

Section V

SUMMARY OF FACILITY ADDITIONS IN THE 2003 10-YEAR ASSESSMENT UPDATE

Summary of Transmission System Additions: 2004-2012

The change in transmission facilities proposed by ATC based on this 2003 Update are listed in Table V-1 and shown graphically in Figures V-1 through V-5. Alternatives for some of the primary alternatives shown in Table V-1 are listed in Table V-2. Also, projects listed in the 2003 10-Year Assessment that are not included in this Update are listed in Appendix B.

In each of these tables, there is a column indicating the planned in-service year for each particular facility and a column indicating the year the facility is needed. There are numerous facilities for which the year it is needed precedes the planned in-service year. There are a variety of reasons for this, including:

- ❑ The preferred alternative to address a particular need may take several years to implement.
- ❑ The need may have previously existed but had been addressed with operating procedures that are becoming less effective or ineffective.
- ❑ The preferred alternative to address a particular need may need to be implemented in phases.
- ❑ New data or information became available that affected the nature of the need or limitation, which necessitated a change in the alternative to be implemented, introducing a delay in implementation.
- ❑ The need for a project was based on load or generation development that was uncertain.
- ❑ Stakeholder input necessitated a change in the alternative to be implemented, introducing a delay in implementation.

Within the tables, the need for each project is identified. Need categories include the following:

Reliability:

- ❑ Facility (line, transformer, substation equipment) normal rating is exceeded under normal system conditions.
- ❑ Facility emergency rating is exceeded under single contingency conditions.
- ❑ Bus voltage is not within 5% of nominal voltage under normal system conditions.
- ❑ Bus voltage is not within 10% of nominal voltage under single contingency conditions.

New generation:

Facility has been identified as necessary to accommodate new generation in generation interconnection studies or related transmission service studies conducted by ATC.

Service limitation:

Facility has been identified by ATC as a chronic cause for interrupting, curtailing, limiting or denying transmission service in real time.

T-D interconnection: Facility is required to interconnect to a new transmission-distribution substation needed by a distribution company served by ATC.

Condition: Facility has been identified by ATC as being in need of repair or replacement.

Stability: Facility has been identified by ATC as needed to ensure ATC dynamic stability criteria is met, or will improve stability response of generation.

Import capability: Facility will enhance import capability or address chronic limiters to the movement of power in the ATC transmission system.

Other identifiers may be used in the “need category” column to provide further explanation as appropriate in particular cases

*Table V-1
Changes to the 2003 10-Year Assessment*

Planned Additions	System Need Year	Projected In-service Year	Planning Zone	Need Category	Planned, Proposed or Provisional	Capital Cost Estimate (Millions)
Rebuild from Nordic SS to Randville SS (5 miles) of single circuit 69 kV line to double circuit 69 kV	2005	2004	2	reliability, condition	Planned	\$ 1.6
Construct a tap to Belle Plain from the Badger-Caroline 115 kV line	2004	2004	4	T-D interconnection	Planned	\$ 1.1
Uprate Rocky Run-Northpoint 115 kV line terminal equipment at Northpoint	2005	2005	1	reliability, new generation	Planned	\$ 0.06
Rebuild existing West Marinette-Menominee 69 kV line to double circuit 138/69 kV	2005	2005	2 & 4	reliability, service limitation	Planned	\$ 6.9
Convert Menominee-Rosebush 69 kV line to 138 kV	2005	2005	2 & 4	reliability, service limitation	Planned	\$ 11.4
Rebuild/reconductor Rosebush-Amberg 138 kV line	2005	2005	2 & 4	reliability, service limitation	Planned	\$ 6.8
Construct a Fox Energy-Forest Junction 345 kV line	2005	2005	4	new generation	Planned	\$ 4.5
Construct new Fox Energy 345 kV switchyard	2005	2005	4	new generation	Planned	\$ 7.1
Install a 26 MVAR capacitor bank at Hartford 138 kV substation	2004	2005	5	reliability	Proposed	\$ 1.0
Install 69 kV phase shifter or fixed reactor at Council Creek	2002	2006	1	reliability	Proposed	\$ 1.9
Construct new Gardner Park 345/115 kV substation	2006	2006	1	service limitation, reliability, import capability & Weston stability	Proposed	Included In A-W Estimate
Replace 345/115 kV 200 MVA transformer at Weston with two 500 MVA units at the Gardner Park substation	2005	2006	1	service limitation, reliability, import capability & Weston stability	Planned	Included In A-W Estimate

