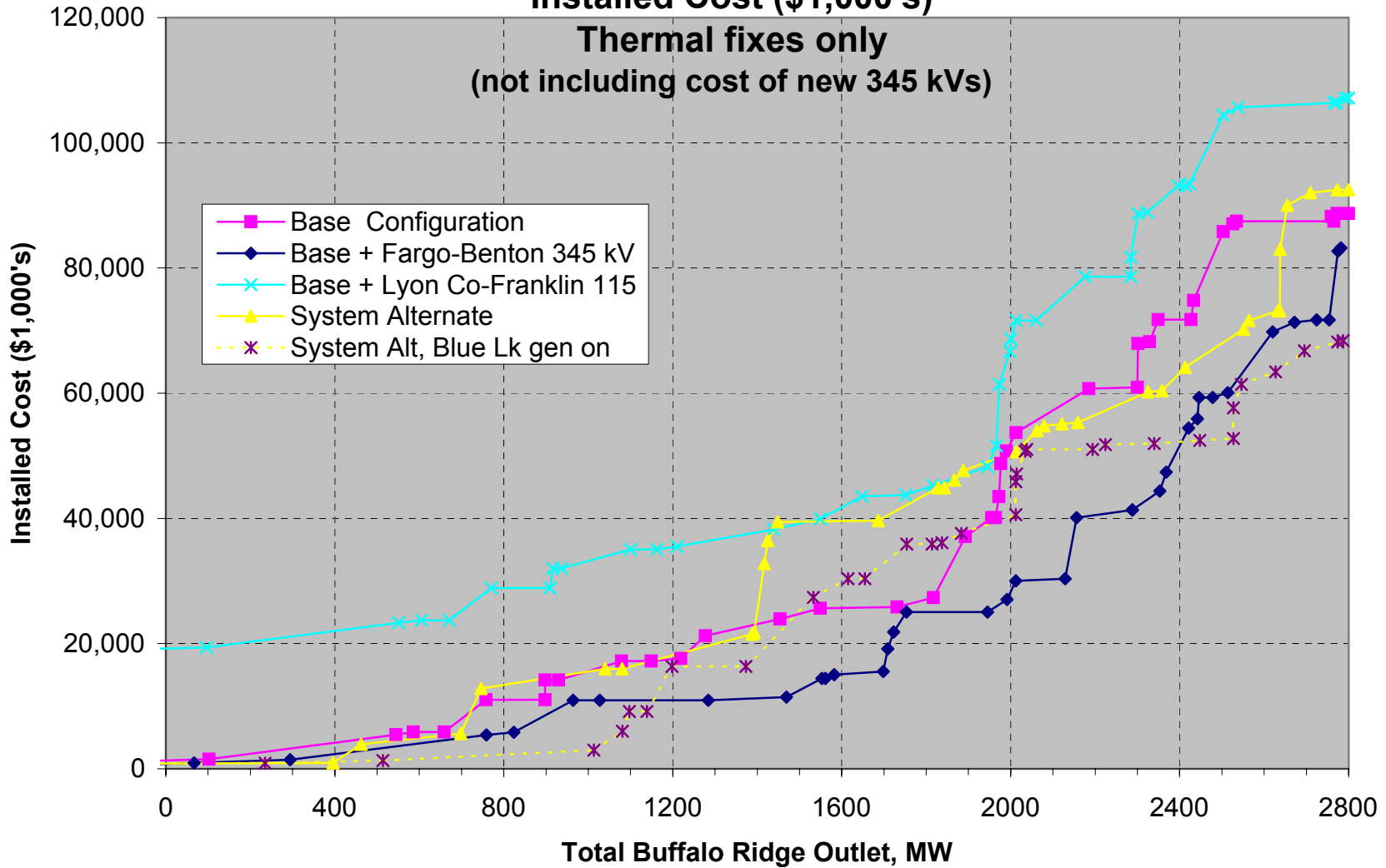


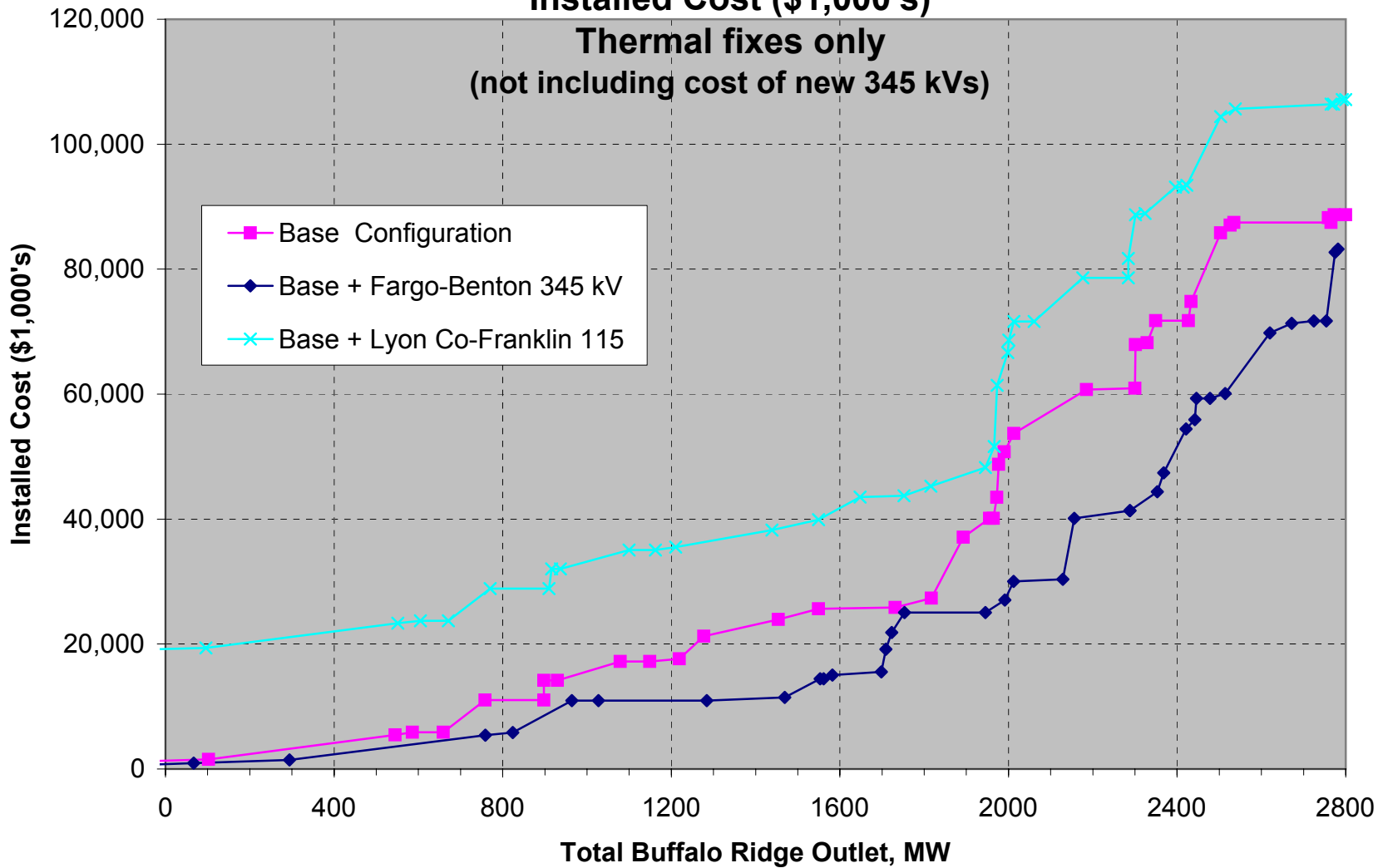
SW MN Buffalo Ridge Generation Outlet Installed Cost (\$1,000's)

