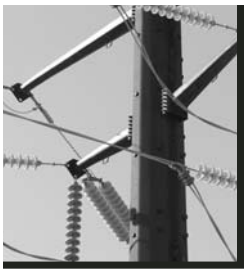


section 5 Results Of Analyses

Summary

- *Discussion of findings from 2004, 2008 and 2012 power flow analyses*
- *Discussion of findings from dynamic stability analyses of 2004 conditions*
- *Discussion of results from simultaneous transfer capability analyses of 2004, 2008 and 2012*
- *Discussion of status of umbrella plans for northern zones (Zones 1, 2 and 4)*
- *Discussion of status of umbrella plans for southern zones (Zones 3 and 5)*
- *Discussion of reinforcements potentially needed to increase transfer capability by up to 3,000 megawatts*

The results of the power flow, dynamic stability and short circuit analyses conducted to develop system expansion plans are provided in this section. For each zone, system performance criteria limits that are exceeded (overloads, low voltages, fault duties, etc.) are identified from the results of each base case and associated contingency cases along with their causes. In addition, system constraints (known transmission service/import limiters) are also identified. The identified needs and exceeded limits are categorized by ATC planning zone. The combined limitations and instances where performance criteria limits are exceeded that were identified in the 2004, 2008 and 2012 analyses are listed in Tables V-2 through V-4, respectively, and shown graphically in Figures V-2 through V-16.

In addition, system constraints that limit ATC's ability to approve transmission service requests or which may cause interruption of transmission service already approved are taken into consideration in developing solutions to limits and needs identified above. These system constraints may be lines, transformers or other equipment whose ratings could be exceeded. ATC monitors incidents where transmission service is interrupted or curtailed by system operators due to various system issues. These incidents are referred to as Transmission Loading Relief incidents. A summary of TLR incidents that occurred on the ATC system during 2001 and 2002 are provided in Tables V-1a and V-1b. From a planning perspective, ATC is concerned about TLRs that occur repeatedly and/or those that cause firm transmission service to be interrupted or curtailed. As shown in Tables V-1a and V-1b, there are a number of chronic or severe limiters that warrant system reinforcements. The 2002 costs associated with generator redispatch to alleviate those limitations are shown in Figure V-1. These limitations were taken into account when developing alternative solutions for other needs identified in the analyses.

Alternative solutions or the primary (currently preferred) solution to the system performance criteria limits exceeded in the analyses are described in this section. For limits exceeded in the 2004 model where the limit must be resolved near term and the preferred solution or a potential solution can reasonably be expected to be completed by 2008, such solutions are included in the 2008 base case. For criteria limits exceeded in the 2004 analysis where the preferred/potential solutions require further verification and/or more analysis, such solutions are not included in the 2008 model, but the need is further investigated in the 2008 analysis. In instances where the need is further verified by the 2008 analysis, 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 2012, with planned and several proposed projects being included in the 2012 base case.

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.

In addition, this section describes results of cursory transfer capability analyses that were conducted for 2004 and 2008 summer peak conditions. These analyses provide a relative measure of the import capability into the ATC service territory and identify some limiting transmission facilities for importing power from both the south and west of ATC.

This section also describes results of stability analyses by zone of the ATC system as it is expected to be configured in 2004. These analyses provide insights into current stability margins at major generating stations on the ATC system.

2004 Summer Peak (steady-state) Analysis

The system performance criteria limits exceeded and other system needs based on the 2004 base and contingency cases are listed in Table V-2, along with the magnitude of the limit exceeded, as applicable, and the cause of the limits being exceeded. Following is a discussion of the criteria limits that were exceeded and the rationale behind the project alternatives selected to be included in this Assessment.

TABLE V-1a Summary of Transmission Loading Relief Incidents - 2002

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

TABLE V-1a (continued) Summary of Transmission Loading Relief Incidents - 2002

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

Note: * - Sum of number of days is based on determining the highest TLR level for a given day so that each day is only counted once
Level 3: non-firm transmission service curttailments

Level 4: transmission system reconfiguration/redispatch

Level 5: firm transmission service curttailments/redispatch

TABLE V-1b Summary of Transmission Loading Relief Incidents - 2001

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

Note: * -Sum of number of days is based on determining the highest service limitation level for a given day so that each day is counted once
Level 3: non-firm transmission service curttailments

Level 4: transmission system reconfiguration/redispatch

Level 5: firm transmission service curttailments/redispatch

TABLE V-2 PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2004

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
1	Eastom – Highway 8 115 kV line	132%		Summit Lake - Venus 115 kV line outage Summit Lake - Aurora St. 115 kV line outage Aurora St - Antigo 115 kV line outage Black Brook - Antigo 115 kV line outage	Load Serving
1	Council Creek 138 kV bus voltage		84 - 95%	Base Case Council Creek – Petenwell 138 kV line outag Sigel – Arpin 138 kV line outage	Load Serving
1	Council Creek 138/ 69 kV transformer	135%		Eau Claire – Arpin 345 kV line outage	Load Serving
1	Petenwell 138/ 69 kV transformer	95%		McKenna – Lakehead Adams 69 kV line outage	Load Serving
1	Caroline 115/ 69 kV transformer	111%		Whitcomb 115/ 69 kV transformer out	Load Serving
1	Summit Lake – Aurora St. 115 kV line	99%		Eastom - Highway 8 115 kV line outage	Load Serving
1	Bunker Hill – Black Brook 115 kV line	103%		Weston - Black Brook 115 kV line outage	Load Serving
1	Bunker Hill – Pine 115 kV line	103%		Hilltop - Sherman St. 115 kV line outage Maine - Pine 115 kV line outage Maine - Hilltop 115 kV line outage	Load Serving
1	Rhinelander Loop 115 kV bus voltages		90%	Eastom - Highway 8 115 kV line outage Aurora St – Antigo 115 kV line outage Black Brook – Antigo 115 kV line outage Hilltop - Sherman St. 115 kV line outage	Load Serving
1	Rhinelander Loop 115 kV bus voltages		90 – 92%	Summit Lake – Venus 115 kV line outage Summit Lake - Aurora St. 115 kV line ou Maine – Hilltop 115 kV line outage Maine – Pine 115 kV line outage	Load Serving
1	Weston – Kelly 115 kV line	95%		Hilltop - Sherman St. 115 kV line outage	Load Serving
1	Weston – Sherman St. 115 kV line	100%		Weston – Morrison Ave. 115 kV line outag	Load Serving
1	Arpin 345/ 138 kV transformer	107%		Arpin – Rocky Run 345 kV line outage	Load Serving
1	Sigel – Arpin 138 kV line	98%		Arpin – Rocky Run 345 kV line outage	Load Serving
1	Sigel 138/ 69 kV transformer	120%		Arpin - Rocky Run 345 kV line outage Sigel - Lakehead Vesper 138 kV line outa Port Edwards - Lakehead Vesper 138 kV outage	Load Serving
1	Sigel, Lakehead Vesper, and Port Edwards 138 kV bus voltage		91 - 92%	Sigel – Arpin 138 kV line outage	Load Serving
1	Wien – Stratford 115 kV line	99%		Arpin 138/ 115 kV transformer outag Aprin – Powers Bluff 115 kV line outa	Load Serving
1	McMillan, Wildwood, Hume, and Powers Bluff 115 kV bus voltage		90 - 92%	Arpin 138/ 115 kV transformer outag Arpin – Powers Bluff 115 kV line outa Hume – Powers Bluff 115 kV line outag	Load Serving
1	Wautoma and Sand Lake 138 kV bus voltage		91 – 95%	Base Case Sigel – Arpin 138 kV line outage Port Edwards – Sand Lake 138 kV line out Green Lake – Roeder 138 kV line outage	Load Serving
1	Roeder 138 kV bus voltage		91%	Green Lake – Roeder 138 kV line outage	Load Serving
1	Metomen 138/ 69 kV transformer	97%		N Fond du Lac - Rosendale 69 kV line ou	Load Serving

TABLE V-2 PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2004 (continued)

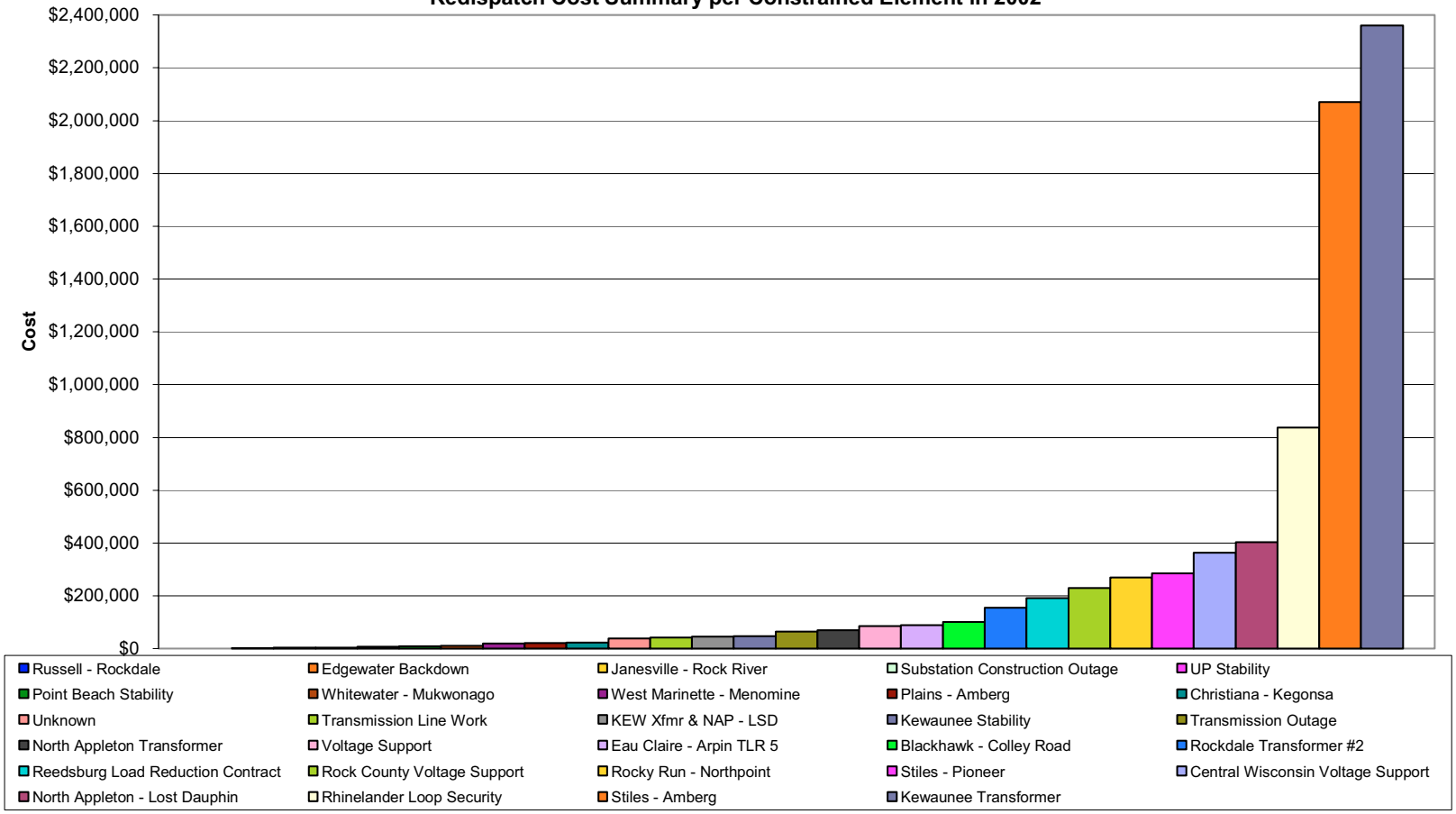
Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
1	Metomen – Rosendale 69 kV line	101%		Metomen 138/69 kV transformer outage	Load Serving
1	Berlin area 69 kV bus voltages		90 – 92%	Metomen – Ripon 69 kV line outage N Ripon Tap - Ripon 69 kV Winneconne - Sunset Point 69 kV	Load Serving
2	M-38 - Cedar 138 kV line	128-99%		M-38 - Perch Lake 138 kV line outage Presque Isle - Perch Lake 138 kV line outage Presque Isle - Dead River 138 kV line outage Dead River - Plains 345 kV line outage	Load Serving
2	Lincoln, 69 kV bus voltage		92%	Iron River-UPP Tap 69 kV line outage	Load Serving
2	Brevort, Lakehead, Hiawatha 138 kV bus voltages		90%	Straits - Brevort 138 kV line outage	Load Serving
2	Lakehead, Hiawatha 138 kV bus voltages		91%	Brevort-Lakehead 138 kV line outage	Load Serving
2	Hiawatha 138 kV bus voltage		91%	Lakehead-Hiawatha 138 kV line outage	Load Serving
2	St Ignace 69 kV bus voltage		92%	Straits 138/69 kV Transformer outage	Load Serving
3	Hillman 138/69 kV Transformer	110%		Pilot Knob - Galena 69 kV line outage	Load Serving
3	Paddock 138/69 kV transformer	104%		Colley Road 138/69 kV transformer outage	Load Serving
3	McCue 138/69 kV transformer	101%		Janesville 138/69 kV transformer outage	Load Serving
3	Turtle - Bradford 69 kV line	100%		Colley Road - Dickinson 138 kV line outage	Load Serving
3	Columbia 345/138 kV 200 MVA transformers	99%		Columbia 345/138 kV 400 MVA transformer outage	Load Serving
3	Columbus - South Beaver Dam 69 kV line	109%		North Randolph - Fox Lake 138 kV line outage	Load Serving
3	Galena 138/69 kV transformer (DPC Facility)	103%		Paddock - Wempletown 345 kV line outage	Load Serving
3	Lake Geneva 69 kV bus voltage		91%	North Lake Geneva - Lake Geneva 69 kV line outage	Load Serving
3	Muscoda, Avoca, Spring Green, Lone Rock, Arena 69 kV bus voltages		90%	Spring Green 138/69 kV transformer outage	Load Serving
3	Aaker Road (Stoughton), Oregon, Brooklyn 69 kV bus voltages		88%	Stoughton - Aaker Road 69 kV line outage	Load Serving
3	AGA (LCI), Pflaum 69 kV bus voltages		91%	Royster - Pflaum Tap 69 kV line outage	Load Serving
3	Concord 138 kV Bus 6, Rubicon 138 kV bus voltages		85-87%	Concord Bus 6 - 5 Bus tie outage	Load Serving
3	Eden 138 kV and Lancaster 138 kV bus voltages		90-91%	Nelson Dewey - Lancaster 138 kV line outage	Load Serving
3	Williams Bay, Brick Church, Elkhorn, Dickinson 138 kV bus voltages		90%	Colley Road - Brick Church 138 kV line outage	Load Serving
3	Cambridge, London, Boxelder, Stonybrook, Lakehead Pumping 138 kV bus voltages		90-91%	Rockdale - Cambridge Tap 138 kV line outage	Load Serving
3	North Beaver Dam and Fox Lake 138 kV bus voltages		85%	North Randolph - Fox Lake 138 kV line outage	Load Serving
3	Pine River, Richland Center, Richland, Eagle (DPC) 69 kV bus voltages		89%	Dayton - Richland Center Tap 69 kV line outage	Load Serving

TABLE V-2 PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2004 (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
4	S Fond du Lac-Willow Rd 69 kV line	109%		Base Case	Load Serving
4	Edgewater 345/138 kV transformer #21	124-98%		Edgewater 345/138 kV transformer #22 outage and Edgewater-Cedarsauk 345 kV line outage Edgewater 345/138 kV transformer #22 outage	Generation Outlet
4	Mullet River 138/69 kV transformer	102%		S Sheboygan Falls 138/69 kV transformer outage S. Sheboygan Falls-Bemis Tap 69 kV line outage	Load Serving
4	S Sheboygan Falls 138/69 kV transformer	110-102%		Edgewater-Sheboygan Falls 69 kV line outage Mullet River 138/69 kV transformer outage Mullet River-N. Mullet River 69 kV line outage	Load Serving
4	Edgewater 138/69 kV transformer #1	102-96%		Edgewater 138/69 kV transformer #2 outage S Sheboygan Falls 138/69 kV transformer outage S. Sheboygan Falls-Bemis Tap 69 kV line outage Mullet River 138/69 kV transformer outage Mullet River-N. Mullet River 69 kV line outage Erdman 138/69 kV transformer outage	Load Serving
4	Edgewater 138/69 kV transformer #2	102-96%		Various outages	Load Serving
4	Adams St.-Sheboygan Falls 69 kV line	137-104%		S Sheboygan Falls 138/69 kV transformer outage S. Sheboygan Falls-Bemis Tap 69 kV line outage Bemis Tap-Monroe St 69 kV line outage	Load Serving
4	Danz-Henry Street 69 kV line	101%		Pulliam-Van Buren 69 kV line outage	Load Serving
4	Pulliam-Danz 69 kV line	101%		Pulliam-Van Buren 69 kV line outage	Load Serving
4	Pulliam-Van Buren 69 kV line	102%		Pulliam-Danz 69 kV line outage	Load Serving
4	Sister Bay 69 kV bus voltage		92%	First Ave-Sawyer 69 kV line outage	Load Serving
4	Butternut 138 kV bus voltage		92%	S Fond du Lac-Butternut 138 kV line outage	Network
5	Pleasant Prairie – Bain 345 kV line	179.0%		Splitting Pleasant Prairie 345 kV bus sections 3 and 4	Load Serving
5	Bain 4 – Bain 5 138 kV bus tie	104.0%		Splitting Pleasant Prairie 345 kV bus sections 3 and 4	Load Serving
5	Bluemound 230 kV bus voltage		88.6%	Various Outages	Load Serving
5	Oak Creek 345/230 kV transformer (T884)	104.6%		Splitting 230 kV bus sections 7 and 8	Load Serving
5	Moorland 138 kV bus sections 4, 5, and 6		87.6%	Various Outages	Load Serving
5	Pleasant Valley – Saukville 138 kV line	107.1%		Splitting Concord 5 and 6	Load Serving
5	Hartford and St. Lawrence 138 kV bus voltages		88 – 89%	Splitting Concord 5 and 6	Load Serving

Figure V-1

Redispatch Cost Summary per Constrained Element in 2002



Zone 1

Summary of Key Findings

- The Rhinelander Loop will require additional interconnections to other portions of the system in order to reliably serve load in the future. Interim measures are needed to avert overloads, low voltages and voltage collapse.
- The Arrowhead-Weston 345 kV line will significantly reduce or potentially preclude the need for operating guides currently in use, will improve system stability and, in concert with other lower voltage projects, will improve import capability.
- Low voltages at and near Council Creek in the Tomah area will require that a combination of reinforcements be implemented to reliably serve load in the future.

In Zone 1, there were a number of facility overloads, several facilities near their emergency ratings, low voltages in the Rhinelander Loop and impending low voltages under contingency throughout the zone. In addition, the need exists to address potentially heavy flows due in part to parallel path flows on certain ATC facilities during non-peak periods and to keep the system intact during outages of the Eau Claire-Arpin and Arpin-Rocky Run 345 kV lines.

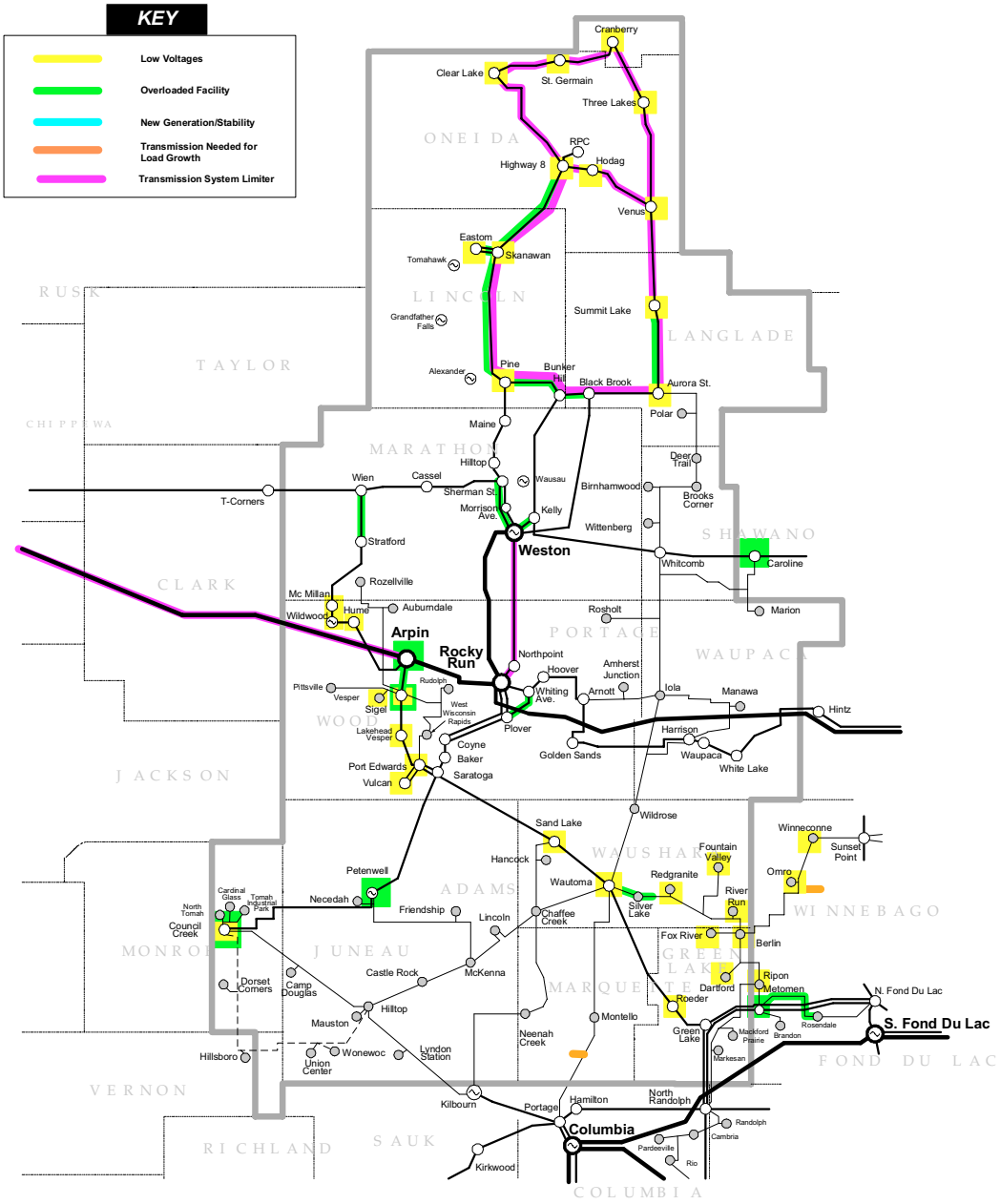
It is anticipated that the parallel path flow and import issues will be addressed in large part by the planned Arrowhead-Weston 345 kV transmission line project and other lower voltage projects. However, the projected in service date for the Arrowhead-Weston project is the end of June 2008, so interim mitigation measures will be necessary to ensure continued reliable transmission service. It is anticipated that modifications to existing operating guides dealing with parallel path flow and imports will be utilized prior to the completion of the Arrowhead-Weston project.

As currently planned, the Arrowhead-Weston project will be constructed in phases. In the first phase, a new 345 kV switchyard at Weston and the southern portion of the Arrowhead-Weston line, from Weston to Stone Lake, will be constructed. This first phase is scheduled to be completed in 2006. At Stone Lake, a 345/161 kV transformer is proposed to be installed and connected to the Weston-Stone Lake line. The existing Stone Lake-Stinson 161 kV line will then be taken out of service and construction on the northern portion of the Arrowhead-Weston line, from Stone Lake to Arrowhead, will begin on the Stone Lake-Stinson right-of-way. The portion of the line from Stone Lake to Stinson will be built for double circuit, carrying the Arrowhead-Weston 345 kV circuit and the Stone Lake-Stinson 161 kV circuit. The transformer at Stone Lake is needed to provide support in northwest Wisconsin while the Stone Lake-Stinson line is being rebuilt. Studies are being conducted to determine the feasibility of making the Stone Lake transformer a permanent facility.

There are a number of projects associated with the Arrowhead-Weston 345 kV line needed to achieve the level of import capability contemplated in the Wisconsin Reliability Assessment Organization report. These projects include constructing a 345 kV switchyard at Weston, replacing the existing 345/115 kV transformer at Weston, rebuilding the Kelly-Whitcomb and the Weston-Northpoint 115 kV lines and installing capacitor banks at Arpin, Weston, Arrowhead and Rocky Run.

For the heavy flows on and the contingency separation of certain 69 kV and 138 kV facilities on the western edge of ATC's service territory, the primary solution would be the Arrowhead-Weston project. However, as noted above, this project is not expected to be in service until the end of June 2008. An interim and supporting mitigation measure, which was previously shown by Alliant and Dairyland to effectively address this near- term situation (in conjunction with the Arpin Operating Guide) was the installation of a phase-shifting transformer at the Council Creek 69 kV bus. The phase-shifting transformer is being evaluated along with an alternative, a series reactor. Further study will aid in the selection of the preferred alternative, which ATC intends to place in service in 2004 or 2005.

Figure V-2-1
Zone 1 Performance Criteria Limits Exceeded and Other Constraints
2003-2004



Two events occurred during the summer of 2001 in which load was involuntarily shed on the 115 kV network north of Wausau, referred to here as the Rhinelander Loop. The results of the analysis show that, consistent with what was seen in real time operations, low voltages can be experienced during certain contingencies. The primary reason for this condition is that loads experienced on Rhinelander Loop during the summers of 2001 and 2002 far exceeded what had been previously forecasted for the area (in 2001 the load exceeded the load that had previously been forecasted for 2006), accelerating the potential for such overloads and low voltages.

As part of the analyses of potential solutions for the Rhinelander Loop, ATC considered needs to be addressed on the adjacent 69 kV network to the north of the Rhinelander Loop (in Zone 2) and transfer capability needs from Wisconsin to the Upper Peninsula of Michigan. For further information on these other needs and their relationship to the needs in the Rhinelander Loop, see the discussion of Umbrella Plan for Northern Zones near the end of this section.

Due to the severity of the problems, it will be necessary to address the needs of the Rhinelander Loop in stages. Short-term solutions, that is, projects that can be implemented prior to 2005 to address the immediate needs of the loop, include the conversion of WPS's 46 kV system between Pine-Grandfather-Tomahawk-Easton to 115 kV and constructing a new 115 kV line between Skanawan and Highway 8 substations.

Alternatives considered as long-term solutions for the Rhinelander Loop limitations include:

- rebuilding additional portions of the Rhinelander Loop,
- constructing a new 115 kV or 138 kV line from Cranberry north to Conover combined with the conversion of the Conover-Plains or Conover-Winona 69 kV lines to 138 kV,
- constructing a new 115 kV or 138 kV line from Venus east to the Amberg or Plains substations or tie into the Plains-Morgan 345 kV line near Dunbar,
- constructing a new 115 kV or 345 kV line from Weston north to Venus, or
- a combination of the above.

Based on its analyses, ATC's preferred solution is the second bullet above, constructing a Cranberry-Conover 138 kV line and rebuilding the Conover-Iron River-Plains 69 kV line and converting to 138 kV operation. This alternative addresses intermediate term reliability issues on the Rhinelander Loop (through ~2015) and provides substantial voltage support on the 69 kV system in the western portion of the Upper Peninsula .This project is needed by 2007.