*Table V-1
Changes to the 2003 10-Year Assessment (continued)*

Planned Additions	System Need Year	Projected In-service Year	Planning Zone	Need Category	Planned, Proposed or Provisional	Capital Cost Estimate (Millions)
Construct Gardner Park-Stone Lake 345 kV line	1997	2006	1	service limitation, reliability, import capability & Weston stability	Planned	\$ 262.1
Install a 345/161 kV transformer at Stone Lake (temporary installation for construction outages)	2006	2006	1	reliability	Proposed	Included In A-W Estimate
Construct an Eagle River-Cranberry/Three Lakes 115 kV line	2006	2006	1	T-D interconnection	Proposed	\$ 0.3
Construct double circuit 138 kV line from Forest Junction/Charter Steel to Howards Grove	2006	2006	4	T-D interconnection	Planned	\$ 8.2
Replace the two existing 33 MVA 138/69 kV transformers at Edgewater with two 60 MVA transformers	2003	2006	4	reliability	Proposed	\$ 2.4
Replace the existing 46.7 MVA 138/69 kV transformer at South Sheboygan Falls with 100 MVA transformer	2003	2006	4	reliability	Proposed	\$ 1.3
Replace the existing 46.7 MVA 138/69 kV transformer at Mullet River with 100 MVA transformer	2003	2006	4	reliability	Proposed	\$ 1.3
Construct a Martin Road-South Fond du Lac/Ohmstead 138 kV line	2006	2006	4	T-D interconnection	Planned	\$ 1.6
Construct Clear Lake-Arnett Road 115 kV line	2007	2007	1	T-D interconnection	Proposed	\$ 2.1
Construct Venus-Metonga 115 kV line	2007	2007	1	T-D interconnections	Proposed	\$ 5.0
Uprate Rockdale to Boxelder 138 kV line	2007	2007	3	reliability	Proposed	\$ 0.3
Construct a Jefferson-Lake Mills-Stony Brook 138 kV line	2006	2007	3	reliability, T-D interconnection	Proposed	\$ 11.3

*Table V-1
Changes to the 2003 10-Year Assessment (continued)*

Planned Additions	System Need Year	Projected In-service Year	Planning Zone	Need Category	Planned, Proposed or Provisional	Capital Cost Estimate (Millions)
Construct new 69 kV line from Brooklyn to Sugar River Substation	2007	2007	3	reliability	Proposed	\$ 5.0
Construct a new Lannon Junction substation at intersection of Granville-Arcadian 345 kV, Sussex-Tamarack 138 kV and Sussex-Germantown 138 kV lines; install a 345/138 kV, 500 MVA transformer	2007	2007	5	reliability	Proposed	\$ 14.2
Install 1-40 MVAR capacitor banks at Arpin 138 kV	2008	2008	1	achieve transfer capability associated with Arrowhead-Weston	Proposed	Included In A-W Estimate
Install 6-34 MVAR capacitor banks at Gardner Park 115 kV	2008	2008	1	achieve transfer capability associated with Arrowhead-Weston	Proposed	Included In A-W Estimate
Install 4-50 MVAR capacitor bank at Arrowhead 230 kV	2008	2008	1	achieve transfer capability associated with Arrowhead-Weston	Proposed	Included In A-W Estimate
Construct a Rubicon-Hustisford 138 kV line	2008	2008	3	reliability	Provisional	\$ 4.8
Rebuild Hustisford-Horicon 69 kV to 138 kV	2008	2008	3	reliability	Provisional	\$ 2.7
Construct 138/69 kV substation at a site near Horicon and install a 138/69 kV transformer	2008	2008	3	reliability	Provisional	\$ 2.8
Construct new Central Wisconsin 345 kV substation	2009	2009	1 & 4	service limitation, reliability, import capability & Weston stability	Proposed	\$ 10.5
Construct Gardner Park-Central Wisconsin 345 kV line	2009	2009	1	service limitation, reliability, import capability & Weston stability	Proposed	\$ 86.6
Construct new 138 kV bus and 138/69 kV 100 MVA transformer at Sugar River Substation	2009	2009	3	reliability	Provisional	\$ 1.4

*Table V-1
Changes to the 2003 10-Year Assessment (continued)*

Planned Additions	System Need Year	Projected In-service Year	Planning Zone	Need Category	Planned, Proposed or Provisional	Capital Cost Estimate (Millions)
Construct new 138 kV line from Sugar River to Southeast Fitchburg Substation	2009	2009	3	reliability	Provisional	\$ 5.2
String a new 138 kV line from Clintonville-Werner West primarily on Morgan-Werner West 345 kV line structures	2004	2009	4	reliability, service limitation	Proposed	included in Morgan-Werner estimate
Reconductor a segment of the Oak Creek-Ramsey6 138 kV line	2009	2009	5	new generation	Proposed	\$ 0.1
Reconductor underground segment of Ramsey5-Harbor 138 kV line	2009	2009	5	new generation	Proposed	\$ 11.5
Reconductor Oak Creek-Allerton 138 kV line	2009	2009	5	new generation	Proposed	\$ 2.0
Expand Oak Creek 345 kV switchyard to interconnect one new generator	2009	2009	5	new generation	Proposed	\$ 18.8
Install two 345 kV series breakers at Pleasant Prairie on lines to Racine (L631) and Zion (L2221)	2009	2009	5	new generation	Proposed	\$ 2.1
Replace seven 138 kV overdutied breakers at Bluemound	2009	2009	5	new generation	Proposed	\$ 2.4
Uprate Kansas-Ramsey6 138 kV line	2009	2009	5	new generation, reliability	Proposed	\$ 0.1
Uprate Oak Creek-Ramsey6 138 kV line	2009	2009	5	new generation, reliability	Proposed	\$ 0.1
Install second 500 MVA 345/138 kV transformer at Oak Creek	2009	2009	5	new generation	Proposed	\$ 8.4
Construct an Oak Creek-Brookdale 345 kV line installing 4 mi. new structures, converting 16.2 mi. of non-operative 230 kV and 5 mi. 138 kV	2010	2010	5	new generation	Proposed	\$ 17.3