**Thermal fixes only
(not including cost of new 345 kVs)**



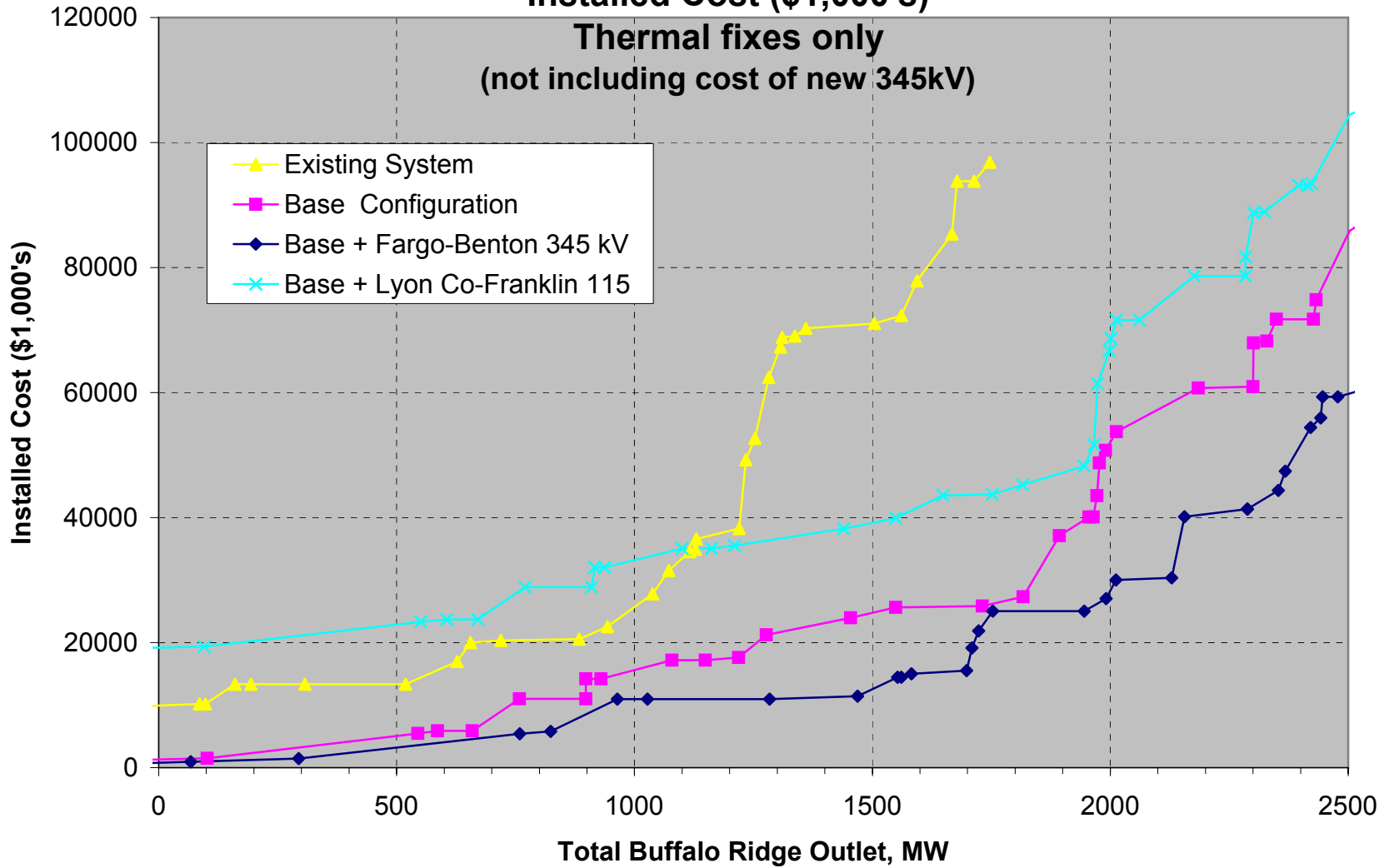
SW MN Buffalo Ridge Generation Outlet Installed Cost (\$1,000's)

Thermal fixes only
(not including cost of new 345 kV)



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

"System Alternative" Configuration--Big Stone at 230 kV
 Option 31A "incremental" improvements in service
 Brookings Co-Lyon Co 115 kV & Lyon Co-Hazel-Blue Lk 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
	-2425	1200	-1225	Wilmarth-Eastwood 115 kV @ 110% of 194	Wilmarth-Dome 115	0.0373	Conductor	Reconductor	4.4 mi	528	528
	-965	1200	235	Hyland Lk-Dean Lk @ 110% of 194	Blue Lk- Parkers Lk 345 & Blue Lk-Eden Pr 345 & Eden Pr 345/115 #9	0.0293	Conductor	Reconductor	3.2 mi	384	912
	-686	1200	514	Morris 230/115 kV tx #2 @ 130% of 100	Granite Falls-Morris-Moorhead 230 & Morris 230/115 tx #1	0.0227	transformer	install larger tx	1 ea	400	1,312
13	-187	1200	1013	Canby-Burr 115 @ 110% of 97	Canby-Big Stone 230	0.0278	Conductor	Rebuild	4.8 mi	1,680	2,992
#	-119	1200	1081	Eden Prairie 345/115 tx #9 @ 130% of 448	Parkers Lk-Blue Lk & Parkers Lk-Eden Pr 345 kV & Eden Pr 345/115 #10	0.0864	Transformer	Replace tx	1 ea	3,000	5,992
	-103	1200	1097	Grant Co-Morris 115 @ 110% of 96	Wahpeton-Fergus Fls 230 & Maple River-Wahpeton 230 & Wahpeton 230/115 tx	0.0235	Conductor	Reconductor	26.5 mi	3,180	9,172
8	-61	1200	1139 R	Grant Co-Morris 115 @ 110% of 96	Wahpeton-Fergus Fls 230	0.0225				0	9,172
	-2	1200	1198	Granite Falls-Morris 230 @ 110% of 239	Hazel-Canby 230	0.0191	Conductor	Reconductor	60.0 mi	7,200	16,372
	173	1200	1373	Winnebago-Winnebago S 161 @ 110% of 16	Prairie Island-Byron 345	0.0224	??			0	16,372
	333	1200	1533	Loon Tp-Eastwood 115 @ 100% of 310	Blue Lk-Inver Hills-Red Rock 345 & Blue Lk-Prairie Island 345	0.0430	Conductor	Rebuild to 600 MV,	22.0 mi	11,000	27,372
	415	1200	1615	Willmar 115/69 tx @ 130% of 112	Granite Falls-Willmar 230	0.0208	Transformer	Install 2nd tx	1 ea	3,000	30,372
	455	1200	1655	Blue Lk-Black Dog 115 @ 350 MVA emerg lin	Blue Lk-Hyland Lk 115 kV	0.0198	Conductor	Need BLL Outlet improvements			30,372
	554	1200	1754	Blair-Granite Falls 230 @ 110% of 398	Hazel-Canby 230	0.0578	Conductor	Reconductor	46.0 mi	5,520	35,892
	614	1200	1814	Blue Lk-Black Dog 115 @ 350 MVA emerg lin	Blue Lk-Parkers Lk 345 & Blue Lk-Eden Prairie 345 & Eden Pr 345/115 #9	0.0456		???			35,892
21	637	1200	1837	Henning-Fergus FI 230 @ 110% of 320	Audubon-Hubbard 230 & Hubbard tx	0.0435	Term equip	Replace equip	2 ea	200	36,092
18	683	1200	1883	St Cloud TpW-Wakefield 115 @ 110% of 113	Hazel-Blue Lk 345	0.0497	Conductor	Reconductor	13.8 mi	1,518	37,610
16	812	1200	2012	Toronto-Burr 115 @ 110% of 144	Brookings Co-Toronto 115	0.1500	Conductor	Reconductor	24.7 mi	2,964	40,574
	812	1200	2012	Sheyenne-Audubon 230 @ 110% of 320	Wahpeton-Fergus Falls 230	0.0363	Conductor	Reconductor	43.9 mi	5,268	45,842
	814	1200	2014	Ortonville-Johnson Jct 230 @ 110% of 390	Hazel-Canby 230	0.0619	Conductor	Install larger wire	24.7 mi	1,235	47,077
14	834	1200	2034	Minn Valley-Panther 230 @ 110% of 388	Hazel-Blue Lk 345	0.0841	Conductor	Reconductor	30.2 mi	3,624	50,701
	838	1200	2038	Granite Falls-Minn Valley 230 @ 110% of 388	Hazel-Canby 230	0.0624	Conductor	Reconductor	2.5 mi	300	51,001
19	994	1200	2194	Wilmarth-Lakefield Gen 345 @ 110% of 1165	Hazel-Blue Lk 345	0.3363				0	51,001
	1024	1200	2224	Johnson Jct-Morris 230 @ 110% of 390	Hazel-Canby 230	0.0619	Conductor	Install larger wire	15.4 mi	770	51,771
	1140	1200	2340	Wahpeton-Fergus Fls 230 @ 110% of 320	Sheyenne-Audubon 230	0.0422	Term Equip	Replace equip	2.0 ea	200	51,971
	1248	1200	2448	Triboji-Spencer 161 @ 110% of 195	Wilmarth-Lakefield 345	0.0384	Conductor	Reconductor	4.0 mi	480	52,451
	1327	1200	2527	Big Stone-Ortonville 230 @ 110% of 390	Watertown-Granite Falls 230 & Blair-Granite Falls 230	0.0292	Conductor	Install larger wire	6.5 mi	325	52,776
	1327	1200	2527	Heron Lk-Brewster 161 @ 110% of 112	Nobles Co-Lakefield Jct 345	0.0293	Conductor	Rebuild	14.0 mi	4,900	57,676
	1346	1200	2546	Granite Falls-Willmar 230 @ 110% of 388	Hazel-Blue Lk 345	0.0688	Conductor	Reconductor	31.0 mi	3,720	61,396
	1427	1200	2627	Brookings Co 345/115 tx 1 or 2 @ 130% of 4	Brookings Co 345/115 tx 2 or 1	0.2542	Install larger txs		2.0 ea	2,000	63,396
22	1495	1200	2695	McLeod-Panther 230 @ 110% of 388	Hazel-Blue Lk 345	0.0847	Conductor	Reconductor	28.2 mi	3,384	66,780
	1574	1200	2774	Wilmarth-Dome 115 @ 110% of 310	Wilmarth-Eastwood 115	0.0350	Conductor	Rebuild to 600 MV,	2.8 mi	1,400	68,180
	1587	1200	2787	Marshall SS-Marshall SE 115 @ 110% of 128	Erie Rd-Saratoga 115	0.0338	Conductor	Reconductor	1.7 mi	204	68,384
	1600	1200	2800	(none)							