In the interim period prior to the completion of either the short-term or long-term solutions, the Rhinelander Loop is vulnerable to low voltages and potentially voltage collapse. As such, ATC, in conjunction with WPS, has developed a plan involving interim measures (transmission capacitors at Hodag and Summit Lake, distributed-superconducting magnetic energy storage units or similar devices, distribution capacitors at various locations served by the loop, temporary diesel generation at Piehl, upgrading circuit breakers and associated protection schemes at Aurora Street and Highway 8) to minimize the risk of the problems identified and meet the planning criteria. In addition, ATC is evaluating the benefits of moving an additional D-SMES unit from the Reedsburg area (Zone 3) to Clear Lake for additional voltage support.

To address low voltages elsewhere in Zone 1, capacitor banks at the Berlin and Ripon 69 kV substations in 2004 and at Wautoma 138 kV and Antigo 115 kV substations in 2006 are needed. To address facility overloads, the 115/69 kV transformer at Whitcomb needs to be uprated (replace current transformers), the Wien-McMillan 115 kV line needs to be reconductored and the Pine-Bunker Hill-Kelly 115 kV line, the North Randolph-Ripon 69 kV line and the Metomen-North Fond du Lac 69 kV line need to be uprated. Overloads on the Arpin 345/138 kV transformer, the Sigel 138/69 kV transformer and Arpin-Sigel 138 kV line are being addressed by the Arpin Operating Guide. The low voltages at the Council Creek 138 kV substation are being addressed through manual control of load tap changers on the Council Creek 138/69 kV transformer and the installation of a capacitor bank in 2005.

In response to customer requests for new distribution interconnections, two new 69 kV lines, one from a new substation near Endeavor to an intersection with the existing Portage-Wautoma 69 kV line and the other from a new Omro Industrial substation to an intersection with the Omro-Berlin 69 kV line, are planned. In addition, new 115 kV transmission lines are planned in the 2004-2006 timeframe from Venus to a new Crandon substation and continuing on to a new Laona substation, from Clear Lake to a new Arnett Road substation, and from a new Eagle River substation to an intersection with the Cranberry-Three Lakes 115 kV line, in response to customer requests for new transmission interconnections.

Zone 2

Summary of Key Findings

- The first phase of the Hiawatha-Indian Lake line rebuild project will address overloads, improve the voltage profile in the area and preclude the need for opening the existing lines during off-peak periods.
- Limitations on the transfer capability from Wisconsin to the Upper Peninsula result in numerous TLRs and costly generation redispatch and are hampered by limited redispatch options. While interim measures taken by ATC raised this transfer capability somewhat, additional transfer capability is sorely needed.
- Overloads of the Presque Isle-Freeman, Freeman-Cedar, Cedar-National identified in the 2002 Assessment are now not considered as likely and as critical based on updated modeling of mine load in the area. The Cedar-M38 138 kV line was identified as being overloaded under contingency and this line will need to be uprated and possibly rebuilt, given its condition.
- Low voltages in Zone 2 may be adequately addressed with capacitor bank installations.

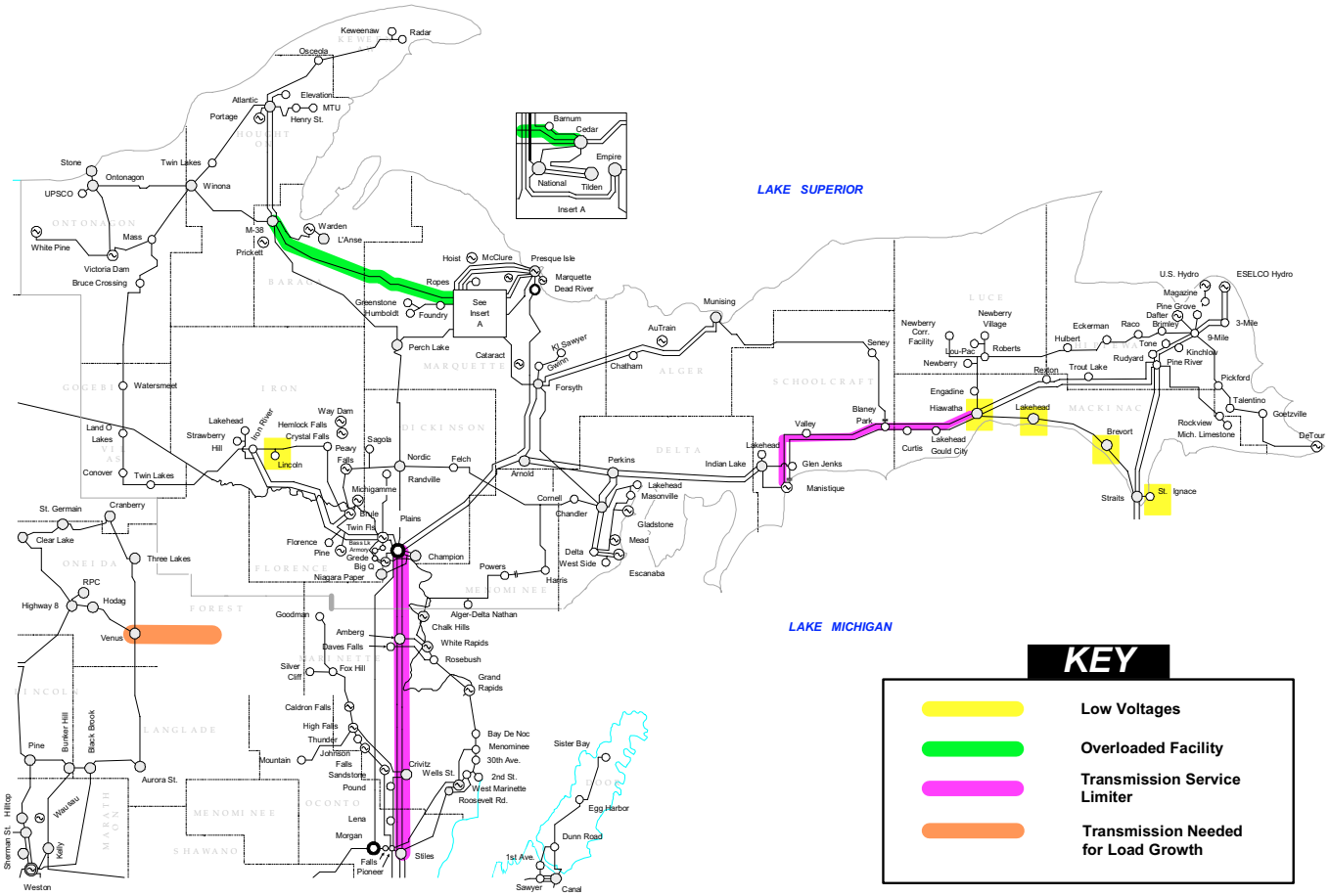


Figure V-3-1
Zone 2 Performance Criteria Limits Exceeded and Other Constraints
2003-2004

Numerous low voltages were found under contingency conditions that need to be addressed. The nature of these low voltages has been investigated and the potential for voltage instability does not appear to be of concern. Approximately 35 MVAR of capacitor banks distributed at Atlantic, Gwinn, Land O' Lakes, Roberts and Talentino were included in the plan, assumed to be placed in service by 2004. An additional capacitor bank (11 MVAR) at Iron River will be needed by 2006. Adding a short 69 kV circuit between Hiawatha and Engadine in 2004 will also improve voltages in the area for 69 kV system outages.

Overloads of the Presque Isle-Freeman, Freeman-Cedar, and Presque Isle-Cedar 138 kV lines identified in the 2002 Assessment are now not considered as likely or as critical based on revised modeling of mine load in the area. However, based on analysis of laser surveys, these three lines will still be uprated by summer 2004.

The Cedar-M38 138 kV line was identified as being overloaded under contingency and this line will need to be uprated and possibly rebuilt, given its poor physical condition.

The analysis identified potential low voltages at the St. Ignace 69 kV bus for an outage of the Straits 138/69 kV transformer. Addition of a 138/69 kV transformer at Straits is slated for 2005. This addition will improve the voltage profile in the eastern Upper Peninsula under various contingencies and will preclude the need for additional 69 kV facilities in the future (see 2008 Analysis, Zone 2).

There have been numerous transmission loading relief incidents in recent years during off-peak periods involving the Hiawatha-Indian Lake 69 kV circuits (see Table V-1). The 2008 off-peak analysis also identified overloads on one of the two Hiawatha-Indian Lake 69 kV lines for various contingencies. In addition, low voltages were identified at Lakehead, Brevort and Hiawatha. Heavy flows during off-peak periods over this system are caused in part by cycling of the Ludington pumped storage facility in the Lower Peninsula of Michigan. Another contributing factor is the increase in use of this system for transactions between ATC customers and entities to the east of Wisconsin. ATC has and is taking various measures to reduce the occurrence of these TLRs, including opening one of the Hiawatha-Indian Lake lines as normal operation and constructing a second Indian Lake-Manistique (Glen Jenks) 69 kV line.

However, these preventive actions are not considered a viable long-term solution. As a long-term solution, ATC is still planning to replace the key limiting element, one of the 69 kV lines between Indian Lake and Hiawatha with a double circuit 138 kV line. This project would address existing and projected limitations west of Hiawatha. One of the 69 kV lines between Indian Lake and Hiawatha has been identified by ATC Maintenance as being in need of rebuilding due to its condition. Thus, replacing this line with a double circuit 138 kV line would (i) eliminate system limitations between Indian Lake and Hiawatha, (ii) address the facility condition issue with one of the existing 69 kV lines, and (iii) improve the system from a strategic standpoint by improving the 138 kV network from Plains to Straits. Given the variety of benefits this project would provide, it is included in the plan to be in service in 2005. However, until a second 138 kV circuit from Hiawatha to Straits is completed and the Plains-Amberg-Stiles constraint is resolved (see below), it will be necessary to operate the rebuilt Hiawatha-Indian Lake line at 69 kV.

The proposed solution for addressing TLRs in Zone 2 for the long term would be to have two 138 kV circuits between Straits and Plains. This would require that the limiting 69 kV circuit between Indian Lake and Hiawatha be replaced with a double circuit 138 kV line, as described above, and eventually add a second 138 kV circuit between Hiawatha and Straits.

The second most frequent TLR limiter for flows into and across Zone 2, the Stiles-Amberg-Plains 138 kV double circuit line, will also require reinforcement in some form for the robust solution to be completely effective (see 2008 Analysis, Zone 4).

The Nordic-Randville 69 kV line is partially built for double circuit operation. This line has been identified as a candidate to be rebuilt based on its condition. The addition of a second 69 kV circuit on this line segment will provide for a network connection between Plains and Nordic, which are the two 138 kV sources for the 69 kV system in this area, increasing reliability of the system during contingencies.

Zone 3

Summary of Key Findings

- The anticipated reliability issues in Sauk County over the next several years are being addressed by converting the Kilbourn-Reedsburg-Kirkwood 69 kV lines to 138 kV. Interim measures to avert overloads, low voltages and voltage collapse are needed until the conversion is completed.
- Accommodating the Riverside generation (under construction) requires numerous transmission system reinforcements be implemented.
- Maintaining reliability of service to load in the Madison area requires that a new source (138 kV or 345 kV interconnection) be implemented in the near term and that a number of lines be uprated in some fashion. Longer term, a 345 kV source on the west side of Madison will be required.
- The proposed West Campus generation project will both necessitate system reinforcements and provide system benefits in the Madison area.
- Load growth in Walworth County is driving the need for system reinforcements.
- Import capability from Illinois can be severely limited by transmission facilities outside of the ATC system for loss of the Wempletown-Paddock 345 kV line (ATC/Commonwalth Edison facility). This limitation can be addressed to varying degrees by resolving the cause (loss of Wempletown-Paddock) or the symptoms (overloaded Dairyland Power Cooperative or Alliant-West facilities).

Several line and transformer overloads and numerous low voltages were identified in Zone 3. In addition, due in large part to significant amounts of new generation in northern Illinois, the need exists to address potentially heavy flows on certain ATC facilities during non-peak periods. This situation is aggravated by the fact that import capability from Illinois can be severely constrained due to insufficient redundancy in the system. Further, the need to accommodate new generation within Zone 3 is driving several reinforcements.

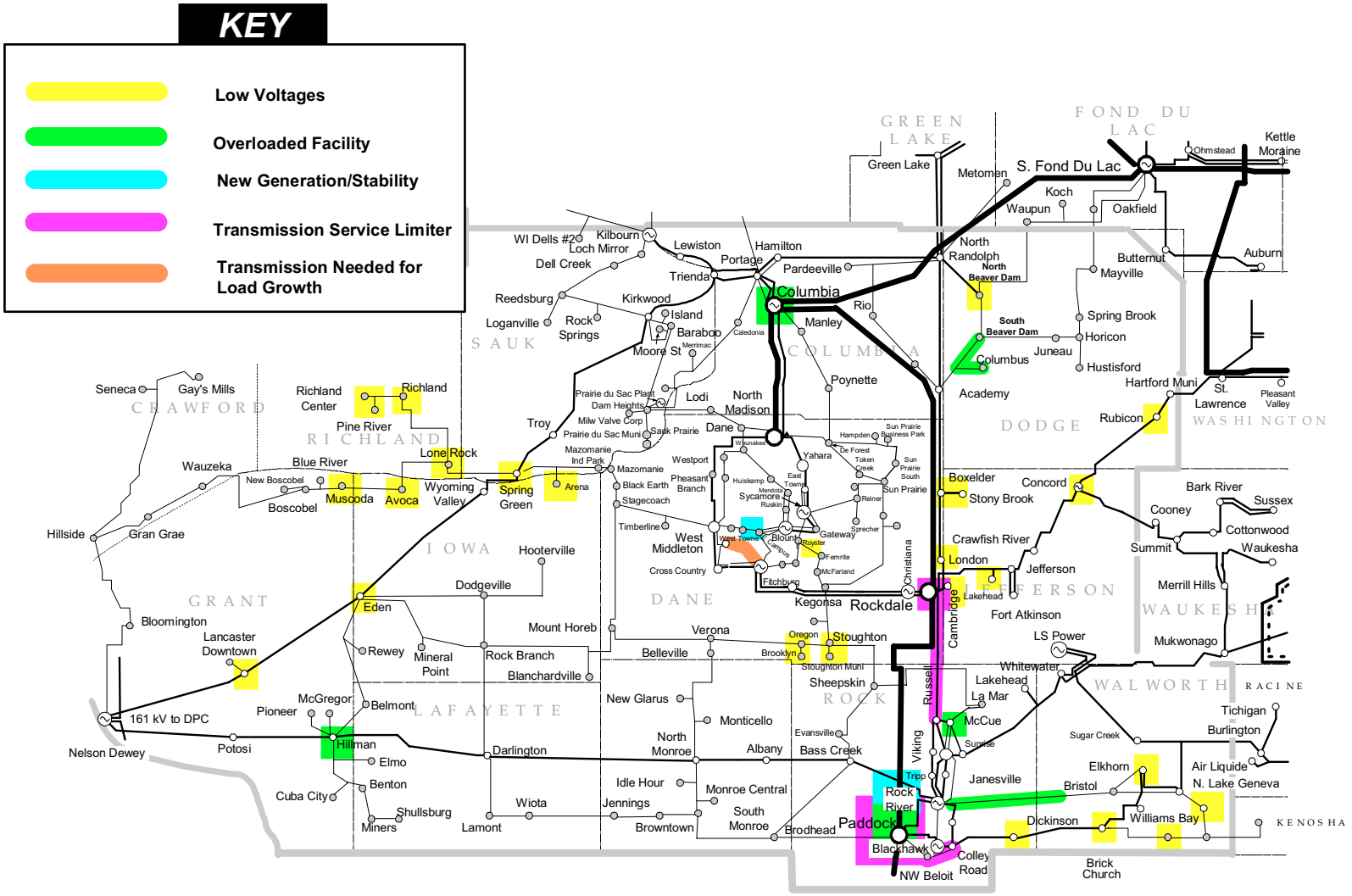


Figure V-4-1
Zone 3 Performance Criteria Exceeded and Other Constraints
2003-2004

In response to certain low voltages, a total of 144 MVAR in capacitor banks distributed at Birchwood, Cross Country, Kegonsa, Lone Rock, North Madison, Oregon, South Monroe, Tokay and Waunakee in 2004 were deemed to be the most feasible solutions. In addition, capacitor banks installations at Verona and Richland Center are planned in 2006. A recent T-D interconnection proposed for Wyocena provides additional support for extending a transmission line from Columbia to Rio with a loop through feed into the new substation (2005). This new line will potentially use existing right-of-way and provide voltage support to the North Randolph to Rio to Academy 69 kV loop. This line also provides adequate support into Columbus to allow the retention of the 69 kV facilities in Columbus after the Academy to South Beaver Dam line is converted to 138 kV (see discussion below).

Several of the identified 138 kV low voltages are currently mitigated by ATC Operations through remote control of a 138/69 kV transformer in a particular area. In certain instances, transformer load tap changers are adjusted to bring the 138 kV contingency voltages above the criteria limits while retaining the 69 kV bus voltages above the criteria limits. This is a balancing act that in some cases eventually will not work. Where this mitigation measure is no longer deemed viable, solutions have been proposed to solve these problems. The most notable example of this situation in Zone 3 is the Beaver Dam area which cannot be supported from the existing 69 kV system beyond approximately 2007. Completion of a 138 kV loop from Academy through South Beaver Dam around the eastern edge of Beaver Dam to North Beaver Dam will solve these voltage problems and address overloads on the Columbus-South Beaver Dam 69 kV line. This project is slated for completion in 2007.

In Sauk County, where single contingency overloads were identified as well, converting the Kilbourn-Reedsburg-Kirkwood 69 kV line to 138 kV was determined to be the optimum solution. This project involves two new 138 kV substations near Reedsburg- Artesian and Zobel with a new 138 kV line between the new substations. The southern portion, from Kirkwood to Artesian, has been converted to 138 kV. The northern portion, from Kilbourn to Zobel, and the Artesian-Zobel will not be completed until late 2003 or 2004.

There were a number of single contingency overloads in Zone 3 based on the 2004 analysis. New 138/69 kV transformer installations are planned for Fitchburg and North Randolph (2004). The Janesville-Riverside 138 kV line will need to be rebuilt in 2005 In addition, the Columbia-Portage double circuit 138 kV line, the Rockdale-Jefferson 138 kV line and the Rockdale-Boxelder 138 kV line will need to be uprated by 2005.
Transmission service studies associated with the Riverside generation (currently under construction) revealed a number of 69 kV line overloads in and around the Madison area. In response, the following projects are included in the plan:

- uprating the existing East Campus-Blount (2004) and the Gateway-Sycamore 69 kV line (2005)
- reconductoring the Blount-Ruskin and Blount-Ruskin Tap 69 kV circuits
- installing a second East Campus-Walnut 69 kV circuit (2004)
- rebuilding 69 kV circuits -- Kegonsa-McFarland-Femrite and Femrite-Royster 69 kV lines (2004)
- constructing a new Femrite to Sprecher 138 kV line and converting the Kegonsa-McFarland-Femrite line and the Sprecher-Reiner-Sycamore line from 69 kV to 138 kV (2007)

While these projects will improve reliability in the Madison area, an overriding long-term concern for the area is the lack of a strong source to the west side of Madison where growth is the most prolific. Preliminary studies of this situation indicate that even reinforcements at 138 kV will likely not be adequate in the long term. Various alternatives under consideration include a new Rockdale-West Middleton 345 kV circuit or a new North Madison-West Middleton 345 kV circuit. However, it is recognized that either of these projects, or their equivalents, will take several years to implement and more immediate relief in this area is needed. The preferred alternative for providing such interim relief is to convert the existing Columbia-North Madison 345/138 double circuit line to double circuit 345 kV. Other options considered involved new 138 kV or 345 kV transmission lines on new right-of-way, which would likely impose similar schedule longer term constraints as the 345 kV line options above.

The Columbia-North Madison line conversion project, along with a new 345 kV bus at North Madison and replacing the existing 345/138 kV transformers at North Madison is proposed (2006). In addition, the Kegonsa substation is proposed to be expanded to accommodate interconnecting the Christiana-Fitchburg circuit and the Kegonsa-Femrite voltage conversion project (see below). Both of these projects will improve voltage profiles and relieve heavy line loading on the east side of Madison and through downtown Madison for the next several years, but a new 345 kV circuit to the west side of Madison will eventually be needed to complete the reinforcements necessary to provide reliable long-term service to the area and to provide a source to the 138 kV network in southwest Wisconsin.

A number of projects related to proposed generation additions are planned. Proposed new generation in Rock County will require a number of projects in 2003 and 2004 to avert overloads and address stability issues. The projects completed, under construction or planned to accommodate this generation and associated transmission service requests include:

- uprating the McCue-Sheepskin 69 kV line*
- reconductoring both Christiana-Kegonsa 138 kV circuits and the Blackhawk-Colley Road line
- replacing the 138 kV breakers at Rock River
- constructing a 138 kV switchyard at a new generation site near the existing Rock River plant
- constructing a double circuit 138 kV between the new generation site and the Rock River 138 kV switchyard
- reconfiguring existing 69 kV and 138 kV circuits to form Rock River-Janesville and Rock River-Sunrise 138 kV circuits
- reconductoring the Whitewater-Mukwonago 138 kV line (2003) (see discussion following)
- rebuilding the Kegonsa-McFarland-Femrite 69 kV line to 138 kV, operated initially at 69 kV*
- rebuilding the Femrite-Royster 69 kV line*
- installing capacitor banks at Cross Country, Fitchburg, Kegonsa, Tokay and West Middleton*
- reconductoring the Russell-Rockdale 138 kV line
- rebuilding the Janesville-Russell 138 kV line
- replacing the existing 138/69 kV transformers at Fitchburg*
- constructing a 138 kV bus at Kegonsa
- constructing a Femrite-Sprecher 138 kV line
- converting the Kegonsa-Femrite 69 kV and Sycamore-Sprecher 69 kV lines to 138 kV
- install a 138/69 kV transformer at Femrite
- replacing the existing 345/138 kV transformers at North Madison*
- converting the Columbia-North Madison 138 kV circuit to 345 kV*
- installing a 138/69 kV transformer at Reiner*

As noted in the prior discussion, the projects above depicted by an asterisk will provide load serving benefits as well.

The Whitewater-Mukwonago 138 kV line has been a limiting element to importing power into Wisconsin for years. This line was reconductored in early 2003, raising its rating by about 80%. Because this line traverses several environmentally sensitive areas, ATC has evaluated the feasibility of rerouting the eastern portion of this line and the possibility of serving the area with other transmission alternatives. The analysis of the various alternatives indicated that maintaining a connection between Whitewater and Mukwonago performed better than any of 11 other alternatives considered. ATC plans to work with all interested resource agencies, environmental groups and landowners to identify viable routes.

There are impending low voltages identified on the system in eastern Rock and western Walworth counties and an overload on the Turtle-Bristol 69 kV line under contingency. Converting the existing Turtle-Bristol 69 kV line to 138 kV, which needs to be rebuilt due to its physical condition, but initially operated at 69 kV will remedy this situation. In conjunction with this project, a new line from West Darien through a new Southwest Delavan substation to Delavan is proposed. This project will allow ATC to retire a portion of the existing Turtle-Bristol line, which is routed through an environmentally sensitive area and provide service to a requested T-D interconnection (Southwest Delavan).

In response to customer requests for new distribution interconnections to the transmission system, a 69 kV circuit from Fitchburg through a new Tokay substation to West Towne is planned in 2004.

Zone 4

Summary of Key Findings

- Load growth in Door County will necessitate transmission reinforcements
- The Morgan-Falls-Pioneer-Stiles 138 kV line will need to be rebuilt to address physical conditions issues, avert overloads and to improve transfer capability to and from the Upper Peninsula of Michigan.
- The Morgan-White Clay 138 kV line will need to be reconductored to avert overloads.
- The Stiles-Amberg-Plains double circuit 138 kV line will need to be uprated.
- Additional 138/69 kV transformer capacity in the Sheboygan area is needed.
- Heavy line loads and low voltages in the system west of Appleton and Green Bay will require additional transmission facilities as well as interim measures.

Several line and transformer overloads and low voltages were revealed in Zone 4 based on the 2004 analysis. In addition, there is a need to address heavy flows on certain ATC facilities from Wisconsin to Michigan's Upper Peninsula during non-peak periods.

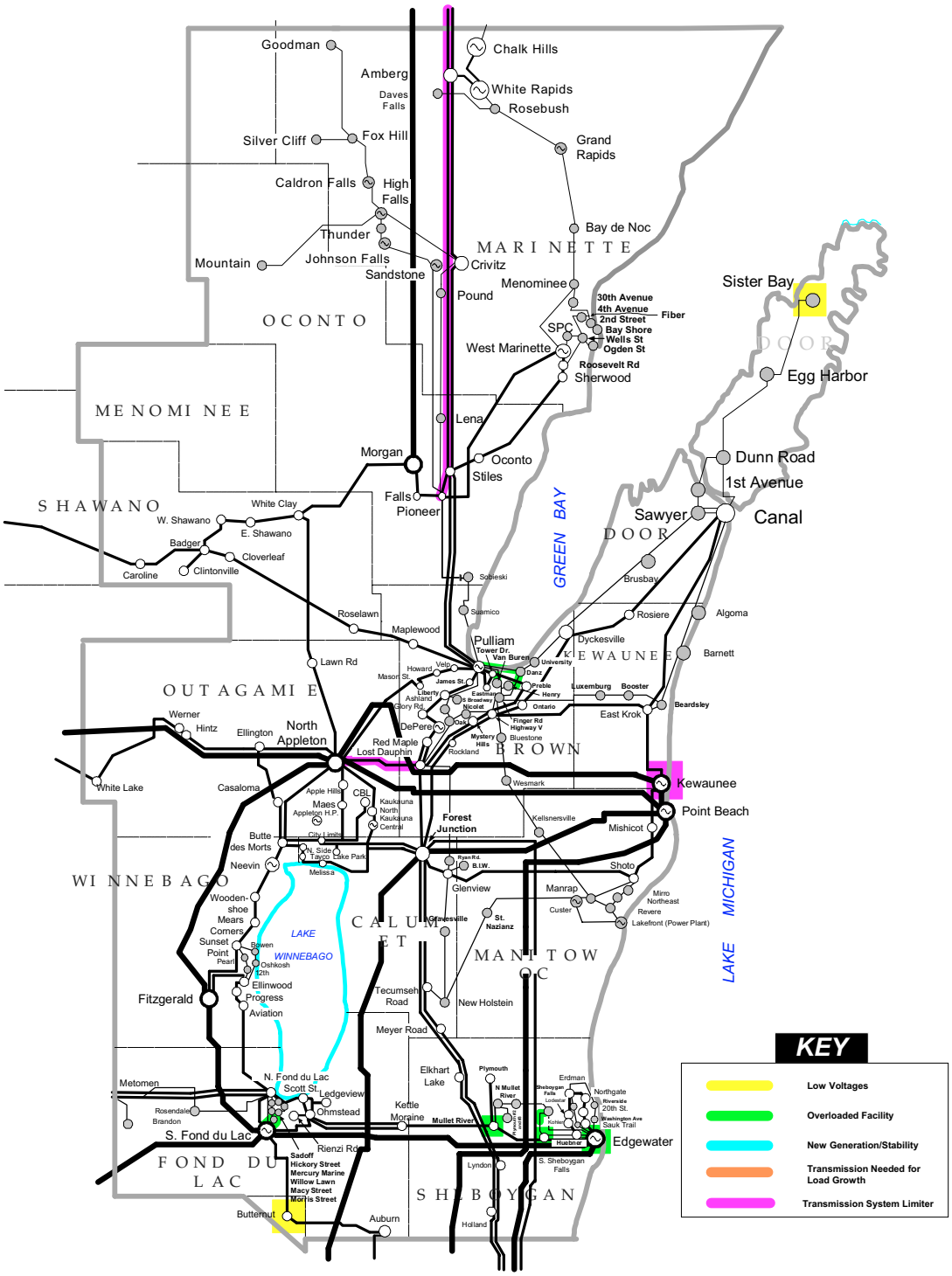
In response to the low voltage violations encountered, a variety of projects have been planned. A new capacitor bank at Canal is planned for 2004, a new 138 kV line from Lodestar to Sheboygan Falls is proposed for 2006 and a new 345/138 kV substation west of the existing Werner substation, Werner West, is proposed for 2006.

