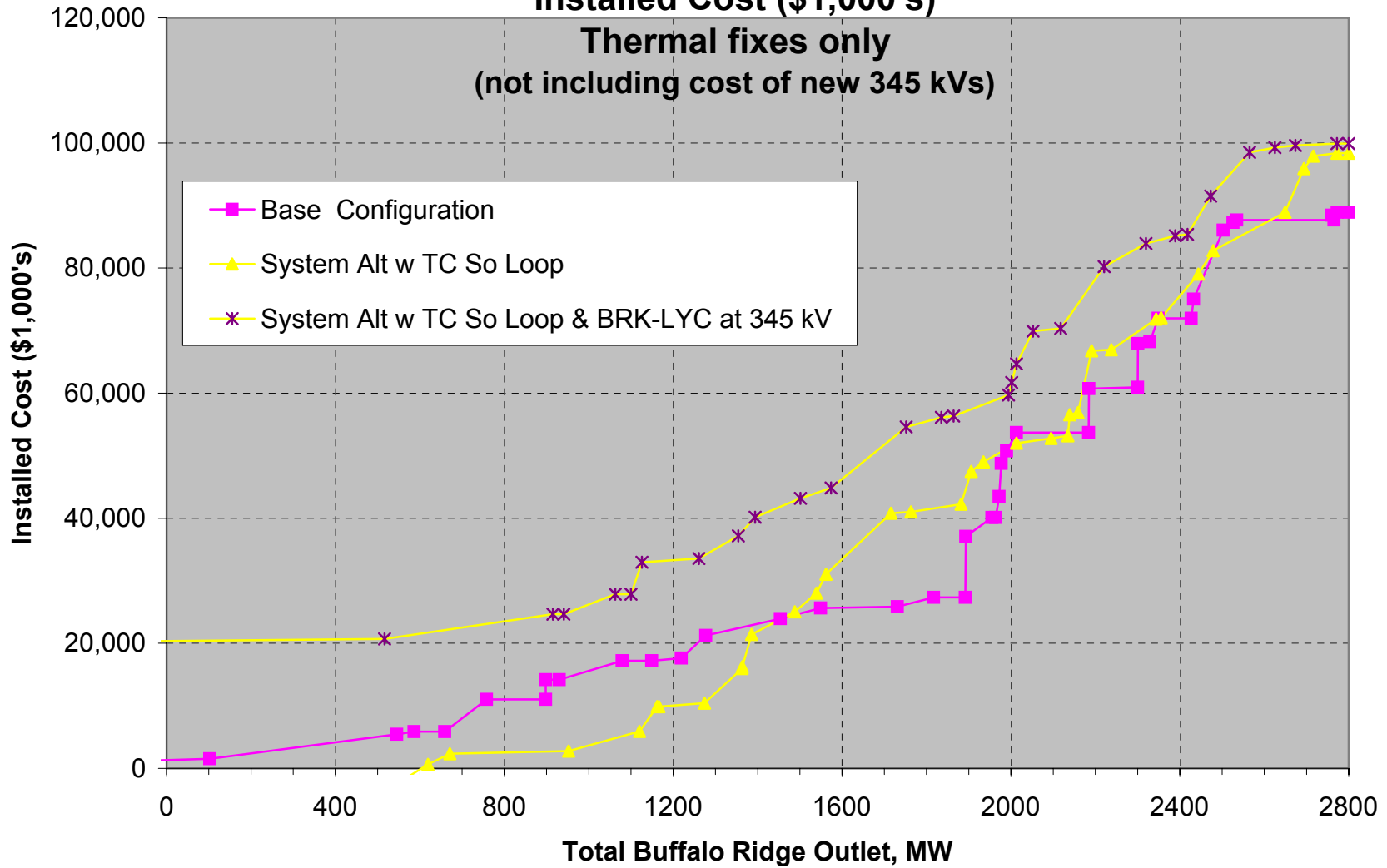


**SW Minnesota Generation Outlet
Installed Cost (\$1,000's)
Thermal fixes only
(not including cost of new 345 kVs)**



Southwest Minnesota-->Twin Cities EHV Development

"System Alternative (revised)" Configuration--Big Stone-Canby-Hazel at 230 kV

Option 31A "incremental" improvements in service

Brookings Co-Lyon Co-Hazel-W Waconia-Blue Lk 345 kV

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

With W Waconia-Helena-Lk Marion-Hampton Corner 345 kV "South Loop"

| Key | SW MN Buffalo Ridge Area Generation | | | Limiting Facility | Contingency | distribution factor | Limiting factor | Remedy | qty | Installed Cost, \$1,000's | |
|-----|--|--------------|-----------------|--|---|---------------------|-----------------|---------------------|---------|---------------------------|------------|
| | TLTG Limit MW | Base Case MW | System Limit MW | | | | | | | item | cumulative |
| | -1277 | 1200 | -77 | Wilmarth-Eastwood 115 kV @ 110% of 194 | Wilmarth-Dome 115 | 0.0317 | Conductor | Reconductor | 4.4 mi | 528 | 19,770 |
| | -684 | 1200 | 516 | Morris 230/115 kV tx #2 @ 130% of 100 | Granite Falls-Morris-Moorhead 230 & Morris 230/115 tx #1 | 0.0219 | transformer | install larger tx | 1 ea | 400 | 20,698 |
| | -285 | 1200 | 915 | Minn Valley-Maynard 115 @ 110% of 78 | Granite Falls-Willmar 230 | 0.0176 | Conductor | Rebuild | 11.3 mi | 3,955 | 24,653 |
| | -259 | 1200 | 941 | Lk Marion-Kenrick 115 @ 110% of 144 | Blue Lk-Parkers Lk 345 & Blue Lk-Eden Prairie 345 & Eden Pr 345/115 tx #9 | 0.0289 | | | | | 24,653 |
| | -137 | 1200 | 1063 | Grant Co-Morris 115 @ 110% of 96 | Wahpeton-Fergus Fls 230 & Maple River-Wahpeton 230 & Wahpeton 230/115 tx | 0.0237 | Conductor | Reconductor | 26.5 mi | 3,180 | 27,833 |
| 8 | -100 | 1200 | 1100 R | Grant Co-Morris 115 @ 110% of 96 | Wahpeton-Fergus Fls 230 | 0.0228 | | | | 0 | 27,833 |
| | -74 | 1200 | 1126 | Maynard-Kerhoven 115 @ 110% of 78 | Granite Falls-Willmar 230 | 0.0204 | Conductor | Rebuild | 14.7 mi | 5,145 | 32,978 |
| | 61 | 1200 | 1261 | Dakota Heights-Kenrick 115 @ 110% of 144 | Blue Lk-Parkers Lk 345 & Blue Lk-Eden Prairie 345 & Eden Pr 345/115 tx #9 | 0.0289 | Conductor | Reconductor | 4.7 mi | | 33,542 |
| 14 | 154 | 1200 | 1354 | Minn Valley-Panther 230 @ 110% of 388 | Hazel-W Waconia 345 | 0.0870 | Conductor | Reconductor | 30.2 mi | 564 | 37,166 |
| | 194 | 1200 | 1394 | Willmar 115/69 tx @ 130% of 112 | Granite Falls-Willmar 230 | 0.0214 | Transformer | Install 2nd tx | 1 ea | 3,000 | 40,166 |
| # | 301 | 1200 | 1501 | Eden Prairie 345/115 tx #9 @ 130% of 448 | Parkers Lk-Blue Lk & Parkers Lk-Eden Pr 345 kV & Eden Pr 345/115 #10 | 0.0802 | Transformer | Replace tx | 1 ea | 3,000 | 43,166 |
| 13 | 374 | 1200 | 1574 | Canby-Burr 115 @ 110% of 97 | Brookings Co-Toronto 115 | 0.1069 | Conductor | Rebuild | 4.8 mi | 1,680 | 44,846 |
| 19 | 552 | 1200 | 1752 | Wilmarth-Lakefield Gen 345 @ 110% of 1165 | Hazel-W Waconia 345 | 0.3435 | Conductor | Reconductor | 54.2 mi | 9,756 | 54,602 |
| 18 | 635 | 1200 | 1835 | St Cloud TpW-Wakefield 115 @ 110% of 113 | Hazel-W Waconia 345 | 0.0506 | Conductor | Reconductor | 13.8 mi | 1,518 | 56,120 |
| 21 | 664 | 1200 | 1864 | Henning-Fergus Fl 230 @ 110% of 320 | Audubon-Hubbard 230 & Hubbard tx | 0.0416 | Term equip | Replace equip | 2 ea | 200 | 56,320 |
| 22 | 794 | 1200 | 1994 | McLeod-Panther 230 @ 110% of 388 | Hazel-W Waconia 345 | 0.0871 | Conductor | Reconductor | 28.2 mi | 3,384 | 59,704 |
| | 802 | 1200 | 2002 | Brookings Co 345/115 tx 1 or 2 @ 130% of 448 | Brookings Co 345/115 tx 2 or 1 | 0.3086 | | Install larger txs | 2.0 ea | 2,000 | 61,704 |
| 16 | 813 | 1200 | 2013 | Toronto-Burr 115 @ 110% of 144 | Brookings Co-Toronto 115 | 0.1500 | Conductor | Reconductor | 24.7 mi | 2,964 | 64,668 |
| | 852 | 1200 | 2052 | Sheyenne-Audubon 230 @ 110% of 320 | Wahpeton-Fergus Falls 230 | 0.0343 | Conductor | Reconductor | 43.9 mi | 5,268 | 69,936 |
| | 918 | 1200 | 2118 | Burnsville-Dakota Heights 115 @ 110% of 144 | Blue Lk-Parkers Lk 345 & Blue Lk-Eden Prairie 345 & Eden Pr 345/115 tx #9 | 0.0289 | Conductor | Reconductor | 3.6 mi | 432 | 70,368 |
| | 1021 | 1200 | 2221 | Wilmarth-Helena 345 @ 110% of 1165 | Hazel-W Waconia 345 | 0.3168 | Conductor | Reconductor | 54.8 mi | 9,864 | 80,232 |
| | 1120 | 1200 | 2320 | Granite Falls-Willmar 230 @ 110% of 388 | Hazel-W Waconia 345 | 0.0707 | Conductor | Reconductor | 31.0 mi | 3,720 | 83,952 |
| | 1189 | 1200 | 2389 | Ortonville-Johnson Jct 230 @ 110% of 390 | Hazel-Canby 230 | 0.0547 | Conductor | Install larger wire | 24.7 mi | 1,235 | 85,187 |
| | 1218 | 1200 | 2418 | Wahpeton-Fergus Fls 230 @ 110% of 320 | Sheyenne-Audubon 230 | 0.0398 | Term Equip | Replace equip | 2.0 ea | 200 | 85,387 |
| | 1273 | 1200 | 2473 | McLeod-Blue Lk 230 @ 110% of 388 | Hazel-W Waconia 345 | 0.0644 | Conductor | Reconductor | 51.0 mi | 6,120 | 91,507 |
| | 1365 | 1200 | 2565 | Loon Tp-Eastwood 115 @ 110% of 310 | Lk Marion 345/115 tx | 0.0357 | Conductor | Install 2nd tx | 1.0 ea | 7,000 | 98,507 |
| | 1425 | 1200 | 2625 | Johnson Jct-Morris 230 @ 110% of 390 | Hazel-Canby 230 | 0.0547 | Conductor | Install larger wire | 15.4 mi | 770 | 99,277 |
| | 1474 | 1200 | 2674 | Big Stone-Ortonville 230 @ 110% of 390 | Watertown-Granite Falls 230 & Blair-Granite Falls 230 | 0.0290 | Conductor | Install larger wire | 6.5 mi | 325 | 99,602 |
| | 1572 | 1200 | 2772 | Granite Falls-Minn Valley 230 @ 110% of 388 | Hazel-Canby 230 | 0.0527 | Conductor | Reconductor | 2.5 mi | 300 | 99,902 |
| | 1600 | 1200 | 2800 | (none) | | | | | | 0 | 99,902 |

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-Lyon Co 115 kV, Lyon 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
10/5/2005

