

Southwest Minnesota-->Twin Cities EHV Development

**Base Configuration--Big Stone at 230 kV**

Option 31A "incremental" improvements in service

Brookings Co-Lyon Co-Franklin-Helena-Lk Marion-Hampton Corner single circuit  
with Lyon Co-Hazel 345 kV

Big Stone-Canby-Hazel @ 230 kV, 2 x 795 ACSR

**Off-Ridge gen sensitivity: added 50 MW at Lyon Co & 50 MW at Franklin**

SW MN Buffalo Ridge Total Area Generation, MW										Installed Cost, \$1,000's	
Key	Base Plan	LYC & FRA gen 50 MW ea	diff	Limiting Facility	Contingency	distribution factor	Limiting factor	Remedy	qty	item	cumulative
	-327	-402	75	Lake Marion-Kenrick 115 @ 110% of 139	Airlake-Lk Marion 115	0.0223	Conductor	Reconductor	3.5 mi	420	420
	-195	-252	57	Wilmarth-Eastwood 115 kV @ 110% of 194	Wilmarth-Dome 115	0.0339	Conductor	Reconductor	4.4 mi	528	948
	102	29	73	Kenrick-Dakota Heights 115 @ 110% of 139	Airlake-Lk Marion 115	0.0223	Conductor	Reconductor	4.7 mi	564	1,512
	545	390	155	Minn Valley-Maynard 115 @ 110% of 78	Granite Falls-Willmar 230	0.0188	Conductor	Rebuild	11.3 mi	3,955	5,467
	586	549	37	Morris 230/115 kV tx #2 @ 130% of 100	Granite Falls-Morris-Moorhead 230 & Morris 230/115 tx #1	0.0223	transformer	install larger tx	1 ea	400	5,867
	659	537	122	Paynesville-Roscoe 69 @ 110% of 47	Paynesville-Wakefield 115	0.0180	Conductor	(Opt 31A facility)		0	5,867
	758	592	166	Maynard-Kerkhoven Tp 115 @ 110% of 78	Granite Falls-Willmar 230	0.0218	Conductor	Rebuild	14.7 mi	5,145	11,012
	898	778	120	Roscoe-Munson 69 @ 110% of 47	Paynesville-Wakefield 115	0.0180	Conductor	(Opt 31A facility)		0	11,012
	898	823	75	Grant Co-Morris 115 @ 110% of 96	Wahpeton-Fergus Fls 230 & Maple River-Wahpeton 230 & Wahpeton 230/115 tx	0.0250	Conductor	Reconductor	26.5 mi		3,180
	930	876	54 R	Grant Co-Morris 115 @ 110% of 96	Wahpeton-Fergus Fls 230	0.0241				0	14,192
	1079	949	130	Willmar 115/69 tx @ 130% of 112	Granite Falls-Willmar 230	0.0227	Transformer	Install 2nd tx	1 ea	3,000	17,192
	1149	1031	118	Farm Tp-Munson Tp @ 110% of 47	Paynesville-Wakefield 115	0.0180	Conductor	(Opt 31A facility)		0	17,192
	1219	1147	72	Burnsville-Dakota Hgts @ 110% of 139	Airlake-Lk Marion 115	0.0223	Conductor	Reconductor	3.6 mi	432	17,624
	1277	1359	-82	Minn Valley-Panther 230 @ 110% of 388	Lyon Co-Franklin 345	0.0812	Conductor	Reconductor	30.2 mi	3,624	21,248
	1454	1343	111	Helena-Blue Lk 345 @ 110% of 1165	Helena-Lk Marion 345	0.3888	Conductor	Reconductor	15.0 mi	2,700	23,948
	1549	1549	0	Canby-Burr 115 @ 110% of 97	Brookings Co-Toronto 115	0.1078	Conductor	Rebuild	4.8 mi	1,680	25,628
	1731	1700	31	Henning-Fergus Fl 230 @ 110% of 320	Audubon-Hubbard 230 & Hubbard tx	0.0433	Term equip	Replace equip	2 ea	200	25,828
	1817	1868	-51	St Cloud TpW-Wakefield 115 @ 110% of 113	Franklin-Helena 345	0.0480	Conductor	Reconductor	13.8 mi	1,518	27,346
	1893	1881	12	Wilmarth-Lakefield Gen 345 @ 110% of 1165	Lyon Co-Franklin 345	0.3338	Conductor	Reconductor	54.2 mi	9,756	37,102
	<b>1955</b>	<b>1867</b>	<b>88</b>	<b>Eden Prairie 345/115 tx #9 @ 130% of 448</b>	<b>Parkers Lk-Blue Lk &amp; Parkers Lk-Eden Pr 345 kV &amp; Eden Pr 345/115 #10</b>	<b>0.0740</b>	<b>Transformer</b>	<b>Replace tx</b>	<b>1 ea</b>		<b>3,000</b>
	1964	1926	38 R	Wilmarth-Lakefield Gen 345 @ 110% of 1165	Franklin-Helena 345	0.3314				0	40,102
	1972	1983	-11	McLeod-Panther 230 @ 110% of 388	Franklin-Helena 345	0.0870	Conductor	Reconductor	28.2 mi	3,384	43,486
	1977	1941	36	Sheyenne-Audubon 230 @ 110% of 320	Wahpeton-Fergus Falls 230	0.0356	Conductor	Reconductor	43.9 mi	5,268	48,754
	1990	1981	9	Brookings Co 345/115 tx 1 or 2 @ 130% of 448	Brookings Co 345/115 tx #2 or 1	0.3096	Transformer	Install larger txs	2 ea	2,000	50,754
	2013	2013	0	Toronto-Burr 115 @ 110% of 144	Brookings Co-Toronto 115	0.1500	Conductor	Reconductor	24.7 mi	2,964	53,718
	2185	2123	62	Loon Tp-Eastwood 115 @ 110% of 310	Lk Marion 345/115 tx	0.0390	Conductor	Add 2nd tx	1.0 ea	7,000	60,718
	2300	2282	18	Wahpeton-Fergus Fls 230 @ 110% of 320	Sheyenne-Audubon 230	0.0411	Term Equip	Replace equip	2.0 ea	200	60,918
	2301	2231	70	Wilmarth-Helena 345 @ 110% of 1165	Franklin-Helena 345	0.3131	Conductor	Reconductor	39.0 mi	7,020	67,938
	2329	2077	252	Granite Falls-Minn Valley 230 @ 110% of 388	Hazel-Minn Valley 230	0.0611	Conductor	Reconductor	2.5 mi	300	68,238
	2349	2182	167	Granite Falls-Willmar 230 @ 110% of 388	Minn Valley-Panther 230	0.0668	Conductor	Reconductor	35.0 ea	3,500	71,738
	2427	2355	72	Winnebago-Winnebago S 161 @ 110% of 161	Prairie Island-Byron 345	0.0224	??			0	71,738
	2433	2014	419	Ft Ridgely-Franklin 115 @ 110% of 139	Franklin-Helena 345	0.0280	Conductor	Reconductor	25.7 mi	3,084	74,822
	2503	2434	69	Loon Tp-Eastwood 115 @ 110% of 310	Helena-Blue Lk 345	0.0476	Conductor	Rebuild to 600 MV,	22.0 mi	11,000	85,822
	2526	2518	8	Ortonville-Johnson Jct 230 @ 110% of 390	Hazel-Canby 230	0.0540	Conductor	Install larger wire	24.7 mi	1,235	87,057
	2535	2404	131	Minn Valley-Hazel 230 @ 110% of 388	Lyon Co-Franklin 345	0.0962	Conductor	Install larger wire	8.0 mi	400	87,457
	2751	2765	-14 R	Brookings Co 345/115 txs @ 100% of 448	(system intact)	0.1700	transformers			0	87,457
	2759	2751	8	Johnson Jct-Morris 230 @ 110% of 390	Hazel-Canby 230	0.0540	Conductor	Install larger wire	15.4 mi	770	88,227
	2773	2748	25	Triboji-Spencer 161 @ 110% of 195	Wilmarth-Lakefield 345	0.0372	Conductor	Reconductor	4.0 mi	480	88,707

