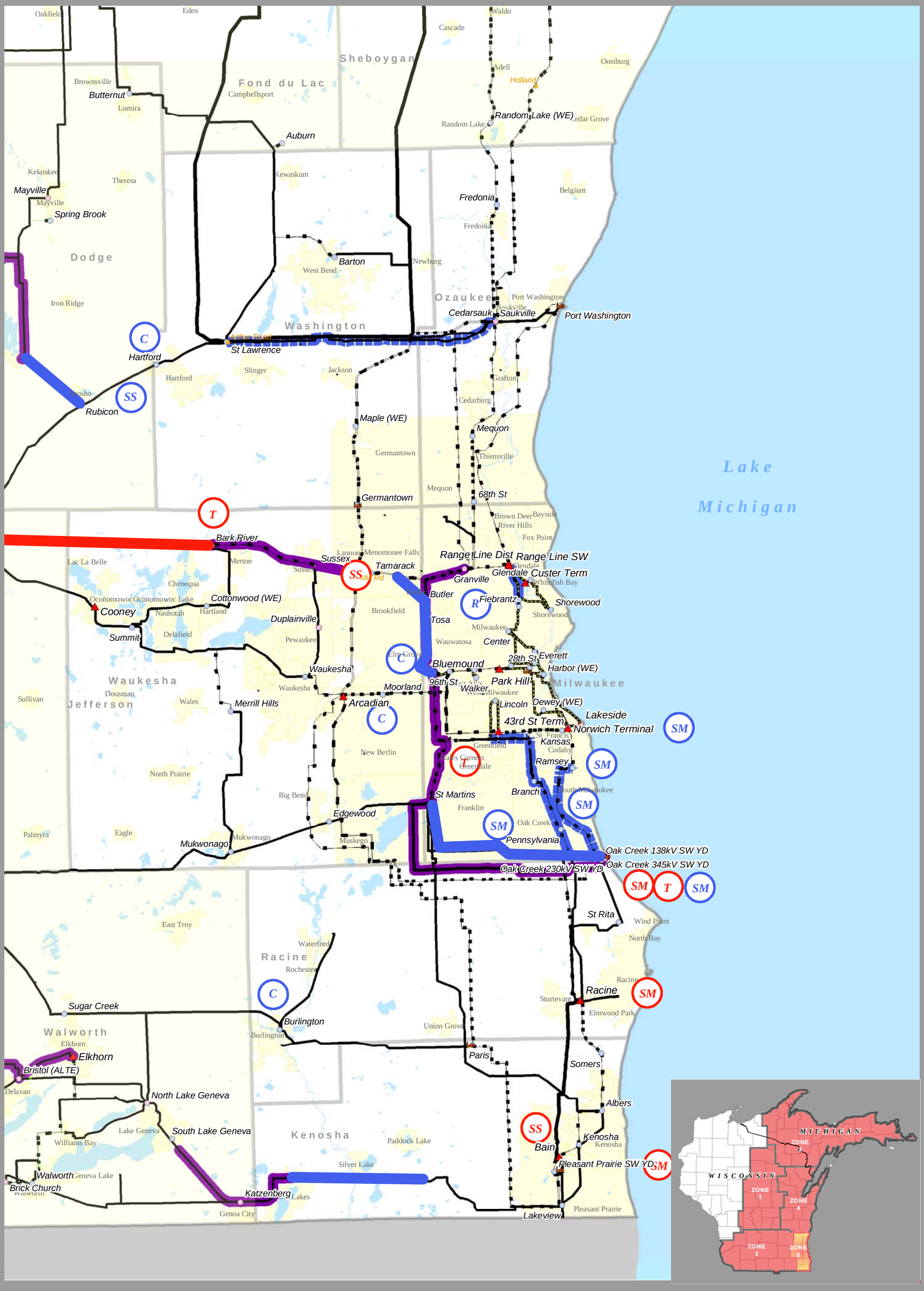
System additions	System need year	Projected in-service year	Planning zone	Need category	Planned, Proposed or Provisional
Install 2-27 MVAR capacitor banks at Moorland 138 kV	2004	2005	5	reliability	Planned
Install 2-27 MVAR capacitor banks at Burlington 138 kV	2005	2006	5	reliability	Proposed
Install series reactor at Cornell	2007	2007	5	reliability	Proposed
Construct a 345-kV bus at Bain	2005	2007	5	reliability	Provisional
Install 200 MVAR capacitor bank at Bluemound	2007	2007	5	reliability	Provisional
Construct a new Mill Road Substation at intersection of Granville-Arcadian 345-kV, Forest Junction-Arcadian 345-kV, Sussex-Tamarack 138-kV and Sussex-Germantown 138-kV lines; install a 345/138-kV, 500 MVA transformer	2007	2008	5	reliability	Proposed
Reconductor Pleasant Valley-Saukville 138-kV line	2008	2008	5	new generation	Proposed
Reconductor Pleasant Valley-St. Lawrence 138-kV line	2008	2008	5	new generation	Proposed
Reconductor Cornell-Range Line 138-kV line	2008	2008	5	new generation	Proposed
Reconductor Oak Creek-Ramsey 138-kV line	2009	2009	5	new generation	Proposed
Reconductor Oak Creek-Allerton 138-kV line	2009	2009	5	new generation	Proposed
Replace relaying on 230-kV circuits at Oak Creek	2009	2009	5	new generation	Proposed
Replace two 345-kV circuit breakers at Pleasant Prairie on the Racine and Zion lines with IPO breakers and upgrade relaying	2009	2009	5	new generation	Proposed
Expand Oak Creek 345-kV switchyard to interconnect one new generator	2009	2009	5	new generation	Proposed