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 |

| | | <u>qty</u> | <u>each</u> | <u>totals</u> |
|-----------------------------|--|------------|-------------|---------------|
| Base Costs for this Option: | Brookings Co-Lyon Co 245 kV | 49.0 mi | 800 | 39,200 |
| | Lyon Co-Hazel 345 kV | 22.0 mi | 800 | 17,600 |
| | Lyon Co-Hazel: remove existing 115 kV | 22.0 mi | 40 | 880 |
| | Hazel-W Waconia-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 |
| | Helena-Lk Marion-Hampton Corner 345 kV | 34.0 mi | 800 | 27,200 |
| | W Waconia-Helena 345 kV | 26.0 mi | 800 | 20,800 |
| | Subtotal (lines) | | | 216,000 |
| | Brookings Co: add 2nd 345/115 kV 448 MVA tx | 1.0 ea | 6,000 | 6,000 |
| | Brookings Co: add 345 kV line term (for Lyon Co) | 1.0 ea | 1,500 | 1,500 |
| | 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 |
| | 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 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 |

Southwest Minnesota-->Twin Cities EHV Development

"System Alternative" Configuration with TC South Outer Loop--Big Stone-Canby-Hazel at 230 kV

Option 31A "incremental" improvements in service

Brookings Co-Lyon Co 115 kV & Lyon Co-Hazel-W Waconia-Blue Lk 345 kV

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

With W Waconia-Helena-Lk Marion-Hampton Corner 345 kV "South Loop"

| Key | SW MN Buffalo Ridge Area Generation | | | Limiting Facility | Contingency | distribution factor | Limiting factor | Remedy | qty | Installed Cost, \$1,000's | |
|-----|--|--------------|-----------------|---|--|---------------------|-----------------|---------------------|---------|---------------------------|------------|
| | TLTG Limit MW | Base Case MW | System Limit MW | | | | | | | item | cumulative |
| | -1329 | 1200 | -129 | Wilmarth-Eastwood 115 kV @ 110% of 194 | Wilmarth-Dome 115 | 0.0328 | Conductor | Reconductor | 4.4 mi | 528 | -7,480 |
| | -752 | 1200 | 448 | 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 | -6,952 |
| 13 | -581 | 1200 | 619 | Granite Falls-Morris 230 @ 110% of 239 | Hazel-Canby 230 | 0.0192 | Conductor | Reconductor | 60.0 mi | 7,200 | 648 |
| | -529 | 1200 | 671 | Canby-Burr 115 @ 110% of 97 | Canby-Big Stone 230 | 0.0277 | Conductor | Rebuild | 4.8 mi | 1,680 | 2,328 |
| | -248 | 1200 | 952 | Lk Marion-Kenrick 115 @ 110% of 144 | Blue Lk-Parkers Lk 345 & Blue Lk-Eden | 0.0288 | Conductor | Reconductor | 3.5 mi | | 2,748 |
| | | | | | Prairie 345 & Eden Pr 345/115 tx #9 | | | | | 420 | |
| | -80 | 1200 | 1120 | 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 | 5,928 |
| 8 | -38 | 1200 | 1162 | Minn Valley-Maynard 115 @ 110% of 78 | Granite Falls-Willmar 230 | 0.0163 | Conductor | Rebuild | 11.3 mi | 3,955 | 9,883 |
| | -34 | 1200 | 1166 R | Grant Co-Morris 115 @ 110% of 96 | Wahpeton-Fergus Fls 230 | 0.0223 | | | | 0 | 9,883 |
| | 74 | 1200 | 1274 | Dakota Heights-Kenrick 115 @ 110% of 144 | Blue Lk-Parkers Lk 345 & Blue Lk-Eden | 0.0288 | Conductor | Reconductor | 4.7 mi | | 10,447 |
| | | | | Prairie 345 & Eden Pr 345/115 tx #9 | | | | | | 564 | |
| | 163 | 1200 | 1363 | Blair-Granite Falls 230 @ 110% of 398 | Hazel-Canby 230 | 0.0576 | Conductor | Reconductor | 46.0 mi | 5,520 | 15,967 |
| | 164 | 1200 | 1364 | Granite Falls-Minn Valley 230 @ 110% of 388 | Hazel-Canby 230 | 0.0622 | Conductor | Reconductor | 2.5 mi | 300 | 16,267 |
| | 186 | 1200 | 1386 | Maynard-Kerhoven 115 @ 110% of 78 | Granite Falls-Willmar 230 | 0.0190 | Conductor | Rebuild | 14.7 mi | 5,145 | 21,412 |
| 14 | 288 | 1200 | 1488 | Minn Valley-Panther 230 @ 110% of 388 | Hazel-W Waconia 345 | 0.0830 | Conductor | Reconductor | 30.2 mi | 3,624 | 25,036 |
| | 339 | 1200 | 1539 | Willmar 115/69 tx @ 130% of 112 | Granite Falls-Willmar 230 | 0.0206 | Transformer | Install 2nd tx | 1 ea | 3,000 | 28,036 |
| # | 362 | 1200 | 1562 | Eden Prairie 345/115 tx #9 @ 130% of 448 | Parkers Lk-Blue Lk & Parkers Lk-Eden Pr 345 kV & Eden Pr 345/115 #10 | 0.0787 | Transformer | Replace tx | 1 ea | 3,000 | 31,036 |
| 19 | 516 | 1200 | 1716 | Wilmarth-Lakefield Gen 345 @ 110% of 1165 | Hazel-W Waconia 345 | 0.3488 | Conductor | Reconductor | 54.2 mi | 9,756 | 40,792 |
| 21 | 563 | 1200 | 1763 | Henning-Fergus Fl 230 @ 110% of 320 | Audubon-Hubbard 230 & Hubbard tx | 0.0430 | Term equip | Replace equip | 2 ea | 200 | 40,992 |
| | 682 | 1200 | 1882 | Ortonville-Johnson Jct 230 @ 110% of 390 | Hazel-Canby 230 | 0.0617 | Conductor | Install larger wire | 24.7 mi | 1,235 | 42,227 |
| | 706 | 1200 | 1906 | Sheyenne-Audubon 230 @ 110% of 320 | Wahpeton-Fergus Falls 230 | 0.0359 | Conductor | Reconductor | 43.9 mi | 5,268 | 47,495 |
| 18 | 735 | 1200 | 1935 | St Cloud TpW-Wakefield 115 @ 110% of 113 | Hazel-W Waconia 345 | 0.0490 | Conductor | Reconductor | 13.8 mi | 1,518 | 49,013 |
| 16 | 813 | 1200 | 2013 | Toronto-Burr 115 @ 110% of 144 | Brookings Co-Toronto 115 | 0.1500 | Conductor | Reconductor | 24.7 mi | 2,964 | 51,977 |
| | 895 | 1200 | 2095 | Johnson Jct-Morris 230 @ 110% of 390 | Hazel-Canby 230 | 0.0617 | Conductor | Install larger wire | 15.4 mi | 770 | 52,747 |
| | 935 | 1200 | 2135 | Burnsville-Dakota Heights 115 @ 110% of 14 | Blue Lk-Parkers Lk 345 & Blue Lk-Eden | 0.0288 | Conductor | Reconductor | 3.6 mi | | 53,179 |
| | | | | | Prairie 345 & Eden Pr 345/115 tx #9 | | | | | 432 | |
| 22 | 939 | 1200 | 2139 | McLeod-Panther 230 @ 110% of 388 | Hazel-W Waconia 345 | 0.0832 | Conductor | Reconductor | 28.2 mi | 3,384 | 56,563 |
| | 959 | 1200 | 2159 | Big Stone-Ortonville 230 @ 110% of 390 | Watertown-Granite Falls 230 & Blair-Granite Falls 230 | 0.0290 | Conductor | Install larger wire | 6.5 mi | 325 | 56,888 |
| | 991 | 1200 | 2191 | Wilmarth-Helena 345 @ 110% of 1165 | Hazel-W Waconia 345 | 0.3204 | Conductor | Reconductor | 54.8 mi | 9,864 | 66,752 |
| | 1038 | 1200 | 2238 | Wahpeton-Fergus Fls 230 @ 110% of 320 | Sheyenne-Audubon 230 | 0.0418 | Term Equip | Replace equip | 2.0 ea | 200 | 66,952 |
| | 1144 | 1200 | 2344 | Heron Lk-Brewster 161 @ 110% of 112 | Nobles Co-Lakefield Jct 345 | 0.0294 | Conductor | Rebuild | 14.0 mi | 4,900 | 71,852 |
| | 1156 | 1200 | 2356 | Marshall SS-Marshall SE 115 @ 110% of 128 | Erie Rd-Saratoga 115 | 0.0333 | Conductor | Reconductor | 1.7 mi | 204 | 72,056 |
| | 1244 | 1200 | 2444 | Loon Tp-Eastwood 115 @ 110% of 310 | Lk Marion 345/115 tx | 0.0400 | Conductor | Install 2nd tx | 1.0 ea | 7,000 | 79,056 |
| | 1279 | 1200 | 2479 | Granite Falls-Willmar 230 @ 110% of 388 | Hazel-W Waconia 345 | 0.0678 | Conductor | Reconductor | 31.0 mi | 3,720 | 82,776 |
| | 1449 | 1200 | 2649 | McLeod-Blue Lk 230 @ 110% of 388 | Hazel-W Waconia 345 | 0.0614 | Conductor | Reconductor | 51.0 mi | 6,120 | 88,896 |
| | 1494 | 1200 | 2694 | Lakefield Jct 345/161 txs @ 130% of 335 | Wilmarth-Lakefield Gen 345 | 0.0682 | transformers | Replace txs | 2.0 ea | 7,000 | 95,896 |
| | 1516 | 1200 | 2716 | Brookings Co 345/115 tx 1 or 2 @ 130% of 4 | Brookings Co 345/115 tx 2 or 1 | 0.2543 | | Install larger txs | 2.0 ea | 2,000 | 97,896 |

| | | | | | | | | | | |
|------|------|------|-----------------------------------|------------------------|--------|-----------|-------------|--------|-----|--------|
| 1572 | 1200 | 2772 | Triboji-Spencer 161 @ 110% of 195 | Wilmarth-Lakefield 345 | 0.0384 | Conductor | Reconductor | 4.0 mi | 480 | 98,376 |
| 1600 | 1200 | 2800 | (none) | | | | | | 0 | 98,376 |

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-Lyon Co 115 kV, Lyon 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).