2800 2800 0 (none)

0 88,707

Notes

1. TLTG analysis run on Summer 2011 off-peak powerflow case representing 1200 MW of "existing" Buffalo Ridge area gen.  
Total SW MN Buffalo Ridge area gen = 1168 + 32 = 1200 MW.
2. Xcel/NSP Buffalo Ridge area line ratings adjusted per NSP wind rating practice.
3. Improvements modeled: "Incremental" Option 31A facilities, plus Brookings Co-Twin Cities 345 kV, 2nd YKE-Brookings 115 kV, 2nd Brookings Co 345/115 tx  
Granite Falls-Willmar 230 kV uprated to 388 MVA (conductor thermal rating)
4. Limiters listed include all which have distribution factor (PTDF or OTDF) of 0.0200 or higher.  
Includes 60% series compensation of Wilmarth-Lakefield Gen 345 kV
6. Big Stone 2 = 600 MW net
7. Big Stone 2 outlet: Big Stone-Morris 230 kV, Big Stone-Canby-Hazel 230 kV (345 kV const), Hazel-Granite Falls/Minn Valley 230 kV.
8. Wilmarth-Helena 345 outage presumed to result in tripping of Wilmarth Calpine gen (cross-tripping scheme).

R Gonzalez, PE

9/7/2005

Presumed facility addition/upgrade costs (\$1,000's)

Reconductor to 795 kcm ACSS	120
Reconductor to 2 x 795 kcm ACSS	180
Reconductor to 477 kcm ACSS	110
Reconductor to 477 kcm ACSR	100
	115 kV
Rebuild to 795 kcm ACSS single ckt	350
Rebuild to 2 x 795 kcm ACSS single ckt	500

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**Base Configuration--Big Stone at 230 kV**

Option 31A "incremental" improvements in service

Brookings Co-Lyon Co-Franklin-Helena-Lk Marion-Hampton Corner single circuit  
with Lyon Co-Hazel 345 kV

Big Stone-Canby-Hazel @ 230 kV, 2 x 795 ACSR

**Off-Ridge gen sensitivity: added 50 MW at Lyon Co & 50 MW at Franklin**

		SW MN Buffalo Ridge Area Generation									Installed Cost, \$1,000's	
Key	TLTG Limit MW	Base Case MW	System Limit MW	Limiting Facility	Contingency	distribution factor	Limiting factor	Remedy	qty	item	cumulative	
	-1602	1200	-402	Lake Marion-Kenrick 115 @ 110% of 139	Airlake-Lk Marion 115	0.0223	Conductor	Reconductor	3.5 mi	420	420	
	-1452	1200	-252	Wilmarth-Eastwood 115 kV @ 110% of 194	Wilmarth-Dome 115	0.0339	Conductor	Reconductor	4.4 mi	528	948	
	-1171	1200	29	Kenrick-Dakota Heights 115 @ 110% of 139	Airlake-Lk Marion 115	0.0223	Conductor	Reconductor	4.7 mi	564	1,512	
	-810	1200	390	Minn Valley-Maynard 115 @ 110% of 78	Granite Falls-Willmar 230	0.0188	Conductor	Rebuild	11.3 mi	3,955	5,467	
	-663	1200	537	Paynesville-Roscoe 69 @ 110% of 47	Paynesville-Wakefield 115	0.0180	Conductor	(Opt 31A facility)		0	5,467	
	-651	1200	549	Morris 230/115 kV tx #2 @ 130% of 100	Granite Falls-Morris-Moorhead 230 & Morris 230/115 tx #1	0.0223	transformer	install larger tx	1 ea	400		
	-608	1200	592	Maynard-Kerkhoven Tp 115 @ 110% of 78	Granite Falls-Willmar 230	0.0218	Conductor	Rebuild	14.7 mi	5,145	11,012	
	-422	1200	778	Roscoe-Munson 69 @ 110% of 47	Paynesville-Wakefield 115	0.0180	Conductor	(Opt 31A facility)		0	11,012	
	-377	1200	823	Grant Co-Morris 115 @ 110% of 96	Wahpeton-Fergus Fls 230 & Maple River-Wahpeton 230 & Wahpeton 230/115 tx	0.0250	Conductor	Reconductor	26.5 mi			
	-324	1200	876 R	Grant Co-Morris 115 @ 110% of 96	Wahpeton-Fergus Fls 230	0.0241				3,180	14,192	
	-251	1200	949	Willmar 115/69 tx @ 130% of 112	Granite Falls-Willmar 230	0.0227	Transformer	Install 2nd tx	1 ea	0	14,192	
	-169	1200	1031	Farm Tp-Munson Tp @ 110% of 47	Paynesville-Wakefield 115	0.0180	Conductor	(Opt 31A facility)		3,000	17,192	