*Table V-1
Changes to the 2003 10-Year Assessment (continued)*

Planned Additions	System Need Year	Projected In service Year	Planning Zone	Need Category	Planned, Proposed or Provisional	Capital Cost Estimate (Millions)
Construct Oak Creek-St Martins 138 kV circuit #2 installing 4 mi. new structures and conductor, plus 12.6 mi. conductor on existing towers	2010	2010	5	new generation	Proposed	\$ 3.4
Construct a Brookdale-Granville 345 kV line converting/reconducting 5.6 mi. 138 kV, rebuilding 7 mi. 138 kV double circuit tower line and converting/reconducting 3 mi. 138 kV on existing 345 kV structures	2010	2010	5	new generation	Proposed	\$ 19.3
Restrung Bluemound-Butler 138 kV line (KK5051) on new 345 kV structures installed with Brookdale-Granville line	2010	2010	5	new generation	Proposed	\$ 1.1
Construct Butler-Tamarack (Carmen) 138 kV line on new 345 kV structures installed with Brookdale-Granville line	2010	2010	5	new generation	Proposed	\$ 1.0
Construct a 345/138 kV switchyard at Brookdale to accommodate two 345 kV lines, a 500 MVA 345/138 kV transformer and 4-138 kV lines plus two 138-26.2 kV transformers	2010	2010	5	new generation	Proposed	\$ 14.8
Expand 345 kV switchyard at Oak Creek to interconnect one new generator plus one new 345 kV line and 138 kV switchyard to accommodate new St. Martins line	2010	2010	5	new generation	Proposed	\$ 4.2
Construct 345 kV line from Paddock to new Sugar River 345 kV switchyard; loop Kegonsa-West Middleton 345 kV line into Sugar River	2012	2012	3	reliability, transfer capability	Provisional	\$ 119.3
Construct 345 kV Bluemound switchyard to accommodate 1-345 kV line and a 500 MVA 345/138 kV transformer	2012	2012	5	new generation	Proposed	\$ 4.8

*Table V-1
Changes to the 2003 10-Year Assessment (continued)*

Planned Additions	System Need Year	Projected In-service Year	Planning Zone	Need Category	Planned, Proposed or Provisional	Capital Cost Estimate (Millions)
Expand Oak Creek 138 kV switchyard to reconnect Units 6 and 9	2012	2012	5	new generation	Proposed	\$ 6.8
Convert and reconductor Oak Creek-Bluemound 230 kV line K862 to 345 kV and loop into Arcadian 345 kV substation	2012	2012	5	new generation	Proposed	\$ 34.8
Construct Oak Creek-Racine 345 kV line with 4 mi new structures and conductor, plus convert 9.6 mi. 138 kV line KK812 to 345 kV	2012	2012	5	new generation	Proposed	\$ 8.1
Replace 22-138 kV overdutied breakers at Harbor, Everett and Haymarket Substations	2012	2012	5	new generation	Proposed	\$ 7.7
Expand Oak Creek 345 kV switchyard to interconnect three new generators	2012	2012	5	new generation	Proposed	\$ 21.5

*Table V-2
Alternative Solutions to Planned, Proposed or Provisional Additions*

Primary Solution(s)	Alternate Solution(s)	Projected In-service Year	Planning Zone
Convert Pine-Grandfather-Tomahawk-Eastom 46 kV system to 115 kV and construct new Lake Nokomis-Highway 8 115 kV line	<ol style="list-style-type: none"> 1) Weston-Venus 345 kV line. 2) Venus-Crandon-Laona-Goodman-Amberg 138 kV line. 3) Venus-Crandon-Laona-Goodman-Plains 138 kV line. 4) Cranberry-Conover 138 kV line and convert Conover-Iron River-Plains to 138 kV. 5) Cranberry-Conover 138 kV line and convert Conover-Winona to 138 kV. 6) Rebuild Bunker Hill-Blackbrook 115 kV line and rebuild Blackbrook-Aurora St. with double circuit 115 kV lines. 7) Generation in upper portion of Rhinelander Loop. 	2004 & 2005	1
New Cranberry-Conover 138 kV line and Convert Conover-Iron River-Plains 69 kV to 138 kV	<ol style="list-style-type: none"> 1) Weston-Venus 345 kV line. 2) Weston-Venus-Plains 345 kV line. 3) Cranberry-Conover 138 kV line and convert Conover-Winona to 138 kV. 4) Venus-Crandon-Laona-Goodman-Plains 138 kV line. 5) Venus-Crandon-Laona-Goodman-Amberg 138 kV line. 6) Generation in upper portion Rhinelander Loop 7) Park Falls-Clear Lake 115 kV line 8) Convert Whitcomb-Aurora St. 69 kV to 115 kV 	2007	1
Two T-D interconnections: Arnett Road & Boulder Junction. New Clear Lake-Arnett Road 115 kV line and a new St. Germain-Boulder Junction 115 kV line. Both lines to be radial.	<ol style="list-style-type: none"> 1) Loop new T-D substations with a Clear Lake-Arnett Rd-Boulder Junction-Conover 115 kV line. 2) Loop new T-D substations with a Clear Lake-Arnett Rd-Boulder Junction-St. Germain 69 kV line. 3) Construct new 69 kV radial lines to Arnett Rd and Boulder Junction with 115/69 kV xfms at Clear Lake and St. Germain. 4) New Clear Lake-Arnett Rd 115 kV line and extend 115 kV line west to NSP's Park Falls substation. 	2006 & 2008	1