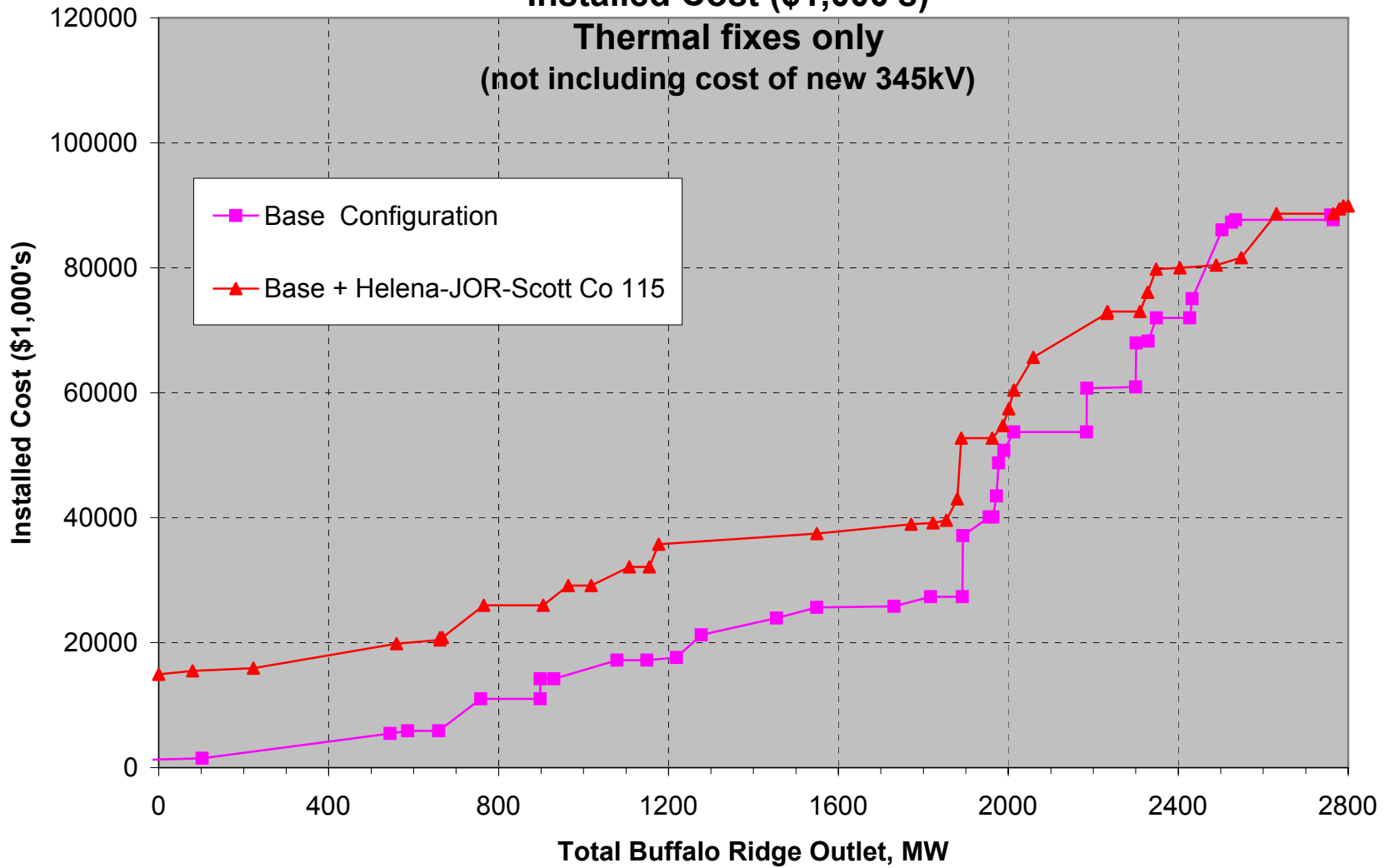
R Gonzalez, PE
10/5/2005

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 |

| | | qty | each | totals |
|-----------------------------|--|---------|-------|---------|
| Base Costs for this Option: | 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-W Waconia-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 |
| | Helena-Lk Marion-Hampton Corner 345 kV | 34.0 mi | 800 | 27,200 |
| | W Waconia-Helena 345 kV | 26.0 mi | 800 | 20,800 |
| | Subtotal (lines) | | | 193,950 |
| | 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 |

**SW Minnesota 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

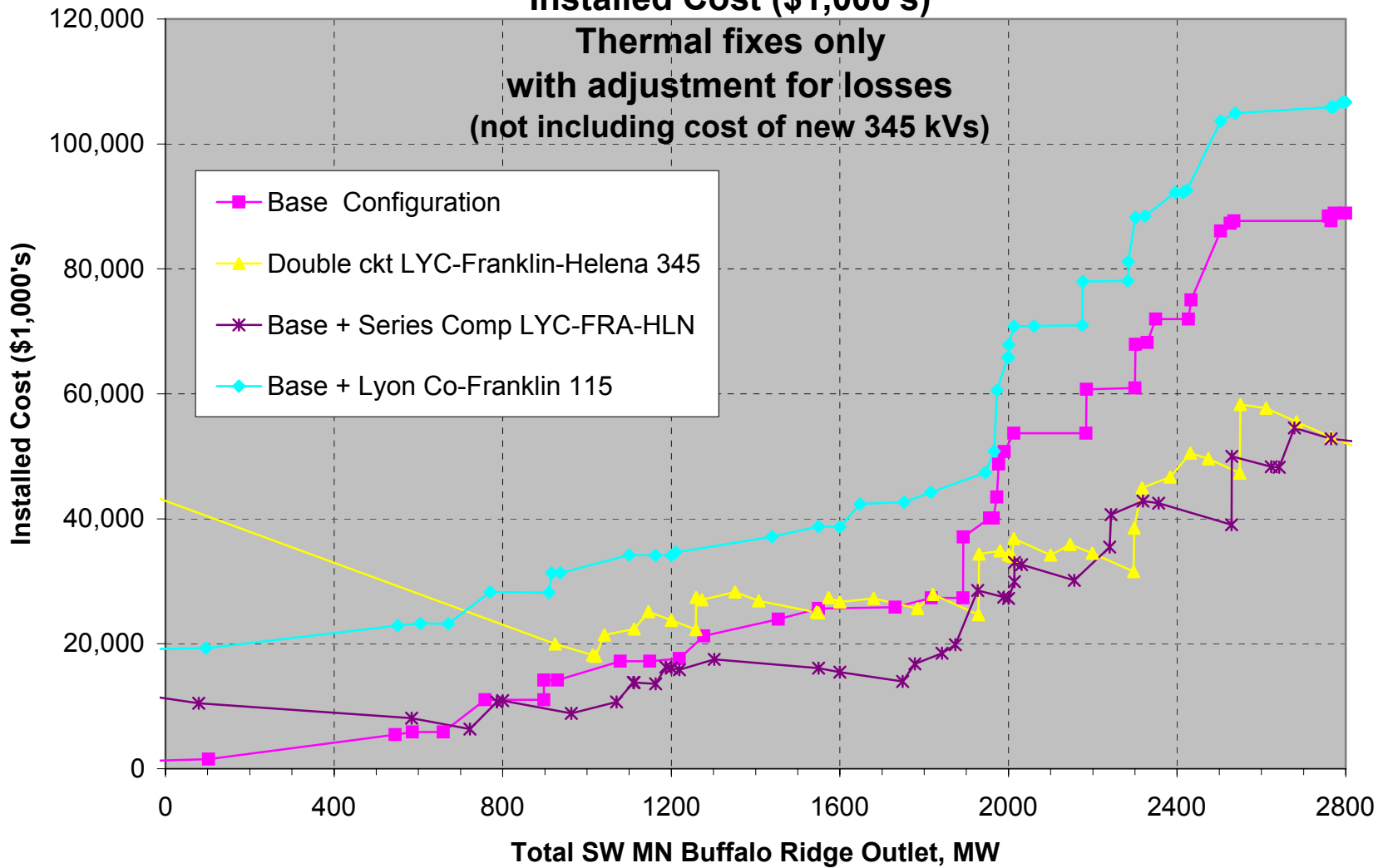
Big Stone-Canby-Hazel @ 230 kV, 2 x 795 ACSR

With Helena 345/115 kV tx & Helena-Jordan-Scott Co 115 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 |
| | | | 0 | | | | | Install facilities | | | 14,950 |
| 5 | -1120 | 1200 | 80 | Wilmarth-Eastwood 115 kV @ 110% of 194 | Wilmarth-Dome 115 | 0.0330 | Conductor | Reconductor | 4.4 mi | 528 | 15,478 |
| 2 | -977 | 1200 | 223 | Lake Marion-Kenrick 115 @ 110% of 139 | Airlake-Lk Marion 115 | 0.0208 | Conductor | Reconductor | 3.5 mi | 420 | 15,898 |
| 9 | -640 | 1200 | 560 | Minn Valley-Maynard 115 @ 110% of 78 | Granite Falls-Willmar 230 | 0.0179 | Conductor | Rebuild | 11.3 mi | 3,955 | 19,853 |
| | -538 | 1200 | 662 | Kenrick-Dakota Heights 115 @ 110% of 139 | Airlake-Lk Marion 115 | 0.0208 | Conductor | Reconductor | 4.7 mi | 564 | 20,417 |
| | -538 | 1200 | 662 | Morris 230/115 kV tx #2 @ 130% of 100 | Granite Falls-Morris-Moorhead 230 & Morris 230/115 tx #1 | 0.0222 | transformer | install larger tx | 1 ea | 400 | 20,817 |
| 3 | -532 | 1200 | 668 | Paynesville-Roscoe 69 @ 110% of 47 | Paynesville-Wakefield 115 | 0.0179 | Conductor | (Opt 31A facility) | | 0 | 20,817 |
| 4 | -435 | 1200 | 765 | Maynard-Kerkhoven Tp 115 @ 110% of 78 | Granite Falls-Willmar 230 | 0.0217 | Conductor | Rebuild | 14.7 mi | 5,145 | 25,962 |
| 7 | -295 | 1200 | 905 | Roscoe-Munson 69 @ 110% of 47 | Paynesville-Wakefield 115 | 0.0179 | Conductor | (Opt 31A facility) | | 0 | 25,962 |
| | -236 | 1200 | 964 | 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 | 29,142 |
| 8 | -182 | 1200 | 1018 R | Grant Co-Morris 115 @ 110% of 96 | Wahpeton-Fergus Fls 230 | 0.0240 | | | | 0 | 29,142 |
| 10 | -92 | 1200 | 1108 | Willmar 115/69 tx @ 130% of 112 | Granite Falls-Willmar 230 | 0.0225 | Transformer | Install 2nd tx | 1 ea | 3,000 | 32,142 |
| 11 | -45 | 1200 | 1155 | Farm Tp-Munson Tp @ 110% of 47 | Paynesville-Wakefield 115 | 0.0179 | Conductor | (Opt 31A facility) | | 0 | 32,142 |
| 14 | -23 | 1200 | 1177 | Minn Valley-Panther 230 @ 110% of 388 | Lyon Co-Franklin 345 | 0.0869 | Conductor | Reconductor | 30.2 mi | 3,624 | 35,766 |
| 13 | 347 | 1200 | 1549 | Canby-Burr 115 @ 110% of 97 | Brookings Co-Toronto 115 | 0.1078 | Conductor | Rebuild | 4.8 mi | 1,680 | 37,446 |
| 18 | 571 | 1200 | 1771 | St Cloud TpW-Wakefield 115 @ 110% of 113 | Franklin-Helena 345 | 0.0505 | Conductor | Reconductor | 13.8 mi | 1,518 | 38,964 |
| 21 | 623 | 1200 | 1823 | Henning-Fergus FI 230 @ 110% of 320 | Audubon-Hubbard 230 & Hubbard tx | 0.0431 | Term equip | Replace equip | 2 ea | 200 | 39,164 |
| 20 | 654 | 1200 | 1854 | Burnsville-Dakota Hgts @ 110% of 139 | Airlake-Lk Marion 115 | 0.0223 | Conductor | Reconductor | 3.6 mi | 432 | 39,596 |
| 22 | 680 | 1200 | 1880 | McLeod-Panther 230 @ 110% of 388 | Franklin-Helena 345 | 0.0870 | Conductor | Reconductor | 28.2 mi | 3,384 | 42,980 |
| 17 | 689 | 1200 | 1889 | Wilmarth-Lakefield Gen 345 @ 110% of 1165 | Lyon Co-Franklin 345 | 0.3348 | Conductor | Reconductor | 54.2 mi | 9,756 | 52,736 |
| 19 | 762 | 1200 | 1962 R | Wilmarth-Lakefield Gen 345 @ 110% of 1165 | Franklin-Helena 345 | 0.3323 | | | | 0 | 52,736 |
| | 787 | 1200 | 1987 | 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 | 54,736 |
| 15 | 801 | 1200 | 2001 | Helena-Blue Lk 345 @ 110% of 1165 | Helena-Lk Marion 345 | 0.3636 | Conductor | Reconductor | 15.0 mi | 2,700 | 57,436 |
| 16 | 813 | 1200 | 2013 | Toronto-Burr 115 @ 110% of 144 | Brookings Co-Toronto 115 | 0.1500 | Conductor | Reconductor | 24.7 mi | 2,964 | 60,400 |
| | 859 | 1200 | 2059 | Sheyenne-Audubon 230 @ 110% of 320 | Wahpeton-Fergus Falls 230 | 0.0355 | Conductor | Reconductor | 43.9 mi | 5,268 | 65,668 |
| 24 | 1032 | 1200 | 2232 | Wilmarth-Helena 345 @ 110% of 1165 | Franklin-Helena 345 | 0.3150 | Conductor | Reconductor | 39.0 mi | 7,020 | 72,688 |
| | 1033 | 1200 | 2233 | Granite Falls-Minn Valley 230 @ 110% of 388 | Hazel-Minn Valley 230 | 0.0604 | Conductor | Reconductor | 2.5 mi | 300 | 72,988 |
| | 1110 | 1200 | 2310 | Winnebago-Winnebago S 161 @ 110% of 161 | Prairie Island-Byron 345 | 0.0224 | ?? | | | 0 | 72,988 |
| | 1128 | 1200 | 2328 | Ft Ridgely-Franklin 115 @ 110% of 139 | Franklin-Helena 345 | 0.0281 | Conductor | Reconductor | 25.7 mi | 3,084 | 76,072 |
| 1 | 1148 | 1200 | 2348 | Granite Falls-Willmar 230 @ 110% of 388 | Minn Valley-Panther 230 | 0.0664 | Conductor | Reconductor | 31.0 ea | 3,720 | 79,792 |
| | 1204 | 1200 | 2404 | Wahpeton-Fergus Fls 230 @ 110% of 320 | Sheyenne-Audubon 230 | 0.0409 | Term Equip | Replace equip | 2.0 ea | 200 | 79,992 |
| | 1289 | 1200 | 2489 | Minn Valley-Hazel 230 @ 110% of 388 | Lyon Co-Franklin 345 | 0.0961 | Conductor | Install larger wire | 8.0 mi | 400 | 80,392 |
| | 1348 | 1200 | 2548 | Ortonville-Johnson Jct 230 @ 110% of 390 | Hazel-Canby 230 | 0.0539 | Conductor | Install larger wire | 24.7 mi | 1,235 | 81,627 |
| | 1431 | 1200 | 2631 | Loon Tp-Eastwood 115 @ 110% of 310 | Lk Marion 345/115 tx | 0.0376 | Conductor | Add 2nd tx | 1.0 ea | 7,000 | 88,627 |
| | 1548 | 1200 | 2765 R | Brookings Co 345/115 txs @ 100% of 448 | (system intact) | 0.1700 | transformers | | | 0 | 88,627 |
| | 1579 | 1200 | 2779 | Johnson Jct-Morris 230 @ 110% of 390 | Hazel-Canby 230 | 0.0539 | Conductor | Install larger wire | 15.4 mi | 770 | 89,397 |
| | 1589 | 1200 | 2789 | Triboji-Spencer 161 @ 110% of 195 | Wilmarth-Lakefield 345 | 0.0372 | Conductor | Reconductor | 4.0 mi | 480 | 89,877 |
| | 1600 | 1200 | 2800 | (none) | | | | | | 0 | 89,877 |