Table PR-17
Transmission System Additions for Zone 5 (continued)

System additions	System need year	Projected in-service year	Planning zone	Need category	Planned, Proposed or Provisional
Loop Ramsey5-Harbor 138-kV line into Norwich and Kansas to form a new line from Ramsey-Norwich and Harbor-Kansas 138-kV lines	2009	2009	5	new generation	Provisional
Construct Rockdale-Concord 345-kV line in parallel with existing 138 kV on existing double-width right-of-way	2009	2009	3 & 5	reliability, service limitation	Proposed
Construct a 345-kV bus and install a 345/138-kV, 500 MVA transformer at Concord	2009	2009	3 & 5	reliability	Proposed
Uprate Kansas-Ramsey6 138-kV line	2010	2010	5	new generation	Proposed
Install second 500 MVA 345/138-kV transformer at Oak Creek	2010	2010	5	new generation	Proposed
Expand 345-kV switchyard at Oak Creek to interconnect one new generator	2010	2010	5	new generation	Proposed
Uprate Oak Creek-Root River 138-kV line	2010	2010	5	new generation	Proposed
Uprate Oak Creek-Nicholson 138-kV line	2010	2010	5	new generation	Proposed
Convert Bark River-Mill Road 138-kV line to 345 kV	2010	2010	3 & 5	reliability, new generation	Proposed
Construct a Concord-Bark River 345-kV line	2010	2010	3 & 5	reliability, new generation	Proposed
Construct a 345-kV bus and install a 345/138-kV, 500 MVA transformer at Bark River	2010	2010	3 & 5	reliability, new generation	Proposed
Expand Oak Creek 345-kV switchyard to interconnect three new generators plus one new 345-kV line and 138-kV switchyard to accommodate new St. Martins line	2013	2013	5	new generation	Provisional
Construct a 345/138-kV switchyard at Hale (Brookdale) to accommodate two 345-kV lines, a 500 MVA 345/138-kV transformer and 4-138-kV lines plus two 138/26.2 kV transformers	2013	2013	5	new generation	Provisional

Table PR-17
Transmission System Additions for Zone 5 (continued)

System additions	System need year	Projected in-service year	Planning zone	Need category	Planned, Proposed or Provisional
Install two 345-kV line terminations at Pleasant Prairie and loop Zion-Arcadian 345-kV line into Pleasant Prairie Substation	2013	2013	5	new generation	Provisional
Construct an Oak Creek-Hale (Brookdale) 345-kV line installing 4 mi. new structures, converting 16.2 mi. of non-operative 230 kV and 5 mi. 138 kV	2013	2013	5	new generation	Provisional
Construct Oak Creek-St. Martins 138-kV circuit #2 installing 16.6 mi. conductor on existing towers	2013	2013	5	new generation	Provisional
Construct a Hale (Brookdale)-Granville 345-kV line converting/reconductoring 5.6 mi. 138 kV, rebuilding 7 mi. 138-kV double-circuit tower line and converting/reconductoring 3 mi. 138 kV on existing 345-kV structures	2013	2013	5	new generation	Provisional
Restring Bluemound-Butler 138-kV line (KK5051) on new 345-kV structures installed with Hale (Brookdale)-Granville line	2013	2013	5	new generation	Provisional
String Butler-Tamarack (Carmen) 138-kV line on new 345-kV structures installed with Hale (Brookdale)-Granville line	2013	2013	5	new generation	Provisional
Replace CTs at Racine 345-kV Substation	2013	2013	5	new generation	Provisional



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

PLANNING ZONE 5

- SS — New Substation
- SM — Substation Modifications
- T — Transformer
- C — Capacitor Bank
- T-D — New T-D Interconnection
- R — Series Reactor

- 345 kV Transmission Line
- 115 or 138 kV Transmission Line
- Rebuilt 115 or 138 kV Transmission Line
- Transmission Line Voltage Conversion