	-53	1200	1147	Burnsville-Dakota Hgts @ 110% of 139	Airlake-Lk Marion 115	0.0223	Conductor	Reconductor	3.6 mi	0	17,192	
	143	1200	1343	Helena-Blue Lk 345 @ 110% of 1165	Helena-Lk Marion 345	0.3888	Conductor	Reconductor	15.0 mi	432	17,624	
	159	1200	1359	Minn Valley-Panther 230 @ 110% of 388	Lyon Co-Franklin 345	0.0812	Conductor	Reconductor	30.2 mi	2,700	20,324	
	351	1200	1549	Canby-Burr 115 @ 110% of 97	Brookings Co-Toronto 115	0.1078	Conductor	Rebuild	4.8 mi	3,624	23,948	
	500	1200	1700 1866	Henning-Fergus Fl 230 @ 110% of 320	Audubon-Hubbard 230 & Hubbard tx	0.0433	Term equip	Replace equip	2 ea	1,680	25,628	
	667	1200	1867	Eden Prairie 345/115 tx #9 @ 130% of 448	Parkers Lk-Blue Lk & Parkers Lk-Eden Pr 345 kV & Eden Pr 345/115 #10	0.0740	Transformer	Replace tx	1 ea	200	25,828	
	668	1200	1868	St Cloud TpW-Wakefield 115 @ 110% of 113	Franklin-Helena 345	0.0480	Conductor	Reconductor	13.8 mi	3,000	28,828	
	681	1200	1881	Wilmarth-Lakefield Gen 345 @ 110% of 1165	Lyon Co-Franklin 345	0.3338	Conductor	Reconductor	54.2 mi	1,518	30,346	
	726	1200	1926 R	Wilmarth-Lakefield Gen 345 @ 110% of 1165	Franklin-Helena 345	0.3314				9,756	40,102	
	741	1200	1941	Shenenne-Audubon 230 @ 110% of 320	Wahpeton-Fergus Falls 230	0.0356	Conductor	Reconductor	43.9 mi	0	40,102	
	781	1200	1981	Brookings Co 345/115 tx 1 or 2 @ 130% of 448	Brookings Co 345/115 tx #2 or 1	0.3096	Transformer	Install larger txs	2 ea	5,268	45,370	
	783	1200	1983	McLeod-Panther 230 @ 110% of 388	Franklin-Helena 345	0.0870	Conductor	Reconductor	28.2 mi	2,000	47,370	
	813	1200	2013	Toronto-Burr 115 @ 110% of 144	Brookings Co-Toronto 115	0.1500	Conductor	Reconductor	24.7 mi	3,384	50,754	
	814	1200	2014	Ft Ridgely-Franklin 115 @ 110% of 139	Franklin-Helena 345	0.0280	Conductor	Reconductor	25.7 mi	2,964	53,718	
	877	1200	2077	Granite Falls-Minn Valley 230 @ 110% of 388	Hazel-Minn Valley 230	0.0611	Conductor	Reconductor	2.5 mi	3,084	56,802	
	923	1200	2123	Loon Tp-Eastwood 115 @ 110% of 310	Lk Marion 345/115 tx	0.0390	Conductor	Add 2nd tx	1.0 ea	300	57,102	
	982	1200	2182	Granite Falls-Willmar 230 @ 110% of 388	Minn Valley-Panther 230	0.0668	Conductor	Reconductor	35.0 ea	7,000	64,102	
	1031	1200	2231	Wilmarth-Helena 345 @ 110% of 1165	Franklin-Helena 345	0.3131	Conductor	Reconductor	39.0 mi	3,500	67,602	
	1082	1200	2282	Wahpeton-Fergus Fls 230 @ 110% of 320	Shenenne-Audubon 230	0.0411	Term Equip	Replace equip	2.0 ea	7,020	74,622	
	1155	1200	2355	Winnebago-Winnebago S 161 @ 110% of 161	Prairie Island-Byron 345	0.0224	??			200	74,822	
	1204	1200	2404	Minn Valley-Hazel 230 @ 110% of 388	Lyon Co-Franklin 345	0.0962	Conductor	Install larger wire	8.0 mi	0	74,822	
	1234	1200	2434	Loon Tp-Eastwood 115 @ 110% of 310	Helena-Blue Lk 345	0.0476	Conductor	Rebuild to 600 MV,	22.0 mi	400	75,222	
	1318	1200	2518	Ortonville-Johnson Jct 230 @ 110% of 390	Hazel-Canby 230	0.0540	Conductor	Install larger wire	24.7 mi	11,000	86,222	
	1543	1200	2765 R	Brookings Co 345/115 txs @ 100% of 448	(system intact)	0.1700	transformers			1,235	87,457	
	1548	1200	2748	Triboji-Spencer 161 @ 110% of 195	Wilmarth-Lakefield 345	0.0372	Conductor	Reconductor	4.0 mi	0	87,457	
	1551	1200	2751	Johnson Jct-Morris 230 @ 110% of 390	Hazel-Canby 230	0.0540	Conductor	Install larger wire	15.4 mi	480	87,937	
										770	88,707	