The recently completed Forest Junction project, which involves rebuilding the existing 138 kV substation, adding two 345/138 kV transformers, looping the Point Beach-Arcadian 345 kV line into the substation, rebuilding the Forest Junction-Highway V 138 kV line and adding a Forest Junction-Lost Dauphin 138 kV circuit (on existing and rebuilt structures), addresses numerous issues in the Fox River Valley, including improving stability response of the Point Beach units, unloading the Kewaunee and North Appleton transformers and improving operating/maintenance flexibility in the area. The Forest Junction project does not, however, totally resolve the overload issues and TLRs on the 138 kV circuits heading north into Green Bay, nor does it resolve the limitations on power flows to the Upper Peninsula of Michigan, both during non-peak periods. A more robust solution involving either line rebuilds through developed areas in Green Bay and other system reinforcements, or a new transmission line will likely be needed to address these needs. Part of this solution will necessarily involve a rebuild of the Morgan-Falls-Pioneer-Stiles 138 kV line, which is a limiting facility to imports and exports, and which will require replacement due to its condition. This project is slated for completion in late 2004. Another consideration in selecting a solution for these limitations is the heavy line loading on the network west of Green Bay. ATC's proposed alternative that could resolve all of these issues is to construct a 345 kV line from Morgan to an intersection with the Rocky Run-North Appleton 345 kV line to the Werner West substation, with345/138 kV transformation at Werner West (see 2008 Analysis, Zone 4).

There were a number of transformer overloads identified in the 2004 analysis (South Sheboygan Falls, Mullet River and Edgewater). In response, a replacement of the existing 345/138 kV transformer at Edgewater (2005) and constructing a second 69 kV circuit between Mullet River and North Mullet River and the conversion of the 69 kV line from North Mullet River to Plymouth Sub #1 is being implemented (late 2003). A new 2.5 mile 138 kV line from Lodestar to Sheboygan Falls along with a new 138/69 kV transformer at Sheboygan Falls is proposed for 2006.

To address low voltages in northern Door County, a capacitor bank is planned at the Canal substation in 2004. In response to new distribution interconnection requests, a new 138 kV line from Erdman to Howard's Grove is planned in 2006 and a rebuild of a portion of the Pulliam-Suamico 69 kV is planned to be rebuilt as a double circuit 138/69 kV line in 2004.

Figure V-5-1
Zone 4 Performance Criteria Limits Exceeded and Other Constraints
2003-2004



Zone 5

Summary of Key Findings

- Most of the line loading and low voltage issues in Zone 5 are caused by opening bus ties at substations.
- Load growth in Waukesha, Washington and Jefferson counties is driving the need for voltage support.

Several of the facility overloads and low voltages shown in the 2004 analysis were caused by circuit breaker operations. ATC is evaluating alternatives to address the situation at Pleasant Prairie and Bain to mitigate the effects of separating bus sections at Pleasant Prairie. The low voltages resulting from separating bus sections at Concord are symptomatic of more widespread issues in Zones 3 and 5, as discussed below.

There are a number of overloads and low-voltage conditions that are impending and show up in conjunction with certain other projects and in the 2008 analysis. In particular, low voltages, particularly in northern Waukesha County, are expected to be problematic in future years. One near-term solution to these problems is a new 345/138 kV substation at a location called Lannon Junction, east of the Tamarack substation. An additional 345/138 kV substation north of Germantown (St. Lawrence is a possibility) may also be warranted.

The condition of the St. Lawrence-Pleasant Valley-Saukville 138 kV line warrants replacement of the structures. This line will be reconductored as part of the rebuild project in 2008.

A new distribution interconnection request will require that a new 138 kV line be constructed from Sussex through a new substation, Duplainville, and on to Waukesha in 2005. This project will improve the voltage profile in the Sussex area.

Dynamic Stability Analysis

In addition to the dynamic stability analyses ATC has conducted for proposed generation, as described in Section VIII, ATC also conducted stability analysis of its 345 kV network and select existing generating stations. This analysis was limited to simulating three-phase faults throughout the 345 kV network at light load levels.

ATC used an as-built existing system (2004) model with loads at 50% of peak load for conducting this analysis. Table V-9 below lists the fault location, the zone, the critical clearing time (CCT) and the system reinforcements, if any, needed to address low CCTs or generator instability.

As noted in Table V-9, there are four generation sites where the calculated CCT was less than the existing CCT and generators could be expected to go unstable for the fault simulated. At two of these locations, Empire and Christiana, minor protective relay adjustments will effectively address the instability.

At Columbia, plans are being developed to expand the 345 kV switchyard to effectively address the instability issue there. At Weston, expansion of the 345 kV switchyard as part of the Arrowhead-Weston 345 kV line project, as well as the line project itself, will effectively address the instability issue there.

In the interim, operating guides and procedures are being employed to prevent generator instability until the ultimate solutions can be implemented.

Figure V-6-1
Zone 5 Performance Criteria Limits Exceeded and Other Constraints
2003-2004

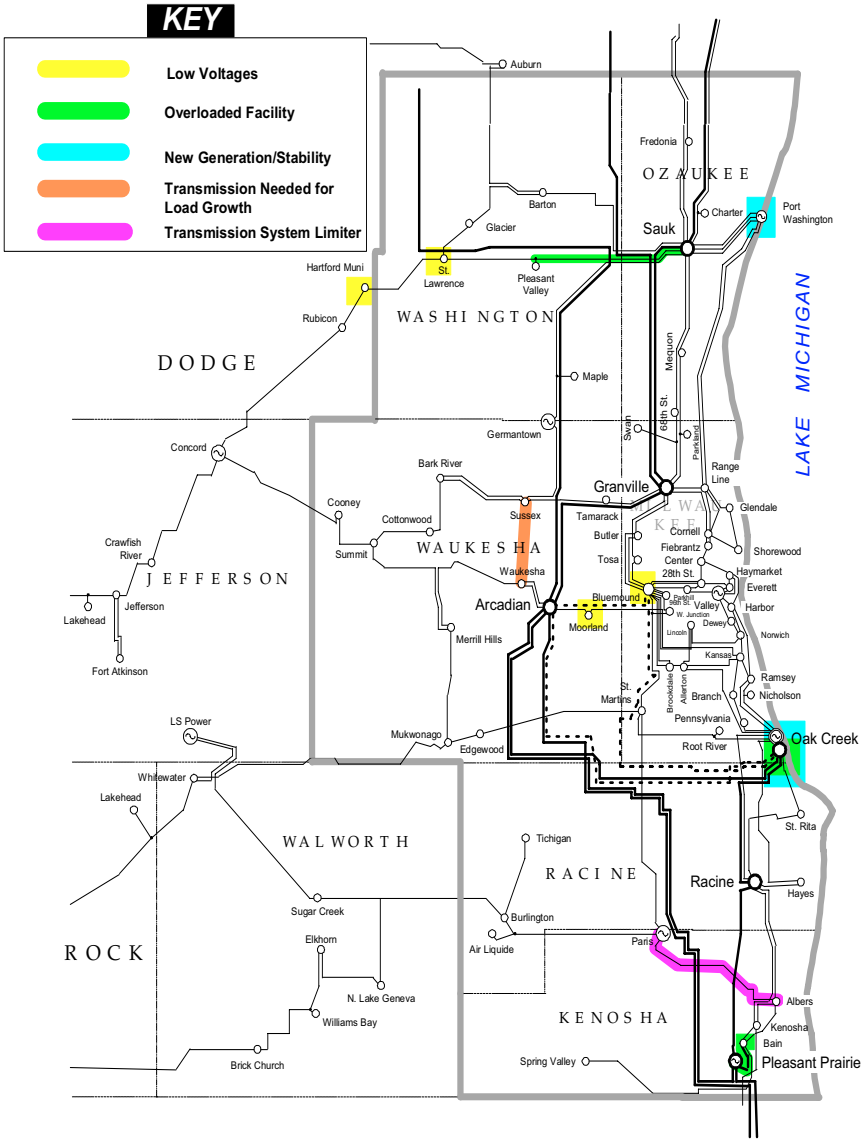


Table V-9 2004 Dynamic Stability Analysis

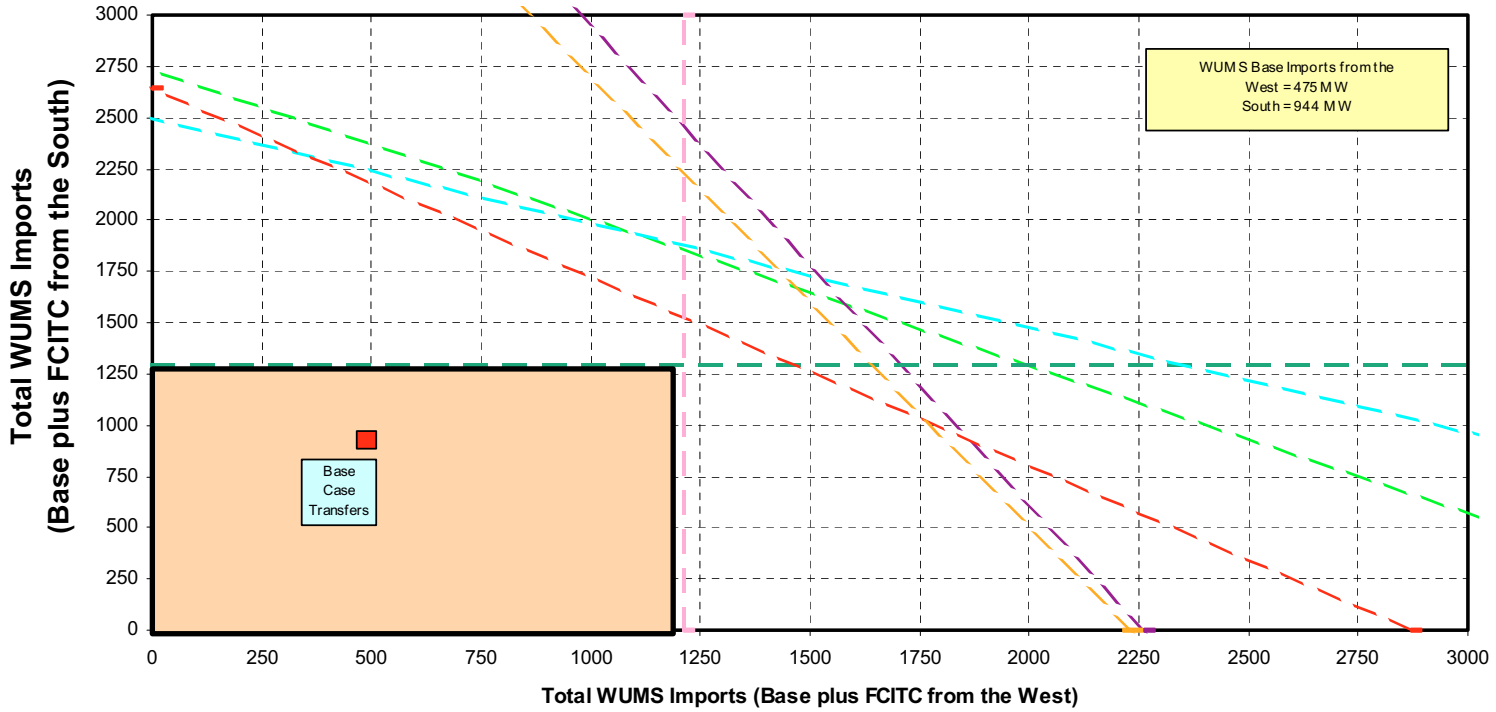
3 Phase Fault - Breaker Failure	Fault Location	Zone	Calculated Critical Clearing Time	Existing Critical Clearing Time	Generators Going Unstable	Required system reinforcements
Columbia - Rockdale 345 kV line	Near Columbia	3	8	12	Columbia Units #1 and #2	Under Study / Plans are being developed
Columbia - S. Fond du Lac 345 kV line	Near Columbia	3	less than 8	12	Columbia Units #1 and #2	Under Study / Plans are being developed
Columbia - N. Madison 345 kV line	Near Columbia	3	less than 8	12	Columbia Units #1 and #2	Under Study / Plans are being developed
Plains - Morgan 345 kV line	Near Plains	2	14	14.65	Empire Unit #1 and #2	New protective relaying and/or fast breakers
Rockdale - Columbia 345 kV line	Near Rockdale	3	15	16	Christiana Unit # 1	New protective relaying and/or fast breakers
Rockdale - Paddock 345 kV line	Near Rockdale	3	14	16	Christiana Unit # 1	New protective relaying and/or fast breakers
Rocky Run - North Appleton 345 kV line	Near Rocky Run	1	13	17	Weston #1, #2 and #3	New protective relaying and/or fast breakers
Rocky Run - Arpin 345 kV line	Near Rocky Run	1	13	17	Weston #1, #2 and #3, Wausau, Alexander, Grandfather	New protective relaying and/or fast breakers
Weston - Rocky Run 345 kV line	Near Weston	1	14	14.5	Weston #1, #2 and #3 and Wausau	New protective relaying and/or fast breakers
Weston 345/115 kV transformer	Near Weston	1	less than 8	16	All generators in the Wausau area (including Weston #1, #2 and #3, Wausau, Alexander, Grandfather)	Rebuild of the Weston 115 kV substation and a second 115/345 kV transformer

Transfer Capability Analysis
ATC conducted cursory transfer capability analyses to provide a relative indication of the simultaneous transfer capability into the ATC system in 2004, assuming ATC is able to implement all of the planned and proposed projects listed in Section VI with projected in service dates of June 2004 or before. This calculation also assumes the base case power transactions throughout the eastern interconnection system that were in the 2004 model discussed in section II of this report. The summary of that analysis is shown in Figure V-7. In Figure V-7, the red box inside the shaded area represents the base transfers modeled in the 2004 case used. The shaded area represents the total transfer capability into the ATC system based on the cursory analyses performed. Total simultaneous transfer capability can be determined by selecting a transfer level from either the west (horizontal axis) or the south (vertical axis) below the first limiting element (dashed lines) and drawing a straight line to the limit (dashed line) for the other direction. For instance, for a 1,000 MW transfer from the west, the maximum transfer achievable from the south is 1,250 MW, or a total transfer capability of 2,250 MW.

It is important to note that the simultaneous transfer capability depicted in Figure V-7 is a relative indication of transfer capability and not necessarily an indication of what is commercially available. The simultaneous transfer capability information in this Assessment was developed by reducing generation within ATC's service territory and increasing generation in surrounding regions to model imports and then identifying limiting transmission facilities per generally accepted industry criteria. ATC assumed that the distribution of power flow across an overloaded transmission facility for a particular transaction must exceed 3% to be considered a contributor to an overload of that facility. ATC also assumed there was a linear relationship between the limits to transfers from the west and transfers from the south which result in straight lines between the end points. In reality, the relationship is not necessarily linear, so the actual limitations between the end points are likely to vary from what is shown.

The transfer capability graph shows that the transfer capability ranges from about 1,200 MW to about 2,400 MW, depending on the bias of the transfers. The most limiting element for transfers from the west is the Wheaton-Eau Claire 161 kV line, which limits transfers from the west to about 1,200 MW. The most limiting element for transfers from the south is the Paris-St. Martins 138 kV line for an outage of the Pleasant Prairie-Racine 345 kV line, which limits transfers from the south to about 1,250 MW.

Figure V-7
WUMS Simultaneous Import Capabilities from the 2004 Summer Model
(Based on all Facilities Monitored)



Blackhawk-Colley Rd 138 kV	for outage of Paddock-Rockdale 345 kV	
Eau Claire-Arpin 345 kV Flow Limit	for outage of N/A	
Center-Fiebrantz 138 kV	for outage of Arcadian-Granville 345 kV	
Lore-Turkey River-Cassville 161 kV	for outage of Wempletown-Paddock 345 kV and Kaiser-Lancaster 69 kV	
Pleasant Prairie-Racine 345 kV	for outage of Wempletown-Paddock 345 kV and Kaiser-Lancaster 69 kV	
T Corners-Wien 115 kV	for outage of loss of Eau Claire-Arpin 345 kV and Op Guide Implemented	
Wheaton-Eau Claire 161 kV	for No outage	
Paddock 345/138 kV Tr.	for outage of Paddock-Rockdale 345 kV	
Paris-St Martins 138 kV	for outage of Pleasant Prairie-Racine 345 kV	

2008 Summer Peak and Shoulder (steady-state) Analysis

The system performance criteria limits exceeded and other system needs shown in the 2008 base and contingency cases are listed in Table V-3, along with the magnitude of the exceeded limit, as applicable, and the cause of the limits being exceeded.

Discussion of Alternative Solutions
In developing a transmission plan based on the results of the 2008 analyses, it was assumed that the many of the primary solutions to needs identified in the 2004 analyses would be in service. However, to determine whether certain needs or impending problems are amplified in the future, certain solutions were left out of the 2008 base cases to confirm the need for the solution. Also, depending on the severity of the overloads or low voltages encountered in 2008 that were not encountered in 2004, solutions for those problems were planned for years prior to 2008 so as to minimize risk. Following is a brief discussion of the criteria limits that were exceeded and the rationale behind the project alternatives selected to be included in this Assessment.

Zone 1

Summary of Key Findings
- The Rhinelander Loop will require additional reinforcement prior to and sometime after 2008. One alternative, a 138 kV line from Cranberry to Conover combined with the conversion of the Conover-Iron River-Plains 69 kV system to 138 kV, would provide adequate support for the Loop through approximately 2015, but it is anticipated that an additional source to the Loop will be needed at some point beyond the current planning horizon.
- Low voltages and overloaded 115 kV facilities in and around the Wausau area will require that a combination of reinforcements be implemented.

Similar to the 2004 results, there were a number of facilities overloaded and several others were near their emergency ratings within Zone 1. After the completion of the short-term Rhinelander Loop projects, low voltages begin to reappear in the Rhinelander Loop. Under single contingency conditions, impending low voltages are seen throughout the zone including the Wausau area.

As discussed in the 2004 analysis, ATC's preferred alternative to address the low voltages within the Rhinelander Loop is to construct a Cranberry-Conover 138 kV line in combination with the rebuilding of the Conover-Iron River-Plains 69 kV line and converting to 138 kV operation. This alternative not only addresses intermediate reliability needs of the Rhinelander Loop, but it provides substantial voltage support to the 69 kV system in the western portion of the Upper Peninsula. Refer to the 2004 analysis discussion for additional details outlining the alternatives that were evaluated to address this issue.

In the 2008 timeframe, several 115 kV lines in the Wausau area are either overloaded or are approaching their emergency ratings. To address these overloads, the two parallel Weston-Sherman St. 115 kV lines and the Weston-Kelly 115 kV line will need to be uprated. The scopes of these projects are still under development, but at a minimum will require upgrading the terminal facilities and increasing the conductor to its maximum operating temperature. An addition, two 115 kV lines in the Wausau area are near their emergency ratings. The Sherman St-Hilltop-Maine 115 kV line and the Weston-Black Brook 115 kV line will need to be uprated. Both lines will require the upgrading of terminal equipment along with some conductor replacements.

To address low voltages and overloads elsewhere within Zone 1, an additional capacitor bank will be needed at the Ripon 69 kV substations in 2008. To address facility overloads, a new 69 kV line from Fitzgerald to the Omro Industrial substation is needed, the 138/69 kV transformers at Sigel and Metomen will need to be upgraded, and the Wautoma-Berlin 69 kV and Whitcomb-Deer Trail 69 kV lines need to be uprated by replacing their terminal equipment.

In response to a new distribution interconnection request, a new distribution substation near Boulder Junction will require that a new 115 kV line be constructed from the existing St. Germain substation to the Boulder Junction area.

Figure V-2-2
Zone 1 Performance Criteria Limits Exceeded and Other Constraints
2004-2008

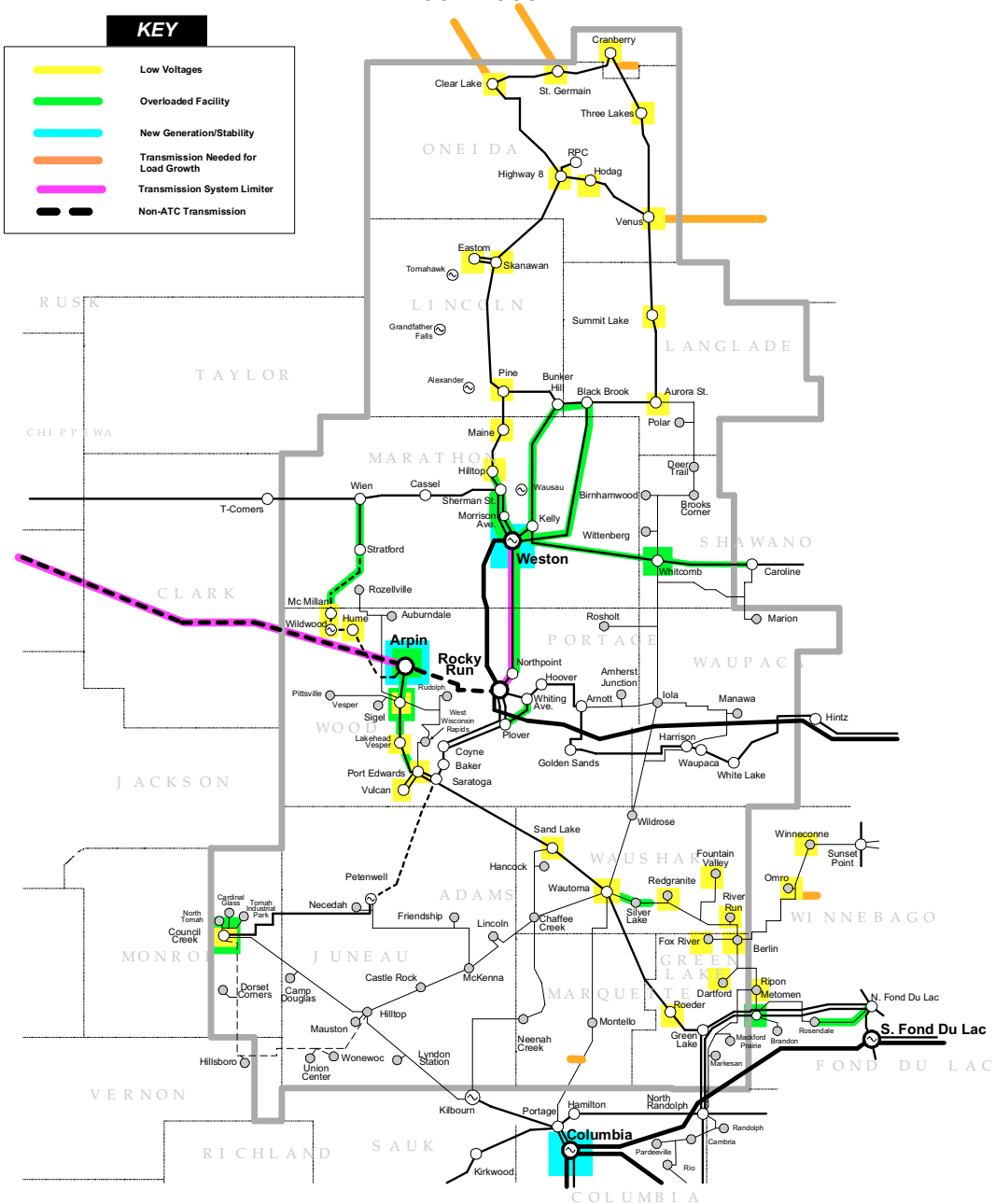


TABLE V-3 PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS - 2008

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
1	Bunker Hill – Black Brook 115 kV line	102%		Weston - Black Brook 115 kV line outage	Load Serving
1	Rhinelander Loop 115 kV bus voltages		< 90%	Various Outages	Load Serving
1	Weston – Black Brook 115 kV line	107%		Hilltop - Sherman St. 115 kV line outage Hilltop – Maine 115 kV line outage Maine – Pine 115 kV line outage	Load Serving
1	Weston – Kelly 115 kV line	119%		Hilltop - Sherman St. 115 kV line outage Hilltop – Maine 115 kV line outage Maine – Pine 115 kV line outage Weston – Black Brook 115 kV line outage	Load Serving and Network
1	Kelly – Bunker Hill 115 kV line	98%		Hilltop - Sherman St. 115 kV line outage	Load Serving
1	Weston – Sherman St. 115 kV line	127%		Weston – Morrison Ave. 115 kV line outage Morrison Ave. – Sherman St. 115 kV line outage	Load Serving and Network
1	Weston – Morrison Ave. 115 kV line	117%		Weston – Sherman St. 115 kV line outage	Load Serving and Network
1	Morrison Ave. – Sherman St. 115 kV line	116%		Weston – Sherman St. 115 kV line outage	Load Serving and Network
1	Hilltop – Sherman St. 115 kV line	100%		Weston – Kelly 115 kV line outage Weston – Black Brook 115 kV line outage	Load Serving and Network
1	Hilltop and Maine 115 kV bus voltages		< 90%	Hilltop - Sherman St. 115 kV line outage Hilltop – Maine 115 kV line outage	Load Serving and Network
1	Sigel 138/69 kV transformer	124%		Arpin – Rocky Run 345 kV line outage Sigel – Lakehead Vesper 138 kV line outage Young Rd – Lakehead Vesper 138 kV line outage Port Edwards – Young Rd. 138 kV line outage	Load Serving and Network
1	Sigel – Arpin 138 kV line	126%		Arpin – Rocky Run 345 kV line outage	Off Peak Load Serving and Network
1	Sigel, Lakehead Vesper, Young Rd. and Port Edwards 138 kV bus voltages		91 - 92%	Sigel – Arpin 138 kV line outage	Load Serving
1	Okray - Plover 115 kV line	107%		Rocky Run – Whiting Ave. 115 kV line outage	Off Peak Load Serving and Network
1	Okray – Whiting Ave. 115 kV line	101%		Rocky Run – Whiting Ave. 115 kV	Off Peak Load Serving and Network
1	Wien – Stratford 115 kV line	114%		Arpin 138/115 kV Transformer outage Arpin – Powers Bluff 115 kV line outage Powers Bluff – Hume 115 kV line outage	Load Serving and Network
1	Stratford – McMillan 115 kV line	110%		Arpin 138/115 kV Transformer outage Arpin – Powers Bluff 115 kV line outage Powers Bluff – Hume 115 kV line outage	Load Serving and Network
1	McMillan, Wildwood, Hume, and Powers Bluff 115 kV bus voltages		< 90%	Arpin 138/115 kV Transformer outage Arpin – Powers Bluff 115 kV line outage Hume – Powers Bluff 115 kV line outage	Load Serving
1	Wautoma and Sand Lake 138 kV bus voltages		91 – 95%	Base Case Sigel – Arpin 138 kV line outage Port Edwards – Sand Lake 138 kV line outage Green Lake – Roeder 138 kV line outage	Load Serving
1	Roeder 138 kV bus voltage		91%	Green Lake – Roeder 138 kV line outage	Load Serving