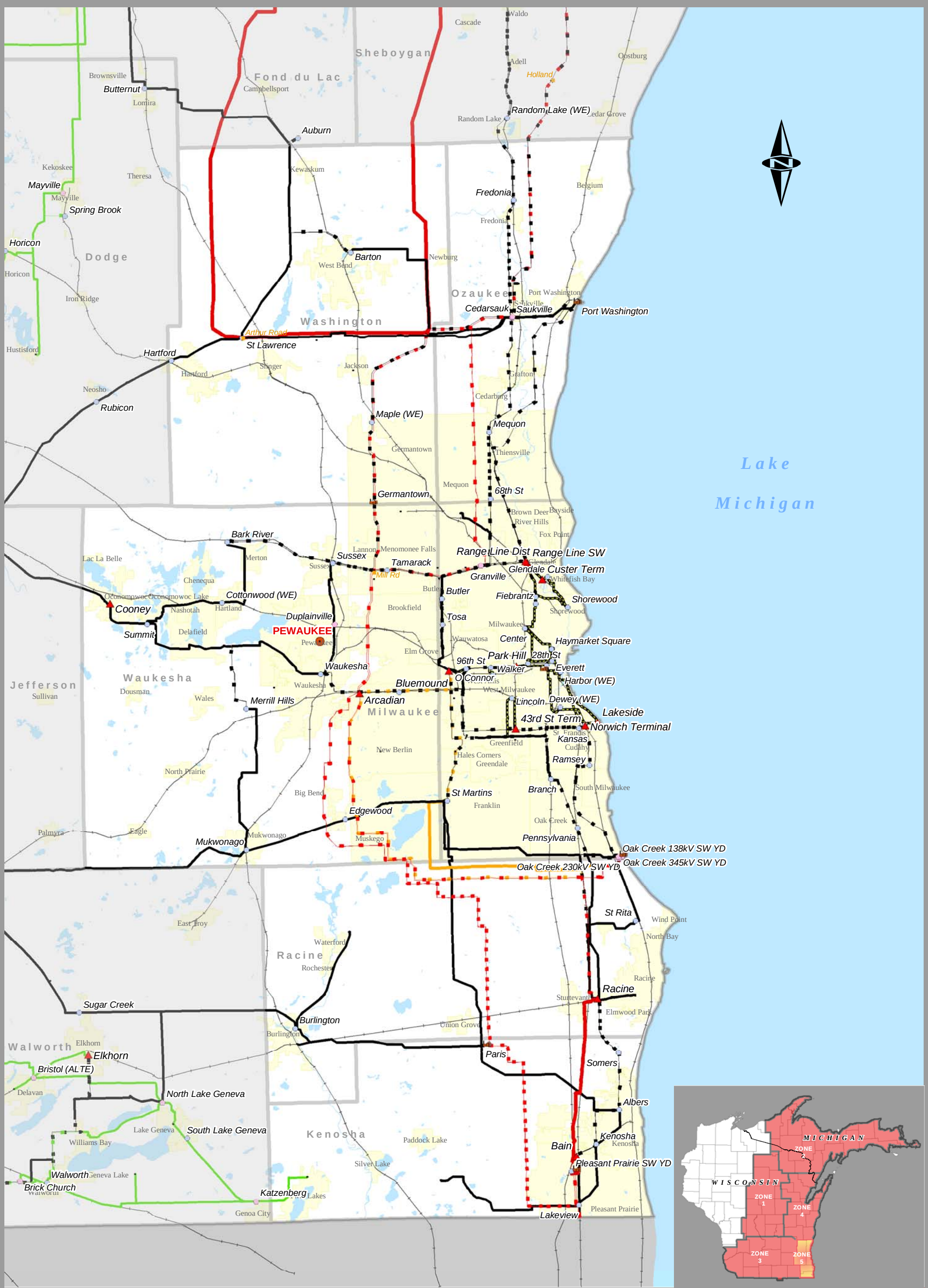
Transmission Related Facilities

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

Table ZS-14
Forecast of Peak Load and Generation in Zone 5

	2006	2010	2014
Peak Forecast (megawatts)	4728.3	5120.5	5341.2
Average Peak Load Growth	N/A	2.01%	1.06%
Existing Generation Capacity (megawatts)	3986.8	3986.8	3986.8
Existing Capacity Less Load	-741.5	-1133.7	-1354.4
Existing Generation Capacity plus Modeled Generating Capacity Additions (megawatts)	3986.8	5841.3	6491.3
Modeled Capacity Less Load (megawatts)	-741.5	720.8	1150.1

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



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Electric Transmission Network and Substations

PLANNING ZONE 5

0 5 10 Miles

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*

Transmission Line Voltage

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

Transmission Related Facilities

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

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.

Zone5 11x17.mxd Modified: January 14, 2005

ZONE & STUDY RESULTS > Zone 5 – 2006 study results

Refer to Table ZS-1 and Figure ZS-13

Summary of key findings

- Many of the line loading and low voltage issues in Zone 5 are a result of opening substation bus ties.
- Continued load growth in Waukesha, Washington and Jefferson counties is driving the need for voltage support.