1600 1200 2800 (none)

0 88,707

Notes

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Includes 60% series compensation of Wilmarth-Lakefield Gen 345 kV
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8. Wilmarth-Helena 345 outage presumed to result in tripping of Wilmarth Calpine gen (cross-tripping scheme).

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Presumed facility addition/upgrade costs (\$1,000's)

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Reconductor to 2 x 795 kcm ACSS	180
Reconductor to 477 kcm ACSS	110
Reconductor to 477 kcm ACSR	100
	115 kV
Rebuild to 795 kcm ACSS single ckt	350
Rebuild to 2 x 795 kcm ACSS single ckt	500

<u>qty</u>	<u>each</u>	<u>totals</u>
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	-1452	1200	-252	Wilmarth-Eastwood 115 kV @ 110% of 194	Wilmarth-Dome 115	0.0339	Conductor	Reconductor	4.4 mi	528	948	
9	-1171	1200	29	Kenrick-Dakota Heights 115 @ 110% of 139	Airlake-Lk Marion 115	0.0223	Conductor	Reconductor	4.7 mi	564	1,512	
2	-810	1200	390	Minn Valley-Maynard 115 @ 110% of 78	Granite Falls-Willmar 230	0.0188	Conductor	Rebuild	11.3 mi	3,955	5,467	
	-651	1200	549	Morris 230/115 kV tx #2 @ 130% of 100	Granite Falls-Morris-Moorhead 230 & Morris 230/115 tx #1	0.0223	transformer	install larger tx	1 ea	400		5,867
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7	-422	1200	778	Roscoe-Munson 69 @ 110% of 47	Paynesville-Wakefield 115	0.0180	Conductor	(Opt 31A facility)		0	11,012	
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10	-251	1200	949	Willmar 115/69 tx @ 130% of 112	Granite Falls-Willmar 230	0.0227	Transformer	Install 2nd tx	1 ea	3,000	17,192	
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13	351	1200	1549	Canby-Burr 115 @ 110% of 97	Brookings Co-Toronto 115	0.1078	Conductor	Rebuild	4.8 mi	1,680	25,628	
21	500	1200	1700	Henning-Fergus Fl 230 @ 110% of 320	Audubon-Hubbard 230 & Hubbard tx	0.0433	Term equip	Replace equip	2 ea	200	25,828	
18	668	1200	1868	St Cloud TpW-Wakefield 115 @ 110% of 113	Franklin-Helena 345	0.0480	Conductor	Reconductor	13.8 mi	1,518	27,346	
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	1600	1200	2800	(none)						0	88,707	