*Table V-2
Alternative Solutions to Planned, Proposed or Provisional Additions (continued)*

Primary Solution(s)	Alternate Solution(s)	Projected In-service Year	Planning Zone
Berlin area reinforcements: New Omro-Fitzgerald 69 kV line. Install capacitor banks at Ripon and Berlin.	1) Reconfigure N. Randolph-Ripon 69 kV line to N. Randolph-Metomen & Metomen-Ripon 69 kV lines. Cap bank installations at Berlin, Ripon and Winneconne and second 138/69 kV transformer at Metomen. 2) Convert Metomen-Ripon-Berlin 69 kV line to 138 kV with a new 138/69 kV transformer at Berlin. 3) Rebuild the Metomen-Ripon-Berlin 69 kV line to a 138-69 kV double circuit with new 138/69 kV transformer at Berlin.	2004 - 2009	1
Uprate Weston-Sherman St., Weston-Morrison-Sherman St., and Sherman St.-Hilltop 115 kV lines	1) Convert WPS's 46 kV system from Maine-Brokaw-Strowbridge-Wausau Hydro-Townline-Kelly to 115 kV. 2) Convert WPS's 46 kV system from Sherman St.-Wausau Hydro-Strowbridge-Townline-Kelly to 115 kV	2007	1
Uprate Weston-Kelly 115 kV line	1) Convert WPS's 46 kV system from Weston-Rothschild-Kelly to 115 kV. 2) Reroute/reterminate Weston end of line to new Weston 345-115 kV substation.	2006	1
Install 69 kV series reactor at Council Creek	1) Install a 69 kV phase shifter Council Creek. 2) Install a new 161/138 kV transformer at Monroe County and convert DPC's Monroe County-Council Creek 69 kV system to 138 kV.	2004	1
Construct a 0.2-mile Hiawatha to Engadine 69 kV line to relieve low voltages under contingency by removing load from the end of a 71-mile, 69 kV line.	Add capacitor bank near Newberry SS.	2003	2
Add a second 138/69 kV transformer at Straits	Replace the Straits 138/69 kV transformer with a larger size	2004	2
Construct second Hiawatha-Straits 138 kV line	Limit flows with a phase shifter and add 138 kV capacitors at Brevort or Lakehead	2007	2
Rebuild and convert one Hiawatha-Indian Lake 69 kV circuit to double circuit 138 kV	Rebuild at 69 kV and limit flows with a phase shifter	2004	2

*Table V-2
Alternative Solutions to Planned, Proposed or Provisional Additions (continued)*

Primary Solution(s)	Alternate Solution(s)	Projected In-service Year	Planning Zone
Convert North Madison 69 kV line through Sun Prairie to Reiner to 138 kV	Reconfigure Sun Prairie 69 kV system, install second 138/69 kV transformer at North Madison	2005	3
Construct a new 345 kV line from Rockdale to West Middleton	Uprate Christiana to Fitchburg 138 kV line to 319 MVA	2004	3
Construct a new 345 kV line from Rockdale to West Middleton	Reconductor Kegonsa to Christiana 138 kV line	2005	3
Construct a new 345 kV line from Rockdale to West Middleton	1) Convert Kegonsa to Femrite to 138 kV, close the 138 kV loop from Femrite to Sprecher, convert the Sycamore to Sprecher line to 138 kV 2) Install Rockdale to Sprecher/Femrite 138 kV double circuit	2008	3
Construct a new 345 kV line from Rockdale to West Middleton	1) Construct a new 345 kV line from North Madison to West Middleton 2) Rockdale to Sprecher/Femrite 138 kV double circuit 3) Numerous 138 kV and 69 kV capacitor banks, reconductor Kegonsa to Christiana, reconductor Fitchburg to Christiana, add a second 138/69 kV transformer at North Madison, add a third 345/138 kV transformer at North Madison, reconductor or uprate North Madison to Sycamore 138 kV line, install a second 138/69 kV transformer at Kegonsa, reconductor all three East Campus to Blount 69 kV lines, reconductor Blount to Gateway 69 kV line.	2009	3
Convert 69 kV line from West Middleton to Spring Green to 138 kV and Construct a new 345 kV line from Rockdale to West Middleton	Install several capacitor banks on 69 kV buses and on 138 kV buses	2008	3
Install line between Spring Green and Prairie du Sac to off load this line	Install parallel transformers at Portage and North Madison	2009	3
Construct a Canal-Dunn Rd 138 kV line and add a 138/69 kV transformer at Dunn Rd	1) Add a third 138/69 kV transformer at Canal 2) Add generation to the 69 kV system in Northern Door County 3) Replace Canal 138/69 kV transformers 1 and 2	2007	4

*Table V-2
Alternative Solutions to Planned, Proposed or Provisional Additions (continued)*