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
	69 kV	115 kV	230 kV	
Rebuild to 795 kcm ACSS single ckt				350
Rebuild to 2 x 795 kcm ACSS single ckt				500

Grand Total	<u>qty</u>	<u>each</u>	<u>totals</u>
			#REF!

Southwest Minnesota-->Twin Cities EHV Development

"System Alternative" Configuration--Big Stone at 230 kV

Option 31A "incremental" improvements in service
Brookings Co-Lyon Co 115 kV & Lyon Co-Hazel-Blue Lk 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
	-2635	1200	-1435	Wilmarth-Eastwood 115 kV @ 110% of 194	Wilmarth-Dome 115	0.0373	Conductor	Reconductor	4.4 mi	528	528
	-804	1200	396	Morris 230/115 kV tx #2 @ 130% of 100	Granite Falls-Morris-Moorhead 230 & Morris 230/115 tx #1	0.0227	transformer	install larger tx	1 ea	400	928
#	-738	1200	462	Eden Prairie 345/115 tx #9 @ 130% of 448	Parkers Lk-Blue Lk & Parkers Lk-Eden Pr 345 kV & Eden Pr 345/115 #10	0.0305	Transformer	Replace tx	1 ea	3,000	3,928
13	-502	1200	698	Canby-Burr 115 @ 110% of 97	Canby-Big Stone 230	0.0278	Conductor	Rebuild	4.8 mi	1,680	5,608
	-454	1200	746	Granite Falls-Morris 230 @ 110% of 239	Hazel-Canby 230	0.0190	Conductor	Reconductor	60.0 mi	7,200	12,808
	-160	1200	1040	Grant Co-Morris 115 @ 110% of 96	Wahpeton-Fergus Fls 230 & Maple River-Wahpeton 230 & Wahpeton 230/115 tx	0.0235	Conductor	Reconductor	26.5 mi	3,180	15,988
8	-120	1200	1080 R	Grant Co-Morris 115 @ 110% of 96	Wahpeton-Fergus Fls 230	0.0225				0	15,988
	188	1200	1388	Blair-Granite Falls 230 @ 110% of 398	Hazel-Canby 230	0.0578	Conductor	Reconductor	46.0 mi	5,520	21,508
	193	1200	1393	Granite Falls-Minn Valley 230 @ 110% of 388	Hazel-Canby 230	0.0624	Conductor	Reconductor	2.5 mi	300	21,808
	217	1200	1417	Loon Tp-Eastwood 115 @ 100% of 310	(system intact)	0.0400	Conductor	Rebuild to 600 MVA	22.0 mi	11,000	32,808
14	225	1200	1425	Minn Valley-Panther 230 @ 110% of 388	Hazel-Blue Lk 345	0.0841	Conductor	Reconductor	30.2 mi	3,624	36,432
	248	1200	1448	Willmar 115/69 tx @ 130% of 112	Granite Falls-Willmar 230	0.0208	Transformer	Install 2nd tx	1 ea	3,000	39,432
21	486	1200	1686	Henning-Fergus Fl 230 @ 110% of 320	Audubon-Hubbard 230 & Hubbard tx	0.0433	Term equip	Replace equip	2 ea	200	39,632
19	628	1200	1828	Sheyenne-Audubon 230 @ 110% of 320	Wahpeton-Fergus Falls 230	0.0363	Conductor	Reconductor	43.9 mi	5,268	44,900
	643	1200	1843	Wilmarth-Lakefield Gen 345 @ 110% of 1165	Hazel-Blue Lk 345	0.3363				0	44,900
	667	1200	1867	Ortonville-Johnson Jct 230 @ 110% of 390	Hazel-Canby 230	0.0619	Conductor	Install larger wire	24.7 mi	1,235	46,135
18	688	1200	1888	St Cloud TpW-Wakefield 115 @ 110% of 113	Hazel-Blue Lk 345	0.0497	Conductor	Reconductor	13.8 mi	1,518	47,653
16	813	1200	2013	Toronto-Burr 115 @ 110% of 144	Brookings Co-Toronto 115	0.1500	Conductor	Reconductor	24.7 mi	2,964	50,617
22	862	1200	2062	McLeod-Panther 230 @ 110% of 388	Hazel-Blue Lk 345	0.0847	Conductor	Reconductor	28.2 mi	3,384	54,001
	879	1200	2079	Johnson Jct-Morris 230 @ 110% of 390	Hazel-Canby 230	0.0540	Conductor	Install larger wire	15.4 mi	770	54,771
	921	1200	2121	Big Stone-Ortonville 230 @ 110% of 390	Watertown-Granite Falls 230 & Blair-Granite Falls 230	0.0292	Conductor	Install larger wire	6.5 mi	325	55,096
	959	1200	2159	Wahpeton-Fergus Fls 230 @ 110% of 320	Sheyenne-Audubon 230	0.0422	Term Equip	Replace equip	2.0 ea	200	55,296
	1125	1200	2325	Heron Lk-Brewster 161 @ 110% of 112	Nobles Co-Lakefield Jct 345	0.0293	Conductor	Rebuild	14.0 mi	4,900	60,196
	1158	1200	2358	Marshall SS-Marshall SE 115 @ 110% of 128	Erie Rd-Saratoga 115	0.0334	Conductor	Reconductor	1.7 mi	204	60,400
	1213	1200	2413	Granite Falls-Willmar 230 @ 110% of 388	Hazel-Blue Lk 345	0.0688	Conductor	Reconductor	31.0 mi	3,720	64,120
	1351	1200	2551	McLeod-Blue Lk 230 @ 110% of 388	Hazel-Blue Lk 345	0.0626	Conductor	Reconductor	51.0 mi	6,120	70,240
	1364	1200	2564	Wilmarth-Dome 115 @ 110% of 310	Wilmarth-Eastwood 115	0.0350	Conductor	Rebuild to 600 MVA	2.8 mi	1,400	71,640
	1432	1200	2632	Dome-Eastwood 115 @ 110% of 310	Wilmarth-Eastwood 115	0.0350	Conductor	Rebuild to 600 MVA	3.0 mi	1,500	73,140
	1437	1200	2637	Winnnebago-Winnnebago S 161 @ 110% of 167	Loon Tp-Eastwood 115	0.0320	??			0	73,140
	1438	1200	2638	Wilmarth-Blue Lk 345 @ 110% of 1165	Hazel-Blue Lk 345	0.2976	Conductor	Reconductor	54.8 mi	9,864	83,004
	1455	1200	2655	Lakefield Jct 345/161 txs @ 130% of 335	Wilmarth-Lakefield Gen 345	0.0689	transformers	Replace txs	2.0 ea	7,000	90,004
	1510	1200	2710	Brookings Co 345/115 tx 1 or 2 @ 130% of 441	Brookings Co 345/115 tx 2 or 1	0.2542	Install larger txs		2.0 ea	2,000	92,004
	1573	1200	2773	Triboji-Spencer 161 @ 110% of 195	Wilmarth-Lakefield 345	0.0384	Conductor	Reconductor	4.0 mi	480	92,484
	1600	1200	2800	(none)						0	92,484