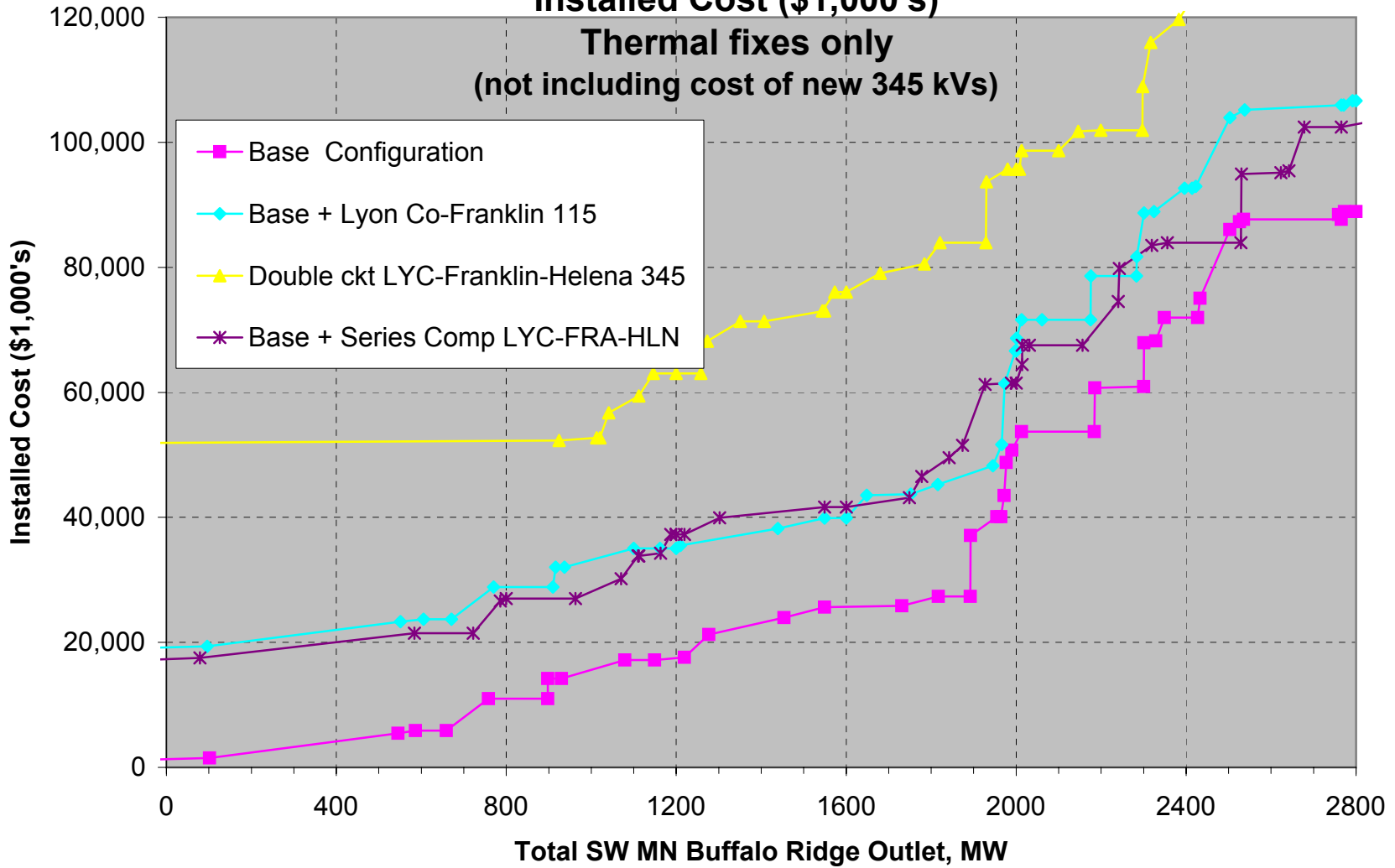
SW Minnesota Generation Outlet Installed Cost (\$1,000's)

Thermal fixes only
with adjustment for losses
(not including cost of new 345 kV's)



SW Minnesota Generation Outlet Installed Cost (\$1,000's)