Primary Solution(s)	Alternate Solution(s)	Projected In-service Year	Planning Zone
Add two 16.3 MVAR capacitor bank at Canal 69 kV in 2004	<ol style="list-style-type: none"> 1) Rebuild Pulliam-Brusbay-Sawyer-Canal 69 kV line for 138 kV 2) Construct a 138 kV line from Egg Harbor to Menominee under the bay of Green Bay and operate at 69 kV 3) Construct a 138 kV line from Sister Bay to Escanaba under the bay of Green Bay and operate at 69 kV 4) Add generation to the 69 kV system in Door County 	2004	4
Add 138 kV conductor for Ellinwood-Sunset Point 138 kV on existing structures	<ol style="list-style-type: none"> 1) Replace Ellinwood 138/69 kV transformer 2) Add a third Ellinwood 138/69 kV transformer 	2005	4
Construct 138 kV line from Forest Junction-Cedarsauk to Howards Grove	<ol style="list-style-type: none"> 1) Construct a 138 kV line from Erdman to Howards Grove 2) Construct a 69 kV line from Erdman to Howards Grove 	2006	4
Construct the Morgan-Werner West 345 kV line and construct a 345/138 kV switchyard at a new Werner West SS; install a 345/138 kV transformer. Loop existing Rocky Run to North Appleton 345 kV and existing Werner to White Lake 138 kV lines into Werner West	<ol style="list-style-type: none"> 1) Construct a 345 kV line from Morgan to N. Appleton, add a fourth 345/138 kV transformer at N. Appleton, uprate the Kaukauna Central Tap-Melissa-Tayco 138 kV line, uprate Butte des Morts 138 kV bus tie, uprate Casaloma-Ellington-N Appleton 138 kV line. 2) Add a fourth 345/138 kV transformer at N. Appleton, uprate the Kaukauna Central Tap-Melissa-Tayco 138 kV line uprate Butte des Morts 138 kV bus, uprate Casaloma-Ellington-N Appleton 138 kV line, uprate Ellington 138 kV bus, uprate Morgan-White Clay 138 kV line, and add a 14.4 MVAR capacitor bank at Casaloma 138 kV 	2009	4
Construct a second Dunn Rd-Egg Harbor 69 kV line	<ol style="list-style-type: none"> 1) Construct a new 138 kV line from Dunn Rd to Egg Harbor 2) Add generation to the 69 kV system in northern Door County 	2007	4
Rebuild Crivitz-High Falls 69 kV double circuit line	<ol style="list-style-type: none"> 1) Construct 25.5 mile 138 kV line from Amberg to Goodman 2) Increase clearances on the Crivitz-High Falls 69 kV double circuit line and add a 5.4 MVAR capacitor bank at High Falls 3) Construct the Laona-Goodman-Amberg 138 kV line 	2007	4
Replace Mullet River and S. Sheboygan Falls 138/69 kV transformers with 100 MVA units and replace Edgewater 138/69 kV transformers with 60 MVA units	<ol style="list-style-type: none"> 1) Tap the Forest Junction-Cedarsauk 138 kV line to Sheboygan Falls and add a 138/69 kV transformer. 2) Construct a 138 kV line to the 69 kV Plymouth Sub #2 and convert Plymouth Sub#2 to 138 kV 3) Construct 2.5 miles of 138 kV line from Lodestar to Sheboygan Falls and install a 138/69 kV, 60 MVA transformer at Sheboygan Falls 	2006	4

*Table V-2
Alternative Solutions to Planned, Proposed or Provisional Additions (continued)*

Primary Solution(s)	Alternate Solution(s)	Projected In-service Year	Planning Zone
Install two 345 kV series breakers at Pleasant Prairie on lines to Racine (L631) and Zion (L2221)	Reconfigure 345 kV lines on bus sections 3 and 4. Reconfigure Pleasant Prairie 345 kV straight bus into ring bus. Construct a 345 kV bus at Bain SS.	2007	5
Construct Rockdale-Concord-Bark River-Lannon Junction 345 kV line with 345/138 kV transformers at Concord, Bark River and Lannon Junction	<ol style="list-style-type: none"> 1) Construct a 345 kV line from Rockdale-Concord-St Lawrence 2) Add a 345/138 kV transformer at St. Lawrence 3) Add a 345/138 kV transformer at Concord 4) Add a 138 kV switching station at Lannon Junction site 	2008/10	3 & 5
Construct Rockdale-Concord-Bark River-Lannon Junction 345 kV line with 345/138 kV transformers at Concord, Bark River and Lannon Junction	<ol style="list-style-type: none"> 1) Construct a Bark River-Concord 138 kV line 2) Construct a Bark River- Hartford 138 kV line 3) Add a 138 kV switching station at Lannon Junction site 4) Rebuild existing Rockdale-Concord-Cooney-Summit 138 kV to double-circuit 138 kV; construct 8-position ring buses at Jefferson and Concord 5) Uprate Stonybrook-Boxelder 138 kV 6) Install 32 MVAR capacitor bank at Summit and 75 MVAR at Concord 138 kV 	2008/10	3 & 5
Construct second Wempletown-Paddock 345 kV line	Install 67 MVA transformer at Galena as an interim measure	2004	3