TABLE V-3 PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2008 (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
1	Wautoma – Spring Lake 69 kV line	100%		Metomen – Ripon 69 kV line outage N Ripon Tap – Ripon 69 kV line outage	Load Serving
1	Metomen 138/69 kV transformer	111%		N Fond du Lac - Rosendale 69 kV line outage Metomen – Rosendale 69 kV line outage Winneconne – Sunset Point 69 kV line outage	Load Serving
1	N. Fond du Lac – Rosendale 69 kV line	97%		Metomen 138/69 kV Transformer outage	Load Serving
1	Berlin area 69 kV bus voltages		< 90%	Metomen - Ripon 69 kV line outage Winneconne - Sunset Point 69 kV line outage	Load Serving
1	Berlin area 69 kV bus voltages		90 – 92%	N Ripon Tap - Ripon 69 kV line outage Metomen – Ripon 69 kV line outage Wautoma – Spring Lake 69 kV line outage	Load Serving
1	Council Creek 138 kV bus voltage		81 - 95%	Base Case Council Creek – Petenwell 138 kV line outage Saratoga - Petenwell 138 kV line outage	Load Serving
1	Council Creek 138/69 kV Transformer	135%		Eau Claire – Arpin 345 kV line outage	Load Serving and Network
1	Arpin 345/138 kV Transformer	108%		Arpin – Rocky Run 345 kV line outage	Off Peak Load Serving and Network
1	Sigel – Lakehead Vesper 138 kV line	106%		Arpin – Rocky Run 345 kV line outage	Off Peak Load Serving and Network
1	Lakehead Vesper – Young Road 138 kV line	105%		Arpin – Rocky Run 345 kV line outage	Off Peak Load Serving and Network
1	Young Road – Port Edwards 138 kV line	105%		Arpin – Rocky Run 345 kV line outage	Off Peak Load Serving and Network
1	Weston - Dewey 115 kV line	109%		Weston – Rocky Run 345 kV line outage	Off Peak Load Serving and Network
1	Dewey - Northpoint 115 kV line	108%		Weston – Rocky Run 345 kV line outage	Off Peak Load Serving and Network
1	Kelly – Whitcomb 115 kV line	116%		N Appleton 345/138 kV Transformer #3 N Appleton-Rocky Run 345 kV line outage Weston – Rocky Run 345 kV line outage	Off Peak Load Serving and Network
1	Whitcomb – Caroline 115 kV line	96%		N Appleton 345/138 kV Transformer #3	Off Peak Load Serving and Network
1	Whitcomb 115/69 kV Transformer	103%		Whitcomb – Caroline 115 kV line outage	Off Peak Load Serving and Network
2	Mass, Watersmeet, Conover, Bruce Crossing, Land O Lakes, Twin Lakes 69 kV bus voltages		87-91%	Mass - UPPCO Mass 69 kV line outage	Load Serving
2	Watersmeet, Bruce Crossing, Land O Lakes 69 kV bus voltages		90-92%	Mass- Bruce Crossing 69 kV line outage	Load Serving
2	Lincoln, 69 kV bus voltage		91%	Iron River-UPP Tap 69 kV line outage	Load Serving
2	Brevort, Lakehead, Hiawatha 138 kV bus voltages		88%	Straits - Brevort 138 kV line outage	Load Serving
2	Lakehead, Hiawatha 138 kV bus voltages		89%	Brevort-Lakehead 138 kV line outage	Load Serving
2	Hiawatha 138 kV bus voltage		90-92%	Lakehead-Hiawatha 138 kV line outage Valley-Glen Jenks 69 kV line outage Straits-McGulpin 138 kV Ckt #1 line outage Straits-McGulpin 138 kV Ckt #3 line outage	Load Serving

TABLE V-3 PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2008 (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
2	Hiawatha, Lakehead 138 kV bus voltages		91-92%	Glen Jenks-Indian Lake 69 kV line outage	Load Serving
2	Winona, Atlantic, M-38 138 kV bus voltages		90-92%	M-38 - Perch Lake 138 kV line outage	Load Serving
2	Mass, Watersmeet, Bruce Crossing, Land O Lakes 69 kV bus voltages		89-92%	Mass - UPPCO Mass 69 kV line outage	Off-Peak Load Serving
2	Bruce Crossing 69 kV bus voltage		90%	Mass-Bruce Crossing 69 kV line outage	Off-Peak Load Serving
2	Cornell-Chandler 69 kV line	122-121%		Empire-Forseyth 138 kV line outage Plains-Arnold 138 kV line outage	Off-Peak Load Serving
2	Indian Lake-Valley 69 kV line Valley-Blaney Park 69 kV line Blaney Park-Curtis 69 kV line Curtis-Gould City 69 kV line Gould City-Hiawatha 69 kV line	159-97%		Hiawatha-Gould City 69 kV line outage Gould City-Curtis- 69 kV line outage Curtis-Blaney Park 69 kV line outage Blaney Park-Valley 69 kV line outage Valley-Glen Jenks 69 kV line outage Glen Jenks-Indian Lake 69 kV line outage	Off-Peak Load Serving
2	Brevort 138 kV bus voltage		90%	Straits-Brevort 138 kV line outage	Off-Peak Load Serving
2	Hiawatha 138 kV bus voltage		90-91%	Straits - Brevort 138 kV line outage Lakehead-Hiawatha 138 kV line outage Brevort-Lakehead 138 kV line outage	Off-Peak Load Serving
2	Lakehead 138 kV bus voltage		90-91%	Straits - Brevort 138 kV line outage Brevort-Lakehead 138 kV line outage	Off-Peak Load Serving
2	Indian Lake 138 kV bus voltage		91-92%	Plains-Arnold 138 kV line outage Perkins-Indian Lake Ckt1 line outage Perkins-Indian Lake Ckt2 line outage	Off-Peak Load Serving
3	North Madison 138/69 kV transformer	95-97%		North Madison - American SS - Yahara River 138 kV line outage	Load Serving
3	Rock River 138/69 kV transformer	96-101%		Blackhawk 138/69 kV transformer outage Colley Road - Dickinson 138 kV line outage	Load Serving
3	Brick Church - Zenda 69 kV line	112%		North Lake Geneva - Lake Geneva 69 kV line outage	Load Serving
3	Paddock - Shirland Avenue 69 kV line	110%		Colley Road 138/69 kV transformer outage	Load Serving
3	Colley Road 138/69 kV transformer	98-108%		Paddock - Shirland Ave. 69 kV line outage Paddock 138/69 kV transformer outage Colley Road - Dickinson 138 kV line outage	Load Serving
3	Colley Road - Brick Church 69 kV line	97%		Colley Road - Dickinson 138 kV line outage	Load Serving
3	Rock River - Turtle 69 kV line	97%		Colley Road - Dickinson 138 kV line outage	Load Serving
3	Brick Church 138/69 kV transformer	97%		Dickinson - Brick Church 138 kV line outage	Load Serving
3	Blackhawk 138/69 kV transformer	109%		Rock River 138/69 kV transformer outage	Load Serving
3	Verona - Oregon 69 kV line	100%		Oregon - Stoughton 69 kV line outage	Load Serving
3	North Stoughton - Kegonsa 69 kV line	102%		McCue - LaMar 69 kV line outage	Load Serving
3	Academy 138/69 kV transformer	96%		North Randolph - Fox Lake 138 kV line outage	Load Serving

TABLE V-3 PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2008 (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
3	West Middleton - Stagecoach 69 kV line	98%		Spring Green 138/69 kV transformer outage	Load Serving
3	Galena 138/69 kV transformer (DPC Facility)	96%		Paddock - Wempletown 345 kV line outage	Load Serving
3	North Madison - Waunakee 69 kV line	109%		North Madison - American SS - Yahara River 138 kV line outage	Off Peak Load Serving
3	North Madison 138/69 kV transformer	107%		North Madison - American SS - Yahara River 138 kV line outage	Off Peak Load Serving
3	West Middleton - Blackhawk 69 kV line	116%		North Madison - American SS - Yahara River 138 kV line outage	Off Peak Load Serving
3	Walnut - Blackhawk 69 kV line	101%		North Madison - American SS - Yahara River 138 kV line outage	Off Peak Load Serving
3	Wingra - Fitchburg 69 kV line	102%		North Madison - American SS - Yahara River 138 kV line outage	Off Peak Load Serving
3	Lake Geneva, Twin Lakes, Katzenberg, South Lake Geneva 69 kV bus voltages		85-87%	North Lake Geneva to Lake Geneva 69 kV Line outage	Load Serving
3	Muscoda, Avoca, Spring Green, Lone Rock, Arena, Mazomanie 69 kV bus voltages		88-90%	Spring Green 138/69 kV transformer outage Spring Green - Lone Rock 69 kV line outage Spring Green - Arena 69 kV line outage	Load Serving
3	Aaker Road (Stoughton), Oregon, Brooklyn, Stoughton, North Stoughton, Verona 69 kV bus voltages		78-91%	Stoughton - Aaker Road 69 kV line outage Oregon - Aaker Road 69 kV line outage North Stoughton - Stoughton 69 kV line outage Kegonsa 138/69 kV transformer outage	Load Serving
3	Stagecoach, Mazomanie, Mount Horeb, Black Earth, Cross Plains 69 kV bus voltages		89-91%	Timberline - West Middleton 69 kV line outage	Load Serving
3	AGA (LCI), Pflaum 69 kV bus voltages		91%	Royster - Pflaum Tap 69 kV line outage	Load Serving
3	Concord 138 kV Bus 6, Rubicon 138 kV bus voltages		85-87%	Concord Bus 6 - Bus 5 Bus tie outage	Load Serving
3	Eden, Lancaster, Spring Green, Wyoming Valley 138 kV Bus Voltages		88-90%	Nelson Dewey - Lancaster 138 kV line outage	Load Serving
3	Williams Bay, Brick Church, Elkhorn, Dickinson, North Lake Geneva 138 kV bus voltages		87-90%	Colley Road - Brick Church 138 kV line outage	Load Serving
3	Cambridge, London, Boxelder, Stonybrook, Lakehead Pumping, Academy 138 kV bus voltages		88-90%	Rockdale - Cambridge Tap 138 kV line outage	Load Serving
3	North Beaver Dam and Fox Lake 138 kV bus voltages		83%	North Randolph - Fox Lake 138 kV line outage	Load Serving
3	Pine River, Richland Center, Richland, Eagle (DPC) 69 kV bus voltages		89-91%	Pine River - Richland Center 69 kV line outage	Load Serving
3	Lewiston 69 kV, Lewiston and Kilbourn 138 kV bus voltages		91%	Trienda - Lewiston 138 kV line outage	Load Serving
3	Fall River 69 kV bus voltage		88%	Academy - Fall River Tap 69 kV line outage	Load Serving
3	Kilbourn and Lyndon Station 69 kV bus voltages		90%	Kilbourn 138/69 kV transformer outage	Load Serving
3	Juneau, Horicon, Horicon Ind. Park and Hustiford 69 kV bus voltages		89-90%	South Beaver Dam - Juneau 69 kV line outage	Load Serving
3	Monroe, Idle Hour, Monticello, South Monroe, Belleville, New Glarus, etc. 69 kV bus voltages		89-91%	North Monroe 138/69 kV transformer outage N Monroe - Idle Hour 69 kV line outage N Monroe - Monticello 69 kV line outage	Load Serving

TABLE V-3 PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2008 (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
3	Burke and East Towne 69 kV bus voltages		91%	North Madison - ABS 138 kV line outage	Off Peak Load Serving
3 and 4	South Fond du Lac-Oakfield 69 kV line	98%		South Beaver Dam-Juneau 69 kV line outage	Load Serving
4	Goodman 69 kV bus voltage		92%	Crivitz-High Falls 69 kV line outage	Load Serving
4	Mountain 69 kV bus voltage		91%	Crivitz-High Falls 69 kV line outage	Load Serving
4	S Sheboygan Falls 138/69 kV Transformer	103-98%		Edgewater-Sheboygan Falls 69 kV line outage Mullet River 138/69 kV transformer outage Mullet River-N. Mullet River 69 kV line outage	Load Serving
4	Edgewater 138/69 kV Transformer #1	101-96%		Edgewater 138/69 kV transformer #2 outage S Sheboygan Falls 138/69 kV transformer outage S. Sheboygan Falls-BemisTap 69 kV line outage Erdman 138/69 kV transformer outage	Load Serving
4	Edgewater 138/69 kV Transformer #2	101-95%		Edgewater 138/69 kV transformer #1 outage S Sheboygan Falls 138/69 kV transformer outage S. Sheboygan Falls-Bemis Tap 69 kV line outage Erdman 138/69 kV transformer outage Edgewater-Sheboygan Falls 69 kV line outage	Load Serving
4	Danz-Henry Street 69 kV line	97%		Pulliam-Van Buren 69 kV line outage	Load Serving
4	Canal 138/68 kV transformer #1	97%		Canal 138/68 kV transformer #2 outage	Load Serving
4	Canal 138/68 kV transformer #2	97%		Canal 138/68 kV transformer #1 outage	Load Serving
4	N Fond du Lac-East Scott Tap 138 kV line	110%		N Fond du Lac-S Fond du Lac 138 kV line outage	Load Serving
4	Sister Bay 69 kV bus voltage		91-92%	First Ave-Sawyer 69 kV line outage Canal-Dunn Rd 69 kV line outage Highway V-Ontario 138 kV line outage East Krok-Canal 138 kV line outage Kewaunee-East Krok 138 kV line outage	Load Serving
4	Butternut 138 kV bus voltage		91%	S Fond du Lac-Butternut 138 kV line outage	Network
4	Crivitz-High Falls 69 kV line	99%		Pioneer-Sandstone 69 kV line outage	Load Serving
4	Pioneer-Sandstone 69 kV line	104%		Crivitz-High Falls 69 kV line outage	Load Serving
4	Sunset Point-Pearl Avenue 69 kV line	102%		Ellinwood-12th Avenue 69 kV line outage	Load Serving
4	Ellington-N Appleton 138 kV line	104%		Butte des Morts-Casaloma 138 kV line outage	Load Serving
4	Ellinwood 138/69 kV Transformer	99%		Fitzgerald-Sunset Point 138 kV line outage	Load Serving
4	N Appleton 345/138 kV transformer #3	104%		N Appleton 345 kV bus tie 2-3 outage	Off-Peak Load Serving and Network
4	Morgan-White Clay 138 kV line	95%		Pulliam-Stiles 138 kV Ckt #1 line outage Pulliam-Stiles 138 kV Ckt #2 line outage	Off-Peak Load Serving and Network
4	Highway V-Preble 138 kV line	95%		Lost Dauphin-Red Maple 138 kV line outage	Off-Peak Load Serving and Network

TABLE V-3 PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2008 (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
4	Caroline-Badger 115 kV line	101-99%		N Appleton-Rocky Run 345 kV line outage and N Appleton-Pt Beach 345 kV line outage and N Appleton 345/138 kV transformer #3 outage N Appleton-Rocky Run 345 kV line outage	Off-Peak Load Serving and Network
5	Pleasant Prairie – Bain 345 kV line	176.4%		Splitting Pleasant Prairie 345 kV bus sections 3 and 4	Load Serving and Network
5	Tichigan and Burlington 138 kV bus section #1		89.8%	Splitting Burlington 138 kV bus	Load Serving and Network
5	Burlington 138 kV area voltages		87-88%	Paris-Air Liquide-Burlington 138 kV line outage	Load Serving and Network
5	Pleasant Valley – Saukville 138 kV line	121.7%		Splitting Concord 5 and 6	Load Serving and Network
5	Pleasant Valley-St. Lawrence 138 kV line	101.8		Splitting Concord 5 and 6	Load Serving and Network
5	Arcadian 4 – Waukesha 1 138 kV line	103.2%		Arcadian 6 – Waukesha 3 138 kV line outage	Load Serving and Network
5	Moorland 138 kV bus voltage		88.8%	Arcadian – Moorland 138kV line outage	Load Serving and Network
5	Oak Creek-Ramsey 138 kV line	104.5%		Oak Creek – Pennsylvania 138 kV line outage	Load Serving and Network
5	Oak Creek 230/138 kV transformer	101.1%		Oak Creek 345/138 kV transformer outage	Load Serving and Network

Zone 2

Summary of Key Findings

- Construction of a second Hiawatha-Straits 138 kV circuit will improve 138 kV voltage profiles in the eastern Upper Peninsula of Michigan and complete two 138 kV circuits across the Upper Peninsula
- Reconductoring or rebuilding the Plains-Stiles double circuit 138 kV line are potential solutions being considered to reduce the limitations to granting transmission service between the Upper Peninsula and Wisconsin, improving the Upper Peninsula/Wisconsin transfer capability.
- The construction of a new Cranberry-Conover 138 kV line and conversion of Conover-Iron River-Plains 69 kV system to 138 kV addresses low voltages for the foreseeable future in western Upper Peninsula (see Zone 1, 2004 Summary of Key Findings)

Converting some of the Conover-Plains 69 kV system to 138 kV will be needed to provide another transmission source to the Rhinelander Loop and, along with capacitor banks, will help address low-voltage conditions in western Upper Peninsula (See 2004 Analysis, Zone 1 discussion)

Installation of the second circuit on the planned rebuild of the Hiawatha-Indian Lake line (2005) along with conversion of the operating voltage of both circuits to 138 kV is planned for 2009. This project will improve voltage profiles in the central Upper Peninsula, address the TLRs experienced on this line and complete the "conduit" through to Hiawatha. This project is planned to be completed once the Hiawatha-Pine River-Straits projects discussed below have been completed.

Continued growth in the eastern Upper Peninsula is projected to cause low voltages at some 138 kV substations. Rebuilding the existing 69 kV circuits from Hiawatha through Pine River to Straits and converting these to 138 kV operation, along with the installation of a 138/69 kV transformer at Pine River and the installation of a second 138/69 kV transformer at Straits, will provide a system that will help deal with a variety of issues in the future, including the completion of a 138 kV "conduit" through the Upper Peninsula.

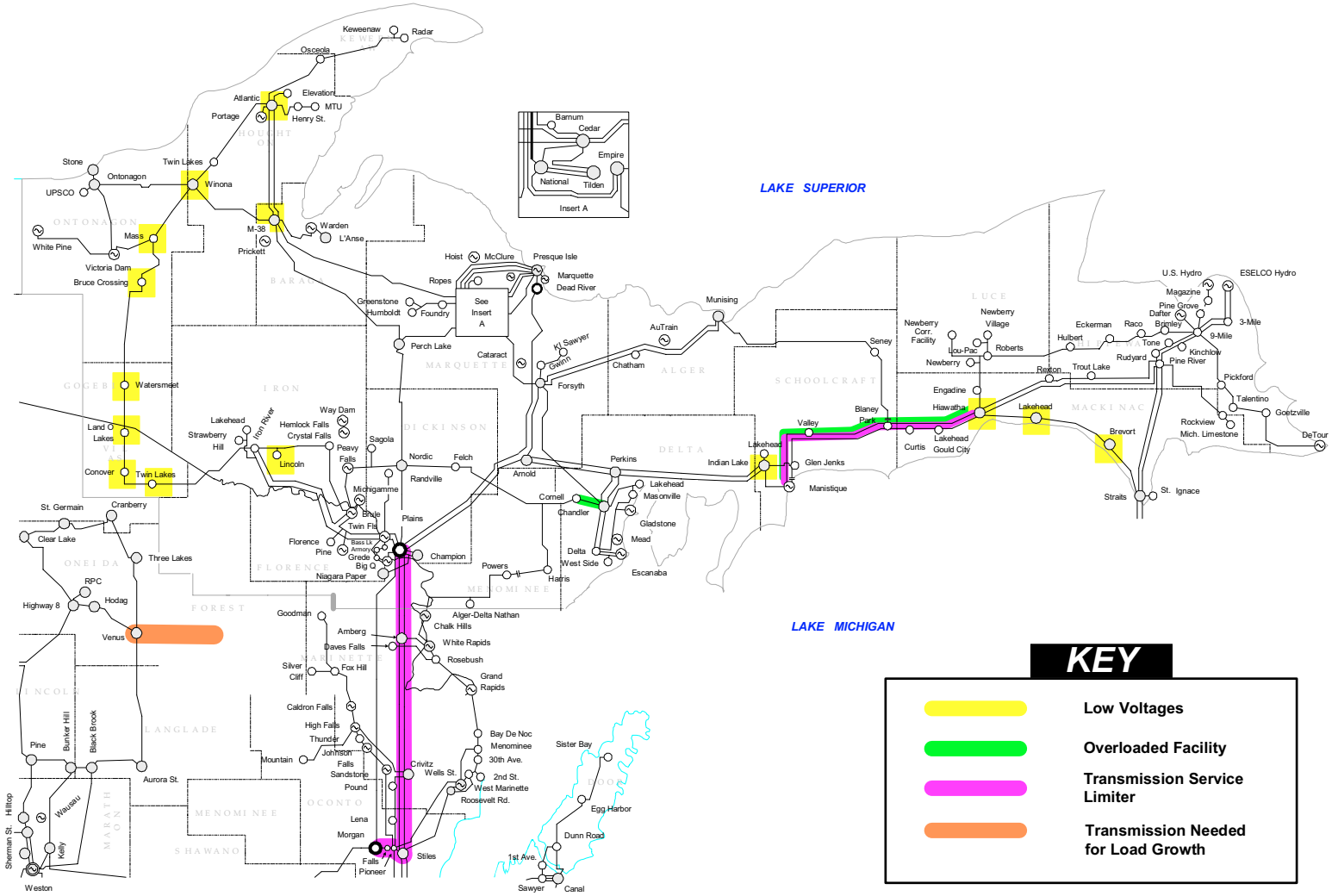


Figure V-3-2
Zone 2 Performance Criteria Limits Exceeded and Other Constraints
2004-2008

Zone 3

Summary of Key Findings

- The West Middleton to Verona to Kegonsa 69 kV network will need additional reinforcements by 2009. One alternative is a new 69 kV line between Brooklyn and Belleville substation.
- Walworth and Kenosha counties will require additional support to accommodate several T-D interconnections, to mitigate impending overloads on various facilities and to support voltages at numerous substations under contingency. Two conversions of lines from 69 kV to 138 kV are proposed to resolve these problems.
- Overloads on 69 kV lines and 138/69 kV transformers in Rock County are impendent by 2008. Some smaller scale projects are proposed to resolve these problems. The 69 kV system in Rock County needs to be monitored to determine if a more robust solution in the area is warranted beyond 2008.
- The 138 kV line from Nelson Dewey to Columbia will require voltage support from other areas adjacent to this line. Projects are planned to address these problems that include several voltage conversions and a major new transmission line to the west side of Madison.
- The numerous low voltages and line overloads and the potential for voltage collapse in the Madison area signal the need for a new 345 kV source on the west side of Madison.
- Impending low voltages along the Illinois border signal the need for reinforcements along the 138 kV system in the area.
- Low voltages at/near Richland Center signal the need for reinforcements in that area.

Several line and transformer overloads and numerous pockets of low voltage were identified in Zone 3. Import capability from the areas to the south and southwest of Zone 3 continues to be a major concern and is being addressed in the Southern Zones Umbrella Plan discussed later in this Section. The addition of 345 kV facilities is proposed to increase imports into the ATC system through Zone 3 and resolve load serving area problems in Dane and Rock Counties.

High load growth in southern Dane County has resulted in low voltages and pending overloads on the transmission facilities feeding the Verona, Oregon and Stoughton areas. Even with the addition of a 138 kV line into Verona (2007) and capacitor bank upgrades at Verona and Oregon (2004, 2006), the voltages in this area continue to be a concern. In addition, as discussed later in this report, the Verona to Oregon 69 kV line is approaching an overload under contingency in 2012. A new 69 kV line from Brooklyn to Belleville will adequately address these problems and will provide network service to Brooklyn which is currently fed from a radial line out of the Oregon substation.

The 138 kV line from Nelson Dewey to Columbia will require voltage support in the 2009 timeframe. Due to the length of this line and the high load growth in Sauk County, the voltage profile along this 138 kV line is an ongoing concern. Several projects are planned to address these problems including: the conversion of the West Middleton to Spring Green line from 69 kV to 138 kV, the conversion of the Hillman to Eden line from 69 kV to 138 kV and the construction of a new 345 kV line from Rockdale to West Middleton substation along with voltage transformations at strategic locations along the way. The Rockdale to West Middleton 345 kV line is also required to provide voltage stability support for the entire Madison area. This project is part of the Southern Zones Umbrella Plan (see this discussion in Section V).

The Walworth County area is experiencing high load growth, especially in the Delavan and Lake Geneva areas. This load growth is causing several problems on the transmission system in this area. Extension of 138 kV from North Lake Geneva to South Lake Geneva resolves the Lake Geneva area problems; however, additional loading problems on the Brick Church transformer and load growth along the Illinois border in Wisconsin require additional measures be taken. One proposed plan is to convert the 69 kV line from South Lake Geneva to Twin Lakes to 138 kV and construct a new 138 kV line from Twin Lakes to Spring Valley substation. This will provide area voltage and load serving support and will provide another west to east corridor for transferring power into and through southern Wisconsin.

Low voltages in several rural areas are signaling the need for new transmission lines, since capacitor banks will not completely relieve these problems. The Richland Center area, even after the installation of 22 MVARs of additional capacitors, is expected to experience marginal to low voltages under contingency beyond 2008. A new 69 kV line from Eden through Muscoda to Richland Center solves these problems, but represents a significant addition of new right-of-way on new corridors. This alternative will require extensive analysis and other alternatives will need to be considered and analyzed in order to ensure the optimum solution is chosen that will meet system needs while minimizing costs and public impact. The Juneau and Horicon area 69 kV voltages start to become a concern under contingency in 2008 and need to be resolved based on the 2012 analysis. The conversion of the South Fond du Lac to Springbrook line from 69 kV to 138 kV will solve these problems. This line also has some maintenance problems that may require significant investment; therefore, this line is potentially a good candidate for a rebuild and subsequent voltage conversion.