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
9/22/2005

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
	69 kV 115 kV 230 kV
Rebuild to 795 kcm ACSS single ckt	350
Rebuild to 2 x 795 kcm ACSS single ckt	500

Base Costs for this Option:		qty	each	totals
	Brookings Co-Lyon Co 115 kV	49.0 mi	350	17,150
	Lyon Co-Hazel 345 kV	22.0 mi	800	17,600
	Lyon Co-Hazel: remove existing 115 kV	22.0 mi	40	880
	Hazel-Blue Lk 345 kV	113 mi	800	90,400
	Hazel-Minn Valley 230 kV	8 mi	450	3,600
	Hazel-Minn Valley: remove existing 115 kV	8 mi	40	320
	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
	Minn Valley 230 kV line re-arrangements	1.0 ea	2,000	2,000
	Subtotal (lines)			145,950
	Brookings Co: add 2nd 345/115 kV 448 MVA tx	1.0 ea	6,000	6,000
	Brookings Co: add 115 kV line term (for Lyon Co)	1.0 ea	1,000	1,000
	Brookings Co: add 115 kV line term (for YKE)	1.0 ea	1,000	1,000
	Brookings Co: add 115 kV line term (for Toronto)	1.0 ea	1,000	1,000
	Brookings Co: add 2 x 40 MVAR 115 kV shunt cap:	2.0 ea	750	1,500
	Lyon Co: add 345 kV line term	1.0 ea	1,500	1,500
	Lyon Co: add 115 kV line term	1.0 ea	1,000	1,000
	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 1 x 40 MVAR shunt cap	1.0 ea	750	750
	Lyon Co: upgrade 2 x 30-->2 x 40 MVAR shunt cap	2.0 ea	25	50
	Hazel Sw Stn: add 3 position 345 kV ring bus	1.0 ea	4,500	4,500
	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 txs	1.0 ea	8,000	8,000
	Hazel Sw Stn: new site development	1.0 ea	1,500	1,500
	Hazel Sw Stn: add 2 x 50 MVAR shunt reactor	2.0 ea	1,200	2,400
	Hazel Sw Stn: add 3 x 60 MVAR shunt capacitors	3.0 ea	1,500	4,500
	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 Yankton Sub: upgrade 4 x 20-->4 x 40 MVAR ca	4.0 ea	25	100

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-Lk Yankton & Lyon Co-Hazel 345 kV
 Big Stone-Canby-Hazel @ 230 kV, 2 x 795 ACSR

With Fargo-Benton Co 345 kV

SW MN Buffalo Ridge Area Generation						distribution	Limiting	Remedy	qty	Installed Cost, \$1,000's	
Key	TLTG Limit MW	Base Case MW	System Limit MW	Limiting Facility	Contingency	factor	factor			item	cumulative
5	-1350	1200	-150	Lake Marion-Kenrick 115 @ 110% of 139	Airlake-Lk Marion 115	0.0212	Conductor	Reconductor	3.5 mi	420	420
	-1133	1200	67	Wilmarth-Eastwood 115 kV @ 110% of 194	Wilmarth-Dome 115	0.0326	Conductor	Reconductor	4.4 mi	528	948
9	-906	1200	294	Kenrick-Dakota Heights 115 @ 110% of 139	Airlake-Lk Marion 115	0.0212	Conductor	Reconductor	4.3 mi	516	1,464
2	-441	1200	759	Minn Valley-Maynard 115 @ 110% of 78	Granite Falls-Willmar 230	0.0187	Conductor	Rebuild	11.3 mi	3955	5,419
	-376	1200	824	Morris 230/115 kV tx #2	Granite Falls-Morris-Moorhead 230 & Morris 230/115 tx #1	0.0267	Transformer	install larger tx	1.0 ea	400	5,819
4	-236	1200	964	Maynard-Kerkhoven Tp 115 @ 110% of 78	Granite Falls-Willmar 230	0.0218	Conductor	Rebuild	14.7 mi	5145	10,964
3	-173	1200	1027	Paynesville-Roscoe 69 @ 110% of 47	Paynesville-Wakefield 115	0.0158	Conductor	(Opt 31A facility)	0.0	0	10,964
7	84	1200	1284	Roscoe-Munson 69 @ 110% of 47	Paynesville-Wakefield 115	0.0158	Conductor	(Opt 31A facility)	0.0	0	10,964
20	269	1200	1469	Burnsville- Dakota Hgts @ 110% of 139	Airlake-Lk Marion 115	0.0212	Conductor	Reconductor	4.0 mi	480	11,444
10	353	1200	1553	Willmar 115/69 tx @ 130% of 112	Granite Falls-Willmar 230	0.0205	Transformer	Install 2nd tx	1.0 ea	3,000	14,444
11	361	1200	1561	Farm Tp-Munson Tp @ 110% of 47	Paynesville-Wakefield 115	0.0158	Conductor	(Opt 31A facility)	0.0	0	14,444
13	382	1200	1582	Canby-Burr 115 @ 110% of 97	Brookings Co-Toronto 115	0.1070	Conductor	Rebuild	4.8 mi	576	15,020
	498	1200	1698	Sheyenne-Fargo 230 @ 110% of 387	Hankson-Wahpeton 230	0.0586	Conductor	Reconductor	4.3 mi	516	15,536
14	509	1200	1709	Minn Valley-Panther 230 @ 110% of 388	Lyon Co-Franklin 345	0.0791	Conductor	Reconductor	30.2 mi	3624	19,160
15	523	1200	1723	Helena-Blue Lk 345 @ 110% of 1165	Helena-Lk Marion 345	0.3680	Conductor	Reconductor	15.0 mi	2,700	21,860
6	553	1200	1753	Grant Co-Morris 115 @ 110% of 96	Wahpeton-Fergus Fls 230 & Maple River-Wahpeton 230 & Wahpeton 230/115 tx	0.0301	Conductor	Reconductor	26.5 mi		25,040
										3180	
8	745	1200	1945 R	Grant Co-Morris 115 @ 110% of 96	Wahpeton-Fergus Fls 230	0.0282			0.0	0	25,040
	791	1200	1991	Brookings Co 345/115 tx 1 or 2 @ 130% of 44	Brookings Co 345/115 tx #2 or 1	0.3091	Transformer	Install larger txs	2 ea	2,000	27,040
16	812	1200	2012	Toronto-Burr 115 @ 110% of 144	Brookings Co-Toronto 115	0.1500	Conductor	Reconductor	24.7 mi	2964	30,004
	929	1200	2129	Grant Co-Elbow Lk 115 @ 110% of 160	Maple River-Alex SS 345	0.0287	Clearance	upgrade structures	3.6 mi	360	30,364
17	956	1200	2156	Wilmarth-Lakefield Gen 345 @ 110% of 1165	Lyon Co-Franklin 345	0.3190	Conductor	Reconductor	54.2 mi	9,756	40,120
	1088	1200	2288	Ortonville-Johnson Jct 230 @ 110% of 390	Hazel-Canby 230	0.0573	Conductor	Install larger wire	24.7 mi	1,235	41,355
	1088	1200	2288	Winnebago-Winnebago S 161 @ 110% of 167	Prairie Island-Byron 345	0.0225	??				41,355
	1153	1200	2353	Eden Prairie 345/115 tx #9 @ 130% of 448	Parkers Lk-Blue Lk & Parkers Lk-Eden Pr 345 kV & Eden Pr 345/115 #10	0.0681	transformer	Replace tx	1.0 ea		44,355
	1168	1200	2368	Hankson-Wahpeton 230 @ 110% of 320	Ortonville-Johnson Jct 230	0.0565	Conductor	Reconductor	25.5 mi	3060	47,415
	1221	1200	2421	Loon Tp-Eastwood 115 @ 110% of 310	Lk Marion 345/115 tx	0.0375	Conductor	Add 2nd tx	1.0 ea	7,000	54,415
18	1242	1200	2442	St Cloud TpW-Wakefield 115 @ 110% of 113	Franklin-Helena 345	0.0440	Conductor	Reconductor	13.8 mi	1518	55,933
22	1246	1200	2446	McLeod-Panther 230 @ 110% of 388	Franklin-Helena 345	0.0787	Conductor	Reconductor	28.2 mi	3,384	59,317
	1278	1200	2478	Elbow Lk-Brandon 115 @ 110% of 160	Maple River-Alex SS 345	0.0287	Clearance	upgrade structures		0	59,317 xxxx
	1314	1200	2514	Johnson Jct-Morris 230 @ 110% of 390	Hazel-Canby 230	0.0573	Conductor	Install larger wire	15.4 mi	770	60,087
24	1420	1200	2620	Wilmarth-Helena 345 @ 110% of 1165	Franklin-Helena 345	0.2967	Conductor	Reconductor	54.0 mi	9,720	69,807
	1472	1200	2672	Morris 230/115 tx #1 @ 130% of 100	Morris 230/115 tx # 2	0.0217	Transformer	Replace tx	1.0 ea	1,500	71,307
	1524	1200	2724	Minn Valley-Hazel 230 @ 110% of 388	Lyon Co-Franklin 345	0.0934	Conductor	Install larger wire	8.0 mi	400	71,707
	1554	1200	2754 R	Brookings Co 345/115 txs @ 100% of 448	(system intact)	0.1690	transformers			0	71,707
	1575	1200	2775	Loon Tp-Eastwood 115 @ 110% of 310	Helena-Blue Lk 345	0.0430	Conductor	Rebuild to 600 MV/	22.0 mi	11,000	82,707
	1582	1200	2782	Triboji-Spencer 161 @ 110% of 195	Wilmarth-Lakefield Gen 345	0.0454	Conductor	Reconductor	4.0 mi	480	83,187
	1600	1200	2800	(none)							