Prior to the summer of 2005, three transmission lines in Zone 5 were uprated. The line conductor clearances on the Mukwonago-Merrill Hills 138-kV line were increased to permit operation at 167 degrees.

The Paris-St. Martins 138-kV line was rebuilt with T2 Hawk conductor to deal with line condition and the increased generator output at Paris.

The Paris-Albers 138-kV line had conductor clearances increased to permit operation at 285 degrees to accommodate increased generator output at Paris.

Two-27 MVAR capacitor banks will be installed at the Moorland 138-kV Substation before the end of July 2005. A similar installation is expected at Burlington 138-kV Substation before the summer of 2006.

A new 138-kV line was completed in July 2005. We Energies built a new distribution substation at Duplainville to serve load. The new 138-kV line runs from Waukesha to Duplainville to Sussex. In addition to serving load at Duplainville, the line provides voltage support in the Sussex area.

Two of the facility overloads found in the 2006 analysis were caused by bus-tie circuit breaker operations.

- Splitting the Pleasant Prairie 345-kV bus between bus sections three and four results in Pleasant Prairie generator #2 being isolated on the Bain 345/138-kV transformer #5. The transformer has a long-term emergency rating of 482 MVA. The occurrence of this contingency will require Pleasant Prairie generator #2 to reduce its output significantly to avoid overloading and damaging the transformer. Construction of a 345-kV bus at Bain is being considered to provide relief should this contingency occur.
- The Saukville-Pleasant Valley 138-kV line overloads by 12.4 percent when the Concord 138-kV bus is split between bus sections five and six. While a bus outage is a low probability event, the Saukville-Pleasant Valley-St. Lawrence 138-kV line still needs to be upgraded prior to 2008 to accommodate the second 600-MW block of generation at Port Washington. The condition of the St.

Lawrence-Pleasant Valley-Saukville 138-kV line warrants replacement of the structures as well as the conductor.

Low voltages were identified at Bluemound under contingency conditions. Capacitor installations at Bluemound and other greater Milwaukee area substations are being evaluated.

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

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

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

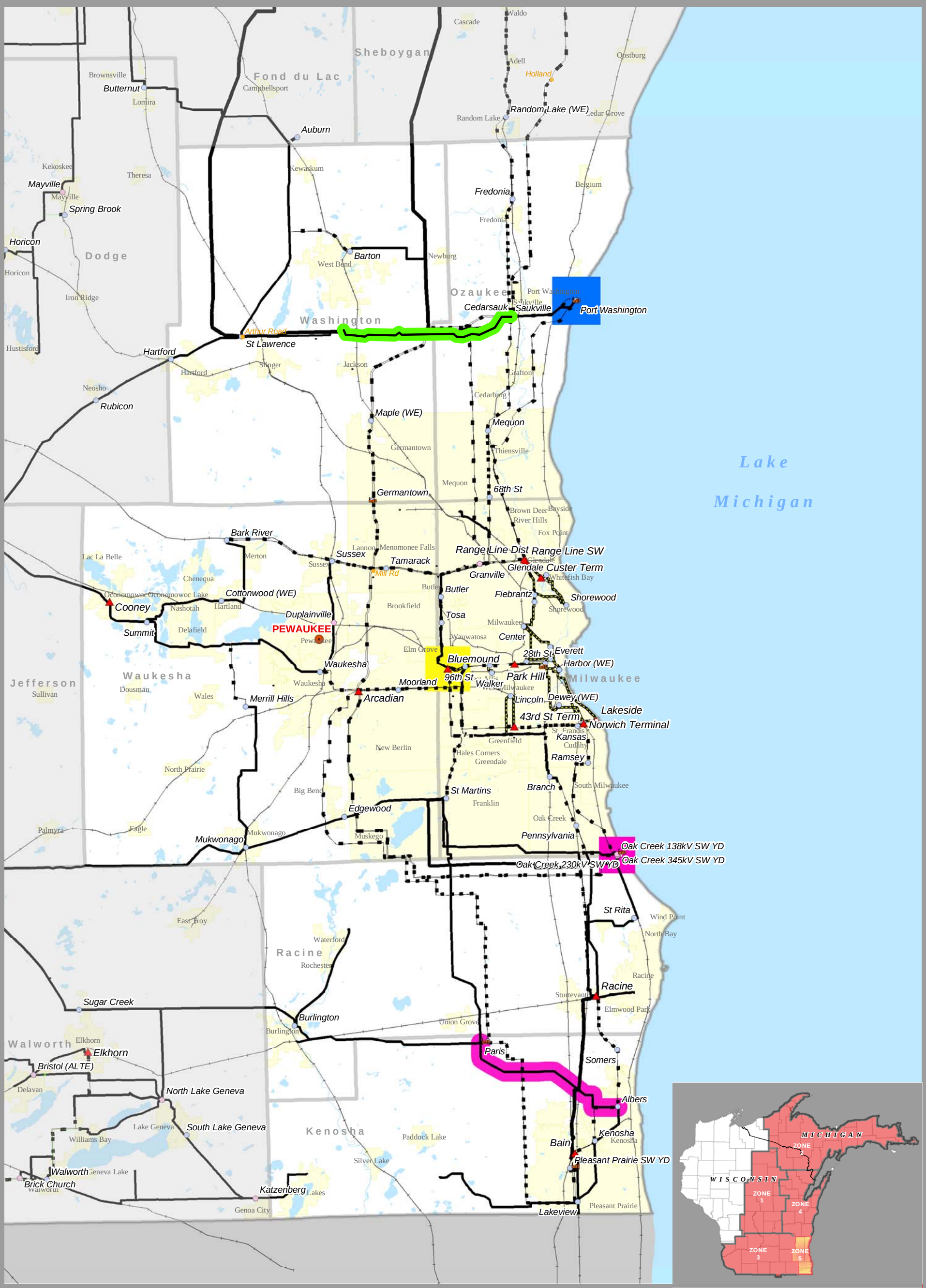
Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
2	Atlantic-Elevation Tap #2 69-kV	106%		Atlantic-Elevation Tap #1 69-kV line outage	Load Serving
2	Atlantic-Elevation Tap #1 69-kV	106%		Osceola-Elevation Tap #2 69-kV line outage	Load Serving
2	Sawyer,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