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3. Improvements modeled: "Incremental" Option 31A facilities, plus Brookings Co-Twin Cities 345 kV, 2nd YKE-Brookings 115 kV, 2nd Brookings Co 345/115 tx  
Granite Falls-Willmar 230 kV uprated to 388 MVA (conductor thermal rating)
4. Limiters listed include all which have distribution factor (PTDF or OTDF) of 0.0200 or higher.  
Includes 60% series compensation of Wilmarth-Lakefield Gen 345 kV
6. Big Stone 2 = 600 MW net
7. Big Stone 2 outlet: Big Stone-Morris 230 kV, Big Stone-Canby-Hazel 230 kV (345 kV const), Hazel-Granite Falls/Minn Valley 230 kV.
8. Wilmarth-Helena 345 outage presumed to result in tripping of Wilmarth Calpine gen (cross-tripping scheme).

R Gonzalez, PE

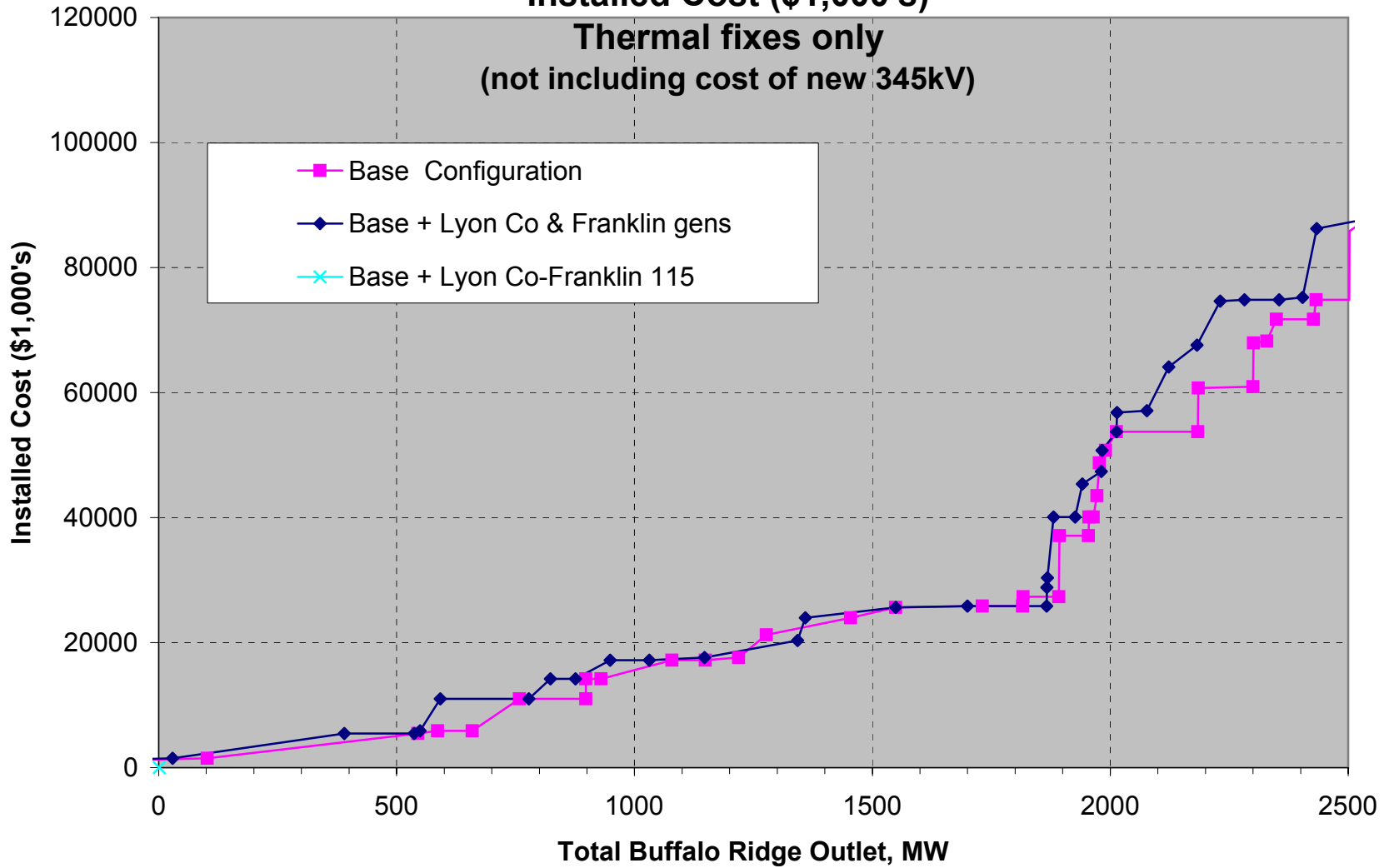
9/7/2005

Presumed facility addition/upgrade costs (\$1,000's)