Figure V-1 Zone 1 Transmission System Solution Alternatives

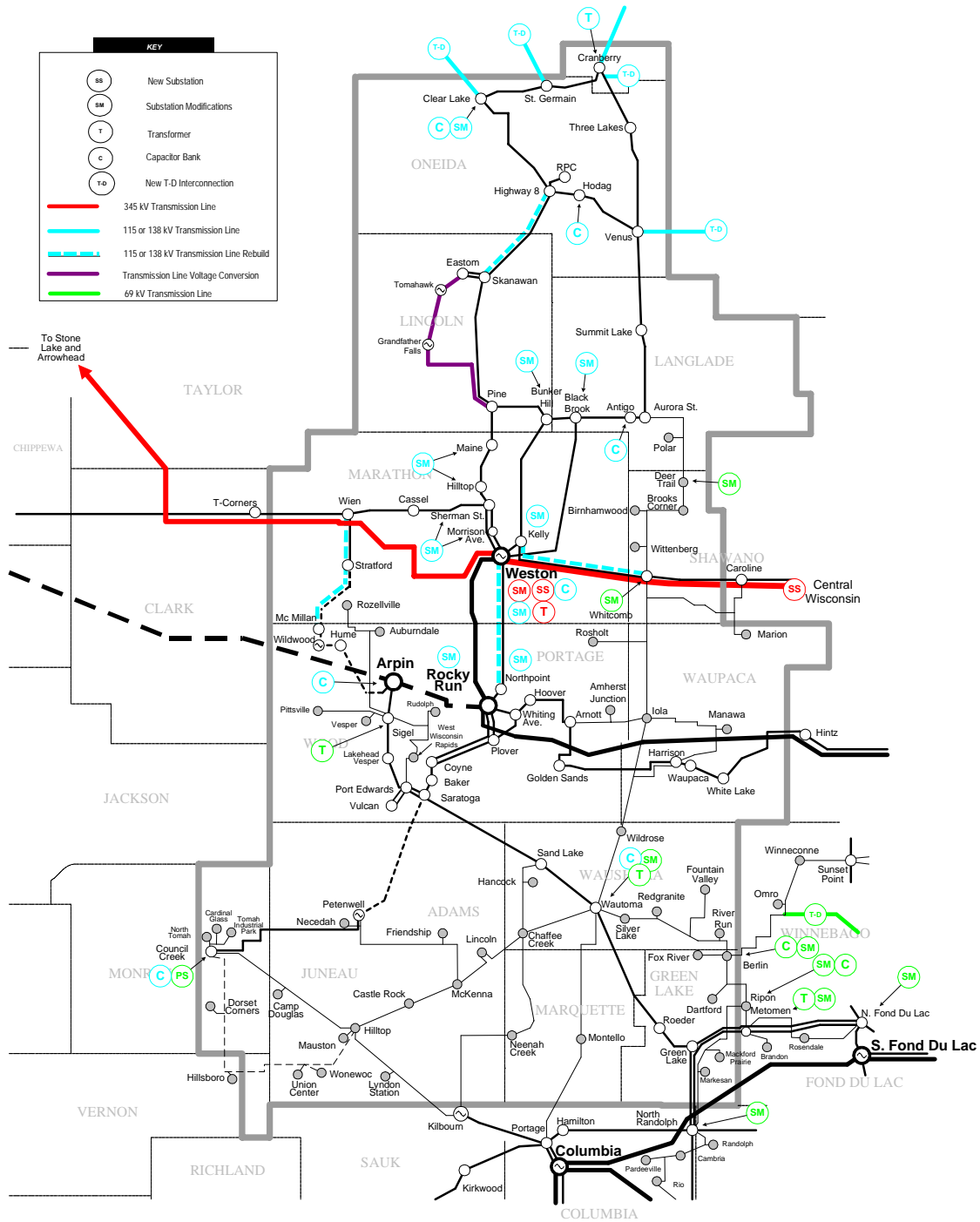
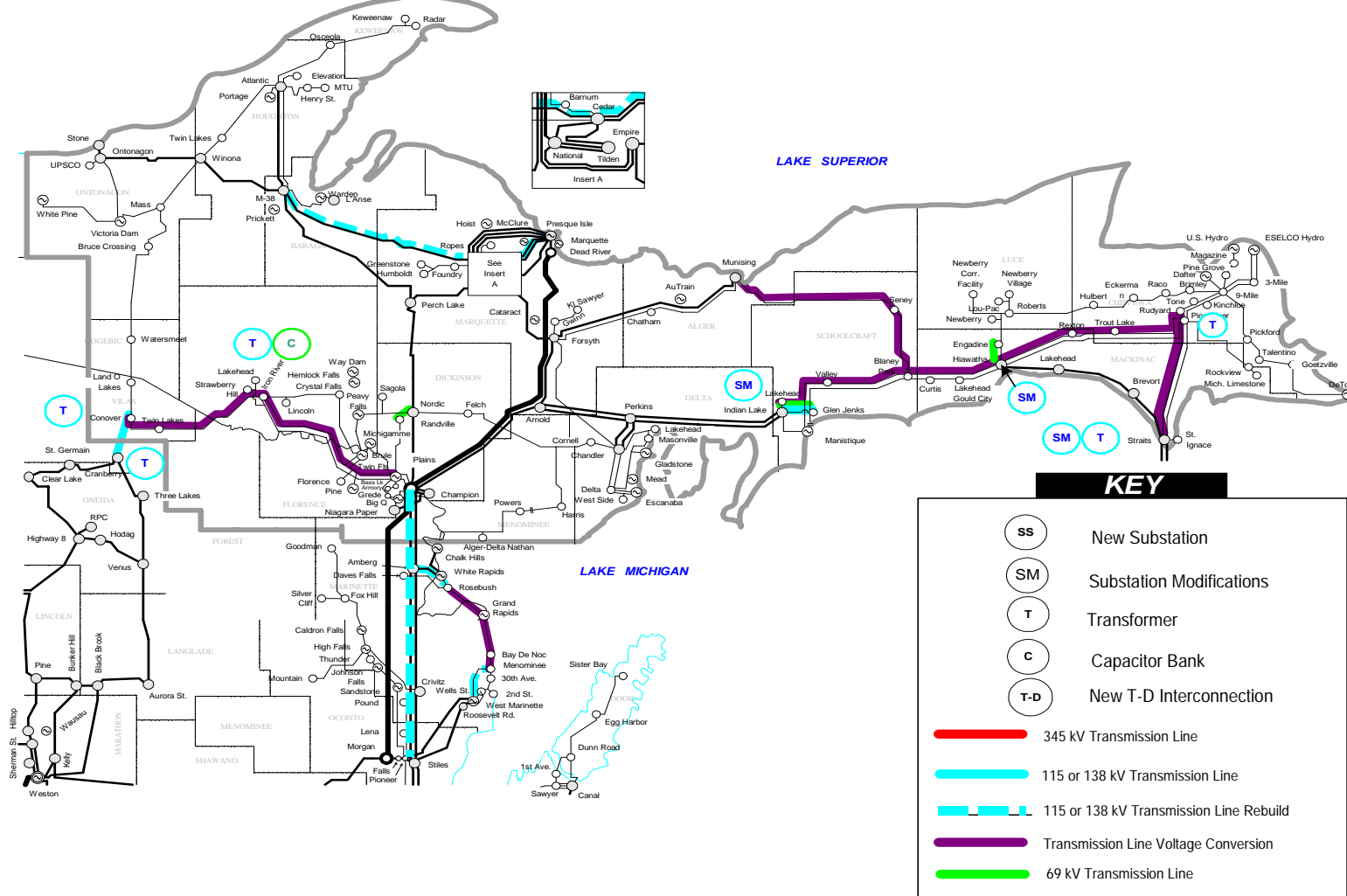