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



Southwest Minnesota-->Twin Cities EHV Development

**Base Configuration--Big Stone at 230 kV
With Double Circuit Lyon Co-Franklin-Helena 345 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 | | | | Limiting Facility | Contingency | distribution factor | Limiting factor | Remedy | qty | Installed item | Cost, \$1,000's cumulative | Losses equivalent capital value | Net Cost | MW Loss reduction w/r to base |
|--|---------------------|--------------------|-----------------------|---|--|------------------------|--------------------|-----------------------------|---------|-------------------|-------------------------------|---------------------------------------|-------------|-------------------------------------|
| Key | TLTG Limit MW | Base Case MW | System Limit MW | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | Incremental cost of 2nd ckt | | | 50,400 | | 50,400 | |
| 5 | -1639 | 1200 | -439 | Lake Marion-Kenrick 115 @ 110% of 139 | Airlake-Lk Marion 115 | 0.0238 | Conductor | Reconductor | 3.5 mi | 420 | 50,820 | -1,989 | 52,809 | -2.0 |
| | -1268 | 1200 | -68 | Wilmarth-Eastwood 115 kV @ 110% of 194 | Wilmarth-Dome 115 | 0.0328 | Conductor | Reconductor | 4.4 mi | 528 | 51,348 | 7,351 | 43,997 | 7.3 |
| 9 | -1233 | 1200 | -33 | Kenrick-Dakota Heights 115 @ 110% of 139 | Airlake-Lk Marion 115 | 0.0238 | Conductor | Reconductor | 4.7 mi | 564 | 51,912 | 8,232 | 43,680 | 8.2 |
| | -276 | 1200 | 924 | Morris 230/115 kV tx #2 @ 130% of 100 | Granite Falls-Morris-Moorhead 230 & Morris 230/115 tx #1 | 0.0205 | transformer | install larger tx | 1 ea | 400 | | 32,325 | | 32.1 |
| | | | | | | | | | | | 52,312 | | 19,987 | |
| 20 | -187 | 1200 | 1013 | Burnsville-Dakota Hgts @ 110% of 139 | Airlake-Lk Marion 115 | 0.0238 | Conductor | Reconductor | 3.6 mi | 432 | 52,744 | 34,565 | 18,179 | 34.3 |
| 3 | -180 | 1200 | 1020 | Paynesville-Roscoe 69 @ 110% of 47 | Paynesville-Wakefield 115 | 0.0160 | Conductor | (Opt 31A facility) | | 0 | 52,744 | 34,742 | 18,003 | 34.5 |
| 2 | -159 | 1200 | 1041 | Minn Valley-Maynard 115 @ 110% of 78 | Granite Falls-Willmar 230 | 0.0164 | Conductor | Rebuild | 11.3 mi | 3,955 | 56,699 | 35,270 | 21,429 | 35.0 |
| 15 | -88 | 1200 | 1112 | Helena-Blue Lk 345 @ 110% of 1165 | Helena-Lk Marion 345 | 0.4262 | Conductor | Reconductor | 15.0 mi | 2,700 | 59,399 | 37,058 | 22,341 | 36.8 |
| 14 | -54 | 1200 | 1146 | Minn Valley-Panther 230 @ 110% of 388 | Lyon Co-Franklin 345 # 1 & 2 | 0.0873 | Conductor | Reconductor | 30.2 mi | 3,624 | 63,023 | 37,914 | 25,109 | 37.7 |
| | | | 1200 | | | | | | | | 63,023 | 39,273 | 23,750 | 39.0 |
| | | | 1258 | | | | | | | | 63,023 | 40,733 | 22,290 | 40.5 |
| 4 | 59 | 1200 | 1259 | Maynard-Kerkhoven Tp 115 @ 110% of 78 | Granite Falls-Willmar 230 | 0.0190 | Conductor | Rebuild | 14.7 mi | 5,145 | 68,168 | 40,758 | 27,410 | 40.5 |
| 7 | 73 | 1200 | 1273 | Roscoe-Munson 69 @ 110% of 47 | Paynesville-Wakefield 115 | 0.0160 | Conductor | (Opt 31A facility) | | 0 | 68,168 | 41,111 | 27,057 | 40.8 |
| | 151 | 1200 | 1351 | Grant Co-Morris 115 @ 110% of 96 | Wahpeton-Fergus Fls 230 & Maple River-Wahpeton 230 & Wahpeton 230/115 tx | 0.0225 | Conductor | Reconductor | 26.5 mi | | | 43,074 | | 42.8 |
| | | | | | | | | | | 3,180 | 71,348 | | 28,274 | |
| 8 | 207 | 1200 | 1407 R | Grant Co-Morris 115 @ 110% of 96 | Wahpeton-Fergus Fls 230 | 0.0216 | | | | 0 | 71,348 | 44,484 | 26,864 | 44.2 |
| 13 | 331 | 1200 | 1549 | Canby-Burr 115 @ 110% of 97 | Brookings Co-Toronto 115 | 0.1083 | Conductor | Rebuild | 4.8 mi | 1,680 | 73,028 | 48,059 | 24,969 | 47.7 |
| 11 | 344 | 1200 | 1544 | Farm Tp-Munson Tp @ 110% of 47 | Paynesville-Wakefield 115 | 0.0160 | Conductor | (Opt 31A facility) | | 0 | 73,028 | 47,933 | 25,095 | 47.6 |
| 10 | 373 | 1200 | 1573 | Willmar 115/69 tx @ 130% of 112 | Granite Falls-Willmar 230 | 0.0200 | Transformer | Install 2nd tx | 1 ea | 3,000 | 76,028 | 48,663 | 27,365 | 48.3 |
| | | | 1600 | | | | | | | | 76,028 | 49,343 | 26,685 | 49.0 |
| | 480 | 1200 | 1680 | Eden Prairie 345/115 tx #9 @ 130% of 448 | Parkers Lk-Blue Lk & Parkers Lk-Eden Pr 345 kV & Eden Pr 345/115 #10 | 0.0789 | Transformer | Replace tx | 1 ea | | | 51,760 | | 51.4 |
| 18 | 584 | 1200 | 1784 | St Cloud TpW-Wakefield 115 @ 110% of 113 | Franklin-Helena 345 #1 & 2 | 0.0505 | Conductor | Reconductor | 13.8 mi | 1,518 | 80,546 | 54,902 | 25,644 | 54.5 |
| 22 | 621 | 1200 | 1821 | McLeod-Panther 230 @ 110% of 388 | Franklin-Helena 345 #1 & 2 | 0.0870 | Conductor | Reconductor | 28.2 mi | 3,384 | 83,930 | 56,019 | 27,911 | 55.6 |
| | | | 1929 | | | | | | | | 83,930 | 59,282 | 24,648 | 58.9 |
| 17 | 730 | 1200 | 1930 | Wilmarth-Lakefield Gen 345 @ 110% of 1165 | Lyon Co-Franklin 345 # 1 & 2 | 0.3330 | Conductor | Reconductor | 54.2 mi | 9,756 | 93,686 | 59,312 | 34,374 | 58.9 |
| | 780 | 1200 | 1980 | Brookings Co 345/115 tx 1 or 2 @ 130% of 44 | Brookings Co 345/115 tx #2 or 1 | 0.3101 | Transformer | Install larger txs | 2 ea | 2,000 | 95,686 | 60,823 | 34,863 | 60.4 |
| | | | 2000 | | | | | | | | 95,686 | 61,427 | 34,259 | 61.0 |
| 19 | 808 | 1200 | 2008 R | Wilmarth-Lakefield Gen 345 @ 110% of 1165 | Franklin-Helena 345 #1 & 2 | 0.3307 | | | | 0 | 95,686 | 61,669 | 34,017 | 61.2 |
| 16 | 813 | 1200 | 2013 | Toronto-Burr 115 @ 110% of 144 | Brookings Co-Toronto 115 | 0.1500 | Conductor | Reconductor | 24.7 mi | 2,964 | 98,650 | 61,820 | 36,830 | 61.4 |
| | 900 | 1200 | 2100 | Winnepago-Winnebago S 161 @ 110% of 16 | Prairie Island-Byron 345 | 0.0224 | ?? | | | 0 | 98,650 | 64,448 | 34,202 | 64.0 |
| | 946 | 1200 | 2146 | Ft Ridgely-Franklin 115 @ 110% of 139 | Franklin-Helena 345 #1 & 2 | 0.0291 | Conductor | Reconductor | 25.7 mi | 3,084 | 101,734 | 65,838 | 35,896 | 65.4 |
| 21 | 999 | 1200 | 2199 | Henning-Fergus Fl 230 @ 110% of 320 | Audubon-Hubbard 230 & Hubbard tx | 0.0395 | Term equip | Replace equip | 2 ea | 200 | 101,934 | 67,439 | 34,495 | 67.0 |
| | | | 2297 | | | | | | | | 101,934 | 70,399 | 31,535 | 69.9 |
| | 1098 | 1200 | 2298 | Loon Tp-Eastwood 115 @ 110% of 310 | Lk Marion 345/115 tx | 0.0384 | Conductor | Add 2nd tx | 1.0 ea | 7,000 | 108,934 | 70,430 | 38,504 | 69.9 |
| 24 | 1117 | 1200 | 2317 | Wilmarth-Helena 345 @ 110% of 1165 | Franklin-Helena 345 #1 & 2 | 0.3132 | Conductor | Reconductor | 39.0 mi | 7,020 | 115,954 | 71,004 | 44,950 | 70.5 |
| 1 | 1183 | 1200 | 2383 | Granite Falls-Willmar 230 @ 110% of 388 | Minn Valley-Panther 230 | 0.0691 | Conductor | Reconductor | 31.0 ea | 3,720 | 119,674 | 72,997 | 46,677 | 72.5 |
| | 1231 | 1200 | 2431 | Sheyenne-Audubon 230 @ 110% of 320 | Wahpeton-Fergus Falls 230 | 0.0326 | Conductor | Reconductor | 43.9 mi | 5,268 | 124,942 | 74,448 | 50,494 | 73.9 |
| | 1274 | 1200 | 2474 | Minn Valley-Hazel 230 @ 110% of 388 | Lyon Co-Franklin 345 # 1 & 2 | 0.0967 | Conductor | Install larger wire | 8.0 mi | 400 | 125,342 | 75,747 | 49,595 | 75.2 |
| | | | 2549 | | | | | | | | 125,342 | 78,012 | 47,330 | 77.5 |
| | 1350 | 1200 | 2550 | Loon Tp-Eastwood 115 @ 110% of 310 | Helena-Blue Lk 345 | 0.0475 | Conductor | Rebuild to 600 MVA | 22.0 mi | 11,000 | 136,342 | 78,043 | 58,300 | 77.5 |
| | 1411 | 1200 | 2611 | Ortonville-Johnson Jct 230 @ 110% of 390 | Hazel-Canby 230 | 0.0533 | Conductor | Install larger wire | 24.7 mi | 1,235 | 137,577 | 79,885 | 57,692 | 79.3 |
| | 1483 | 1200 | 2683 | Lk Marion 345/115 tx @ 130% of 448 | Helena-Blue Lk 345 | 0.0581 | Transformer | (added 2nd tx) | | 0 | 137,577 | 82,060 | 55,517 | 81.5 |
| | 1540 | 1200 | 2765 R | Brookings Co 345/115 txs @ 100% of 448 | (system intact) | 0.1700 | transformers | | | 0 | 137,577 | 84,538 | 53,039 | 84.0 |
| | 1612 | 1200 | 2812 | Wahpeton-Fergus Fls 230 @ 110% of 320 | Sheyenne-Audubon 230 | 0.0377 | Term Equip | Replace equip | 2.0 ea | 200 | 137,777 | 85,958 | 51,819 | 85.4 |
| | 1643 | 1200 | 2843 | Johnson Jct-Morris 230 @ 110% of 390 | Hazel-Canby 230 | 0.0533 | Conductor | Install larger wire | 15.4 mi | 770 | 138,547 | 86,894 | 51,653 | 86.3 |
| | 1700 | 1200 | 2900 | (none) | | | | | | 0 | 138,547 | 88,616 | 49,931 | 88.0 |

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 = 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 |

| Incremental Costs for this Option: | | qty | each | totals |
|------------------------------------|-----------|---------|-------|--------|
| Lyon Co-Franklin 345 kV | (2nd ckt) | 44.0 mi | 400 | 17,600 |
| Franklin-Helena 345 kV | (2nd ckt) | 67.0 mi | 400 | 26,800 |
| Lyon Co: 345 kV line termination | | 1.0 ea | 1,500 | 1,500 |
| Franklin: 345 kV line terminations | | 2.0 ea | 1,500 | 3,000 |
| Helena: 345 kV line termination | | 1.0 ea | 1,500 | 1,500 |
| | Total | | | 50,400 |

Southwest Minnesota-->Twin Cities EHV Development

Base Configuration--Big Stone at 230 kV
With 60% series compensation of Lyon Co-Franklin-Helena 345 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