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

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

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

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



AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

Performance Criteria Limits Exceeded and Other Constraints 2005-2006

PLANNING ZONE 5

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 Service Limiter

Transmission Related Facilities

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

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

ZONE & STUDY RESULTS > Zone 5 – 2010 study results

Refer to Table ZS-2 and Figure ZS-14

Summary of key findings

- New generation in the greater Milwaukee area will drive many system improvements in Zone 5 within the next decade.
- A relatively weak 138-kV network in Jefferson, Washington and Waukesha counties will require reinforcements, including a new 345-kV line and new 345/138-kV transformations.
- All of the following projects were discussed in the 2004 10-Year Assessment or the 2004 Update.

Major projects expected between 2006 and 2010

Port Washington generation: New generation is planned at Port Washington and will be installed in two phases. The first phase is planned for a 2005 in-service date and includes installation of a 600-MW block of combined-cycle generation. The five 138-kV circuits from Port Washington (two circuits to Range Line and three circuits to Saukville) were rebuilt with larger conductors prior to summer 2005. The second phase places a second 600-MW block of combined-cycle generation in service by the summer of 2008. The additional generation requires the St. Lawrence-Pleasant Valley-Saukville 138-kV line to be uprated. While a larger conductor is required, the age and condition of the line warrants replacement of the structures as well. In addition, replacement of the cable of the underground portion of the Range Line-Cornell 138-kV line also is required.

Oak Creek generation: The 2004 10-Year Assessment stated that We Energies received Public Service Commission of Wisconsin approval for installing the first two phases of generation at Oak Creek. The proposed third phase of generation at Oak Creek was not approved. The proposed Oak Creek generation met the criteria to be included in our planning models and the first two Oak Creek 650-MW units were included in the 2010 10-Year Assessment model. No transmission reinforcements associated with Oak Creek Phase 3 were included in the 2010 model.

Rockdale-Mill Road 345-kV line: Past studies have shown low bus voltages in eastern Jefferson, western Waukesha, and southern Washington counties, all areas where load growth has been and is expected to remain high. To provide relief, a new 345-kV line connecting the Madison area with the Milwaukee area has been proposed. The recommended reinforcements include:

- construct a new 345/138-kV Mill Road Substation (formerly known as Lannon Junction) at the intersection of the Forest Junction-Arcadian 345-kV line, the Arcadian-Granville 345-kV line, Germantown-Bark River 138-kV line and Sussex-Tamarack 138-kV line (2008). This project will improve the 138-kV voltage profile in the area and facilitate expansion of the 345-kV network to the west of this substation. A 500 MVA, 345/138-kV transformer will be installed.

- ❑ construct a Rockdale-Concord 345-kV line adjacent to the existing Rockdale-Jefferson-Concord 138-kV line on existing double-width right-of-way and install a 500 MVA, 345/138-kV transformer at Concord (2010).
- ❑ convert the Bark River-Mill Road 138-kV line (currently built to 345-kV standards) to 345-kV operation and install a 500 MVA, 345/138-kV transformer at Bark River (2010).
- ❑ construct a new 345-kV line from Concord to Bark River (2010).

In addition to improving the voltage profiles in Jefferson, Waukesha and Washington counties, reducing loadings on parallel 138-kV circuits and reducing system losses, the above reinforcements will improve ATC's existing east-west transfer capability in this region.