Reconductor to 795 kcm ACSS	120
Reconductor to 2 x 795 kcm ACSS	180
Reconductor to 477 kcm ACSS	110
Reconductor to 477 kcm ACSR	100
	115 kV
Rebuild to 795 kcm ACSS single ckt	350
Rebuild to 2 x 795 kcm ACSS single ckt	500

       qty             each             totals

**SW MN Buffalo Ridge Generation Outlet**  
**Installed Cost (\$1,000's)**  
**Thermal fixes only**  
**(not including cost of new 345kV)**



Southwest Minnesota-->Twin Cities EHV Development

**Base Configuration--Big Stone at 230 kV**

Option 31A "incremental" improvements in service

Brookings Co-Lyon Co-Franklin-Helena-Lk Marion-Hampton Corner single circuit  
with Lyon Co-Hazel 345 kV

Big Stone-Canby-Hazel @ 230 kV, 2 x 795 ACSR

SW MN Buffalo Ridge Area Generation											
Key	TLTG Limit MW	Base Case MW	System Limit MW	Limiting Facility	Contingency	distribution factor	Limiting factor	Remedy	qty	Installed Cost, \$1,000's item	Cumulative
5	-1527	1200	-327	Lake Marion-Kenrick 115 @ 110% of 139	Airlake-Lk Marion 115	0.0223	Conductor	Reconductor	3.5 mi	420	420
	-1395	1200	-195	Wilmarth-Eastwood 115 kV @ 110% of 194	Wilmarth-Dome 115	0.0339	Conductor	Reconductor	4.4 mi	528	948
9	-1098	1200	102	Kenrick-Dakota Heights 115 @ 110% of 139	Airlake-Lk Marion 115	0.0232	Conductor	Reconductor	4.7 mi	564	1,512
2	-655	1200	545	Minn Valley-Maynard 115 @ 110% of 78	Granite Falls-Willmar 230	0.0188	Conductor	Rebuild	11.3 mi	3,955	5,467
	-614	1200	586	Morris 230/115 kV tx #2 @ 130% of 100	Granite Falls-Morris-Moorhead 230 & Morris 230/115 tx #1	0.0223	transformer	install larger tx	1 ea	400	5,867
3	-541	1200	659	Paynesville-Roscoe 69 @ 110% of 47	Paynesville-Wakefield 115	0.0180	Conductor	(Opt 31A facility)		0	5,867
4	-442	1200	758	Maynard-Kerkhoven Tp 115 @ 110% of 78	Granite Falls-Willmar 230	0.0218	Conductor	Rebuild	14.7 mi	5,145	11,012
7	-302	1200	898	Roscoe-Munson 69 @ 110% of 47	Paynesville-Wakefield 115	0.0180	Conductor	(Opt 31A facility)		0	11,012
	-302	1200	898	Grant Co-Morris 115 @ 110% of 96	Wahpeton-Fergus Fls 230 & Maple River-Wahpeton 230 & Wahpeton 230/115 tx	0.0250	Conductor	Reconductor	26.5 mi		3,180
8	-270	1200	930 R	Grant Co-Morris 115 @ 110% of 96	Wahpeton-Fergus Fls 230	0.0241				0	14,192
10	-121	1200	1079	Willmar 115/69 tx @ 130% of 112	Granite Falls-Willmar 230	0.0227	Transformer	Install 2nd tx	1 ea	3,000	17,192
11	-51	1200	1149	Farm Tp-Munson Tp @ 110% of 47	Paynesville-Wakefield 115	0.0180	Conductor	(Opt 31A facility)		0	17,192
20	19	1200	1219	Burnsville-Dakota Hgts @ 110% of 139	Airlake-Lk Marion 115	0.0223	Conductor	Reconductor	3.6 mi	432	17,624
14	77	1200	1277	Minn Valley-Panther 230 @ 110% of 388	Lyon Co-Franklin 345	0.0873	Conductor	Reconductor	30.2 mi	3,624	21,248
15	254	1200	1454	Helena-Blue Lk 345 @ 110% of 1165	Helena-Lk Marion 345	0.3888	Conductor	Reconductor	15.0 mi	2,700	23,948
13	349	1200	1549	Canby-Burr 115 @ 110% of 97	Brookings Co-Toronto 115	0.1078	Conductor	Rebuild	4.8 mi	1,680	25,628
21	531	1200	1731	Henning-Fergus Fl 230 @ 110% of 320	Audubon-Hubbard 230 & Hubbard tx	0.0433	Term equip	Replace equip	2 ea	200	25,828
			1816								25,828
18	617	1200	1817	St Cloud TpW-Wakefield 115 @ 110% of 113	Franklin-Helena 345	0.0505	Conductor	Reconductor	13.8 mi	1,518	27,346
			1892								27,346
17	693	1200	1893	Wilmarth-Lakefield Gen 345 @ 110% of 1165	Lyon Co-Franklin 345	0.3338	Conductor	Reconductor	54.2 mi	9,756	37,102
			1954								37,102