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 = 1160 + 40 = 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
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, 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

8/15/2005

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
	69 kV	115 kV	230 kV	
Rebuild to 795 kcm ACSS single ckt				350
Rebuild to 2 x 795 kcm ACSS single ckt				500

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

With Lyon Co-Franklin 115 kV

SW MN Buffalo Ridge Area Generation				Limiting Facility	Contingency	distribution factor	Limiting factor	Remedy	qty	Installed Cost, \$1,000's	
Key	TLTG Limit MW	Base Case MW	System Limit MW							item	cumulative
								Lyon Co-Franklin 115 kV		17,900	17,900
5	-1532	1200	-332	Lake Marion-Kenrick 115 @ 110% of 139	Airlake-Lk Marion 115	0.0224	Conductor	Reconductor	3.5 mi	420	18,320
	-1398	1200	-198	Wilmarth-Eastwood 115 kV @ 110% of 194	Wilmarth-Dome 115	0.0339	Conductor	Reconductor	4.4 mi	528	18,848
9	-1104	1200	96	Kenrick-Dakota Heights 115 @ 110% of 139	Airlake-Lk Marion 115	0.0224	Conductor	Reconductor	4.3 mi	516	19,364
2	-649	1200	551	Minn Valley-Maynard 115 @ 110% of 78	Granite Falls-Willmar 230	0.0188	Conductor	Rebuild	11.3 mi	3,955	23,319
	-595	1200	605	Morris 230/115 kV tx #2	Granite Falls-Morris-Moorhead 230 & Morris 230/115 tx #1	0.0221	Transformer	install larger tx	1.0 ea	400	
											23,719
3	-529	1200	671	Paynesville-Roscoe 69 @ 110% of 47	Paynesville-Wakefield 115	0.0179	Conductor	(Opt 31A facility)			0
4	-430	1200	770	Maynard-Kerkhoven Tp 115 @ 110% of 78	Granite Falls-Willmar 230	0.0217	Conductor	Rebuild	14.7 mi	5,145	28,864
7	-290	1200	910	Roscoe-Munson 69 @ 110% of 47	Paynesville-Wakefield 115	0.0179	Conductor	(Opt 31A facility)			0
6	-284	1200	916	Grant Co-Morris 115 @ 110% of 96	Wahpeton-Fergus Fls 230 & Maple River-Wahpeton 230 & Wahpeton 230/115 tx	0.0249	Conductor	Reconductor	26.5 mi		
										3,180	32,044
8	-263	1200	937 R	Grant Co-Morris 115 @ 110% of 96	Wahpeton-Fergus Fls 230	0.0240					0
10	-100	1200	1100	Willmar 115/69 tx @ 130% of 112	Granite Falls-Willmar 230	0.0225	Transformer	Install 2nd tx	1.0 ea	3,000	35,044
11	-38	1200	1162	Farm Tp-Munson Tp @ 110% of 47	Paynesville-Wakefield 115	0.0179	Conductor	(Opt 31A facility)			0
20	10	1200	1210	Burnsville- Dakota Hgts @ 110% of 139	Airlake-Lk Marion 115	0.0224	Conductor	Reconductor	4.0 mi	480	35,524
15	239	1200	1439	Helena-Blue Lk 345 @ 110% of 1165	Helena-Lk Marion 345	0.3903	Conductor	Reconductor	15.0 mi	2,700	38,224
13	349	1200	1549	Canby-Burr 115 @ 110% of 97	Brookings Co-Toronto 115	0.1078	Conductor	Rebuild	4.8 mi	1,680	39,904
14	448	1200	1648	Minn Valley-Panther 230 @ 110% of 388	Lyon Co-Franklin 345	0.0808	Conductor	Reconductor	30.2 mi	3,624	43,528
21	552	1200	1752	Henning-Fergus Fl 230 @ 110% of 320	Audubon-Hubbard 230 & Hubbard tx	0.0431	Term equip	Replace equip	2.0 ea	200	43,728
18	616	1200	1816	St Cloud TpW-Wakefield 115 @ 110% of 113	Franklin-Helena 345	0.0505	Conductor	Reconductor	13.8 mi	1,518	45,246
	745	1200	1945	Eden Prairie 345/115 tx #9 @ 130% of 448	Parkers Lk-Blue Lk & Parkers Lk-Eden Pr 345 kV & Eden Pr 345/115 #10	0.0742	Transformer	Replace tx	1.0 ea		
										3,000	48,246
22	766	1200	1966	McLeod-Panther 230 @ 110% of 388	Franklin-Helena 345	0.0870	Conductor	Reconductor	28.2 mi	3,384	51,630
17	773	1200	1973	Wilmarth-Lakefield Gen 345 @ 110% of 1165	Franklin-Helena 345	0.3307	Conductor	Reconductor	54.2 mi	9,756	61,386
	798	1200	1998	Sheyenne-Audubon 230 @ 110% of 320	Wahpeton-Fergus Falls 230	0.0354	Conductor	Reconductor	43.9 mi	5,268	66,654
	801	1200	2001	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	68,654
16	813	1200	2013	Toronto-Burr 115 @ 110% of 144	Brookings Co-Toronto 115	0.1500	Conductor	Reconductor	24.7 mi	2,964	71,618
17	861	1200	2061 R	Wilmarth-Lakefield Gen 345 @ 110% of 1165	Lyon Co-Franklin 345	0.3216	Conductor				0
	976	1200	2176	Loon Tp-Eastwood 115 @ 110% of 310	Lk Marion 345/115 tx	0.0391	Conductor	Add 2nd tx	1.0 ea	7,000	78,618
			2284								0
	1084	1200	2284	Ft Ridgely-Franklin 115 @ 110% of 139	Franklin-Helena 345	0.0290	Conductor	Reconductor	25.7 mi	3,084	81,702
24	1101	1200	2301	Wilmarth-Helena 345 @ 110% of 1165	Franklin-Helena 345	0.3131	Conductor	Reconductor	39.0 mi	7,020	88,722
	1124	1200	2324	Wahpeton-Fergus Fls 230 @ 110% of 320	Sheyenne-Audubon 230	0.0409	Term Equip	Replace equip	2.0 ea	200	88,922
1	1196	1200	2396	Granite Falls-Willmar 230 @ 110% of 388	Minn Valley-Panther 230	0.0661	Conductor	Reconductor	35.0 mi	4,200	93,122
	1214	1200	2414	Winnebago-Winnebago S 161 @ 110% of 161	Prairie Island-Byron 345	0.0224	??				0
	1223	1200	2423	Granite Falls-Minn Valley 230 @ 110% of 388	Hazel-Minn Valley 230	0.0599	Conductor	Reconductor	2.5 mi	300	93,422
	1294	1200	2503	Loon Tp-Eastwood 115 @ 110% of 310	Helena-Blue Lk 345	0.0477	Conductor	Rebuild to 600 MV	22.0 mi	11,000	104,422
	1338	1200	2538	Ortonville-Johnson Jct 230 @ 110% of 390	Hazel-Canby 230	0.0538	Conductor	Install larger wire	24.7 mi	1,235	105,657
	1571	1200	2771	Johnson Jct-Morris 230 @ 110% of 390	Hazel-Canby 230	0.0538	Conductor	Install larger wire	15.4 mi	770	106,427
	1565	1200	2765 R	Brookings Co 345/115 txs @ 100% of 448	(system intact)	0.1690	transformers				0
	1592	1200	2792	Triboji-Spencer 161 @ 110% of 195	Wilmarth-Lakefield 345	0.0371	Conductor	Reconductor	4.0 mi	720	107,147
	1600	1200	2800	(none)							0