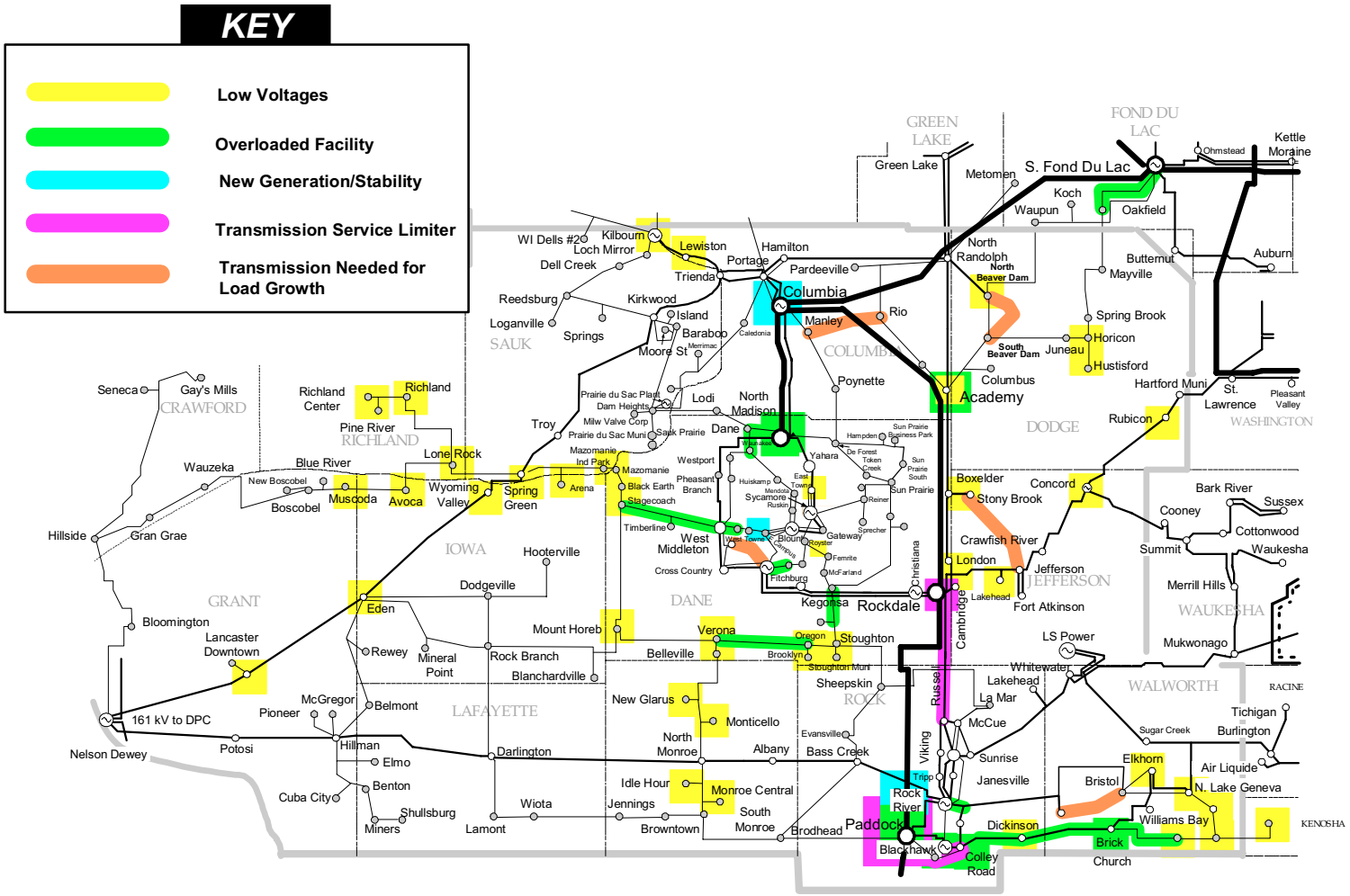


Figure V-4-2
Zone 3 Performance Criteria Exceeded and Other Constraints
2004-2008

Zone 4

Summary of Key Findings

- Construction of a new 345/138 kV substation at a Werner West site will avert overloads and improve 138 kV voltage profiles in the area.
- Construction of a new 345 kV line from Morgan to Werner West will significantly increase transfer capability between Wisconsin and the Upper Peninsula, avert overloads in and around the Green Bay area, improve 138 kV voltage profiles in the Fox Valley and Green Bay areas and significantly lower losses.
- Upper Peshtigo area overloads/low voltages will necessitate reinforcements
- Low voltages in Door County will necessitate additional reinforcements

Several line and transformer overloads and impending overloads as well as low voltages were identified in Zone 4 based on the 2008 analysis. An uprate of the Morgan-White Clay 138 kV line is proposed for 2005, a reconductor or rebuild of the Plains-Stiles line is proposed in 2005, a rebuild and voltage conversion for 69 kV to 138 kV is under consideration for the West Marinette-Amberg line, a capacitor bank addition at Butternut is proposed for 2007, a rebuild of the Crivitz–High Falls 69 kV double circuit line is proposed for 2007, the reconductor of a portion of the Sunset Point-Pearl Ave 69 kV line is proposed for 2007, a 138 kV line from Canal to Dunn Road and a 138/69 kV transformer at Dunn Road are proposed for 2007.

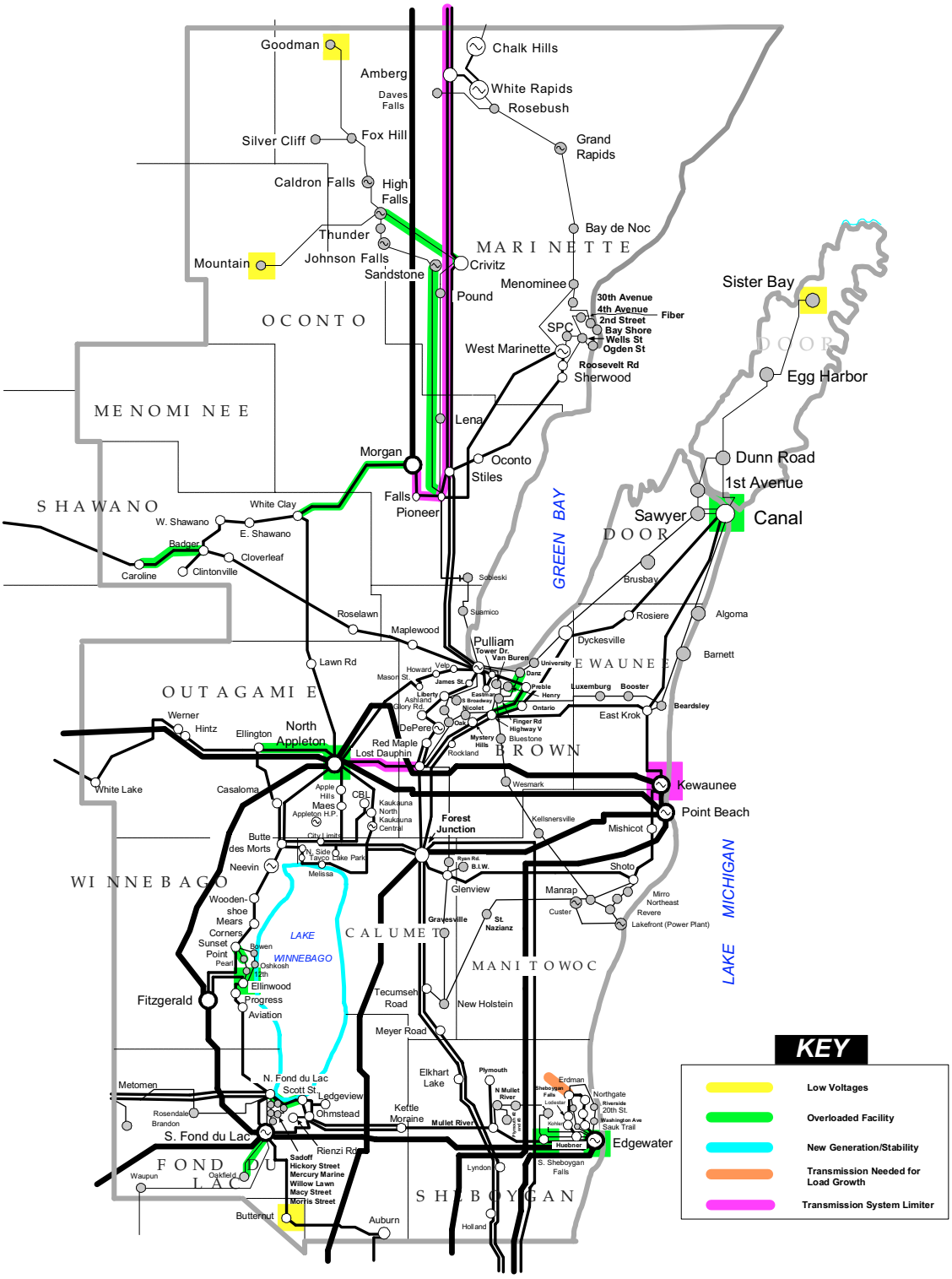
As a near-term measure to improve transfer capability between Wisconsin and the Upper Peninsula, ATC is investigating reconductoring the Plains-Stiles double circuit 138 kV line. The intent would be to achieve greater transfer capability as quickly as possible while minimizing capital expenditures (see 2004 Zone 2 discussion).

A rebuild/voltage conversion of the West Marinette to Amberg 69 kV line to 138 kV is under consideration should ATC find that rebuilding or reconductoring the Amberg-Stiles is not viable, that a maintenance rebuild is warranted, that significant new load additions materialize, or a combination thereof. This project would provide a third source into the West Marinette area and relieve the Stiles to Amberg 138 kV portion of the limitations to transfer capability between Wisconsin and Michigan.

The proposed Werner West 345 kV substation in 2006 would aid the transmission system by reducing loading on the North Appleton and Kewaunee 345/138 kV transformers along with the 138 kV lines west of North Appleton. The proposed project would also provide beneficial voltage support to an area that is projected to experience low voltages even with the recent capacitor bank installations in the area. Completion of this project would result in deferring the need to relieve immanent overloads on the 138 kV lines between Werner West and North Appleton.

The proposed Morgan to Werner West 345 kV line in 2009 would aid the transmission system by reducing the south to north loading on the 138 kV lines through the Green Bay area, thus deferring or eliminating the need for numerous 138 kV transmission line upgrades/rebuilds in and around Green Bay. The proposed project would also provide the extra transmission capacity needed to fully utilize the upgrades to the Wisconsin-Upper Peninsula transmission corridor which are scheduled to be completed before this project (i.e., Plains-Stiles and Cranberry-Conover).

Figure V-5-2
Zone 4 Performance Criteria Limits Exceeded and Other Constraints
2004-2008



Zone 5

Summary of Key Findings

- Addressing a relatively weak 138 kV network in Jefferson, Washington and Waukesha Counties will require reinforcements, including new 345/138 kV transformations and a new 345 kV transmission line.
- Accommodating planned new generation in the Milwaukee metro area will drive much of the system expansion in Zone 5 later this decade.

Line, transformer and bus equipment overloads were identified in Zone 5, as were a multitude of low voltages. Capacitor installations at Moorland and Burlington are proposed to improve 138 kV bus voltages in those areas.

Construction of a 138 kV line from Waukesha to Duplainville to Sussex is planned for 2005. While this line serves load at Duplainville and provides support to northern Waukesha county, it increases loading on the Arcadian-Waukesha 138 kV circuits, necessitating replacement of substation equipment at Waukesha and Arcadian.

In the 2008 analysis, numerous low bus voltages were identified in eastern Jefferson, western Waukesha, and southern Washington counties, all areas where load growth has been and is expected to be high. These conditions occurred for an intact system and under contingency. Numerous reinforcement options were considered and evaluated to address these system limitations for the long term. The preferred option for addressing these impending low voltage conditions while simultaneously managing the load growth within the area involves the following reinforcements:

- Construct a new 345/138 kV Lannon Junction substation at the intersection of the Forest Junction-Arcadian 345 kV line, the Arcadian-Granville 345 kV line, Germantown-Bark River 138 kV and Sussex-Tamarack 138 kV line (2007). 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.
- Install a 500 MVA, 345/138 kV transformer at Lannon Junction (2007).
- Construct a second Germantown-Lannon Junction 138 kV line (2007). This project will address potential overloads on the existing Germantown-Bark River line and address marginal stability margins at the Germantown power plant.
- Rebuild the Rockdale-Jefferson-Concord 138 kV line to double circuit 345/138 kV and install a500 MVA, 345/138 kV transformer at Concord (2009).
- Convert the Bark River-Lannon Junction 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).

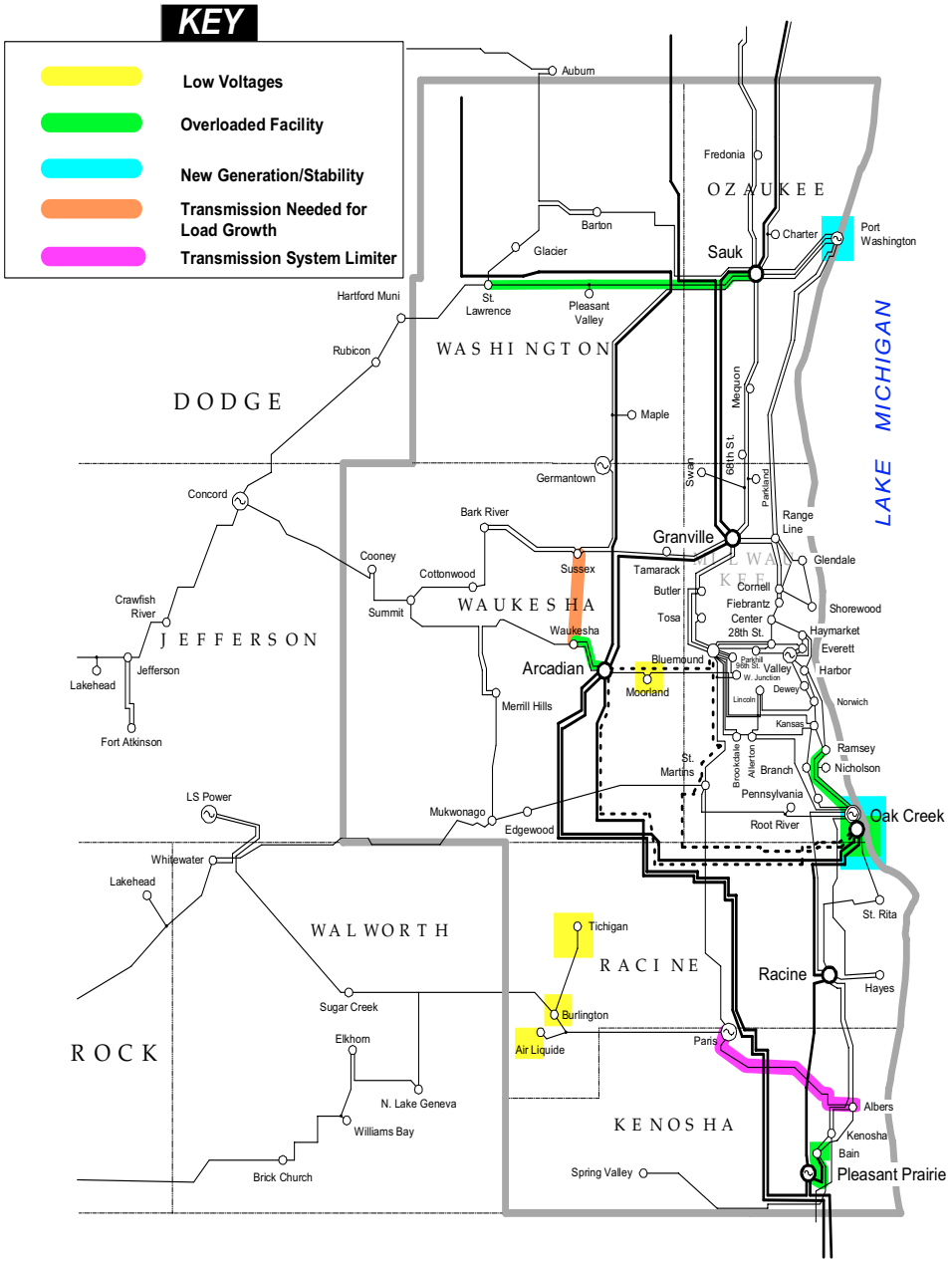
In addition to improving the voltage profiles in Jefferson, Waukesha and Washington Counties, reducing loadings on parallel 138 kV circuits, improving system stability at Germantown and reducing losses, the above reinforcements will improve ATC's existing east-west transfer capability, addressing one of the issues identified in the southern zone umbrella plan analyses discussed later in this section.

New generation is planned at Port Washington and will be installed in two phases. The first phase of generation is scheduled to be in service in 2005, while the second phase is scheduled for a 2008 in service date. The first phase of new generation at Port Washington (and retirement of existing generation) will require that the five 138 kV circuits from Port Washington (two circuits to Range Line and three circuits to Saukville) be rebuilt with larger conductors to increase their capacities. As part of the second phase, the St. Lawrence – Pleasant Valley – Saukville 138 kV line will need to be rebuilt. The condition of the line warrants replacement of the structures. Replacement of the cable of the underground portion of the Range Line-Cornell 138 kV will also be required for the second phase of generation.

The proposed new generation at Oak Creek coupled with projected load growth will trigger the need for numerous system reinforcements in the Milwaukee metro area between 2007 and 2011. The current list of reinforcements, based on the most current information available, include:

- Expand Oak Creek 345 kV switchyard to interconnect one new 650 megawatt generator, moving the existing Oak Creek Unit #7 from the 230 kV bus to the 345 kV bus, two 345 kV lines (Oak Creek-Brookdale and Oak Creek-Bluemound) plus installation of two 345 kV series breakers for interconnection purposes. Expand the Oak Creek 138 kV switchyard to accommodate a new Oak Creek-St. Martins 138 kV line. (2007).
- Construct an Oak Creek-Brookdale 345 kV line. This project, as proposed, will involve installing four miles of new structures, and converting 16 miles of non-operative 230 kV and five miles 138 kV line. (2007).
- Construct a 345/138 kV switchyard at Brookdale to accommodate two 345 kV lines; one 500 MVA, 345/138 kV transformer and four 138 kV lines plus two 138/26.2 kV transformers (2007).
- Construct a Brookdale-Granville 345 kV line. This project, as proposed, will involve converting/reconductoring six miles of 138 kV line, rebuilding seven miles of 138 kV double circuit tower line and converting/reconductoring three miles of 138 kV circuit on existing 345 kV structures (2007).
- Restring the five mile Bluemound-Butler 138 kV line on new 345 kV structures installed with Brookdale-Granville 345 kV line (2007).
- Construct a one-mile Butler-Tamarack (Carmen) 138 kV line on new 345 kV structures installed with Brookdale-Granville line (2007).
- Construct Oak Creek-St. Martins 138 kV circuit #2 installing four miles of new structures and conductor, plus 13 miles of conductor on existing towers (2007).

Figure V-6-2
Zone 5 Performance Criteria Limits Exceeded and Other Constraints
2004-2008



- Construct 345 kV Bluemound switchyard to accommodate one 345 kV line and one 345/138 kV transformer (2007).
- Convert/reconductor Oak Creek-Bluemound 230 kV line to 345 kV (2007).
- Install series circuit breakers on two 345 kV lines at the Pleasant Prairie switchyard (2007).
- Replace seven 138 kV overdutied breakers at Bluemound (2007).
- Reconductor the Oak Creek-Ramsey6 138 kV line (2007).
- Reconductor the underground segment of Ramsey5-Harbor 138 kV line (2007).
- Reconductor the Oak Creek-Allerton 138 kV line (2007).
- Expand Oak Creek 345 kV switchyard to connect one new 650 megawatt generator plus installation of one 345 kV series breaker for interconnection purposes (2009).
- Expand Oak Creek 345 kV switchyard to interconnect three new generators (totaling 650 megawatts), moving the existing Oak Creek Unit #8 from the 230 kV bus and two 345 kV lines (Oak Creek-Racine and Oak Creek-Bluemound), plus installation of five 345 kV series breakers for interconnection and/or stability purposes (2011).
- Expand the Oak Creek 138 kV switchyard to reconnect existing units #6 and #9 from the 230 kV bus (2011).
- Convert and reconductor Oak Creek-Bluemound 230 kV line to 345 kV and loop this line into the Arcadian 345 kV substation (2011).
- Expand the 345 kV switchyard at Bluemound to accommodate three additional 345 kV lines and two additional 345/138 kV transformers (2011).
- Reroute Brookdale-Granville 345 kV line into the expanded Bluemound 345 kV switchyard (2011).
- Construct a new Oak Creek-Racine 345 kV line with four miles of new conductor installed on the vacant position of the structures installed with the Oak Creek-Brookdale 345 kV line in 2007 and convert 10 miles of 138 kV line to 345 kV (2011).
- Replace 22-138 kV overdutied breakers at Harbor, Everett and Haymarket Substations (2011).

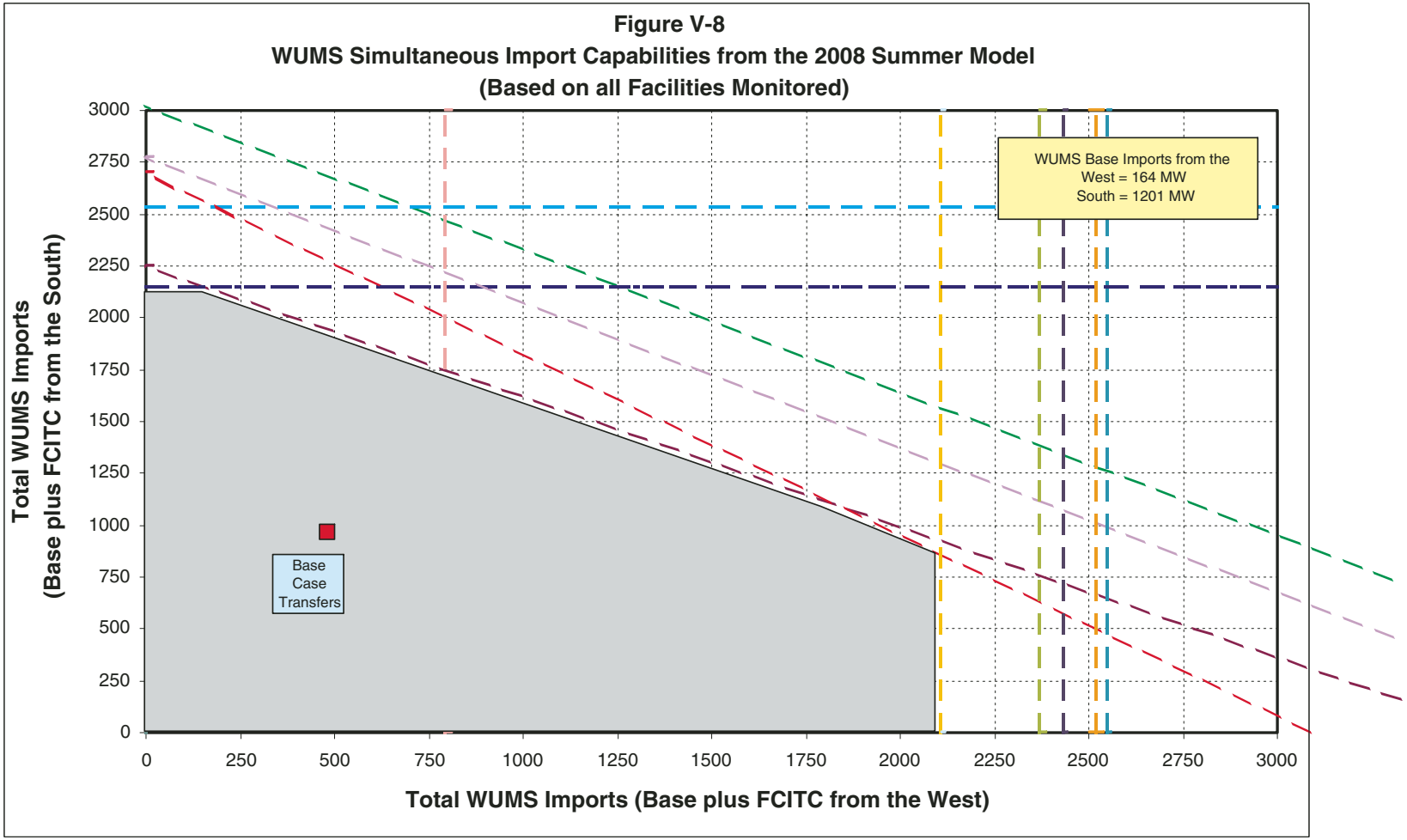
Transfer Capability Analysis

ATC conducted transfer capability analysis to provide a relative indication of the simultaneous transfer capability into the ATC system in 2008 assuming ATC is able to implement all of the planned and proposed projects listed in Section VI with projected in service dates of June, 2008 or before, most notably the Arrowhead-Weston project. The summary of that analysis is shown in Figure V-8. In Figure V-8, the red box inside the shaded area represents the base transfers modeled in the 2008 case used. The shaded area represents the total transfer capability into the ATC system based on the cursory analyses. Total simultaneous transfer capability can be determined by selecting a transfer level from either the west (horizontal axis) or the south (vertical axis) below the first limiting element (dashed lines) and drawing a straight line to the limit (dashed line) for the other direction. For instance, for a 2,000 MW transfer from the west, the maximum transfer achievable from the south is 900 MW, or a total transfer capability of 2,900 MW.

As previously noted, the simultaneous transfer capability depicted in Figure V-8 is a relative indication of transfer capability and not necessarily an indication of what is commercially available. The simultaneous transfer capability information in this Assessment was developed by reducing generation within ATC's service territory and increasing generation in surrounding regions and then identifying limiting transmission facilities. ATC assumed that the distribution of power flow across an overloaded transmission facility for a particular transaction must exceed 3% to be considered a contributor to an overload. ATC also assumed there was a linear relationship between the limits to transfers from the west and transfers from the south.

The transfer capability graph shows that the maximum transfer from the south is about 2,200 MW, the maximum transfer from the west is about 2,100 MW and the maximum simultaneous transfer capability is about 3,000 MW. The most limiting element for transfers from the west is the Wheaton-Eau Claire 161 kV line, though this is a line identified in the WIRES report that would require reconductoring to achieve the targeted 3,000 MW of transfer capability for the Arrowhead-Weston option, and that Xcel has determined will require reconductoring in the future for reliability purposes. ATC intends to coordinate with Xcel to ensure that this limitation is adequately addressed by 2008. Assuming the Wheaton-Eau Claire limitation is addressed, the limiting element becomes the Caroline-Badger 115 kV line for an outage of the North Appleton-Rocky Run 345 kV line, limiting transfers from the west to about 2,100 MW. The most limiting elements for transfers from the south are the Itasca-Lombard 345 kV Red line for an outage of the Des Plains-Lombard 345 kV line, or with a heavy bias from the south, the Jefferson-Kingsbury 138 kV Red line for an outage of the Ohio-Clinton-DeKoven 138 kV Red line, or with a heavy bias from the west, the Lore-Turkey River-Cassville 161 kV line for an outage of the Wempletown-Paddock 345 kV line.