	755	1200	1955	Eden Prairie 345/115 tx #9 @ 130% of 448	Parkers Lk-Blue Lk & Parkers Lk-Eden Pr 345 kV & Eden Pr 345/115 #10	0.0740	Transformer	Replace tx	1 ea		3,000
19	764	1200	1964 R	Wilmarth-Lakefield Gen 345 @ 110% of 1165	Franklin-Helena 345	0.3314				0	40,102
22	772	1200	1972	McLeod-Panther 230 @ 110% of 388	Franklin-Helena 345	0.0870	Conductor	Reconductor	28.2 mi	3,384	43,486
	777	1200	1977	Sheyenne-Audubon 230 @ 110% of 320	Wahpeton-Fergus Falls 230	0.0356	Conductor	Reconductor	43.9 mi	5,268	48,754
	790	1200	1990	Brookings Co 345/115 tx 1 or 2 @ 130% of 44	Brookings Co 345/115 tx #2 or 1	0.3096	Transformer	Install larger txs	2 ea	2,000	50,754
16	813	1200	2013	Toronto-Burr 115 @ 110% of 144	Brookings Co-Toronto 115	0.1500	Conductor	Reconductor	24.7 mi	2,964	53,718
			2184								53,718
	985	1200	2185	Loon Tp-Eastwood 115 @ 110% of 310	Lk Marion 345/115 tx	0.0390	Conductor	Add 2nd tx	1.0 ea	7,000	60,718
	1100	1200	2300	Wahpeton-Fergus Fls 230 @ 110% of 320	Sheyenne-Audubon 230	0.0411	Term Equip	Replace equip	2.0 ea	200	60,918
24	1101	1200	2301	Wilmarth-Helena 345 @ 110% of 1165	Franklin-Helena 345	0.3131	Conductor	Reconductor	39.0 mi	7,020	67,938
	1129	1200	2329	Granite Falls-Minn Valley 230 @ 110% of 388	Hazel-Minn Valley 230	0.0611	Conductor	Reconductor	2.5 mi	300	68,238
	1149	1200	2349	Granite Falls-Willmar 230 @ 110% of 388	Minn Valley-Panther 230	0.0668	Conductor	Reconductor	35.0 ea	3,500	71,738
	1227	1200	2427	Winnebago-Winnebago S 161 @ 110% of 16	Prairie Island-Byron 345	0.0224	??			0	71,738
	1233	1200	2433	Ft Ridgely-Franklin 115 @ 110% of 139	Franklin-Helena 345	0.0280	Conductor	Reconductor	25.7 mi	3,084	74,822
			2502								74,822
	1303	1200	2503	Loon Tp-Eastwood 115 @ 110% of 310	Helena-Blue Lk 345	0.0476	Conductor	Rebuild to 600 MV,	22.0 mi	11,000	85,822
	1326	1200	2526	Ortonville-Johnson Jct 230 @ 110% of 390	Hazel-Canby 230	0.0540	Conductor	Install larger wire	24.7 mi	1,235	87,057



1335	1200	2535	Minn Valley-Hazel 230 @ 110% of 388	Lyon Co-Franklin 345	0.0962	Conductor	Install larger wire	8.0 mi	400	87,457
1551	1200	2751 R	Brookings Co 345/115 txs @ 100% of 448	(system intact)	0.1700	transformers			0	87,457
1559	1200	2759	Johnson Jct-Morris 230 @ 110% of 390	Hazel-Canby 230	0.0540	Conductor	Install larger wire	15.4 mi	770	88,227
1573	1200	2773	Triboji-Spencer 161 @ 110% of 195	Wilmarth-Lakefield 345	0.0372	Conductor	Reconductor	4.0 mi	480	88,707
1600	1200	2800	(none)						0	88,707

Notes

1. TLTG analysis run on Summer 2011 off-peak powerflow case representing 1200 MW of "existing" Buffalo Ridge area gen.  
Total SW MN Buffalo Ridge area gen = 1168 + 32 = 1200 MW.
2. Xcel/NSP Buffalo Ridge area line ratings adjusted per NSP wind rating practice.
3. Improvements modeled: "Incremental" Option 31A facilities, plus Brookings Co-Twin Cities 345 kV, 2nd YKE-Brookings 115 kV, 2nd Brookings Co 345/115 tx Granite Falls-Willmar 230 kV uprated to 388 MVA (conductor thermal rating)
4. Limiters listed include all which have distribution factor (PTDF or OTDF) of 0.0200 or higher.  
Includes 60% series compensation of Wilmarth-Lakefield Gen 345 kV
6. Big Stone 2 = 600 MW net
7. Big Stone 2 outlet: Big Stone-Morris 230 kV, Big Stone-Canby-Hazel 230 kV (345 kV const), Hazel-Granite Falls/Minn Valley 230 kV.
8. Wilmarth-Helena 345 outage presumed to result in tripping of Wilmarth Calpine gen (cross-tripping scheme).