With the Port Washington generation scheduled to be in service prior to the Oak Creek generation, power flows from Port Washington into downtown Milwaukee are expected to be heavier than seen today. Many of the transmission lines in the downtown Milwaukee area are underground lines, which inherently have low impedance to power flow. This results in the Cornell-Fiebrantz-Center 138-kV line being heavily loaded. An operating guide is available that opens the Cornell line breaker on the Cornell-Fiebrantz 138-kV line. We are investigating installing a reactor on the Cornell-Fiebrantz-Center 138-kV line. This would increase the line impedance, thus reducing power flows. Another solution to reduce power flowing on the Center-Fiebrantz-Cornell line is to build new underground facilities in the downtown Milwaukee area. Alternatives could include a new 138-kV underground line from Haymarket Substation to Shorewood or Center to Granville.

The Bain-Kenosha 138-kV line overloaded for a number of contingencies. A relay setting at Kenosha is the limiting element.

The Albers-Bain 138-kV line loads to its summer emergency limit for an outage of the Bain-Kenosha 138-kV line. The limiting elements are bus jumpers at Bain and the line conductor clearances.

The Oak Creek 230-kV bus tie between bus sections five and nine, as well as the Oak Creek 230/138-kV transformer, overload for a number of contingencies. The proposed solution is to install a second 500 MVA, 345/138-kV transformer at Oak Creek.

The Harbor-Ramsey 138-kV line will overload for a number of contingencies. The proposed solution is to loop the line into the Kansas and Norwich substations creating new lines from Kansas-Harbor and Norwich-Ramsey.

The Racine-Oak Creek 345-kV line overloads by less than 1 percent for an outage of the Arcadian-Oak Creek 345-kV line. A current transformer is the limiting element.

The Oak Creek-Pennsylvania 138-kV line overloads by less than 1 percent for various contingencies. Bus jumpers, disconnect switches, current transformers at Oak Creek and bus jumpers, current transformers, and a circuit breaker at Pennsylvania need to be replaced to increase the line rating.

The Oak Creek-Ramsey 138-kV line overloads by up to 9 percent for various outages. The limiting elements are the bus jumpers at Oak Creek and a 0.8-mile section of the line, currently built with 556 kcmil ACSR conductor. The jumpers need to be replaced and the line clearances increased to permit operation at 275 degrees.

The Oak Creek-Allerton 138-kV line loads up to 95 percent of its rating for an outage of the Oak Creek-Pennsylvania 138-kV line.

All of these overloads are relieved by proposed system additions or modifications, which are necessary for the new Oak Creek generation additions for phase 1 and 2.

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

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

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

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

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

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

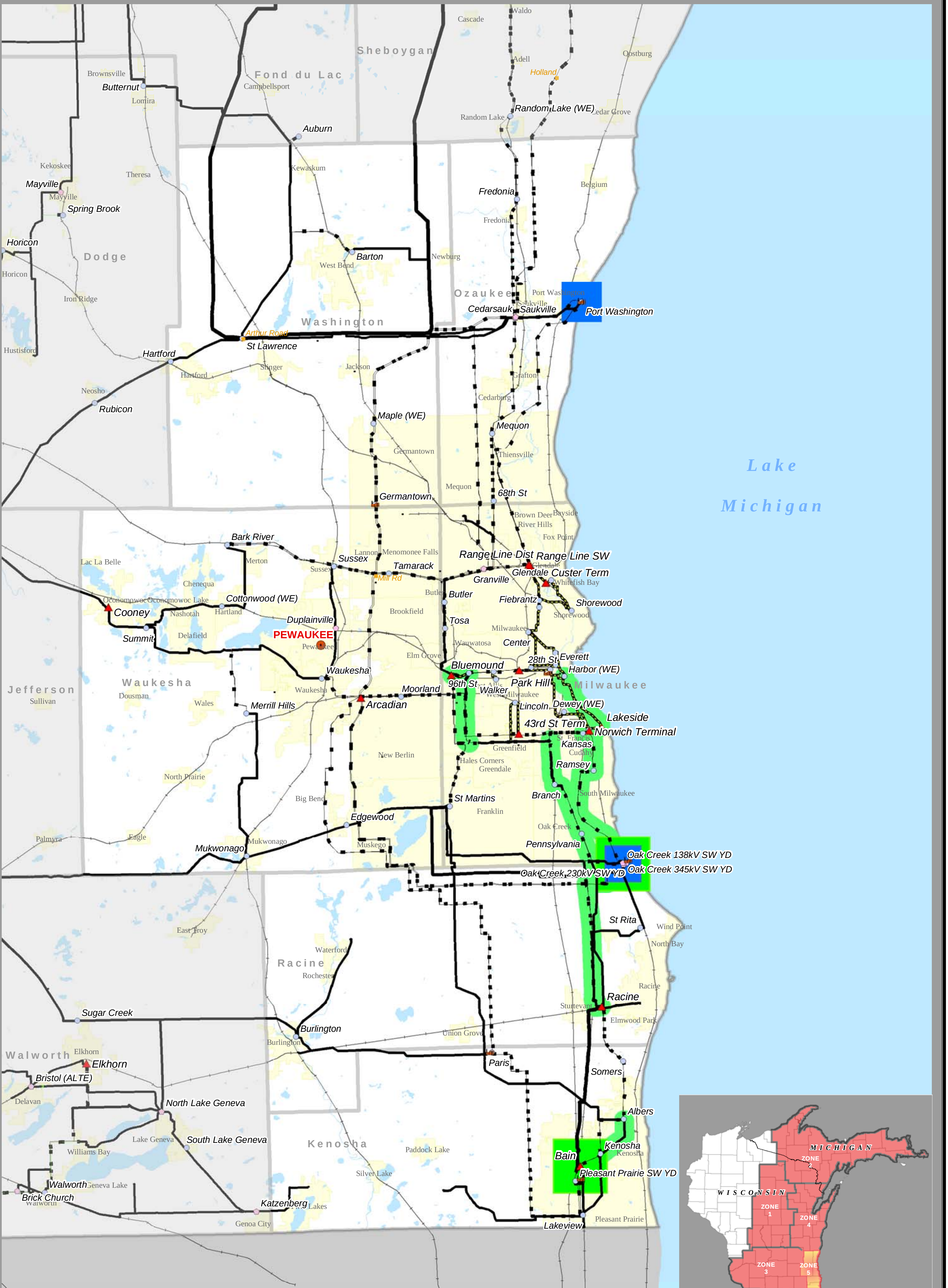
TABLE ZS-2 (continued)
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2010