Figure V-8
WUMS Simultaneous Import Capabilities from the 2008 Summer Model
(Based on all Facilities Monitored)



Wheaton-Eau Claire 161 kV	for outage of Arrowhead 345/230 kV Phase Shifter	Caroline-Badger 115 kV	for outage of N Appleton-Rocky Run 345 kV
Itasca-Lombard 345 kV Red	for outage of Des Plaines-Lombard 345 kV Red	Whiting Ave-Hoover 138 kV	for outage of N Appleton-Rocky Run 345 kV
Jefferson-Kingsbury 138 kV Blue	for outage of Ohio-Clinton-Dekoven 138 kV Blue	Arpin-Rocky Run 345 kV	for outage of Arrowhead 345/230 kV Phase Shifter
Itasca-Lombard 345 kV Blue	for outage of Des Plaines-Lombard 345 kV Blue	Badger 115/138 kV Tr	for outage of N Appleton-Rocky Run 345 kV
Jefferson-Kingsbury 138 kV Red	for outage of Ohio-Clinton-Dekoven 138 kV Red	Arrowhead 345/230 kV Phase Shifter	for outage of King-Eau Claire-Arpin 345 kV
Lore-Turkey River-Cassville 161 kV	for outage of Wempletown-Paddock 345 kV & Kaiser-Lancaster 69 kV		
Pleasant Prairie-Racine 345 kV	for outage of Wempletown-Paddock 345 kV & Kaiser-Lancaster 69 kV		

2012 Summer Peak (steady-state) Analysis

The system performance criteria limits exceeded and other system needs shown in the 2012 base and contingency cases are listed in Table V-4, along with the magnitude of the exceeded limit, as applicable, and the cause of the limits being exceeded.

Zone 1

Summary of Key Findings

- The Rhinelander Loop will require additional reinforcement sometime around the 2015 time frame. One potential alternative is a new 138 kV line from Laona to the Plains or Amberg substations.
- Generator interconnection studies are being performed for the addition of a large generator in the Wausau area. Even though this project did not meet the criteria for inclusion into this 10-Year Assessment, it is anticipated that the requirements will be met for the fall update to the 2003 10-Year Assessment. The reinforcements required for this generator will significantly change the projects needed within Zone 1 for the 2008-2012 time frame.

Many alternatives have been evaluated as long-term solutions for the Rhinelander Loop as discussed earlier in the 2004 and 2008 sections. Not included in these discussions were alternatives that included potential 345 kV facilities due to the lead time needed to implement such projects. Of the 345 kV alternatives that have been evaluated, the best performing project consisted of a new Weston-Venus-Plains 345 kV line utilizing the existing 345 kV facilities between Weston and Black Brook. Although this 345 kV alternative meets the needs for the Rhinelander Loop for the foreseeable future, ATC is currently favoring a lower voltage and lower cost fix which includes a new 138 kV line from Laona to the Plains or Amberg substations.

To address low voltages elsewhere within Zone 1, an additional capacitor bank will be needed at the Clear Lake 115 kV substation in 2012. To address facility overloads, the 138/69 kV transformers at Wautoma will need to be upgraded, and the Metomen-Ripon 69 kV line will need to be uprated.

Zone 2

Summary of Key Findings

- The poor condition of the line and system reliability will require rebuilding Blaney Park-Munising 69 kV line for 138 kV.
- Low voltages in Zone 2 may be adequately addressed with capacitor bank installations.

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

The 2012 analysis also showed low 138 kV voltages in various locations in Zone 2. The proposed rebuild/conversion of the Hiawatha-Pine River-Straits and Plains-Iron River-Conover 69 kV lines to 138 kV should address most of these low voltages. If load growth is higher than expected, additional capacitor projects may need to be developed in the future.

TABLE V-4 PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS - 2012

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
1	Bunker Hill – Black Brook 115 kV line	107%		Weston - Black Brook 115 kV line outage	Load Serving
1	Rhinelander Loop 115 kV bus voltages		90 – 92%	Various outages	Load Serving
1	Weston – Black Brook 115 kV line	102%		Hilltop - Sherman St. 115 kV line outage Hilltop – Maine 115 kV line outage Maine – Pine 115 kV line outage	Load Serving
1	Weston – Kelly 115 kV line	95%		Hilltop - Sherman St. 115 kV line outage Hilltop – Maine 115 kV line outage Maine – Pine 115 kV line outage	Load Serving and Network
1	Maine - Hilltop 115 kV line	98%		Weston – Kelly 115 kV line outage Weston – Black Brook 115 kV line outage	Load Serving and Network
1	Hilltop – Sherman St. 115 kV line	109%		Weston – Kelly 115 kV line outage Various other outages	Load Serving and Network
1	Hilltop and Maine 115 kV bus voltages		91 - 92%	Hilltop - Sherman St. 115 kV line outage Hilltop – Maine 115 kV line outage	Load Serving and Network
1	Arpin 345/138 kV transformer	109%		Arpin – Rocky Run 345 kV line outage	Load Serving and Network
1	Sigel – Arpin 138 kV line	116%		Arpin – Rocky Run 345 kV line outage	Load Serving and Network
1	Sigel – Lakehead Vesper 138 kV line	96%		Arpin – Rocky Run 345 kV line outage	Load Serving and Network
1	Young Road – Lakehead Vesper 138 kV line	95%		Arpin – Rocky Run 345 kV line outage	Load Serving and Network
1	Sigel, Lakehead Vesper, Young Rd. and Port Edwards 138 kV bus voltages		91 - 92%	Sigel – Arpin 138 kV line outage	Load Serving
1	Okray - Plover 115 kV line	106%		Rocky Run – Whiting Ave. 115 kV line outage	Load Serving and Network
1	Wautoma 138/69 kV transformer	98%		Sand Lake 138/69 kV transformer outage Various other outages	Load Serving and Network
1	Wautoma and Sand Lake 138 kV bus voltage		90 – 94%	Base Case Sigel – Arpin 138 kV line outage Port Edwards – Sand Lake 138 kV line outage Green Lake – Roeder 138 kV line outage	Load Serving
1	Roeder 138 kV bus voltage		91%	Green Lake – Roeder 138 kV line outage	Load Serving
1	Wautoma – Spring Lake 69 kV line	112%		Metomen – Ripon 69 kV line outage N Ripon Tap – Ripon 69 kV line outage Winneconne – Sunset Point 69 kV line outage	Load Serving
1	Metomen - Ripon 69 kV line	98%		North Randolph – Markesan Tap 69 kV line outage	Load Serving
1	NW. Ripon Tap – Ripon 69 kV line	103%		Winneconne – Sunset Point 69 kV line outage	Load Serving
1	Ripon – Mackford Prairie Tap 69 kV line	97%		Metomen – Ripon 69 kV line outage	Load Serving
1	N. Fond du Lac – Rosendale 69 kV line	111%		Metomen 138/69 kV transformer outage	Load Serving
1	Berlin area 69 kV bus voltages		< 90%	Metomen - Ripon 69 kV line outage NW. Ripon - Ripon 69 kV line outage Winneconne – Sunset Point 69 kV line outage	Load Serving

TABLE V-4 PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2012 (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
1	Whitcomb 115/69 kV transformer	96%		Antigo – Black Brook 115 kV line outage Antigo – Aurora St. 115 kV line outage	Load Serving
1	Whitcomb – Wittenberg 69 kV line	111%		Antigo – Black Brook 115 kV line outage Antigo – Aurora St. 115 kV line outage	Load Serving
1	Montello area 69 kV bus voltages		91 – 92%	Portage – Lakehead Portage Pipeline 69 kV line outage	Load Serving
1	Hilltop to Kilbourn 69 kV bus voltages		< 90%	Kilbourn 138/69 kV transformer outage	Load Serving
1	Kilbourn to Neenah Creek 69 kV bus voltages		< 90%	Kilbourn 138/69 kV transformer outage	Load Serving
2	Cornell-Chandler 69 kV line	96%		Empire-Forsyth 138 kV line outage	Load Serving
2	Twin Falls North-Twin Falls South 69 kV line	99%		New Quinessec-KFM Tap 69 kV line outage KFM Tap-Grede Tap 69 kv line outage	Load Serving
2	Lincoln, Crystal Falls 69 kV bus voltages		90-91%	Iron River-UPP Tap 69 kV line outage	Load Serving
2	Lincoln, Iron River, Strawberry Hill Tap, Lakehead, Crystal Falls, Strawberry Hill 69 kV bus voltages		90-92%	Iron River 138/69 kV transformer outage	Load Serving
2	Straits 138 kV bus voltage		92%	Straits-McGulpin 138 kV Ckt #1 line outage Straits-McGulpin 138 kV Ckt #3 line outage	Load Serving
2	Atlantic 138 kV bus voltage		90-92%	Atlantic-M-38 138 kV line outage M-38 - Perch Lake 138 kV line outage	Load Serving
2	Brevort 138 kV bus voltage		87-92%	Plains-Arnold 138 kV line outage Plains 345/138 kV transformer outage Straits-Brevort 138 kV line outage Valley-Glen Jenks 69 kV line outage Glen Jenks-Indian Lake 69 kV line outage Straits-McGulpin 138 kV Ckt #1 line outage Straits-McGulpin 138 kV Ckt #3 line outage	Load Serving
2	Detour 69 kV bus voltage		92%	Indian Lake-Glen Jenks 69 kV line outage	Load Serving
2	Hiawatha 138 kV bus voltage		88-91%	Various outages	Load Serving
2	Lakehead 138 kV bus voltage		88-92%	Various outages	Load Serving
2	Indian Lake 138 kV bus voltage		91-92%	Plains-Arnold 138 kV line outage Perkins-Indian Lake Ckt1 line outage Perkins-Indian Lake Ckt2 line outage	Load Serving
3	Paddock-Shirland Avenue 69 kV line	107%		Colley Road 138/69 kV transformer outage	Load Serving
3	Colley Road 138/69 kV transformer	105%		Paddock 138/69 kV transformer outage	Load Serving
3	Walworth-North Lake Geneva 69 kV line	104%		Brick Church-Walworth 69 kV line outage	Load Serving
3	McCue 138/69 kV transformer	103%		Janesville 138/69 kV transformer outage	Load Serving
3	Janesville 138/69 kV transformer	98%		McCue 138/69 kV transformer outage	Load Serving
3	Janesville-Milton Lawns 69 kV line	104%		McCue 138/69 kV transformer outage	Load Serving
3	Verona-Oregon 69 kV line	100%		Oregon-Stoughton 69 kV line outage	Load Serving
3	North Stoughton-Kegonsa 69 kV line	97%		McCue-LaMar 69 kV line outage	Load Serving

TABLE V-4 PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2012 (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
3	Verona-Oregon 69 kV line	100-119%		North Stoughton-Kegonsa 69 kV line outage, Oregon-Aaker Road 69 kV line outage, Stoughton-Aaker Road 69 kV line outage	Load Serving
3	West Middleton-Pheasant Branch 69 kV line	98-102%		Waunakee-Waunakee Muni 69 kV line outage, North Madison 138/69 kV line outage	Load Serving
3	South Beaver Dam-Juneau Tap 69 kV line	98%		Mayville-Oakfield 69 kV line outage	Load Serving
3	Rockdale-Jefferson 138 kV line	104-113%		Rockdale-Boxelder 138 kV line outage	Load Serving
3	Rockdale-Boxelder 138 kV line loading	119%-133%		Rockdale-Jefferson 138 kV line outage	Load Serving
3	Aaker Road (Stoughton), Oregon, Brooklyn, Stoughton, North Stoughton 69 kV bus voltages		88-90%	Verona-Oregon 69 kV line outage Oregon-Aaker Road 69 kV line outage North Stoughton-Kegonsa 69 kV line outage Stoughton-Aaker Road 69 kV line outage	Load Serving
3	Timberline and Cross Plains 69 kV bus voltages		89-91%	Timberline-West Middleton 69 kV line outage	Load Serving
3	Concord 138 kV Bus 6, Rubicon 138 kV bus voltages		86-89%	Concord Bus 6-Bus 5 Bus tie outage	Load Serving
3	Pine River, Richland Center, Richland, Eagle (DPC) 69 kV bus voltages		90%	Lone Rock-Richland Center 69 kV line outage	Load Serving
3	Lewiston, Kilbourn, Dell Creek, Loch Mirror, Zobel, Birchwood and Nishan 138 kV bus voltages and Lewiston 69 kV bus voltages		88-91%	Trienda-Lewiston and Lewiston-Kilbourn 138 kV line outages	Load Serving
3	Kilbourn, Lyndon Station 69 kV bus voltages		85-87%	Kilbourn 138/69 kV transformer outage	Load Serving
3	Juneau, Horicon, Horicon Ind. Park and Hustiford 69 kV bus voltages		89-90%	South Beaver Dam-Juneau 69 kV line outage	Load Serving
4	Custer-St Nazianz 69 kV line	96%		Tecumseh Rd-New Holstein 69 kV line outage Tecumseh Rd 138/69 kV transformer outage	Load Serving
4	Tecumseh Rd 138/69 kV transformer	96%		Gravesville-Glenview 69 kV line outage	Load Serving
4	Ellinwood 138/69 kV transformer #1	110%		Fitzgerald-Sunset Point 138 kV line outage	Load Serving
4	Danz-Henry Street 69 kV line	97%		Pulliam-Van Buren 69 kV line outage	Load Serving
4	Erdman-Northgate 138 kV line	101%		Edgewater-Huebner 138 kV line outage	Load Serving
4	City Limits 138 kV bus tie 1-2	98%		N Appleton-Apple Hills 138 kV line outage	Load Serving
4	City Limits-Kaukauna Combined Locks Tap 138 kV line	97%		N Appleton-Apple Hills 138 kV line outage	Load Serving
4	Ellington-Casaloma 138 kV line	97%		Butte des Morts-Casaloma 138 kV line outage	Load Serving
4	Kaukauna Combined Locks Tap, Kaukauna Combined Locks, Maes, Apple Hills 138 kV bus voltages		91-90%	N Appleton-Apple Hills 138 kV line outage	Load Serving
4	Wooden Shoe, Mears Corners, Quarry Run 138 kV bus voltage		91-90%	Neevin-Quarry Run 138 kV line outage	Load Serving
4	Beardsley, East Krok 69 kV bus voltages		92%	East Krok 138/69 kV transformer outage	Load Serving
4	Goodman 69 kV bus voltage		92-91%	Various outages	Load Serving
4	Sister Bay 69 kV bus voltage		92-90%	Various outages	Load Serving
5	Pleasant Prairie – Bain 345 kV line	176.5%		Splitting Pleasant Prairie 345 kV bus sections 3 and 4.	Load Serving
5	Racine 345/138 kV transformer	102.9%		Outage of one Racine transformer causes the other transformer-overload	Load Serving
5	Hartford 138 kV bus voltage		89.85%	Splitting Concord bus between buses 5 and 6	Load Serving

TABLE V-4 PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2012 (continued)

Planning Zone	Criteria Exceeded/Need	% of Facility Rating	% of Nominal Bus Voltage	Cause	Condition
5	Arcadian 345/138 kV transformer #2		101.1%	Arcadian transformer #1 outage	Load Serving
5	Arcadian 345/138 kV transformer #3		101.6%	Arcadian transformer #1 outage	Load Serving
5	Oak Creek 345/138 kV transformer	105.6%		Various outages	Load Serving
5	Branch-Kansas 138 kV line	98.4%		Oak Creek-Pennsylvania 138 kV line outage	Load Serving
5	Kansas-Ramsey 138 kV line	104.5%		Oak Creek-Pennsylvania 138 kV line outage	Load Serving
5	Arcadian6 – Waukesha 3 138 kV line	108.9		Arcadian 4 – Waukesha 1 138 kV line outage	Load Serving
5	Arcadian 4 – Waukesha 1 138 kV line	103.2%		Arcadian 6 – Waukesha 3 138 kV line outage	Load Serving

Figure V-2-3
Zone 1 Performance Criteria Limits Exceeded and Other Constraints
2008-2012

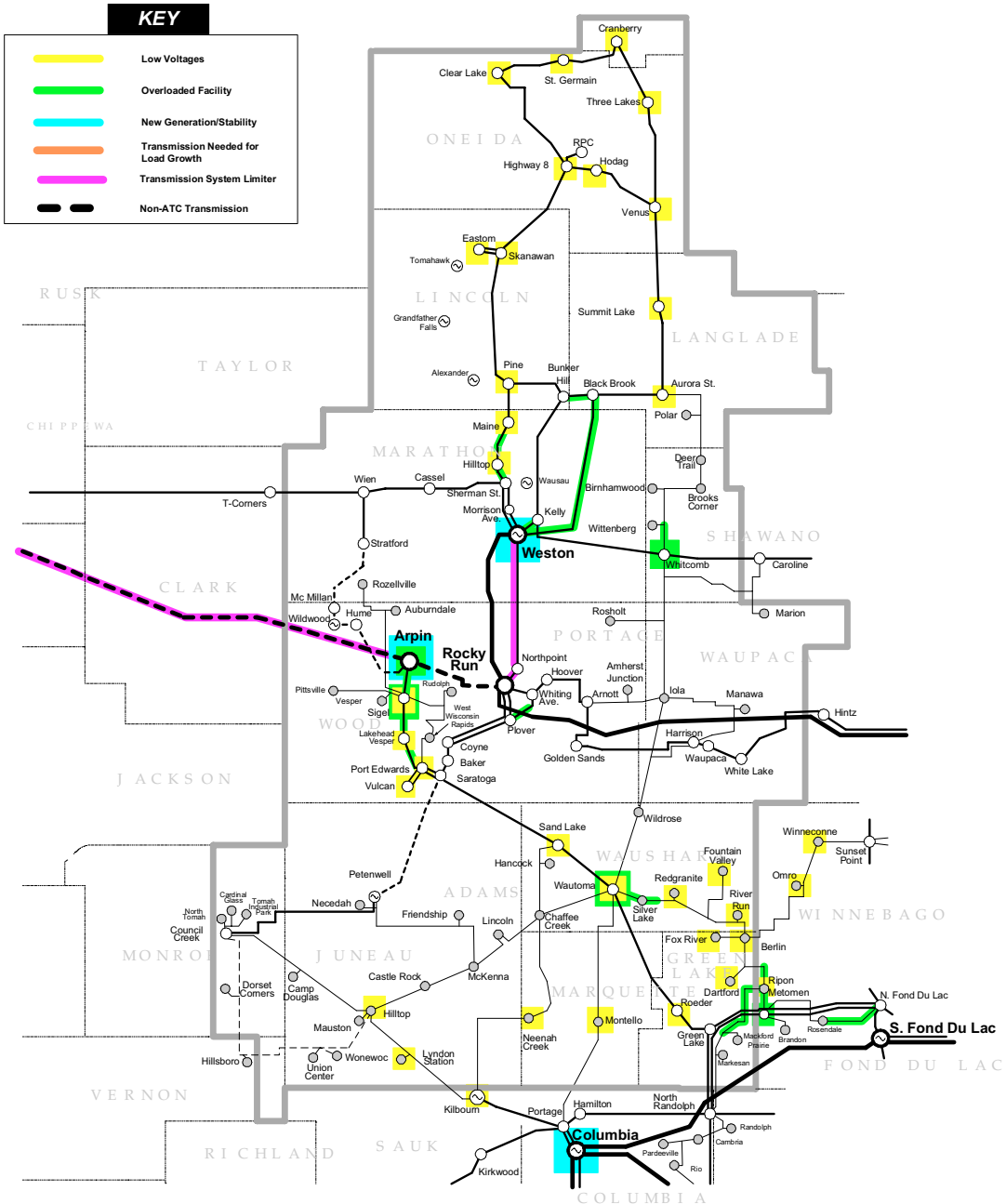
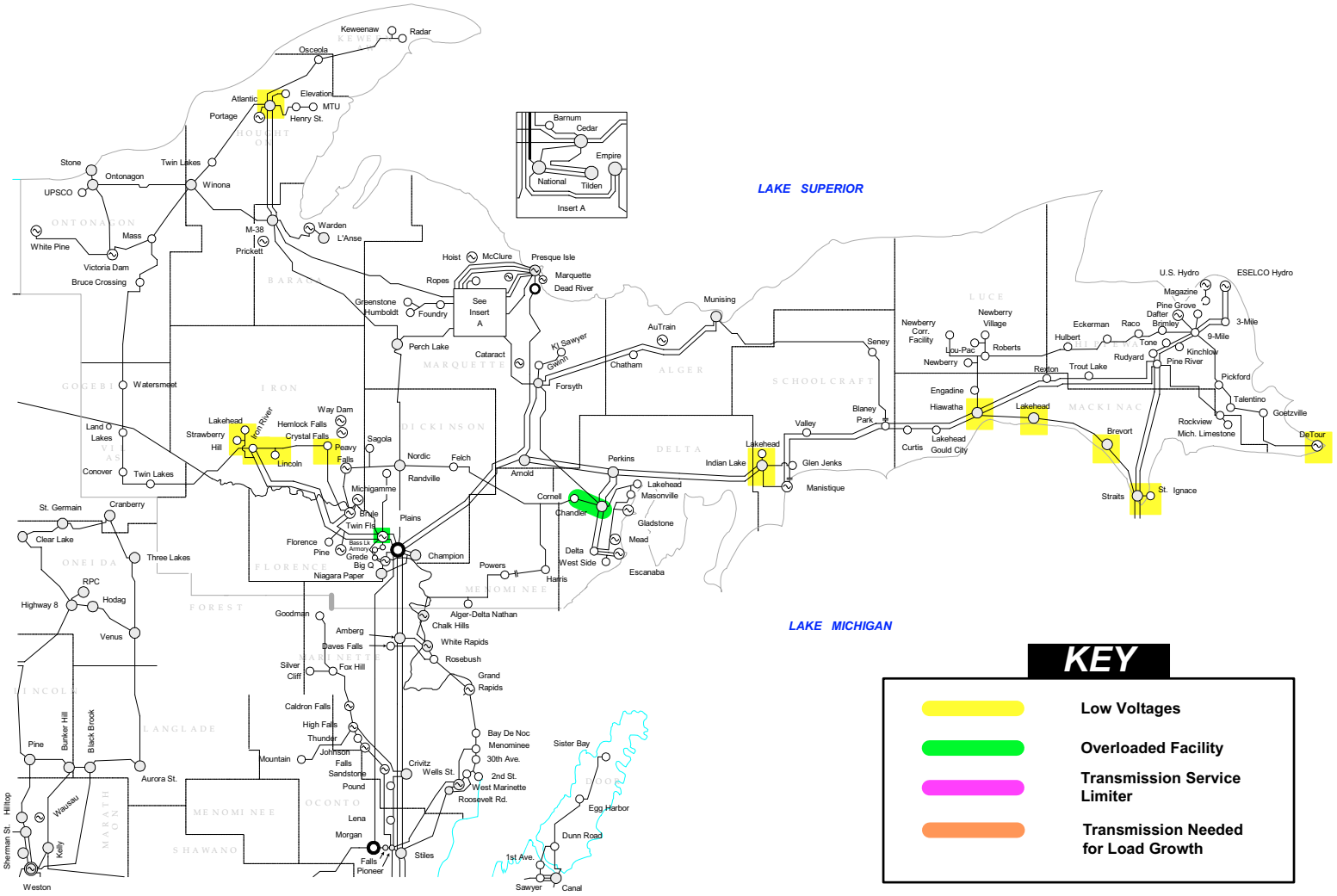


Figure V-3-3
Zone 2 Performance Criteria Limits Exceeded and Other Constraints
2008-2012



Zone 3

Summary of Key Findings

- A third source in Sauk County will likely be needed to address anticipated load growth in Reedsburg, Baraboo and Wisconsin Dells.
- Portions of the 69 kV infrastructure in the Madison area will need to be reinforced in order to continue serving this growing load reliably.
- Area 138 kV bus voltages at Kilbourn substation (Wisconsin Dells) and 69 kV bus voltages north of Wisconsin Dells are a growing concern.
- Heavy load growth in Waukesha, Washington, Dodge and Jefferson counties will require the construction of 345 kV lines for voltage and load support. A new 345 kV line from Rockdale to Lannon Junction is proposed to solve these problems (see 2008 and 2012 discussion in Zone 5).

Depending upon where the majority of new load growth in Sauk County appears, a new 138 kV or 161 kV line into the Kilbourn to Kirkwood 138 kV transmission loop will likely be needed in 2012 to 2014. Since the 138 kV voltages at Kilbourn substation are a major concern, one alternative is to bring another 138 kV line into that substation. A second circuit from Portage or a new circuit from either Petenwell or Council Creek could be constructed to support the voltage at Kilbourn. Preliminary studies indicate that a second circuit from Portage to Kilbourn is the preferred alternative at this time since it is the shortest line and performs the best. Additional alternatives will need to be considered and analyzed to determine the optimum solution.

The North Madison 138/69 kV transformer is projected to experience high loading in the 2012 time frame. Although it is not shown to be in violation in 2012, it is close to the violation flagging level of 95%. As loads grow in Madison, this transformer and associated 69 kV lines will likely experience overloads for the loss of the North Madison to Yahara River 138 kV line. This situation indicates that large amounts of power are flowing from North Madison substation into the metro Madison area and that the loss of the high capacity 138 kV line on the east side of the city causes flow to move onto adjacent 69 kV circuits. While replacing the transformer may be an option, another possible solution to this problem is the conversion of the North Madison to Waunakee to Blount 69 kV line to 138 kV. Portions of this line are already constructed to accommodate a conversion and spare underground pipes in downtown Madison are being extended to accommodate an underground 138 kV circuit from Blount.

Zone 4

Summary of Key Findings

- Upper Peshtigo area low voltages will necessitate reinforcements
- Door County load growth will necessitate additional reinforcements
- Low 138 kV voltages in the Appleton and Neenah areas signal the need for reinforcements in that area.

Several impending line and transformer overloads and as well as impending low voltages were identified in Zone 4 based on the 2012 analysis. A new 138 kV circuit between Sunset Point and Ellinwood, which could be strung on existing structures, is proposed for 2009. A capacitor bank addition at Apple Hills is proposed for 2011. A new 138 kV circuit between City Limits and North Side, which could be constructed on existing right-of-way, is proposed for 2011.

A second 69 kV line from Dunn Rd to Egg Harbor is proposed for 2011. Low system voltages and increased load growth in northern Door County are the reasons necessitating the project. This project will provide a second source to the Egg Harbor area, improving system voltages and increase the reliability.

Zone 5

Summary of Key Findings

- In a continuation of the findings in the 2008 section for Zone 5, the areas that exhibited problems in 2008 showed slightly worse problems in 2012. In addition, a few new problems appeared.

An outage of one of the Racine 345/138 kV transformers causes the other transformer to overload. This is due to converting the existing Oak Creek–Racine 138 kV line to 345 kV operation. It may be necessary to find a way to build a second Oak Creek - Racine 345 kV line, while retaining the Oak Creek – Racine 138 kV line.

An outage of Arcadian 345/138 kV transformer #1 (500 MVA) results in Arcadian 345/138kV transformers #2 and #3 (300 MVA each) overloading. A possible solution is replacing transformers #2 and #3 with larger transformers.

The Oak Creek 345/138 kV transformer overloads for various outages. One possible solution is installing a second transformer at Oak Creek. The overloads listed above and possible solutions may be revised with changing system conditions.