| Key | SW MN Buffalo Ridge Area Generation | | | Limiting Facility | Contingency | distribution factor | Limiting factor | Remedy | qty | Installed item | Cost, \$1,000's cumulative | Losses equivalent capital value | Net Cost | MW Loss reduction w/r to base |
|-----|-------------------------------------|--------------|-----------------|--|--|---------------------|-----------------|---------------------|---------|----------------|----------------------------|---------------------------------|----------|-------------------------------|
| | TLTG Limit MW | Base Case MW | System Limit MW | | | | | | | | | | | |
| 5 | -1538 | 1200 | -338 | Lake Marion-Kenrick 115 @ 110% of 139 | Airlake-Lk Marion 115 | 0.0230 | Conductor | Add series comp | 3.5 mi | 420 | 16,000 | 1,787 | | 1.8 |
| | -1336 | 1200 | -136 | Wilmarth-Eastwood 115 kV @ 110% of 194 | Wilmarth-Dome 115 | 0.0334 | Conductor | Reconductor | 4.4 mi | 528 | 16,948 | 4,330 | 12,618 | 4.3 |
| 9 | -1121 | 1200 | 79 | Kenrick-Dakota Heights 115 @ 110% of 139 | Airlake-Lk Marion 115 | 0.0230 | Conductor | Reconductor | 4.7 mi | 564 | 17,512 | 7,036 | 10,476 | 7.0 |
| 2 | -616 | 1200 | 584 | Minn Valley-Maynard 115 @ 110% of 78 | Granite Falls-Willmar 230 | 0.0184 | Conductor | Rebuild | 11.3 mi | 3,955 | 21,467 | 13,393 | 8,074 | 13.3 |
| 3 | -478 | 1200 | 722 | Paynesville-Roscoe 69 @ 110% of 47 | Paynesville-Wakefield 115 | 0.0174 | Conductor | (Opt 31A facility) | | 0 | 21,467 | 15,130 | 6,337 | 15.0 |
| 4 | -414 | 1200 | 786 | Maynard-Kerkhoven Tp 115 @ 110% of 78 | Granite Falls-Willmar 230 | 0.0215 | Conductor | Rebuild | 14.7 mi | 5,145 | 26,612 | 15,936 | 10,676 | 15.8 |
| | -400 | 1200 | 800 | Morris 230/115 kV tx #2 @ 130% of 100 | Granite Falls-Morris-Moorhead 230 & Morris 230/115 tx #1 | 0.0211 | transformer | install larger tx | 1 ea | 400 | | 16,112 | | 16.0 |
| 7 | -237 | 1200 | 963 | Roscoe-Munson 69 @ 110% of 47 | Paynesville-Wakefield 115 | 0.0174 | Conductor | (Opt 31A facility) | | 0 | 27,012 | 18,164 | 8,848 | 18.0 |
| | -130 | 1200 | 1070 | Grant Co-Morris 115 @ 110% of 96 | Wahpeton-Fergus Fls 230 & Maple River-Wahpeton 230 & Wahpeton 230/115 tx | 0.0242 | Conductor | Reconductor | 26.5 mi | | 27,012 | 19,511 | | 19.4 |
| 14 | -90 | 1200 | 1110 | Minn Valley-Panther 230 @ 110% of 388 | Lyon Co-Franklin 345 | 0.0887 | Conductor | Reconductor | 30.2 mi | 3,180 | 30,192 | 20,014 | 13,802 | 19.9 |
| 8 | -88 | 1200 | 1112 R | Grant Co-Morris 115 @ 110% of 96 | Wahpeton-Fergus Fls 230 | 0.0241 | | | | 0 | 33,816 | 20,039 | 13,777 | 19.9 |
| 20 | -37 | 1200 | 1163 | Burnsville-Dakota Hgts @ 110% of 139 | Airlake-Lk Marion 115 | 0.0230 | Conductor | Reconductor | 3.6 mi | 432 | 34,248 | 20,681 | 13,567 | 20.5 |
| 10 | -13 | 1200 | 1187 | Willmar 115/69 tx @ 130% of 112 | Granite Falls-Willmar 230 | 0.0218 | Transformer | Install 2nd tx | 1 ea | 3,000 | 37,248 | 20,983 | 16,265 | 20.8 |
| | | | 1200 | | | | | | | | 37,248 | 21,147 | 16,101 | 21.0 |
| 11 | 19 | 1200 | 1219 | Farm Tp-Munson Tp @ 110% of 47 | Paynesville-Wakefield 115 | 0.0174 | Conductor | (Opt 31A facility) | | 0 | 37,248 | 21,386 | 15,862 | 21.2 |
| 15 | 102 | 1200 | 1302 | Helena-Blue Lk 345 @ 110% of 1165 | Helena-Lk Marion 345 | 0.4080 | Conductor | Reconductor | 15.0 mi | 2,700 | 39,948 | 22,431 | 17,517 | 22.3 |
| 13 | 358 | 1200 | 1549 | Canby-Burr 115 @ 110% of 97 | Brookings Co-Toronto 115 | 0.1076 | Conductor | Rebuild | 4.8 mi | 1,680 | 41,628 | 25,540 | 16,088 | 25.4 |
| | | | 1600 | | | | | | | | 41,628 | 26,182 | 15,446 | 26.0 |
| 18 | 549 | 1200 | 1749 | St Cloud TpW-Wakefield 115 @ 110% of 113 | Franklin-Helena 345 | 0.0511 | Conductor | Reconductor | 13.8 mi | 1,518 | 43,146 | 29,183 | 13,963 | 29.0 |
| 22 | 578 | 1200 | 1778 | McLeod-Panther 230 @ 110% of 388 | Franklin-Helena 345 | 0.0884 | Conductor | Reconductor | 28.2 mi | 3,384 | 46,530 | 29,767 | 16,763 | 29.6 |
| | 642 | 1200 | 1842 | Eden Prairie 345/115 tx #9 @ 130% of 448 | Parkers Lk-Blue Lk & Parkers Lk-Eden Pr 345 kV & Eden Pr 345/115 #10 | 0.0762 | Transformer | Replace tx | 1 ea | | | 31,056 | | 30.8 |
| | 674 | 1200 | 1874 | Brookings Co 345/115 tx 1 or 2 @ 130% of 448 | Brookings Co 345/115 tx #2 or 1 | 0.3189 | Transformer | Install larger txs | 2 ea | 3,000 | 49,530 | 31,700 | 18,474 | 31.5 |
| 17 | 727 | 1200 | 1927 | Wilmarth-Lakefield Gen 345 @ 110% of 1165 | Lyon Co-Franklin 345 | 0.3320 | Conductor | Reconductor | 54.2 mi | 9,756 | 61,286 | 32,768 | 28,518 | 32.5 |
| 21 | 789 | 1200 | 1989 | Henning-Fergus Fl 230 @ 110% of 320 | Audubon-Hubbard 230 & Hubbard tx | 0.0433 | Term equip | Replace equip | 2 ea | 200 | 61,486 | 34,016 | 27,470 | 33.8 |
| | | | 2000 | | | | | | | | 61,486 | 34,238 | 27,248 | 34.0 |
| 16 | 814 | 1200 | 2014 | Toronto-Burr 115 @ 110% of 144 | Brookings Co-Toronto 115 | 0.1500 | Conductor | Reconductor | 24.7 mi | 2,964 | 64,450 | 34,520 | 29,930 | 34.3 |
| | 814 | 1200 | 2014 | Ft Ridgely-Franklin 115 @ 110% of 139 | Franklin-Helena 345 | 0.0309 | Conductor | Reconductor | 25.7 mi | 3,084 | 67,534 | 34,520 | 33,014 | 34.3 |
| 19 | 831 | 1200 | 2031 R | Wilmarth-Lakefield Gen 345 @ 110% of 1165 | Franklin-Helena 345 | 0.3278 | | | | 0 | 67,534 | 34,862 | 32,672 | 34.6 |
| | 956 | 1200 | 2156 | Winnebago-Winnebago S 161 @ 110% of 167 | Prairie Island-Byron 345 | 0.0228 | ?? | | | 0 | 67,534 | 37,380 | 30,154 | 37.1 |
| | 1040 | 1200 | 2240 | Loon Tp-Eastwood 115 @ 110% of 310 | Lk Marion 345/115 tx | 0.0388 | Conductor | Add 2nd tx | 1.0 ea | 7,000 | 74,534 | 39,072 | 35,462 | 38.8 |
| | 1043 | 1200 | 2243 | Sheyenne-Audubon 230 @ 110% of 320 | Wahpeton-Fergus Falls 230 | 0.0336 | Conductor | Reconductor | 43.9 mi | 5,268 | 79,802 | 39,132 | 40,670 | 38.9 |
| 1 | 1119 | 1200 | 2319 | Granite Falls-Willmar 230 @ 110% of 388 | Lyon Co-Franklin 345 | 0.0702 | Conductor | Reconductor | 31.0 ea | 3,720 | 83,522 | 40,663 | 42,859 | 40.4 |
| | 1156 | 1200 | 2356 | Minn Valley-Hazel 230 @ 110% of 388 | Lyon Co-Franklin 345 | 0.1007 | Conductor | Install larger wire | 8.0 mi | 400 | 83,922 | 41,408 | 42,514 | 41.1 |
| | | | 2529 | | | | | | | | 83,922 | 44,892 | 39,030 | 44.6 |
| | 1330 | 1200 | 2530 | Loon Tp-Eastwood 115 @ 110% of 310 | Helena-Blue Lk 345 | 0.0476 | Conductor | Rebuild to 600 MVA | 22.0 mi | 11,000 | 94,922 | 44,912 | 50,010 | 44.6 |
| | 1423 | 1200 | 2623 | Wahpeton-Fergus Fls 230 @ 110% of 320 | Sheyenne-Audubon 230 | 0.0387 | Term Equip | Replace equip | 2.0 ea | 200 | 95,122 | 46,785 | 48,337 | 46.5 |
| | 1442 | 1200 | 2642 | Granite Falls-Minn Valley 230 @ 110% of 388 | Hazel-Minn Valley 230 | 0.0550 | Conductor | Reconductor | 2.5 mi | 300 | 95,422 | 47,168 | 48,254 | 46.8 |
| 24 | 1478 | 1200 | 2678 | Wilmarth-Helena 345 @ 110% of 1165 | Franklin-Helena 345 | 0.2876 | Conductor | Reconductor | 39.0 mi | 7,020 | 102,442 | 47,893 | 54,549 | 47.6 |
| | 1407 | 1200 | 2765 R | Brookings Co 345/115 txs @ 100% of 448 | (system intact) | 0.1750 | transformers | | | 0 | 102,442 | 49,645 | 52,797 | 49.3 |
| | 1662 | 1200 | 2862 | Ortonville-Johnson Jct 230 @ 110% of 390 | Hazel-Canby 230 | 0.0504 | Conductor | Install larger wire | 24.7 mi | 1,235 | 103,677 | 51,599 | 52,078 | 51.2 |
| | 1700 | 1200 | 2900 | (none) | | | | | | 0 | 103,677 | 52,364 | 51,313 | 52.0 |

Notes

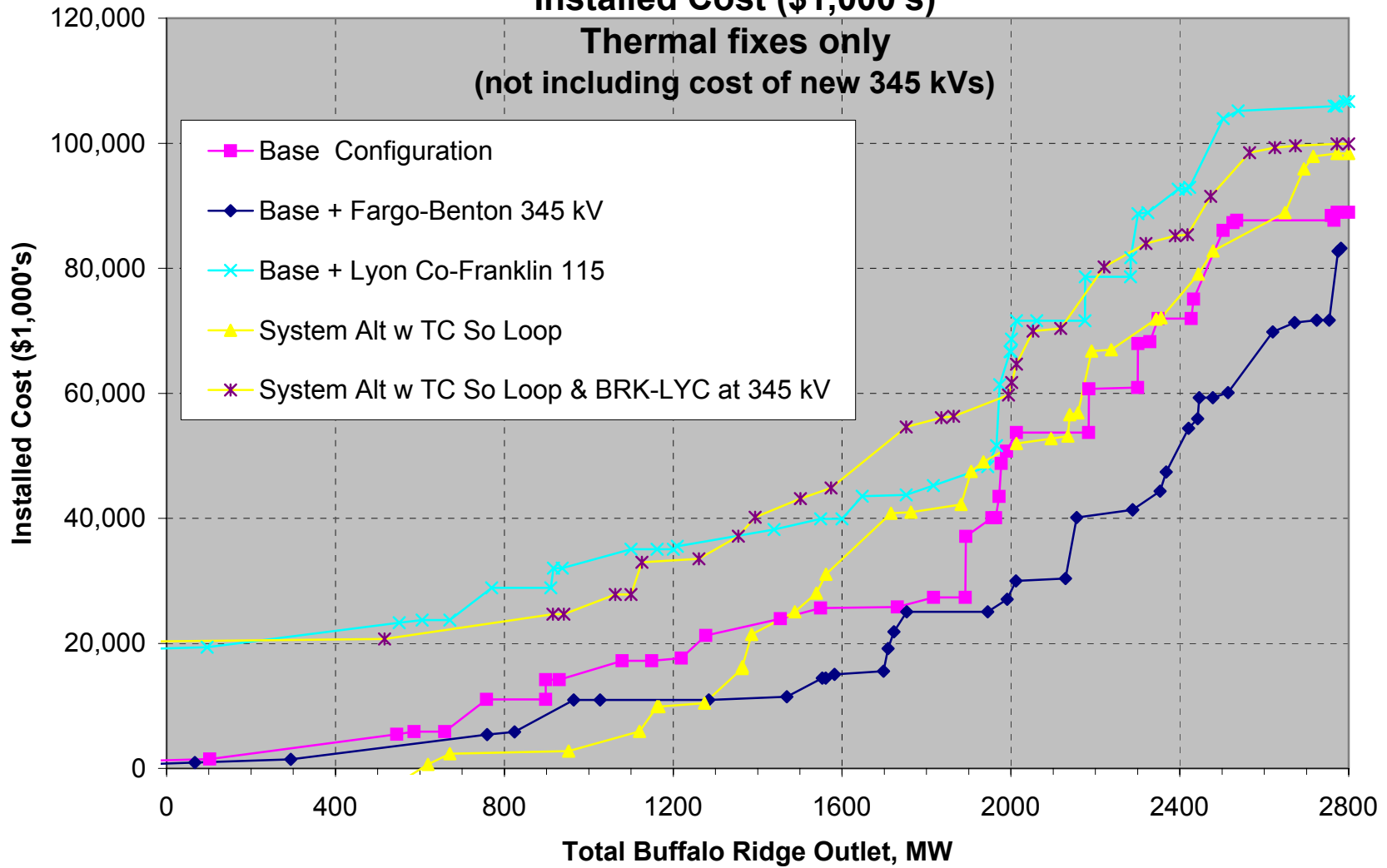
1. TLTG analysis run on Summer 2011 off-peak powerflow case representing 1200 MW of "existing" Buffalo Ridge area gen. Total SW MN Buffalo Ridge area gen = 1168 + 32 = 1200 MW.
2. Xcel/NSP Buffalo Ridge area line ratings adjusted per NSP wind rating practice.
3. Improvements modeled: "Incremental" Option 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).