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

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

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

Figure ZS-14



AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

Performance Criteria Limits Exceeded and Other Constraints 2007-2010

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 Related Facilities

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

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

Zone5 11x17.mxd Modified: January 14, 2005

ZONE & STUDY RESULTS > Zone 5 – 2014 study results

Refer to Table ZS-3 and Figure ZS-15

Summary of key findings

- ❑ Most of the line and transformer overloads seen in 2010 are no longer an issue as a result of the system additions and modifications required for Oak Creek generation being in place.

We Energies is proposing the installation of a third block of generation at Oak Creek in 2013. The 2010 analysis did not include any system improvements required by Oak Creek Phases 1 and 2. The 2014 analysis included all transmission requirements for all three phases of the Oak Creek generation project. Following is the list of system additions and modifications required for each of the three phases.

2009 - Oak Creek generation Phase 1

- ❑ build a new Oak Creek 345-kV switchyard to interconnect one new 650-MW generator
- ❑ reconductor a segment of the Oak Creek-Ramsey 138-kV line
- ❑ reconductor the underground segment of the Ramsey-Harbor 138-kV line. This project has been revised to terminate the Ramsey-Harbor line into the Kansas/Norwich substations creating a Kansas-Harbor 138-kV line and a Norwich-Ramsey 138-kV line.
- ❑ reconductor the Oak Creek-Allerton 138-kV line
- ❑ replace two 345-kV circuit breakers at Pleasant Prairie on the Racine and Zion lines with IPO breakers and upgrade relaying

2010 - Oak Creek generation Phase 2

- ❑ expand 345-kV switchyard at Oak Creek to interconnect a second new 650-MW generator and a second 345/138-kV, 500 MVA transformer
- ❑ expand Oak Creek 138-kV switchyard to connect the 345/138-kV, 500 MVA transformer
- ❑ uprate Kansas-Ramsey 138-kV line. This is new to the 2005 10-Year Assessment.
- ❑ reconductor the Oak Creek-Root River 138-kV line. This is new to this 10-Year Assessment.
- ❑ uprate terminal equipment and increase line clearances on the Oak Creek-Nicholson 138-kV line to permit operation at 230 degrees. This is new to this 10-Year Assessment.

2013 - Oak Creek generation Phase 3

- ❑ loop the Zion-Arcadian 345-kV line into Pleasant Prairie. This is new to this 10-Year Assessment.

- ❑ expand the Oak Creek 345-kV switchyard to interconnect the third 650-MW block of generation
- ❑ construct an Oak Creek-Hale-Granville 345-kV line using new right-of-way and/or converting/reconductoring existing lines for use at 345 kV
- ❑ construct an Oak Creek-St. Martins 138-kV circuit
- ❑ restring the Bluemound-Butler 138-kV line on new 345-kV structures installed with the Hale-Granville line
- ❑ construct a Butler-Tamarack (Carmen) 138-kV line on new 345-kV structures installed with Hale-Granville line
- ❑ construct a 345/138-kV switchyard at Hale (Brookdale) to accommodate two 345-kV lines and a 345/138-kV transformer

The following projects were included in the 2004 10-Year Assessment. Studies have found they are no longer needed to support new generation at Oak Creek and have been removed from ATC's plans.