Figure V-4-3
Zone 3 Performance Criteria Exceeded and Other Constraints
2008-2012

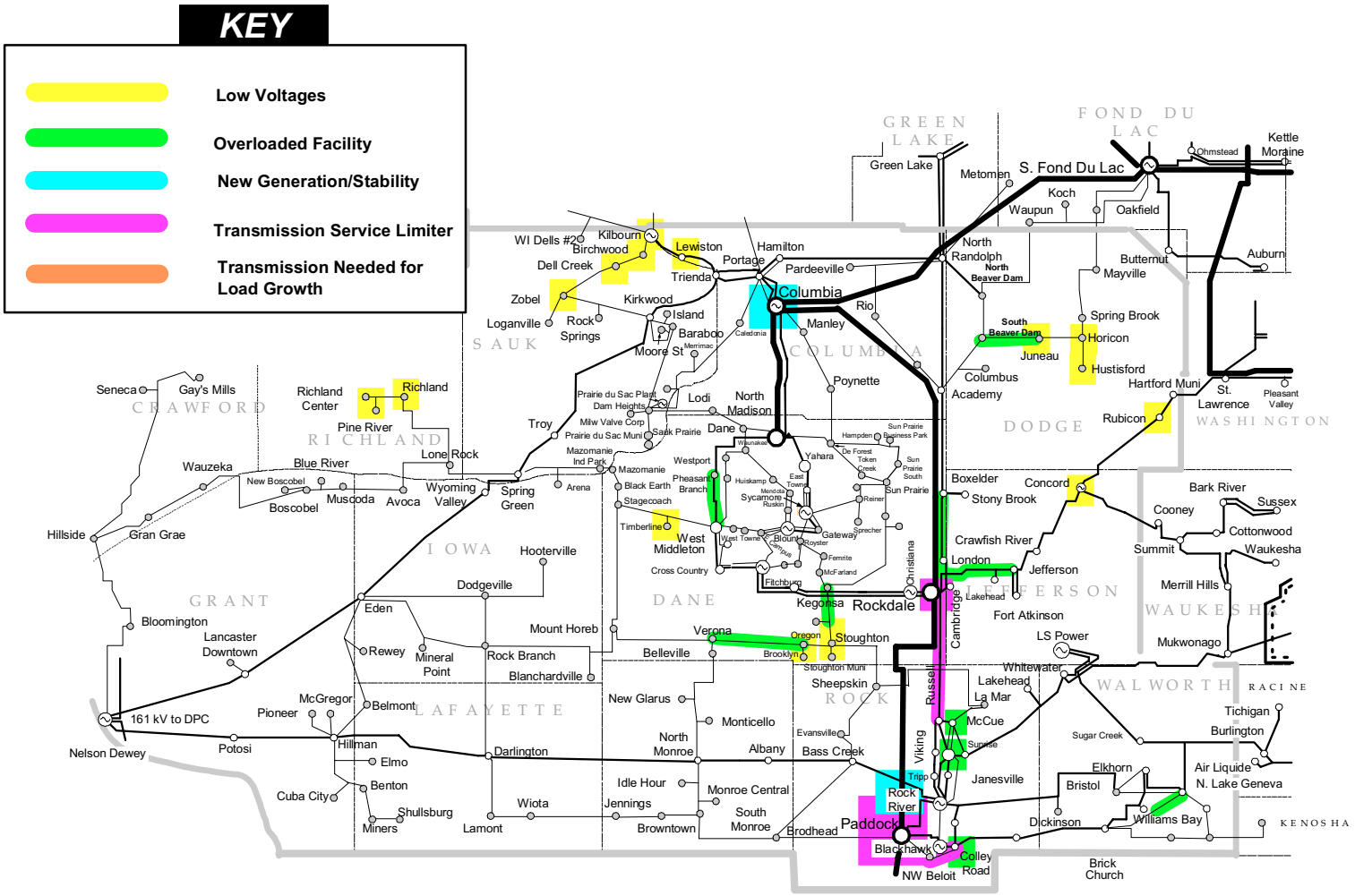


Figure V-5-3
Zone 4 Performance Criteria Limits Exceeded and Other Constraints
2008-2012

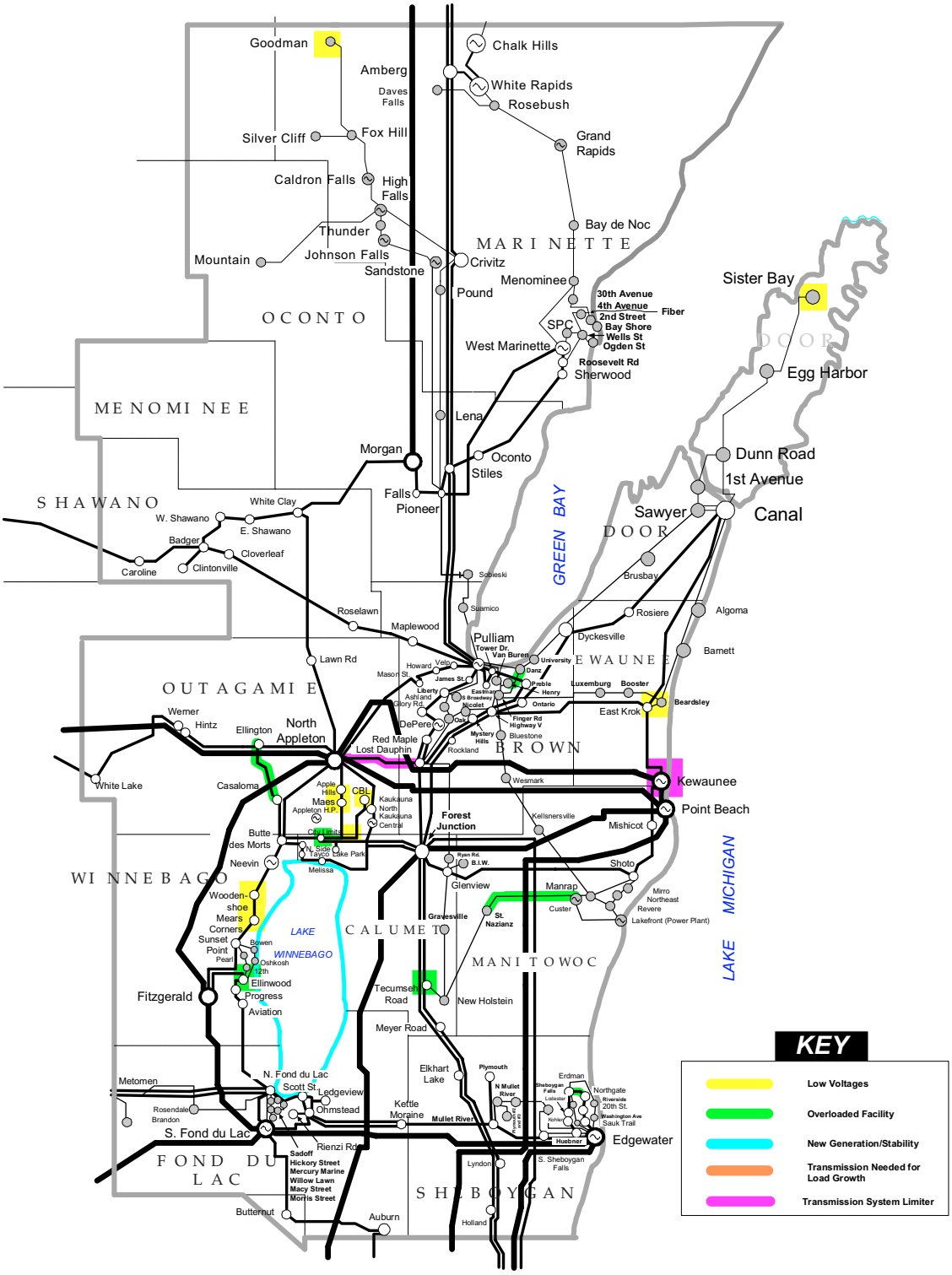
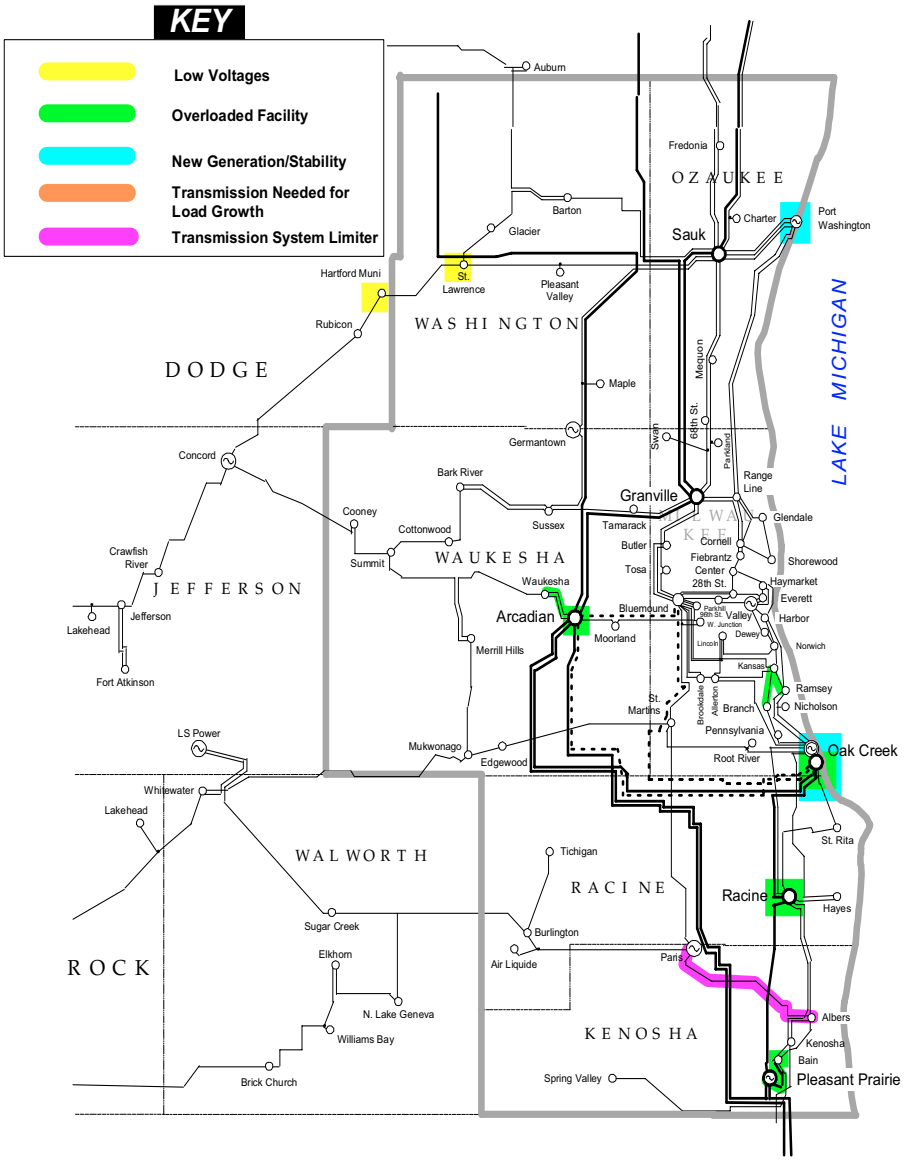


Figure V-6-3
Zone 5 Performance Criteria Limits Exceeded and Other Constraints
2008-2012



Umbrella Plans

This and previous Assessments have been conducted to identify needs and limitations on ATC's transmission system within the 10-year planning horizon and describe preferred and alternative transmission projects to address those needs and limitations. The Assessments are based on various snapshots of anticipated future conditions; summer peak and shoulder peak conditions in two or three future years to provide perspectives on the nature and severity of the needs and limitations. Specific forecasts of load and generation are used to define the anticipated future conditions. Of course, there are many uncertainties about how the future will actually unfold. Addressing some of the issues identified in this Assessment well beyond the 10-year planning horizon along with consideration of key near-term uncertainties require analyses and solutions that go well beyond the snapshot analyses described above. ATC defines umbrella plans as collections of potential projects developed based on analyses conducted to optimize alternative projects over selected possible future scenarios.

The following sections describe umbrella plans developed within ATC's northern zones (Zones 1, 2 and 4) and southern zones (Zones 3 and 5). The key issues addressed, the possible future scenarios considered and the evaluation criteria used are described along with the umbrella plans. It should be noted that these plans reflect ATC's current ideas about how best to address future needs and limitations. ATC anticipates that certain portions of these plans will change as new information becomes available and some uncertainties become more predictable. Thus, while ATC may move forward with implementation of particular projects within these umbrella plans, the plans will be updated in future Assessments.

Umbrella Plan for Northern Zones (Zones 1, 2 and 4)

The umbrella plan within the northern zones in ATC's service territory was introduced in the 2002 Assessment. Since that time, considerable analyses have been conducted to evaluate different combinations of alternatives. This effort has led to the proposed and conceptual projects shown in Figure V-9.

The Northern Zones Umbrella Plan is divided into two phases. The proposed Phase 1 projects shown in Figure V-9 include those projects that ATC believes represent the most effective means to address needs and issues from both system performance and cost perspectives. The conceptual Phase 2 projects shown in Figure V-9 reflect those projects that ATC believes will meet the long-term needs in the area, but will require further analyses.

The key issues that this umbrella plan was developed to address are:

- Inadequate transfer capability between Wisconsin and the Upper Peninsula
- Elimination of other transmission service constraints
- Long-term load serving needs in the Rhinelander Loop and throughout the Upper Peninsula
- Replacement of aging infrastructure in poor condition
- Elimination of operating guides, remedial action schemes and special protection schemes
- Accommodation of potential future generation

Based on the analyses performed to date, the Northern Zones Umbrella Plan includes the following projects:

A: Reconductor or rebuild the Plains-Stiles double circuit 138 kV line. This project is needed now. ATC currently intends to complete the project in 2004 or 2005.

B: Rebuild one of the Hiawatha-Indian Lake 69 kV lines to double circuit 138 kV standards, but string only one of the circuits initially and operate that circuit at 69 kV. ATC currently intends to complete this first phase of the project by 2005.

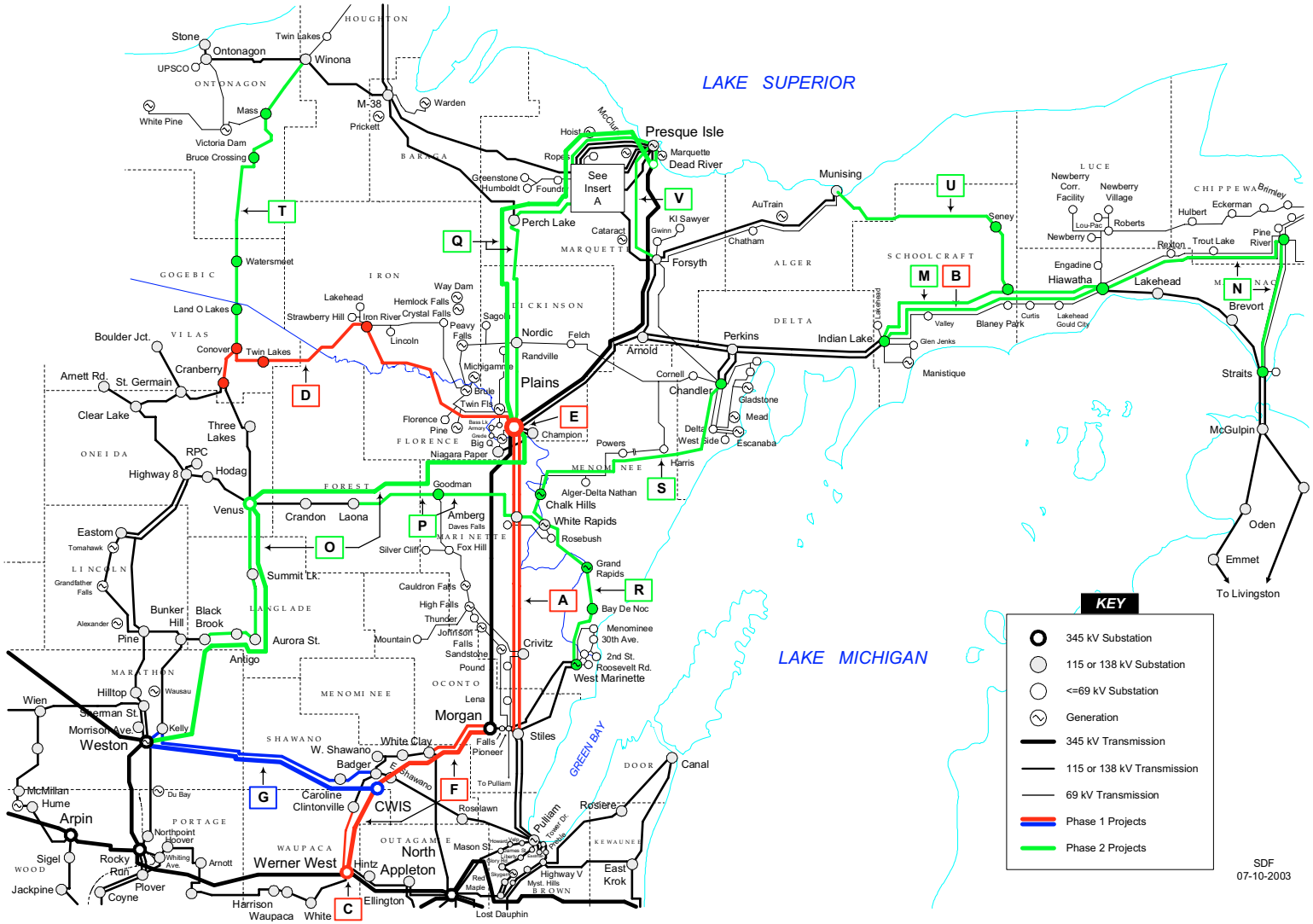
C: Construct a new 345 kV/138 kV substation called Werner West near the intersection of the Rocky Run-North Appleton 345 kV line and the Werner-White Lake 138 kV line. ATC currently intends to complete this substation project by 2006.

D: Construct a new 138 kV line between Cranberry and Conover and rebuild and convert a 69 kV line between Conover and Plains from 69 kV to 138 kV. This project is needed by 2007.

E: Add a second 250 MVA, 345/138 kV transformer at Plains by 2007.

F: Construct a new 345 kV line from Werner West (see above) to Morgan. This project is needed by 2008. ATC currently intends to complete this project in the 2009 timeframe.

Figure V-9
Umbrella Plan for Northern Zones



Conceptual Umbrella Plan Development for Southern Zones (Zones 3 and 5)

The umbrella plans for southern zones were introduced in ATC's update to the 2002 Assessment. Similar to the discussion above, within the southern zones in ATC's service territory, there are a number of issues for which potential solutions would necessarily affect adjacent southern zones. Significant analyses have been completed since the 2002 Assessment Update. The findings to date are summarized below.

The proposed Southern Zones Umbrella Plan projects shown in Figure V-10 are those projects that ATC believes represent the most effective means to address needs and issues from system performance and cost perspectives. The conceptual projects shown in Figure V-10 reflect those that ATC believes will meet the long-term needs in the area, but will require further analyses.

The key issues this umbrella plan was developed to address are:

- Provide additional import capability
- Remove the adverse effects of the loss of the Wempletown-Paddock 345 kV line
- Provide additional south-central to southeast (Zone 3 to Zone 5) transfer capability
- Address overloaded line and transformers and improve voltage profiles throughout both zones
- Ensure stability of proposed generation in southeast Wisconsin
- Address dynamic stability limitations at Pleasant Prairie, Paris, Concord and Germantown power plants
- Potential reroute/removal of a portion of the Whitewater-Mukwonago 138 kV line

The key future scenarios considered were:

- Excluding proposed generation in southeast Wisconsin
- Excluding proposed generation in the Madison area
- Retirement of generation in the Madison area
- Additional generation development in north-central and northwest Illinois
- Additional generation development in Illinois and a new 345 kV west-east line in northern Illinois

Based on the analyses performed to date, ATC has made the following findings:

- Constructing a Rockdale-Concord-Bark River-Lannon Junction 345 kV line and associated substation facilities will provide numerous and significant benefits. The first phase of this project, as proposed, consists of:
  - Constructing a new Rockdale-Concord 345 kV line
  - Installing a 345/138 kV transformer at Concord
  - Constructing a new 345/138 kV substation (Lannon Junction) at the intersection of the Granville-Arcadian 345 kV line, the Forest Junction-Arcadian 345 kV line, Sussex-Tamarack 138 kV line and Sussex-Germantown 138 kV line
  - Constructing a second Germantown-Lannon Junction 138 kV line

  These projects will provide voltage support (avert voltage collapse), relieve line overloads, improve dynamic stability of Germantown generation, increase transfer capability from Illinois, significantly reduce losses and accommodate future load growth. ATC currently intends to complete the Lannon Junction substation and Germantown-Lannon Junction line by 2007, the Rockdale-Concord line and Concord transformer by 2009.

- Constructing the facilities associated with the first phase of the proposed Elm Road generation project will improve dynamic stability of the Elm Road generation and existing Oak Creek generation, relieve line overloads, replace aging 230 kV facilities and accommodate future load growth. Those facilities, as proposed, consist of:
  - Constructing a new Oak Creek-Brookdale-Granville 345 kV line
  - Expanding the Oak Creek 345 kV switchyard
  - Constructing 345 kV and 138 kV buses at Brookdale
  - Converting the existing Oak Creek-Bluemound 230 kV line to 345 kV
  - Installing a 345/138 kV transformer at Bluemound
  - Constructing a new Oak Creek-St. Martins 138 kV line
  - Constructing a new Butler-Tamarack 138 kV line
  - Replacing substation equipment at various locations

  ATC currently intends to complete these projects coincident with the completion of the first phase of the Elm Road generation project, which is scheduled to be completed in 2007.

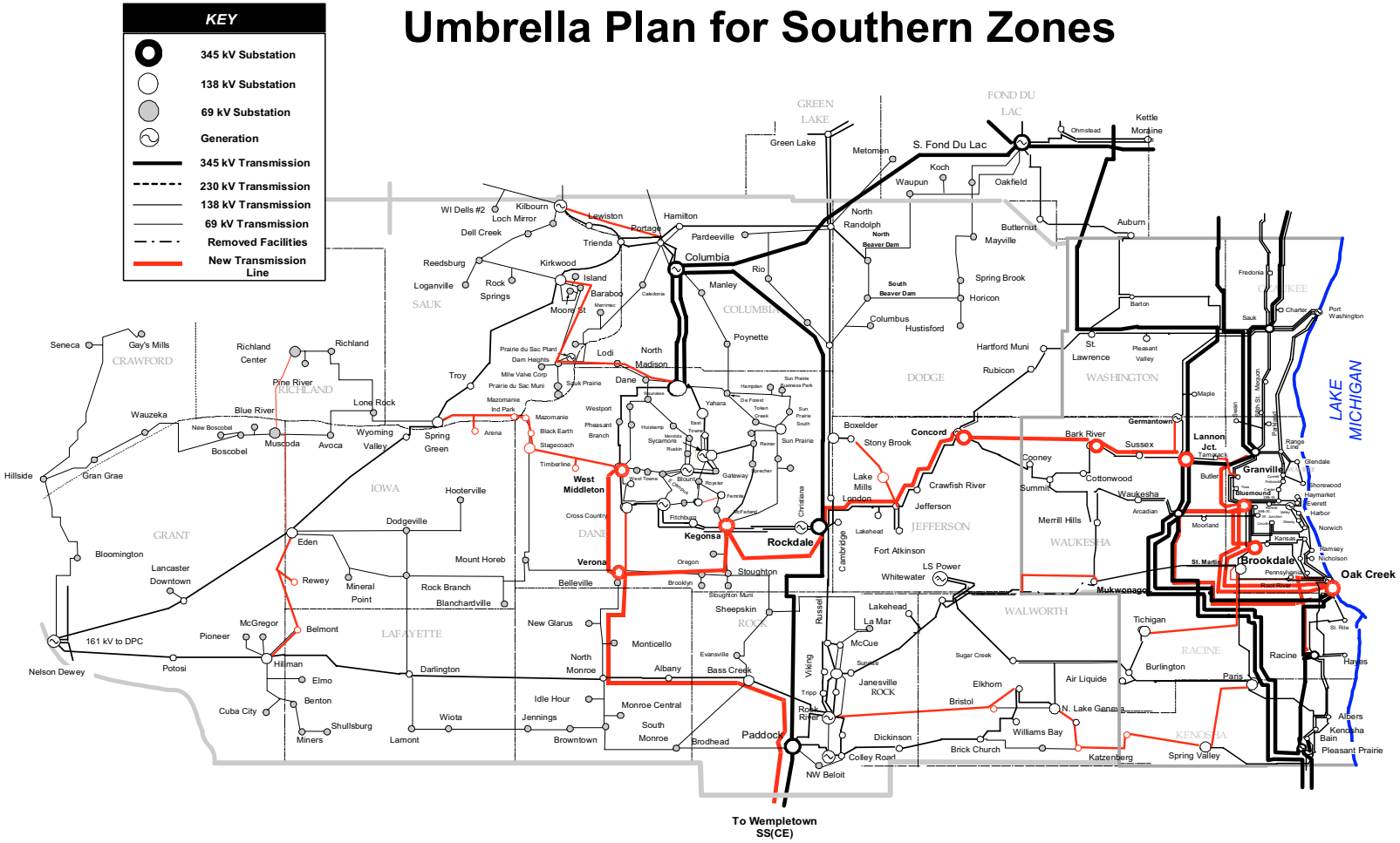
- Rerouting the eastern portion of the Whitewater-Mukwonago 138 kV line is the best solution to address system needs and environmental concerns. Abandoning the line is not a viable option from a system performance perspective. If new right-of-way can be obtained, ATC currently intends to complete this project by 2007.

- Converting the Rock River-Turtle-Bristol-Elkhorn 69 kV line to 138 kV will relieve line overloads, improve voltage profiles and accommodate future load growth. ATC currently intends to complete this project by 2008.

- Constructing a new 345 kV line from Rockdale through Kegonsa to West Middleton (preferably a potential step-down transformer at Kegonsa to minimize the impact of heavy flow from the west to the east of Madison) and installing a 345/138 kV transformer at West Middleton will relieve line overloads, avert voltage collapse, decrease system losses and accommodate future load growth. ATC currently intends to complete this project by 2009.

- Constructing the second phase of the Rockdale-Concord-Bark River-Lannon Junction 345 kV line would relieve line overloads, improve voltage stability, further decrease system losses, further increase import capability from Illinois and accommodate future load growth. The second phase projects would consist of:
  - Constructing a new Concord-Bark River 345 kV line
  - Converting the existing Lannon Junction-Bark River 138 kV line to 345 kV
  - Installing a 345/138 kV transformer at Bark River

Figure V-10
Umbrella Plan for Southern Zones



ATC currently intends to complete this project in 2010.

- Constructing the facilities associated with the second phase of the proposed Elm Road generation project will improve dynamic stability of the Elm Road generation and existing Oak Creek generation, relieve line overloads, replace aging 230 kV facilities and accommodate future load growth. Those facilities, as proposed, consist of:
  - Constructing a new Pleasant Prairie-Libertyville (Commonwealth Edison) 345 kV line
  - Expanding the Oak Creek 345 kV switchyard
  - Installing system termination equipment for Pleasant Prairie-Libertyville (Commonwealth Edison) 345 kV line

ATC currently intends to complete these projects coincident with the completion of the first phase of the Elm Road generation project, which is scheduled to be completed in 2009.

- Constructing a North Lake Geneva-Twin Lakes-Spring Valley 138 kV line would relieve line overloads, improve voltage profiles in the area, eliminate radial transmission service to Twin Lakes and Spring Valley and improve south-central to southeast (Zone 3 to Zone 5) transfer capability. This project would consist of:
  - Converting the existing North Lake Geneva-South Lake Geneva-Katzenberg-Twin Lakes 69 kV line to 138 kV
  - Installing a 138/69 kV transformer at South Lake Geneva
  - Extending the Zenda 69 kV circuit to South Lake Geneva to accommodate a proposed T-D interconnection southwest of Lake Geneva
  - Constructing a new Twin Lakes-Spring Valley 138 kV line

ATC currently intends to complete these projects in 2009.