Figure V-2 Zone 2 Transmission System Solution Alternatives



KEY

-  New Substation
-  Substation Modifications
-  Transformer
-  Capacitor Bank
-  New T-D Interconnection
-  Phase Shifter






-  345 kV Transmission Line
-  115 or 138 kV Transmission Line
-  115 or 138 kV Transmission Line Rebuild
-  Transmission Line Voltage Conversion
-  69 kV Transmission Line

Figure V-3
Zone 3 Transmission System Solution Alternatives

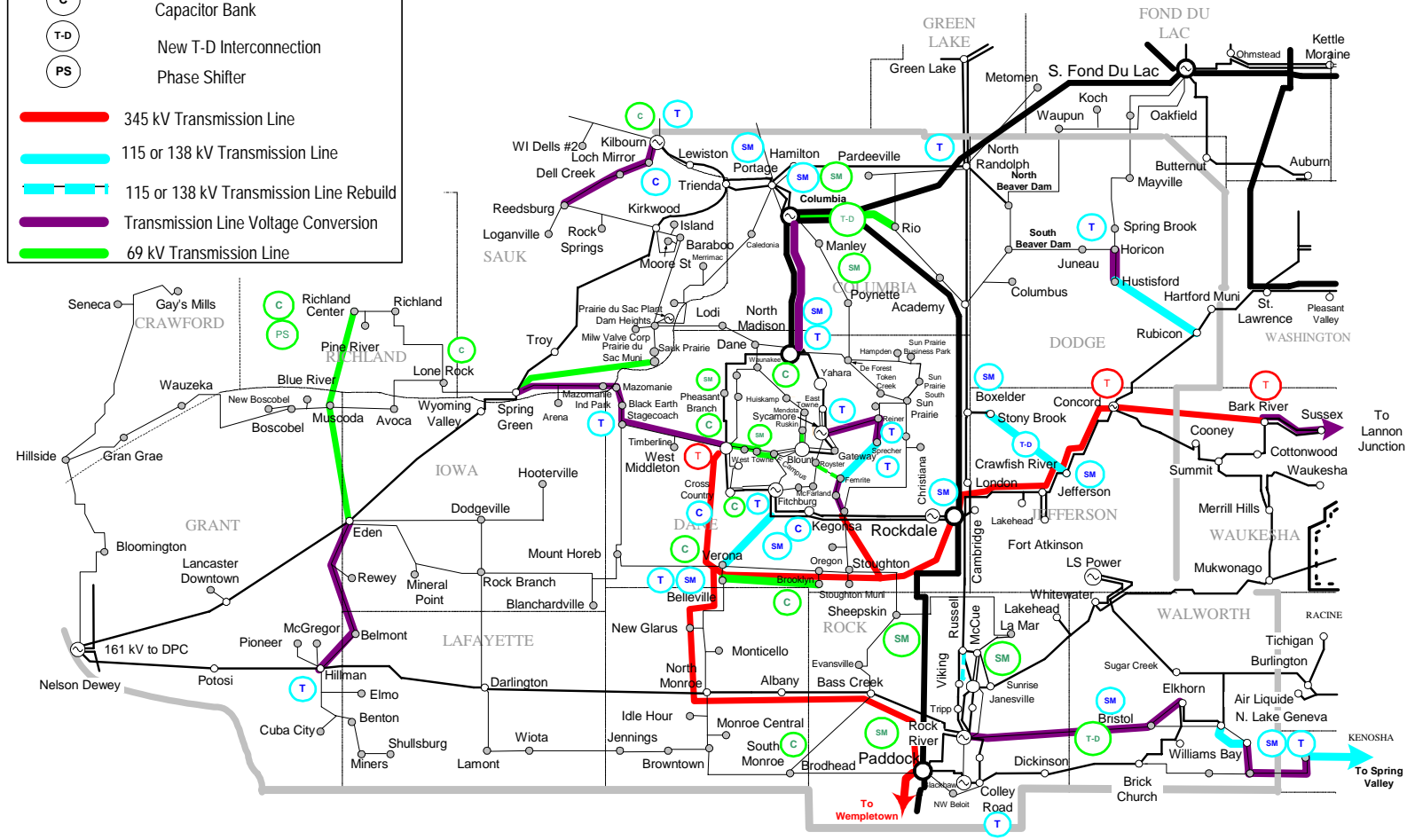
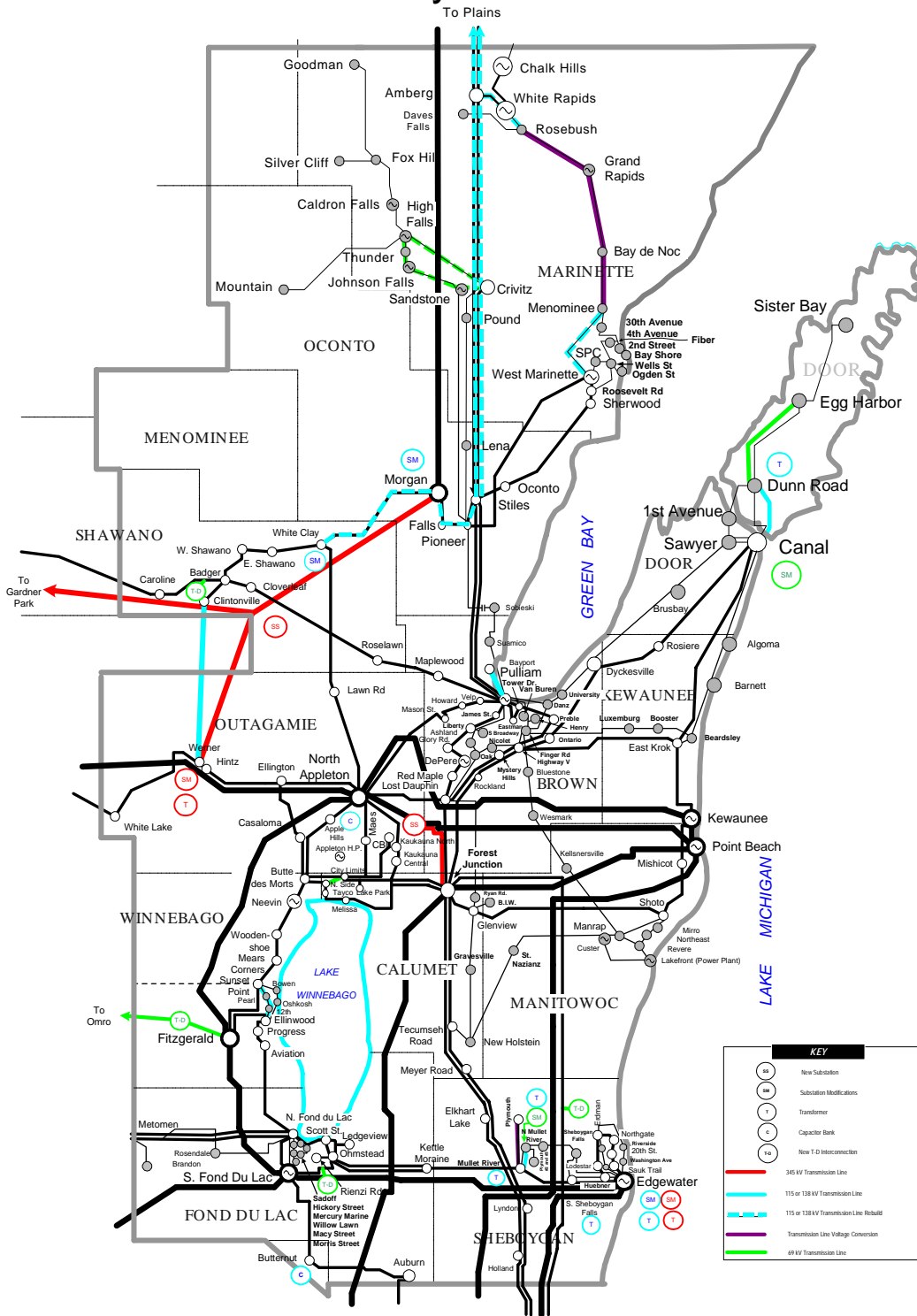


Figure V-4 Zone 4 Transmission System Solution Alternatives



KEY	
(SM)	New Substation
(M)	Substation Modifications
(T)	Transformer
(C)	Capacitor Bank
(D)	New T.D. Interconnection
(F)	
(H)	
(M)	
(N)	
(O)	
(P)	
(Q)	
(R)	
(S)	
(U)	
(V)	
(W)	
(X)	
(Y)	
(Z)	