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 = 1160 + 40 = 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, new Lyon Co-Franklin 115 kV (795 kcm ACSS).
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, 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
	69 kV	115 kV	230 kV	
Rebuild to 795 kcm ACSS single ckt				350
Rebuild to 2 x 795 kcm ACSS single ckt				500
Rebuild to 795/477 kcm ACSS double ckt 115/69 kV				500

Basic Option cost

Build 44 mi; assume 1/2 of mileage is single ckt 115 kV, 1/2 is 115/69 kV double ckt, 795 ACSS (310 MVA)/477 kcm ACSS line terms at Lyon Co and Franklin @ \$1,000 each

18,700
2,000
20,700
2,800
17,900

Less: 8 mi between Milroy & Sheridan already built for load serving purposes

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										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
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
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
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
	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 448	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
	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	Wahpeton-Fergus Falls 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
1	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 161	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
	1303	1200	2503	Loon Tp-Eastwood 115 @ 110% of 310	Helena-Blue Lk 345	0.0476	Conductor	Rebuild to 600 MVA	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	2765 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 updated 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

Base Costs for this Option:		<u>qty</u>	<u>each</u>	<u>totals</u>
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
Lyon Co-Hazel: remove existing 115 kV	22.0 mi	40		880
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)			195,280
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 tx	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 Toronto)	1.0 ea	1,000		1,000
Brookings Co: add 50 MVAr shunt reactor	1.0 ea	1,200		1,200
Brookings Co: add 2 x 40 MVAR shunt caps	2.0 ea	750		1,500
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 1 x 40 MVAR 115 kV shunt capaci	1.0 ea	750		750
Lyon Co: upgrade 2 x 40 -->2 x 40 MVAR shunt	2.0 ea	25		50

Southwest Minnesota-->Twin Cities EHV Development

Existing Configuration--Big Stone at 230 kV
Option 31A "incremental" improvements in service