- Constructing a new Spring Valley-Paris 138 kV line would improve voltage profiles in the area, improve dynamic stability at Paris, and improve transfer capability by providing the second path to Paris. ATC is contemplating the project by 2009.

- Constructing a new Tichigan-St. Martins 138 kV line would improve voltage profiles in the Tichigan area and eliminate radial transmission service to Tichigan. ATC is contemplating the project in the next six to nine years.

- The projects that would improve voltage profiles and accommodate future load growth in the Kilbourn area include
  - Constructing a second Kilbourn-Portage 138 kV line by expanding the right-of-way of existing 138 kV line
  - Constructing a new North Madison-Kirkwood 138 kV line by expanding the right-of-way of the existing 69 kV line

ATC is contemplating these projects or equivalents in the next six to nine years.

- Constructing a Verona 345 kV switching station, constructing a new Wempletown-Verona 345 kV line, and looping Kegonsa-West Middleton 345 kV line into Verona would relieve line overloads, improve voltage stability, improve transfer capability from Illinois, eliminate various transmission service limitations, significantly reduce system losses and accommodate future load growth. This project would require a new 345 kV line from Paddock to Verona since ATC plans to install a second 345 kV circuit between Wempletown and Paddock by 2005. ATC currently intends to complete this project in 2011.

- Constructing the projects associated with the third phase of generation at Elm Road would ensure stability of the Elm Road and Oak Creek generators, relieve overloads and accommodate future load growth. Those projects would consist of:
  - Converting the remaining Oak Creek-Bluemound 230 kV circuit to 345 kV
  - Routing the Brookdale-Granville 345 kV line into Bluemound substation
  - Expanding the Bluemound 345 kV switchyard to accommodate the above lines
  - Constructing a new Oak Creek-Racine 345 kV line and convert 138 kV line KK812 to 345 kV
  - Expanding the Oak Creek 138 kV and 345 kV switchyard
  - Installing an additional 345/138 kV transformer at Oak Creek
  - Replacing substation equipment at various locations

ATC currently intends to complete these projects coincident with the completion of the third phase of the Elm Road generation project, which is scheduled to be completed in 2011.

- Constructing a new Richland Center-Muscoda-Eden 69 kV line with 138 kV structure and moving the phase-shifter from Lone Rock to Richland Center will provide long-term solution to load serving needs in the Richland area and improve voltage profiles in the area. ATC is contemplating the project or an equivalent by 2012.

- Projects that are common with or similar to plans in the 10-Year Assessment are
  - Constructing a new Stony Brook-Lake Mills-Jefferson 138 kV line. The project would not only accommodate T-D interconnections at Lake Mills and Waterloo but also improve voltage profiles in London and Jefferson areas. ATC is contemplating the project by 2006,
  - Constructing a new Cross Country-Verona 138 kV line. The project would improve voltage profiles and accommodate future load growth in the area. ATC is contemplating the project by 2007,
  - Converting the Eden-Hillman 69 kV line to 138 kV. The project would improve voltage profiles and accommodate future load growth in the area. ATC is contemplating the project by 2009, and
  - Rebuilding and converting the Spring Green-West Middleton 69 kV line to 138 kV. The project would improve the voltage profiles, accommodate future load growth in the area and provide voltage support in the Kilbourn area as well. ATC is contemplating the project by 2009.

345 kV Network Development and Strategic Expansion

The 2004, 2008 and 2012 analyses for this Assessment and the umbrella plans identify transmission system limitations within the ATC system, future uncertainties and potential projects to address those limitations and uncertainties. This section of the Assessment is an extension of those analyses, with three key purposes:

1. Identifying areas on the ATC system where 345 kV infrastructure is noticeably deficient and would likely be needed to accommodate any significant load or generation development,
2. Identifying projects that could provide strategic advantages to ATC customers by improving their ability to access broad energy markets, and
3. Identifying transmission projects that would be needed to achieve an additional 1,000 megawatts, 2,000 megawatts and 3,000 megawatts of import capability from existing conditions.

345 kV Network Development

The ATC transmission system has been constructed over a period of more than 80 years, evolving from simple networks tying generation to load centers, to the complex system that exists today. Today, the existing system is nearly fully subscribed and there is little room for generation development or load growth without significant investment in new transmission infrastructure despite the recent investments made and being made by ATC.

The 345 kV facilities on the ATC system were constructed to accommodate generation development, interconnections between utilities and reliability. Due to load growth, additional generation and in particular, increased energy transactions, most of these 345 kV facilities are more heavily loaded. This situation has resulted in a system that must rely heavily on certain 138 kV, 115 kV and 69 kV facilities to transfer power through the system, leaving little capacity on these facilities to accommodate load growth and causing many more limitations to energy transactions to occur.

Development of additional 345 kV facilities in key locations could substantially improve the ability of the transmission system to transfer power into and through the ATC system, and do so in a far more efficient manner. Table V-5 contains a list of planned/proposed, conceptual and strategic projects along with what would drive the need for such projects and the planned or potential in service dates associated with each. These projects are also shown in Figure V-12. These project categories are defined as follows:

- *Planned/Proposed* projects are those that have been identified previously in this Assessment as solutions to existing or emerging needs, including accommodating planned generation included in the Assessment analysis. These projects or their equivalents will need to be implemented in order to ensure reliable system operation.
- *Conceptual* projects are those that, if developed, would improve the efficiency of the system, potentially facilitate the development of generation, accommodate large new load additions, facilitate maintenance scheduling and improve the overall security of the system. Note that the conceptual projects, for the most part, tie portions of the 345 kV network together where there are insufficient or no existing 345 kV facilities.
- *Strategic* projects are those that would increase transfer capability into the ATC system and in some instances address reliability needs. Additional work is underway by ATC on the evaluation of possible strategic access projects. There will be further discussion on this topic in the 2003 Update report.

Table V-5
Planned/Proposed, Conceptual and Strategic 345 kV Projects

Planned/Proposed 345 kV Projects
Arrowhead-Weston
Morgan-Werner West
Wempletown-Paddock (2nd circuit)
Oak Creek-Brookdale-Granville
Lannon Jct.-Bark River-Concord-Rockdale
Rockdale-Verona-West Middleton
Oak Creek-Bluemound circuits (convert from 230 kV)

Conceptual 345 kV Projects
Arpin-Columbia
Dead River-Plains-Venus-Weston
Big Bend-Paddock
Weston-'Central Wisconsin'
North Madison-West Middleton

Strategic 345 kV Projects
Byron (CE)-North Monroe-Verona
Salem-Nelson Dewey-Spring Green-West Middleton
Point Beach-Ludington
Eau Claire-Fitzgerald

Under the *Conceptual* category, the Arpin-Columbia line would provide a needed north-south path on the western side of the ATC system, improve stability at Weston and reduce losses. The Dead River-Plains-Venus-Weston line would improve generator stability at Weston and at Presque Isle, increase transfer capability between the Upper Peninsula and Wisconsin, improve voltage stability in the Upper Peninsula, reduce losses and provide a long-term solution for the Rhinelander Loop. The Big Bend-Paddock line would improve generator stability in southeast Wisconsin, provide additional south-central to southeast (Zone 3 to Zone 5) transfer capability, increase import capability from Illinois and reduce losses. The Weston-Central Wisconsin project would be needed to accommodate proposed generation at Weston. Central Wisconsin would be a new substation on the proposed Morgan-Werner West line. The North Madison-West Middleton project would complete the 345 kV network around the Madison area, providing room for future load growth as well as reducing losses.

Under the *Strategic* category, the Byron-Verona line would improve voltage stability in the Madison area, increase import capability from Illinois and reduce losses. The Salem-Nelson Dewey-Spring Green-West Middleton line would provide additional import capability in addition to voltage support in the southwest portion of Wisconsin and reducing losses. The Point Beach-Ludington line would improve import capability, relieve line loading in the Upper Peninsula and lower system losses. The Eau Claire-fitzgerald line would increase import capability, relieve line loading, and lower system losses.

Increasing Import Capability
ATC conducted analyses for this Assessment to provide perspective on what representative transmission facilities might need to be constructed in order to increase transfer capability into the ATC system by up to 3,000 megawatts from existing import capability levels. Specifically, analyses were conducted to identify facilities needed to provide 1,000 megawatts, 2,000 megawatts and 3,000 megawatts of incremental transfer capability to approximately 2,970 megawatts, 3,970 megawatts and 4,970 megawatts.

These analyses were not intended to predict available transfer capability. They did not include an Assessment of voltage limits on transfer capability and only included known generator or voltage stability limits. These studies also have not been reviewed by systems adjacent to ATC's system for potentially more limiting issues in their systems.

These analyses were conducted based on a 2008 summer peak power flow model with all generation assumed for the Assessment, plus additional generation at Weston, included in the model. Transfers were modeled by increasing the output of existing generation external to the ATC system and decreasing generation output within the ATC territory. To the extent possible, transfers were split equally from the west and from the south of ATC. The following key transmission facilities were included in the model.
- Second Wempletown-Paddock 345 kV circuit
- Arrowhead-Weston 345 kV line
- Werner West 345/138 kV substation
- Werner West-Central Wisconsin-Morgan 345 kV line
- Weston-Central Wisconsin 345 kV line
- All transmission reinforcements identified for interconnection of and transmission service for Elm Road phase 1, Port Washington phase 1 and 2, West Campus and Riverside.

Facilities needed in addition to the key facilities above are summarized in Tables V-6 through V-8 and shown in Figures V-12 through V-14 for the import level increases of 1,000 through 3,000 megawatts, respectively.

Figure V-11
Planned, Proposed, Conceptual and Strategic 345 kV Projects

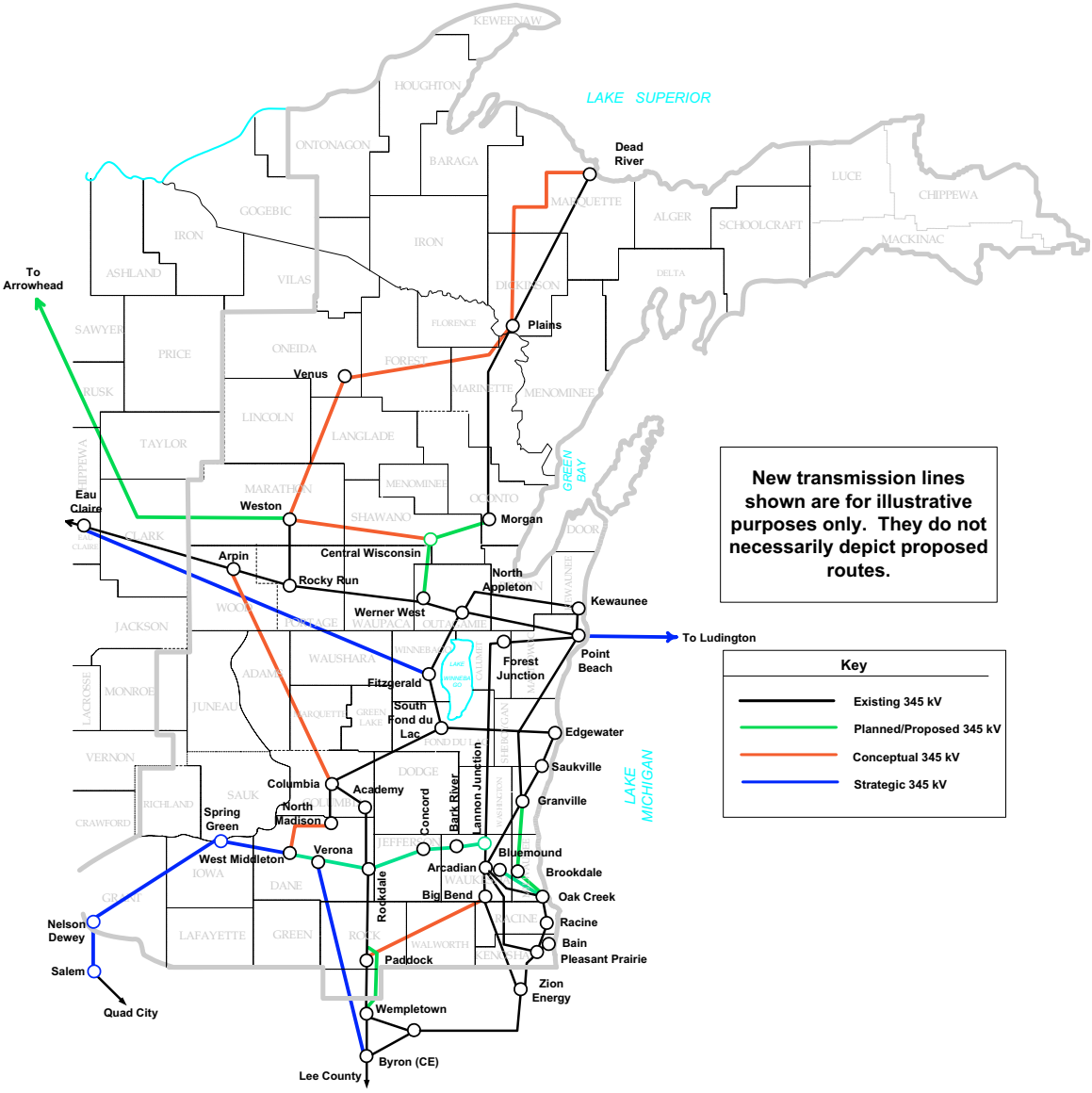


Table V-6
Representative Transmission Facilities Needed to Increase Import Capability by 1,000 Megawatts

Uprate Rocky Run-Werner West 345 kV line
Add second Morgan-Falls-Pioneer 138 kV circuit
Install a second 345/138 kV transformer at Oak Creek (planned)
Construct a Rockdale-West Middleton 345 kV line (proposed)
Install a 345/138 kV transformer at West Middleton (proposed)

Figure V-12
Representative Transmission Facilities Needed to Increase Import Capability by 1,000 MW
Based on 2008 Summer Peak Power Flow Model

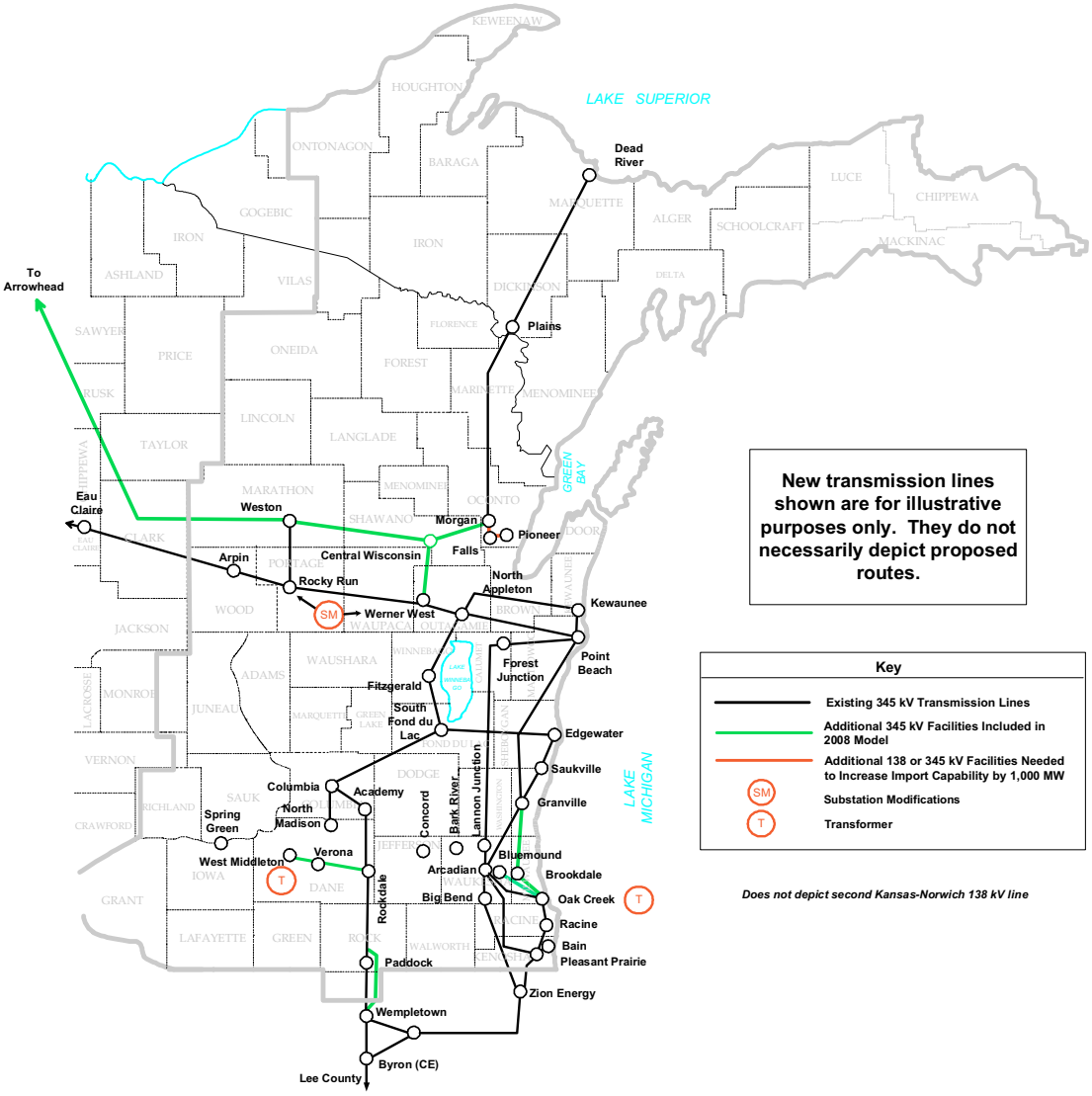


Table V-7
Representative Transmission Facilities Needed to Increase Import Capability by 2,000 Megawatts

All projects listed in Table V-6
Rebuild Morgan-White Clay 138 kV line
Rebuild Blackhawk-Colley Road 138 kV line
Construct a Rockdale-Concord-Bark River-Lannon Junction 345 kV line (proposed)
Install a 345/138 kV transformer at Concord (proposed)
Install a 345/138 kV transformer at Bark River (proposed)
Install a 345/138 kV transformer at Lannon Junction (proposed)
Construct a Byron-North Monroe 345 kV line
Install a 345/138 kV transformer at North Monroe
Rebuild North Monroe-Monticello-New Glarus-Bellville-Verona 138 kV line
Install a 138/69 kV transformer at Verona
Construct a Verona-Cross Country 138 kV line
Construct a Russell-Sheepskin 138 kV line
Rebuild/convert Sheepskin-Stoughton 69 kV line to 138 kV
Rebuild/convert Stoughton – North Stoughton – Kegonsa 69 kV line to 138 kV
Install a 138/69 kV Transformer at Stoughton and Sheepskin
Construct a Jackson County – Port Edwards 161 kV line
Install a 161/138 kV Transformer at Port Edwards

Figure V-13
Representative Transmission Facilities Needed to Increase Import Capability by 2,000 MW
Based on 2008 Summer Peak Power Flow Model

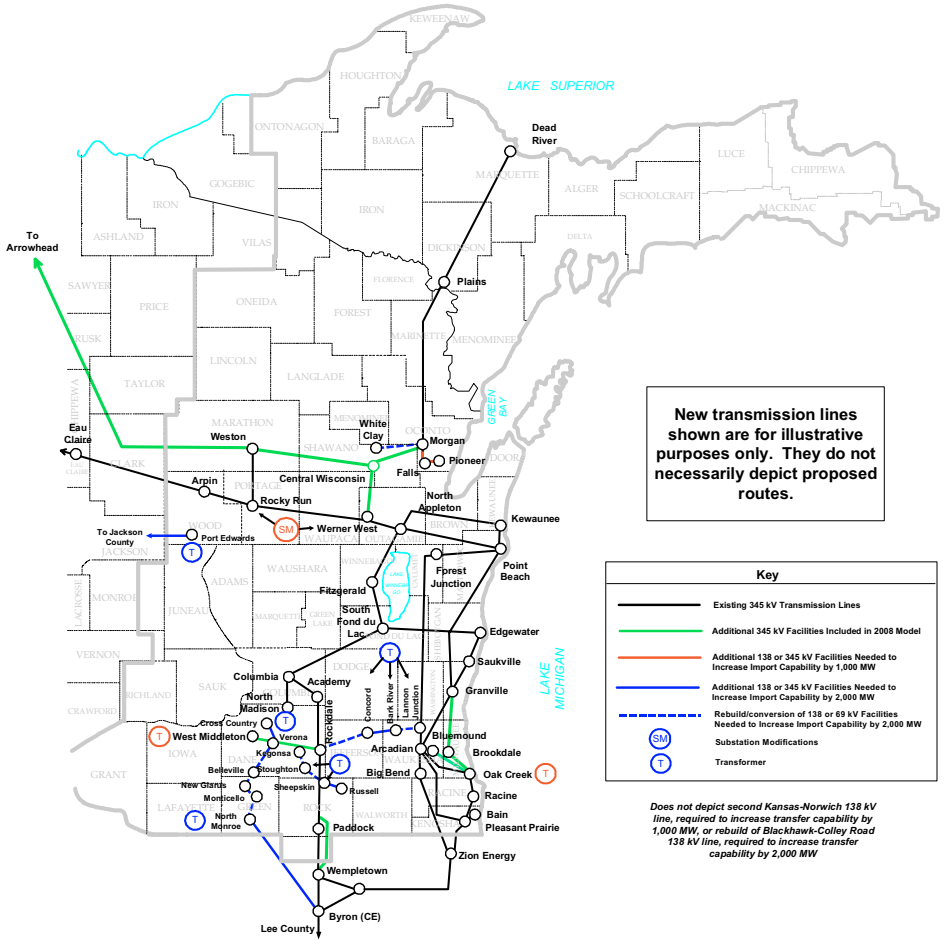
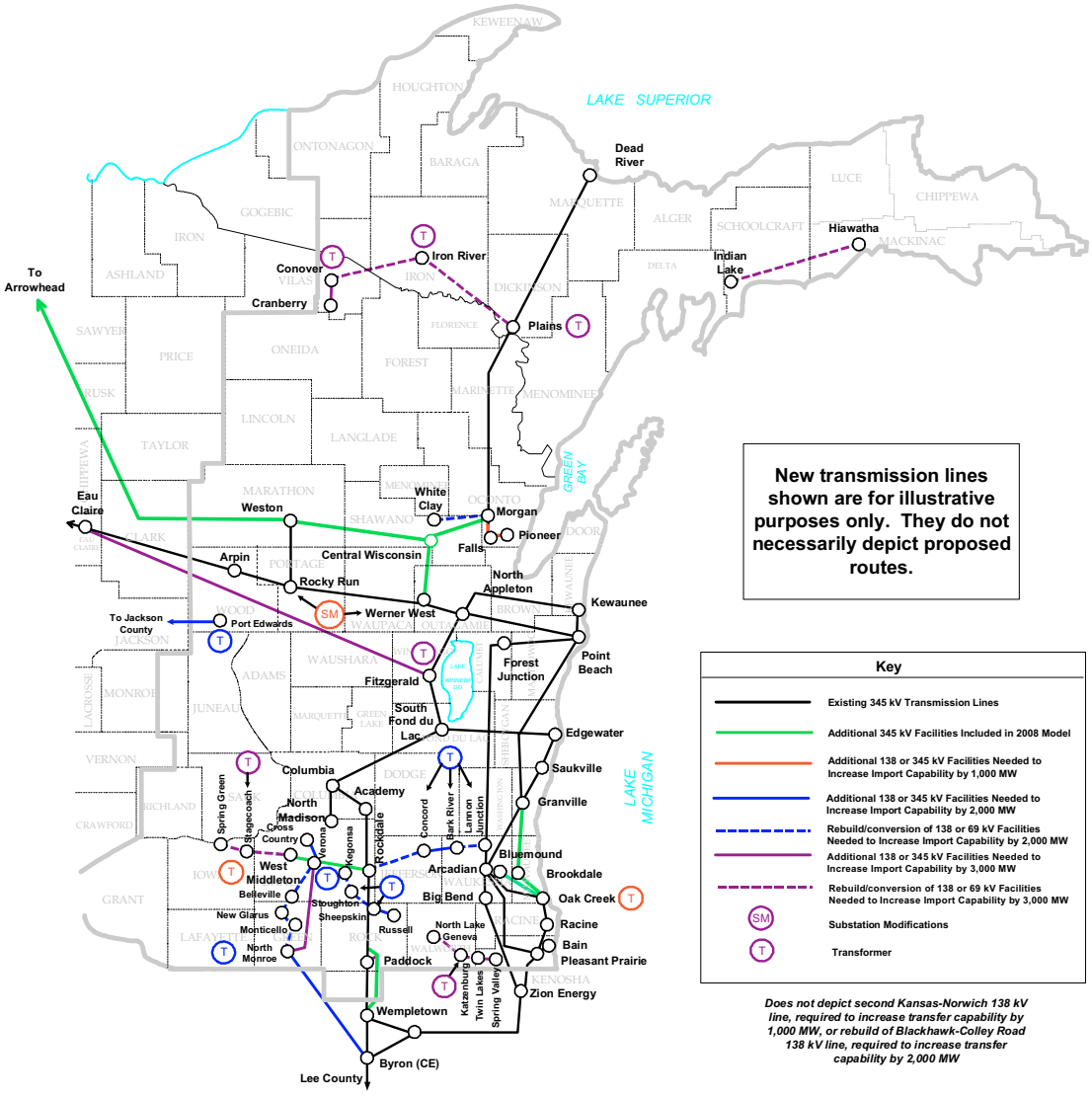


Table V-8
Representative Transmission Facilities Needed to Increase Import Capability by 3,000 Megawatts

All projects listed in Tables V-6 and V-7
Construct a North Monroe-Verona 345 kV line
Construct a Verona-West Middleton 345 kV line
Construct an Eau Claire-Fitzgerald 345 kV line
Install a second 345/138 kV transformer at Fitzgerald
Construct a Spring Valley-Twin Lakes 138 kV line (proposed)
Rebuild/convert Twin Lakes-Katzenburg-S. Lake Geneva-N. Lake Geneva 69 kV line to 138 kV (proposed)
Install a 138/69 kV transformer at Katzenburg
Install a second 345/138 kV transformer at Plains
Rebuild/convert West Middleton-Stagecoach-Spring Green 69 kV line to 138 kV (proposed)
Install a 138/69 kV transformer at Stagecoach (proposed)
Rebuild one Hiawatha-Indian Lake 69 kV line (planned)
Construct a Cranberry-Conover 138 kV line (planned)
Install 138/69 kV transformers at Conover and Iron River (planned)
Rebuild/convert Conover-Iron River-Plains 69 kV to 138 kV (planned)
Connect the Wempletown-Rockdale 345 kV circuit into Paddock

Figure V-14
Representative Transmission Facilities Needed to Increase Import Capability by 3,000 MW
Based on 2008 Summer Peak Power Flow Model



Does not depict second Kansas-Norwich 138 kV line, required to increase transfer capability by 1,000 MW, or rebuild of Blackhawk-Colley Road 138 kV line, required to increase transfer capability by 2,000 MW