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

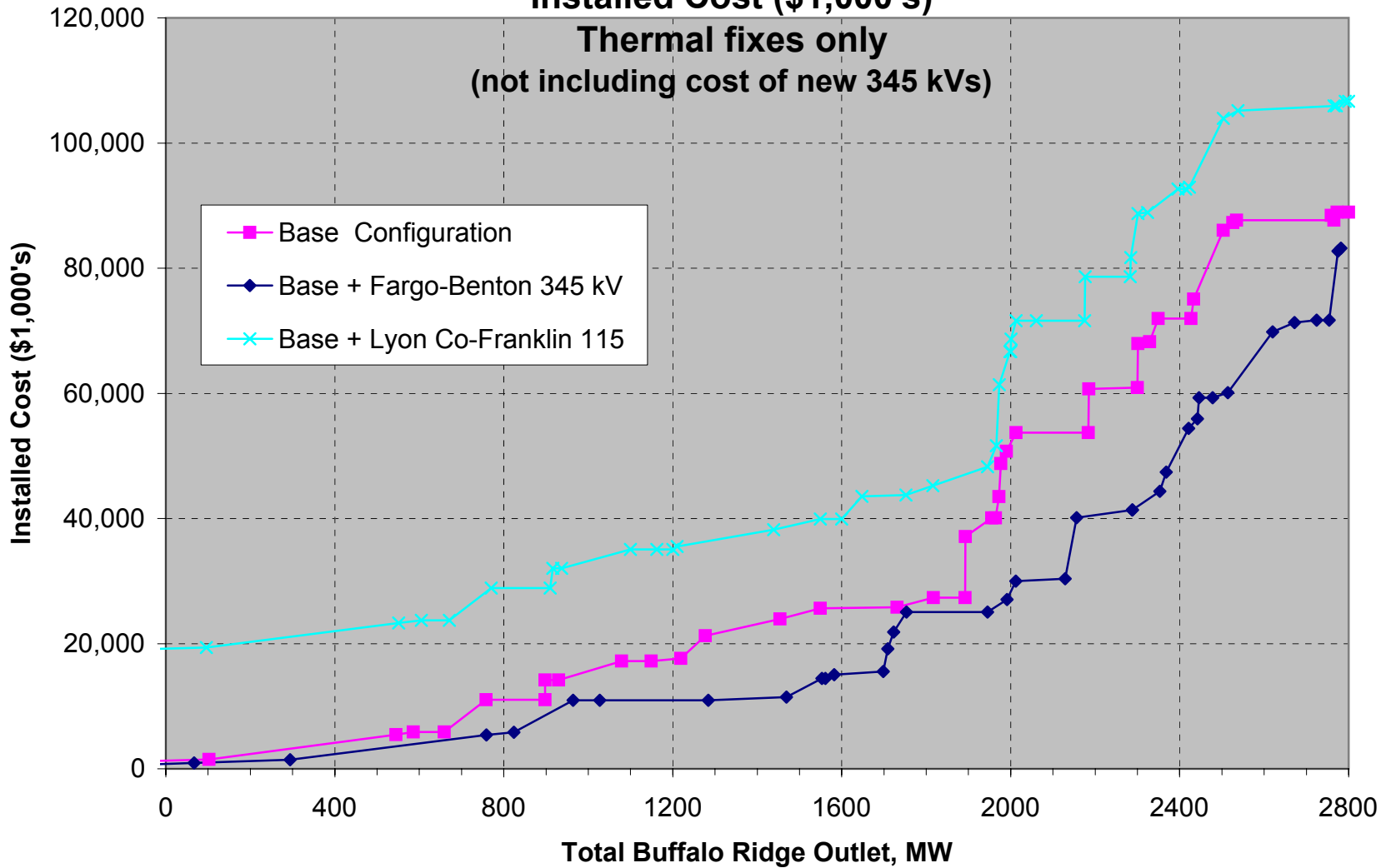
| | |
|--|--------|
| Reconductor to 795 kcm ACSS | 120 |
| Reconductor to 2 x 795 kcm ACSS | 180 |
| Reconductor to 477 kcm ACSS | 110 |
| Reconductor to 477 kcm ACSR | 100 |
| | 115 kV |
| Rebuild to 795 kcm ACSS single ckt | 350 |
| Rebuild to 2 x 795 kcm ACSS single ckt | 500 |

| Base Costs for this Option: | | <u>qty</u> | <u>each</u> | <u>totals</u> |
|-----------------------------|-------------------------------------|------------|-------------|---------------|
| | Lyon Co-Franklin 345 kV series comp | 1.0 ea | 8,000 | 8,000 |
| | Franklin-Helena 345 kV series comp | 1.0 ea | 8,000 | 8,000 |
| | Total | | | 16,000 |

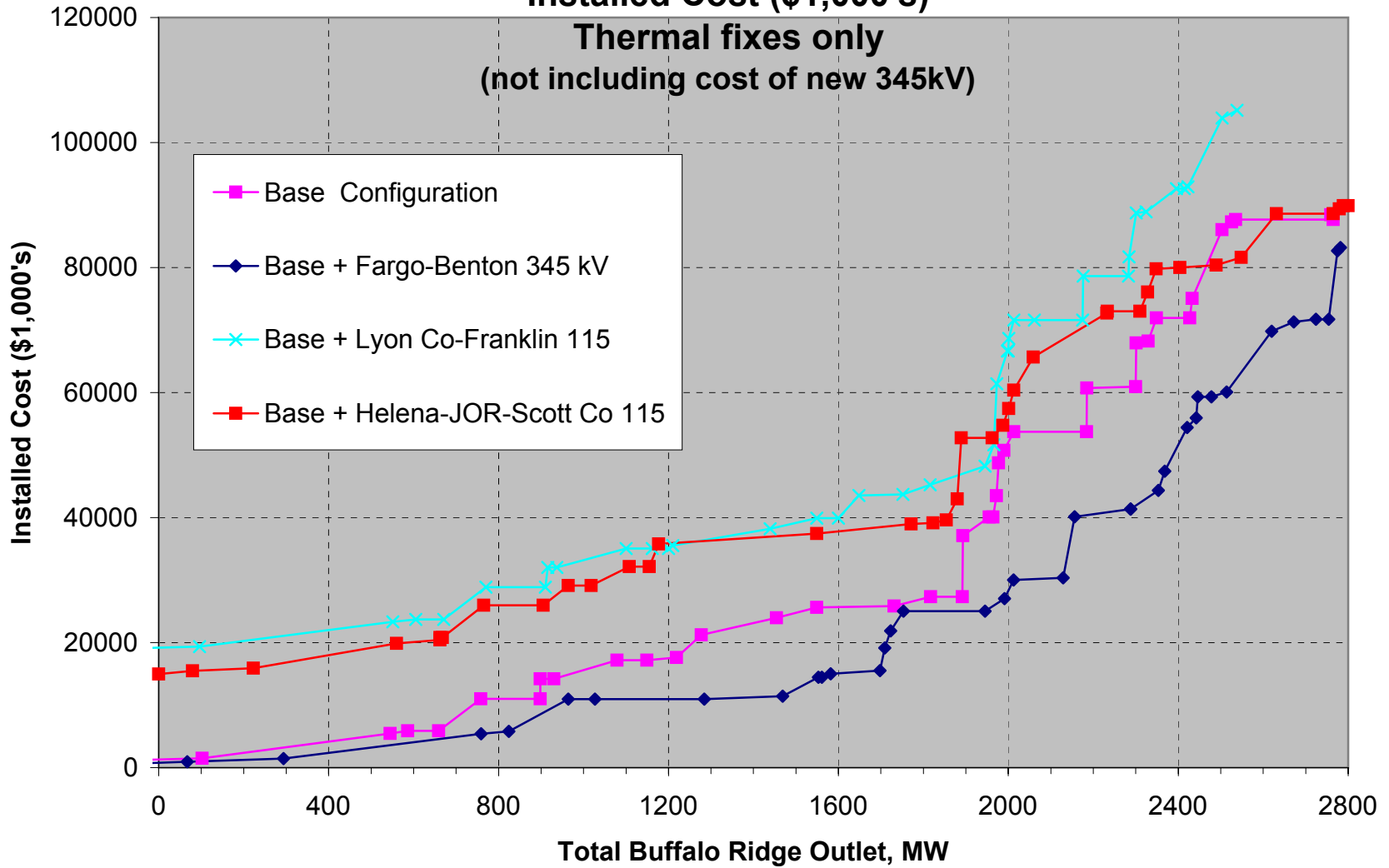
**SW Minnesota Generation Outlet
Installed Cost (\$1,000's)
Thermal fixes only
(not including cost of new 345 kV)**



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



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



Southwest Minnesota-->Twin Cities EHV Development

"System Alternative (original)" Configuration--Big Stone-Canby-Hazel 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 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 |
| | 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 (original)" Configuration--Big Stone-Canby-Hazel at 230 kV

Option 31A "incremental" improvements in service
 Brookings Co-Lyon Co 115 kV & Lyon Co-Hazel-Blue Lk 345 kV
 (No Twin Cities "South 345 kV Loop")
 Big Stone-Canby-Hazel @ 230 kV, 2 x 795 ACSR

| Key | SW MN Buffalo Ridge Area Generation | | | Limiting Facility | Contingency | distribution factor | Limiting factor | Remedy | qty | Installed Cost, \$1,000's | |
|-----|-------------------------------------|--------------|-----------------|--|--|---------------------|-----------------|---------------------|---------|---------------------------|------------|
| | TLTG Limit MW | Base Case MW | System Limit MW | | | | | | | 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 |
| # | -362 | 1200 | 838 | 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 | 15,808 |
| | -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 | 18,988 |
| 8 | -139 | 1200 | 1061 | Minn Valley-Maynard 115 @ 110% of 78 | Granite Falls-Willmar 230 | 0.0165 | Conductor | Rebuild | 11.3 mi | 3,955 | 22,943 |
| | -120 | 1200 | 1080 R | Grant Co-Morris 115 @ 110% of 96 | Wahpeton-Fergus Fls 230 | 0.0225 | | | | 0 | 22,943 |
| | 85 | 1200 | 1285 | Maynard-Kerhoven 115 @ 110% of 78 | Granite Falls-Willmar 230 | 0.0192 | Conductor | Rebuild | 14.7 mi | 5,145 | 28,088 |
| | 188 | 1200 | 1388 | Blair-Granite Falls 230 @ 110% of 398 | Hazel-Canby 230 | 0.0578 | Conductor | Reconductor | 46.0 mi | 5,520 | 33,608 |
| | 193 | 1200 | 1393 | Granite Falls-Minn Valley 230 @ 110% of 388 | Hazel-Canby 230 | 0.0624 | Conductor | Reconductor | 2.5 mi | 300 | 33,908 |
| | 217 | 1200 | 1417 | Loon Tp-Eastwood 115 @ 100% of 310 | (system intact) | 0.0400 | Conductor | Rebuild to 600 MVA | 22.0 mi | 11,000 | 44,908 |
| 14 | 225 | 1200 | 1425 | Minn Valley-Panther 230 @ 110% of 388 | Hazel-Blue Lk 345 | 0.0841 | Conductor | Reconductor | 30.2 mi | 3,624 | 48,532 |
| | 248 | 1200 | 1448 | Willmar 115/69 tx @ 130% of 112 | Granite Falls-Willmar 230 | 0.0208 | Transformer | Install 2nd tx | 1 ea | 3,000 | 51,532 |
| 21 | 486 | 1200 | 1686 | Henning-Fergus FI 230 @ 110% of 320 | Audubon-Hubbard 230 & Hubbard tx | 0.0433 | Term equip | Replace equip | 2 ea | 200 | 51,732 |
| | 628 | 1200 | 1828 | Sheyenne-Audubon 230 @ 110% of 320 | Wahpeton-Fergus Falls 230 | 0.0363 | Conductor | Reconductor | 43.9 mi | 5,268 | 57,000 |
| 19 | 643 | 1200 | 1843 | Wilmarth-Lakefield Gen 345 @ 110% of 1165 | Hazel-Blue Lk 345 | 0.3363 | | | | 0 | 57,000 |
| | 667 | 1200 | 1867 | Ortonville-Johnson Jct 230 @ 110% of 390 | Hazel-Canby 230 | 0.0619 | Conductor | Install larger wire | 24.7 mi | 1,235 | 58,235 |
| 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 | 59,753 |
| 16 | 813 | 1200 | 2013 | Toronto-Burr 115 @ 110% of 144 | Brookings Co-Toronto 115 | 0.1500 | Conductor | Reconductor | 24.7 mi | 2,964 | 62,717 |
| 22 | 862 | 1200 | 2062 | McLeod-Panther 230 @ 110% of 388 | Hazel-Blue Lk 345 | 0.0847 | Conductor | Reconductor | 28.2 mi | 3,384 | 66,101 |
| | 879 | 1200 | 2079 | Johnson Jct-Morris 230 @ 110% of 390 | Hazel-Canby 230 | 0.0540 | Conductor | Install larger wire | 15.4 mi | 770 | 66,871 |
| | 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 | 67,196 |
| | 959 | 1200 | 2159 | Wahpeton-Fergus Fls 230 @ 110% of 320 | Sheyenne-Audubon 230 | 0.0422 | Term Equip | Replace equip | 2.0 ea | 200 | 67,396 |
| | 1125 | 1200 | 2325 | Heron Lk-Brewster 161 @ 110% of 112 | Nobles Co-Lakefield Jct 345 | 0.0293 | Conductor | Rebuild | 14.0 mi | 4,900 | 72,296 |
| | 1158 | 1200 | 2358 | Marshall SS-Marshall SE 115 @ 110% of 128 | Erie Rd-Saratoga 115 | 0.0334 | Conductor | Reconductor | 1.7 mi | 204 | 72,500 |
| | 1213 | 1200 | 2413 | Granite Falls-Willmar 230 @ 110% of 388 | Hazel-Blue Lk 345 | 0.0688 | Conductor | Reconductor | 31.0 mi | 3,720 | 76,220 |
| | 1351 | 1200 | 2551 | McLeod-Blue Lk 230 @ 110% of 388 | Hazel-Blue Lk 345 | 0.0626 | Conductor | Reconductor | 51.0 mi | 6,120 | 82,340 |
| | 1364 | 1200 | 2564 | Wilmarth-Dome 115 @ 110% of 310 | Wilmarth-Eastwood 115 | 0.0350 | Conductor | Rebuild to 600 MVA | 2.8 mi | 1,400 | 83,740 |
| | 1432 | 1200 | 2632 | Dome-Eastwood 115 @ 110% of 310 | Wilmarth-Eastwood 115 | 0.0350 | Conductor | Rebuild to 600 MVA | 3.0 mi | 1,500 | 85,240 |
| | 1437 | 1200 | 2637 | Winnebago-Winnebago S 161 @ 110% of 161 | Loon Tp-Eastwood 115 | 0.0320 | ?? | | | 0 | 85,240 |
| | 1438 | 1200 | 2638 | Wilmarth-Blue Lk 345 @ 110% of 1165 | Hazel-Blue Lk 345 | 0.2976 | Conductor | Reconductor | 54.8 mi | 9,864 | 95,104 |
| | 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 | 102,104 |
| | 1510 | 1200 | 2710 | Brookings Co 345/115 tx 1 or 2 @ 130% of 448 | Brookings Co 345/115 tx 2 or 1 | 0.2542 | | Install larger txs | 2.0 ea | 2,000 | 104,104 |
| | 1573 | 1200 | 2773 | Triboji-Spencer 161 @ 110% of 195 | Wilmarth-Lakefield 345 | 0.0384 | Conductor | Reconductor | 4.0 mi | 480 | 104,584 |
| | 1600 | 1200 | 2800 | (none) | (none) | | | | | 0 | 104,584 |