- ❑ construct Oak Creek-Racine 345-kV line
- ❑ replace 22 overdutied 138-kV breakers at Harbor, Everett and Haymarket substations
- ❑ replace seven 138-kV overdutied breakers at Bluemound
- ❑ construct 345-kV Bluemound switchyard to accommodate one 345-kV line and a 345/138-kV transformer

The Albers-Kenosha 138-kV line loads to its summer emergency rating for an outage of the Bain-Kenosha 138-kV line. The limiting element is the 1.64-mile portion of the line, which has a 477 kcmil ACSR line conductor. Conductor clearances can be increased to provide relief.

The transmission additions and modifications required by the new Port Washington and Oak Creek generation projects removed all of the overloads and low voltages seen in 2006 and 2010.

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

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

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

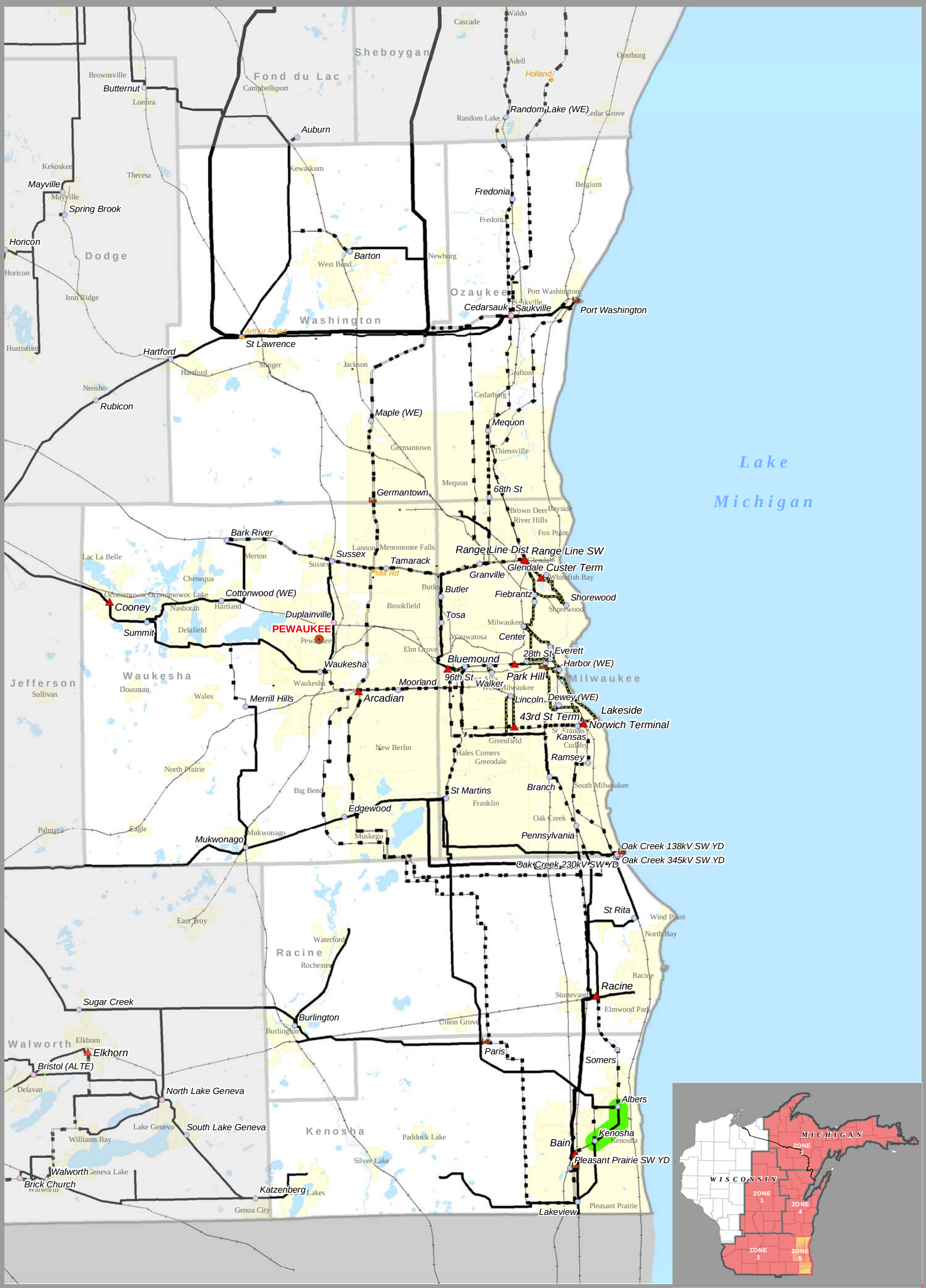
Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
3	Oregon-Stoughton 69-kV line	97-107%		Sugar River (Montrose)-Verona 69-kV line outage	Load Serving
3	Stagecoach-Timberlane Tap 69-kV line	97%		Sugar River-Verona 69-kV line and Spring Green 138/69-kV transformer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

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

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

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

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



AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

Performance Criteria Limits Exceeded and Other Constraints 2011-2014

PLANNING ZONE 5

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 Related Facilities

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

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