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9/7/2005

Presumed facility addition/upgrade costs (\$1,000's)

Reconductor to 795 kcm ACSS	120
Reconductor to 2 x 795 kcm ACSS	180
Reconductor to 477 kcm ACSS	110
Reconductor to 477 kcm ACSR	100
	115 kV
Rebuild to 795 kcm ACSS single ckt	350
Rebuild to 2 x 795 kcm ACSS single ckt	500

	qty	each	totals
Base Costs for this Option:			
Brookings Co-Lyon Co 345 kV	49.0 mi	800	39,200
Lyon Co-Franklin 345 kV	44.0 mi	800	35,200
Franklin-Helena 345 kV	67.0 mi	800	53,600
Helena-Lk Marion-Hampton Corner 345 kV	34.0 mi	800	27,200
Lyon Co-Hazel 345 kV	22.0 mi	800	17,600
Yankee-Brookings Co 115 kV #2 (620 MVA)	14.0 mi	500	7,000
Brookings Co-Toronto 115 kV (310 MVA)	20.0 mi	350	7,000
Hazel-Minn Valley 230 kV	8.0 mi	450	3,600
Minn Valley 230 kV line re-arrangements	1.0 ea	2,000	2,000
Blue Lk-Wilmarth in-ant out to Helena Sw Stn	1.0 ea	2,000	2,000
	Subtotal (lines)		194,400
Brookings Co: add 345 kV line term (Lyon Co)	1.0 ea	1,500	1,500
Brookings Co: add 2nd 345/115 kV 448 MVA l	1.0 ea	6,000	6,000
Brookings Co: add 115 kV line term (for YKE)	1.0 ea	1,000	1,000
Brookings Co: add 115 kV line term (for Toron	1.0 ea	1,000	1,000
Brookings Co: add 50 MVAr shunt reactor	1.0 ea	1,200	1,200
Lyon Co: Add 4-position 345 kV ring bus	1.0 ea	6,000	6,000
Lyon Co: Add 345/115 kV 448 MVA tx	1.0 ea	6,000	6,000

Lyon Co: add 50 MVAR shunt reactor	1.0 ea	1,200	1,200
Lyon Co: add 2 x 40 MVAR shunt capacitors	2.0 ea	600	1,200
Franklin: Add 3-position 345 kV ring bus	1.0 ea	4,500	4,500
Franklin: Add 345/115 kV 448 MVA tx	1.0 ea	6,000	6,000
Franklin: convert 115 kV bus to ring	1.0 ea	2,500	2,500
Franklin: add 50 MVAR shunt reactor	1.0 ea	1,200	1,200
Franklin: add 2 x 40 MVAR shunt caps	2.0 ea	1,000	2,000
Hazel Sw Stn: add 4 position 230 kV ring bus	1.0 ea	4,800	4,800
Hazel Sw Stn: add 2 x 336 MVA 345/230 kV tx	1.0 ea	8,000	8,000
Hazel Sw Stn: add 345 kV line term	1.0 ea	1,500	1,500
Hazel Sw Stn: new site development	1.0 ea	1,500	1,500
Minn Valley Stn: add 6-position ring bus	1.0 ea	10,000	10,000
Yankee: add 115 kV line term	1.0 ea	1,000	1,000
Toronto: establish 3-position 115 kV ring bus	1.0 ea	3,000	3,000
Lk Marion: establish 3-position 345 kV ring bu:	1.0 ea	4,500	4,500
Lk Marion: add 345/115 kV 448 MVA tx	1.0 ea	6,000	6,000
Lk Marion: convert 115 kV to 4-position ring	1.0 ea	3,000	3,000
Lk Marion: add 50 MVAR shunt reactor	1.0 ea	1,200	1,200
Helena Sw Stn: add 4-position 345 kV ring bu:	1.0 ea	6,000	6,000
Helena Sw Stn: new site development	1.0 ea	1,500	1,500
Hampton Corner Sw Stn: add 3-position 345 k	1.0 ea	4,500	4,500
Hampton Corner Sw Stn: new site developme	1.0 ea	1,500	1,500
Various: relaying revisions for new configurati	1.0 ea	2,000	2,000

Subtotal (stations) 101,300

Grand Total 295,700





4,500  
6,000  
3,000  
1,200  
6,000  
1,500  
4,500  
1,500

28,200