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

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
	-2825	1200	-1625	Wilmarth-Eastwood 115 kV @ 110% of 194	Wilmarth-Dome 115	0.0404	Conductor	Reconductor	4.4 mi	528	528
	-1645	1200	-445	Hoot Lk-Fergus Fls 115 @ 110% of 96	Wahpeton-Fergus Fls 230	0.0193	Conductor	Reconductor	2.1 mi	252	780
2	-1381	1200	-181	Minn Valley-Maynard 115 @ 110% of 78	Granite Falls-Willmar 230	0.0257	Conductor	Rebuild	11.3 mi	3,955	4,735
4	-1212	1200	-12	Maynard-Kerkhoven Tp 115 @ 110% of 78	Granite Falls-Willmar 230	0.0296	Conductor	Rebuild	14.7 mi	5,145	9,880
	-1114	1200	86	Granite Falls-Minn Valley 230 @ 110% of 388	Granite Falls-Willmar 230 & Willmar 230/69 tx	0.1072	Conductor	Reconductor	2.5 mi	300	10,180
3	-1102	1200	98	Paynesville-Roscoe 69 @ 110% of 47	Paynesville-Wakefield 115	0.0236	Conductor	(Opt 31A facility)		0	10,180
6	-1040	1200	160	Grant Co-Morris 115 @ 110% of 96	Fergus Falls-Wahpeton 230 & Wahpeton tx	0.0338	Conductor	Reconductor	26.5 mi	3,180	13,360
8	-1006	1200	194 R	Grant Co-Morris 115 @ 110% of 96	Fergus Falls-Wahpeton 230	0.0323				0	13,360
7	-893	1200	307	Roscoe-Munson 69 @ 110% of 47	Paynesville-Wakefield 115	0.0236	Conductor	(Opt 31A facility)		0	13,360
11	-681	1200	519	Farm Tp-Munson Tp @ 110% of 47	Paynesville-Wakefield 115	0.0236	Conductor	(Opt 31A facility)		0	13,360
14	-573	1200	627	Minn Valley-Panther 230 @ 110% of 388	Wilmarth-Lakefield Gen 345	0.1152	Conductor	Reconductor	30.2 mi	3,624	16,984
10	-545	1200	655	Willmar 230/69 tx @ 130% of 84	Willmar-Kandiyohi 230	0.0209	Transformer	Install 2nd tx	1.0 ea	3,000	19,984
	-481	1200	719	Grant Co-Elbow Lk 115 @ 110% of 160	Henning-Fergus Fls 230	0.0252	Clearance	upgrade structures	3.6 mi	360	20,344
21	-316	1200	884	Henning-Fergus Fl 230 @ 110% of 320	Audubon-Hubbard 230 & Hubbard tx	0.0559	Term equip	Replace equip	2.0 ea	200	20,544
	-257	1200	943	Minn Valley 230/115 tx # 6	Granite Falls-Minn Valley 230	0.0593	Transformer	Replace tx	1.0 ea	2,000	22,544
	-162	1200	1038	Sheyenne-Audubon 230 @ 110% of 318	Wahpeton-Fergus Fls 230	0.0451	Conductor	Reconductor	43.9 mi	5,268	27,812
1	-128	1200	1072	Granite Falls-Willmar 230 @ 110% of 388	Minn Valley-Panther 230	0.0922	Conductor	Reconductor	31.0 mi	3,720	31,532
	-84	1200	1116	Willmar 115/69 tx @ 130% of 112	Granite Falls-Willmar 230 & Willmar 230/69 tx	0.0228	Transformer	Install 2nd tx	1.0 ea	3,000	34,532
	-72	1200	1128	Morris 230/115 tx #1 or 2 @ 130% of 100	Morris 230/115 tx #2 or 1	0.0245	Transformer	install larger tx	1.0 ea	400	34,932
	-70	1200	1130	Elbow Lk-Brandon 115 @ 110% of 160	Henning-Fergus Fls 230	0.0256	Clearance	upgrade structures	16.6 mi	1,660	36,592
13	20	1200	1220	Canby-Burr 115 @ 110% of 97	Canby-Big Stone 230	0.0976	Conductor	Rebuild	4.8 mi	1,680	38,272
	34	1200	1234	Loon Tp-Eastwood 115 @ 110% of 310	Byron 345/161 tx	0.0420	Conductor	Rebuild to 600 MV,	22.0 mi	11,000	49,272
22	53	1200	1253	McLeod-Panther 230 @ 110% of 388	Wilmarth-Lakefield Gen 345	0.1137	Conductor	Reconductor	28.2 mi	3,384	52,656
17	82	1200	1282	Wilmarth-Lakefield Gen 345 @ 110% of 1165	Sherco #3 gen	0.3287	Conductor	Reconductor	54.2 mi	9,756	62,412
	107	1200	1307	Heron Lk-Brewster 161 @ 110% of 112	Lakefield Jct-Nobles Co 345	0.0289	Conductor	Rebuild	14.0 mi	4,900	67,312
18	110	1200	1310	St Cloud TpW-Wakefield 115 @ 110% of 113	Wilmarth-Lakefield Gen 345	0.0606	Conductor	Reconductor	13.8 mi	1,518	68,830
	137	1200	1337	Wahpeton-Fergus Fls 230 @ 110% of 320	Sheyenne-Audubon 230	0.0527	Term equip	Replace equip	2.0 ea	200	69,030
	160	1200	1360	Ortonville-Johnson Jct 230 @ 110% of 390	Canby-Granite Falls 230	0.0943	Conductor	Install larger wire	24.7 ea	1,235	70,265
	304	1200	1504	Johnson Jct-Morris 230 @ 110% of 390	Canby-Granite Falls 230	0.0943	Conductor	Install larger wire	15.4 mi	770	71,035
	361	1200	1561	Brandon-Alex SS 115 @ 110% of 160	Henning-Fergus Fls 230	0.0252	Clearance	upgrade structures	13.0 mi	1,300	72,335
	394	1200	1594	Blue Lk-McLeod 230 @ 110% of 388	Wilmarth-Lakefield Gen 345	0.0866	Conductor	Reconductor	46.0 mi	5,520	77,855
	467	1200	1667	Burr-Marietta 115 @ 110% of 96	Canby-Burr 115	0.1500	Conductor	Rebuild	21.5 mi	7,525	85,380
	478	1200	1678	Marietta-Big Stone 115 @ 110% of 96	Canby-Burr 115	0.1500	Conductor	Rebuild	24.1 mi	8,435	93,815
	514	1200	1714	Farm Tp-Richmond 69 @ 110% of 48	Paynesville-Wakefield 115	0.0216	Conductor	Reconductor	0.1 mi	12	93,827
	547	1200	1747	Eden Prairie 345/115 tx #9 @ 130% of 448	Parkers Lk-Blue Lk & Parkers Lk-Eden Pr 345 kV & Eden Pr 345/115 #10	0.0680	transformer	Replace tx	1.0 ea	3,000	96,827
	597	1200	1797	Circle Tp-Fair Pk 69 @ 110% of 84	Blue Lk-Wilmarth 345 & Hyland Lk-Dean Lk 115	0.0201	Conductor	Reconductor	5.1 mi	612	97,439
	600	1200	1800	LeSauk Tp-Long Prairie 115 @ 110% of 98	Inman-Wing River 230	0.0252					97,439
	637	1200	1837	Magnolia-Elk 161 @ 110% of 167	Lakefield Jct-Nobles Co 345	0.0353	Conductor	Reconductor	26.7 mi	3,204	100,643

664	1200	1864	Big Stone-Ortonville 230 @ 110% of 390	Big Stone-Blair 230	0.0243	Conductor	Install larger wire	2.0 mi	100	100,743
671	1200	1871	Blue Heron-Richmond 69@ 110% of 48	Paynesville-Wakefield 115	0.0216	Conductor	Reconductor	3.8 mi	456	101,199
682	1200	1882	Magnolia-Split Rk tp 161 @ 110% of 200	Nobles Co-Lakefield 345	0.0401	Conductor	Reconductor	15.0 mi	1,800	102,999
682	1200	1882	Hutch MN-Hutch 3M 115 @ 110% of 174	Blue Lk 230/115 tx or BLL-McLeod 230	0.0452	Conductor	Reconductor	0.76 mi ?	91	103,090
717	1200	1917	Dawson-Canby 115 @ 110% of 94	Canby 230/115 tx	0.1110	Conductor	Reconductor	21.2 mi	2,544	105,634
720	1200	1920	Toronto-Burr 115 kV @ 100% of 144	(system intact)	0.2143	Conductor	Reconductor	24.7 mi	2,964	108,598
784	1200	1984	Big Stone-Blair 230 @ 110% of 480	Hazel-Canby 230	0.0813	Conductor	Reconductor	33.2 mi	3,984	112,582
785	1200	1985	Wilmarth-Blue Lk 345 @ 110% of 1165	Loon Tp-Eastwood 115	0.3149					

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 = 1160 + 40 = 1200 MW.
2. Xcel/NSP Buffalo Ridge area line ratings adjusted per NSP wind rating practice.
3. Improvements modeled: none
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, 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

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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
	69 kV	115 kV	230 kV	
Rebuild to 795 kcm ACSS single ckt				350
Rebuild to 2 x 795 kcm ACSS single ckt				500

Southwest Minnesota-->Twin Cities EHV Development

Base Configuration--Big Stone at 345 kV

Option 31A "incremental" improvements in service
 Brookings Co-Lyon Co-Franklin-Helena-Lk Marion-Hampton Corner single circuit
 with Lyon Co-Lk Yankton & Lyon Co-Hazel 345 kV
 Big Stone-Canby-Hazel @ 345 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 item	Cost, \$1,000's cumulative
5	-1849	1200	-649	Lake Marion-Kenrick 115 @ 110% of 139	Airlake-Lk Marion 115	0.0254	Conductor	Rebuild as part of Lake Marion	mi		
1	-1648	1200	-448	Granite Falls-Willmar 230 @ 110% of 239	Sherco #3 gen	0.0276	terminal equip	Replace equip	ea		
9	-1459	1200	-259	Kenrick-Dakota Heights 115 @ 110% of 139	Airlake-Lk Marion 115	0.0254	Conductor	Rebuild as part of Lake Marion-Black Dog 345			
	-1245	1200	-45	Wilmarth-Eastwood 115 kV @ 110% of 194	Wilmarth-Dome 115	0.0427	Conductor	Reconductor			
2	-758	1200	442	Minn Valley-Maynard 115 @ 110% of 78	Granite Falls-Willmar 230	0.0177	Conductor	Rebuild	mi		
4	-544	1200	656	Maynard-Kerkhoven Tp 115 @ 110% of 78	Granite Falls-Willmar 230	0.0205	Conductor	Rebuild			
3	-514	1200	686	Paynesville-Roscoe 69 @ 110% of 47	Paynesville-Wakefield 115	0.0175	Conductor	(Opt 31A facility)			
20	-472	1200	728	Burnsville- Dakota Hgts @ 110% of 139	Airlake-Lk Marion 115	0.0254	Conductor	Rebuild as part of Lake Marion-Black Dog 345			
7	-271	1200	929	Roscoe-Munson 69 @ 110% of 47	Paynesville-Wakefield 115	0.0175	Conductor	(Opt 31A facility)			
6	-108	1200	1092	Grant Co-Morris 115 @ 110% of 96	Maple River-Fergus Fls 230 &	0.0243	Conductor	Reconductor	mi		
8	-81	1200	1119 R	Grant Co-Morris 115 @ 110% of 96	Wahpeton-Fergus Fls 230	0.0229					
10	-68	1200	1132	Willmar 115/69 tx @ 130% of 112	Granite Falls-Willmar 230	0.0218	Transformer	Install 2nd tx			
11	-14	1200	1186	Farm Tp-Munson Tp @ 110% of 47	Paynesville-Wakefield 115	0.0175	Conductor	(Opt 31A facility)			
14	80	1200	1280	Minn Valley-Panther 230 @ 110% of 388	Lyon Co-Franklin 345	0.0798	Conductor	Reconductor	mi		
15	178	1200	1378	Helena-Blue Lk 345 @ 110% of 1165	Helena-Lk Marion 345	0.4200	Conductor	Reconductor	mi		
13	248	1200	1448	Canby-Burr 115 @ 110% of 97	Brookings Co-Toronto 115	0.1613	Conductor	Reconductor	mi		
16	569	1200	1769	Toronto-Burr 115 @ 110% of 144	Brookings Co-Toronto 115	0.2143	Conductor	Reconductor	mi		
	607	1200	1807	Eden Prairie 345/115 tx #9 @ 130% of 448	Parkers Lk-Blue Lk & Parkers Lk-Eden Pr 345 kV & Eden Pr 345/115 #10	0.0827					
17	608	1200	1808	Wilmarth-Lakefield Gen 345 @ 110% of 1165	Lyon Co-Franklin 345	0.3852	Conductor	Stop?			
18	624	1200	1824	St Cloud TpW-Wakefield 115 @ 110% of 113	Franklin-Helena 345	0.0493	Conductor				
	645	1200	1845	Grant Co-Elbow Lk 115 @ 110% of 160	Henning-Inman 230	0.0189					
19	682	1200	1882 R	Wilmarth-Lakefield Gen 345 @ 110% of 1165	Franklin-Helena 345	0.3831	Conductor				
21	709	1200	1909	Henning-Fergus Fl 230 @ 110% of 320	Audubon-Hubbard 230 & Hubbard tx	0.0429					
22	811	1200	2011	McLeod-Panther 230 @ 110% of 388	Franklin-Helena 345	0.0805					
	904	1200	2104	Loon Tp-Eastwood 115 @ 110% of 310	Lk Marion 345/115 tx	0.0434					
24	980	1200	2180	Wilmarth-Helena 345 @ 110% of 1165	Franklin-Helena 345	0.3540					
23	1093	1200	2293	Brookings Co-Toronto 115 @ 110% of 310	Hazel-Canby 230	0.1904					
	1155	1200	2355	Ortonville-Johnson Jct 230 @ 110% of 390	Hazel-Canby 230	0.0637					
	1200	1200	2400	(none)							

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 = 1160 + 40 = 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
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 345 kV, Hazel-Granite Falls/Minn Valley 230 kV.
8. Wilmarth-Helena 345 outage presumed to result in tripping of Wilmarth Calpine gen (cross-tripping scheme).

8/15/2005

Southwest Minnesota-->Twin Cities EHV Development

Base Configuration

Option 31A "incremental" improvements in service
 Brookings Co-Lyon Co-Franklin-Helena-Lk Marion/Black Dog 345 kV single circuit
 with Lyon Co-Lk Yankton & Lyon Co-Hazel 345 kV
 Big Stone-Canby-Hazel @ 230 kV, 2 x 795 ACSR
With Lk Marion-Black Dog 345 kV

SW MN Buffalo Ridge Area Generation						distribution	Limiting	Remedy	qty	Installed	Cost, \$1,000's
Key	TLTG Limit MW	Base Case MW	System Limit MW	Limiting Facility	Contingency	factor	factor			item	cumulative
1	-1616	1200	-416	Granite Falls-Willmar 230 @ 110% of 239	Sherco #3 gen	0.0291	terminal equip	Replace equip	ea		
2	-709	1200	491	Minn Valley-Maynard 115 @ 110% of 78	Granite Falls-Willmar 230	0.0173	Conductor	Rebuild	mi		
3	-563	1200	637	Paynesville-Roscoe 69 @ 110% of 47	Paynesville-Wakefield 115	0.0168	Conductor	(Opt 31A facility)			
4	-474	1200	726	Maynard-Kerkhoven Tp 115 @ 110% of 78	Granite Falls-Willmar 230	0.0199	Conductor	Rebuild			
5	-392	1200	808	Lake Marion-Kenrick 115 @ 110% of 139	Blue Lk-Parkers Lk 345 & Blue Lk-Eden Prairie 345 & Eden Pr tx	0.0291	Conductor	Rebuild as part of Lake Marion	mi		
7	-309	1200	891	Roscoe-Munson 69 @ 110% of 47	Paynesville-Wakefield 115	0.0168	Conductor	(Opt 31A facility)			
6	-303	1200	897	Grant Co-Morris 115 @ 110% of 96	Maple River-Fergus Fls 230 & Fergus Fl-Wahpeton 230 & Wahpeton	0.0238	Conductor	Reconductor	mi		
8	-261	1200	939 R	Grant Co-Morris 115 @ 110% of 96	Wahpeton-Fergus Fls 230	0.0229					
10	-113	1200	1087	Willmar 115/69 tx @ 130% of 112	Granite Falls-Willmar 230	0.0210	Transformer	Install 2nd tx			
9	-68	1200	1132	Kenrick-Dakota Heights 115 @ 110% of 139	Blue Lk-Parkers Lk 345 & Blue Lk-Eden Prairie 345 & Eden Pr tx	0.0291	Conductor	Rebuild as part of Lake Marion-Black Dog 345			
11	-41	1200	1159	Farm Tp-Munson Tp @ 110% of 47	Paynesville-Wakefield 115	0.0168	Conductor	(Opt 31A facility)			
14	53	1200	1253	Minn Valley-Panther 230 @ 110% of 388	Lyon Co-Franklin 345	0.0786	Conductor	Reconductor	mi		
15	232	1200	1432	Helena-Blue Lk 345 @ 110% of 1165	Helena-Lk Marion 345	0.3983	Conductor	Reconductor	mi		
13	244	1200	1444	Canby-Burr 115 @ 110% of 97	Brookings Co-Toronto 115	0.1546	Conductor	Reconductor	mi		
16	569	1200	1769	Toronto-Burr 115 @ 110% of 144	Brookings Co-Toronto 115	0.2143	Conductor	Reconductor	mi		
	589	1200	1789	Eden Prairie 345/115 tx #9 @ 130% of 448	Parkers Lk-Blue Lk & Parkers Lk-Eden Pr 345 kV & Eden Pr 345/115 #10	0.0785					
21	601	1200	1801	Henning-Fergus Fl 230 @ 110% of 320	Audubon-Hubbard 230 & Hubbard tx	0.0408					
17	641	1200	1841	Wilmarth-Lakefield Gen 345 @ 110% of 1165	Lyon Co-Franklin 345	0.3721	Conductor	Stop?			
18	644	1200	1844	St Cloud TpW-Wakefield 115 @ 110% of 113	Franklin-Helena 345	0.0478	Conductor				
19	706	1200	1906 R	Wilmarth-Lakefield Gen 345 @ 110% of 1165	Franklin-Helena 345	0.3707	Conductor				
20	788	1200	1988	Burnsville- Dakota Hgts @ 110% of 139	Blue Lk-Parkers Lk 345 & Blue Lk-Eden Prairie 345 & Eden Pr tx	0.0291	Conductor	Rebuild as part of Lake Marion-Black Dog 345			
22	822	1200	2022	McLeod-Panther 230 @ 110% of 388	Franklin-Helena 345	0.0787					
	863	1200	2063	Sheyenne-Audubon 230 @ 110% of 318	Wahpeton-Fergus Fls 230	0.0334					
24	1019	1200	2219	Wilmarth-Helena 345 @ 110% of 1165	Franklin-Helena 345	0.3416					
23	1078	1200	2278	Brookings Co-Toronto 115 @ 110% of 310	Hazel-Canby 230	0.1962					
	1178	1200	2378	Ortonville-Johnson Jct 230 @ 110% of 390	Hazel-Canby 230	0.0614					
12	1189	1200	2389	Winnebago-Winnebago S 161 @ 110% of 16	Prairie Island-Byron 345	0.0244	??				
	1200	1200	2400	(none)							

Notes

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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-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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