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
10/5/2005

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: | | <u>qty</u> | <u>each</u> | <u>totals</u> |
|---|--|------------|-------------|---------------|
| 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 |

Southwest Minnesota-->Twin Cities EHV Development

Base Configuration--Big Stone-Canby-Hazel 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 | | | | | | | | | | 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 | -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 |
| 8 | 745 | 1200 | 1945 R | Grant Co-Morris 115 @ 110% of 96 | Wahpeton-Fergus Fls 230 | 0.0282 | | | 0.0 | 3180 | 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 161 | 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 |
| | 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-Canby-Hazel 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

| Key | SW MN Buffalo Ridge Area Generation | | | Limiting Facility | Contingency | distribution factor | Limiting factor | Remedy | qty | Installed item | Cost, \$1,000's cumulative | Losses equivalent capital value | Net Cost | MW Loss reduction w/r to base |
|-------------------------|-------------------------------------|--------------|-----------------|---|--|---------------------|-----------------|---------------------|---------|----------------|----------------------------|---------------------------------|----------|-------------------------------|
| | TLTG Limit MW | Base Case MW | System Limit MW | | | | | | | | | | | |
| Lyon Co-Franklin 115 kV | | | | | | | | | | | | | | |
| 5 | -1532 | 1200 | -332 | Lake Marion-Kenrick 115 @ 110% of 139 | Airlake-Lk Marion 115 | 0.0224 | Conductor | Reconductor | 3.5 mi | 17,900 | 17,900 | -251 | 18,571 | -0.2 |
| | -1398 | 1200 | -198 | Wilmarth-Eastwood 115 kV @ 110% of 194 | Wilmarth-Dome 115 | 0.0339 | Conductor | Reconductor | 4.4 mi | 420 | 18,320 | -150 | 18,998 | -0.1 |
| 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 | 73 | 19,291 | 0.1 |
| 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 | 416 | 22,903 | 0.4 |
| | -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 | 457 | 23,262 | 0.5 |
| 3 | -529 | 1200 | 671 | Paynesville-Roscoe 69 @ 110% of 47 | Paynesville-Wakefield 115 | 0.0179 | Conductor | (Opt 31A facility) | | 0 | 23,719 | 507 | 23,212 | 0.5 |
| 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 | 582 | 28,282 | 0.6 |
| 7 | -290 | 1200 | 910 | Roscoe-Munson 69 @ 110% of 47 | Paynesville-Wakefield 115 | 0.0179 | Conductor | (Opt 31A facility) | | 0 | 28,864 | 687 | 28,177 | 0.7 |
| 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 | | | 692 | | 0.7 |
| 8 | -263 | 1200 | 937 R | Grant Co-Morris 115 @ 110% of 96 | Wahpeton-Fergus Fls 230 | 0.0240 | | | | 3,180 | 32,044 | | 31,352 | |
| 10 | -100 | 1200 | 1100 | Willmar 115/69 tx @ 130% of 112 | Granite Falls-Willmar 230 | 0.0225 | Transformer | Install 2nd tx | 1.0 ea | 0 | 32,044 | 708 | 31,336 | 0.7 |
| 11 | -38 | 1200 | 1162 | Farm Tp-Munson Tp @ 110% of 47 | Paynesville-Wakefield 115 | 0.0179 | Conductor | (Opt 31A facility) | | 3,000 | 35,044 | 831 | 34,213 | 0.8 |
| | | | 1200 | | | | | | | 0 | 35,044 | 878 | 34,166 | 0.9 |
| 20 | 10 | 1200 | 1210 | Burnsville- Dakota Hgts @ 110% of 139 | Airlake-Lk Marion 115 | 0.0224 | Conductor | Reconductor | 4.0 mi | 35,044 | 906 | 34,138 | 0.9 | |
| 15 | 239 | 1200 | 1439 | Helena-Blue Lk 345 @ 110% of 1165 | Helena-Lk Marion 345 | 0.3903 | Conductor | Reconductor | 15.0 mi | 480 | 35,524 | 914 | 34,610 | 0.9 |
| 13 | 349 | 1200 | 1549 | Canby-Burr 115 @ 110% of 97 | Brookings Co-Toronto 115 | 0.1078 | Conductor | Rebuild | 4.8 mi | 2,700 | 38,224 | 1,087 | 37,137 | 1.1 |
| | | | 1600 | | | | | | | 1,680 | 39,904 | 1,170 | 38,734 | 1.2 |
| 14 | 448 | 1200 | 1648 | Minn Valley-Panther 230 @ 110% of 388 | Lyon Co-Franklin 345 | 0.0808 | Conductor | Reconductor | 30.2 mi | 39,904 | 1,208 | 38,696 | 1.2 | |
| 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 | 3,624 | 43,528 | 1,160 | 42,368 | 1.2 |
| 18 | 616 | 1200 | 1816 | St Cloud TpW-Wakefield 115 @ 110% of 113 | Franklin-Helena 345 | 0.0505 | Conductor | Reconductor | 13.8 mi | 200 | 43,728 | 1,055 | 42,673 | 1.0 |
| | 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 | 1,518 | 45,246 | 991 | 44,255 | 1.0 |
| 22 | 766 | 1200 | 1966 | McLeod-Panther 230 @ 110% of 388 | Franklin-Helena 345 | 0.0870 | Conductor | Reconductor | 28.2 mi | 3,000 | 48,246 | 861 | 47,385 | 0.9 |
| 17 | 773 | 1200 | 1973 | Wilmarth-Lakefield Gen 345 @ 110% of 1165 | Franklin-Helena 345 | 0.3307 | Conductor | Reconductor | 54.2 mi | 3,384 | 51,630 | 840 | 50,790 | 0.8 |
| | 798 | 1200 | 1998 | Sheyenne-Audubon 230 @ 110% of 320 | Wahpeton-Fergus Falls 230 | 0.0354 | Conductor | Reconductor | 43.9 mi | 9,756 | 61,386 | 833 | 60,553 | 0.8 |
| | | | 2000 | | | | | | | 5,268 | 66,654 | 808 | 65,846 | 0.8 |
| | 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 | 66,654 | 806 | 65,848 | 0.8 | |
| 16 | 813 | 1200 | 2013 | Toronto-Burr 115 @ 110% of 144 | Brookings Co-Toronto 115 | 0.1500 | Conductor | Reconductor | 24.7 mi | 68,654 | 805 | 67,849 | 0.8 | |
| 17 | 861 | 1200 | 2061 R | Wilmarth-Lakefield Gen 345 @ 110% of 1165 | Lyon Co-Franklin 345 | 0.3216 | Conductor | | | 2,964 | 71,618 | 793 | 70,825 | 0.8 |
| | | | 2175 | | | | | | | 0 | 71,618 | 744 | 70,874 | 0.7 |
| | 976 | 1200 | 2176 | Loon Tp-Eastwood 115 @ 110% of 310 | Lk Marion 345/115 tx | 0.0391 | Conductor | Add 2nd tx | 1.0 ea | 71,618 | 629 | 70,989 | 0.6 | |
| | | | 2283 | | | | | | | 7,000 | 78,618 | 628 | 77,990 | 0.6 |
| | 1084 | 1200 | 2284 | Ft Ridgely-Franklin 115 @ 110% of 139 | Franklin-Helena 345 | 0.0290 | Conductor | Reconductor | 25.7 mi | 0 | 78,618 | 521 | 78,097 | 0.5 |
| 24 | 1101 | 1200 | 2301 | Wilmarth-Helena 345 @ 110% of 1165 | Franklin-Helena 345 | 0.3131 | Conductor | Reconductor | 39.0 mi | 3,084 | 81,702 | 520 | 81,182 | 0.5 |
| | 1124 | 1200 | 2324 | Wahpeton-Fergus Fls 230 @ 110% of 320 | Sheyenne-Audubon 230 | 0.0409 | Term Equip | Replace equip | 2.0 ea | 7,020 | 88,722 | 502 | 88,220 | 0.5 |
| 1 | 1196 | 1200 | 2396 | Granite Falls-Willmar 230 @ 110% of 388 | Minn Valley-Panther 230 | 0.0661 | Conductor | Reconductor | 31.0 mi | 200 | 88,922 | 479 | 88,443 | 0.5 |
| | 1214 | 1200 | 2414 | Winnebago-Winnebago S 161 @ 110% of 16 | Prairie Island-Byron 345 | 0.0224 | ?? | | | 3,720 | 92,642 | 407 | 92,235 | 0.4 |
| | 1223 | 1200 | 2423 | Granite Falls-Minn Valley 230 @ 110% of 388 | Hazel-Minn Valley 230 | 0.0599 | Conductor | Reconductor | 2.5 mi | 0 | 92,642 | 389 | 92,253 | 0.4 |
| | 1294 | 1200 | 2503 | Loon Tp-Eastwood 115 @ 110% of 310 | Helena-Blue Lk 345 | 0.0477 | Conductor | Rebuild to 600 MV | 22.0 mi | 300 | 92,942 | 380 | 92,562 | 0.4 |
| | 1338 | 1200 | 2538 | Ortonville-Johnson Jct 230 @ 110% of 390 | Hazel-Canby 230 | 0.0538 | Conductor | Install larger wire | 24.7 mi | 11,000 | 103,942 | 299 | 103,643 | 0.3 |
| | 1571 | 1200 | 2771 | Johnson Jct-Morris 230 @ 110% of 390 | Hazel-Canby 230 | 0.0538 | Conductor | Install larger wire | 15.4 mi | 1,235 | 105,177 | 264 | 104,913 | 0.3 |
| | 1565 | 1200 | 2765 R | Brookings Co 345/115 txs @ 100% of 448 | (system intact) | 0.1690 | transformers | | | 770 | 105,947 | 29 | 105,918 | 0.0 |
| | 1592 | 1200 | 2792 | Triboji-Spencer 161 @ 110% of 195 | Wilmarth-Lakefield 345 | 0.0371 | Conductor | Reconductor | 4.0 mi | 0 | 105,947 | 35 | 105,912 | 0.0 |
| | 1600 | 1200 | 2800 | (none) | | | | | | 720 | 106,667 | 8 | 106,659 | 0.0 |
| | | | | | | | | | | 0 | 106,667 | 0 | 106,667 | 0.0 |

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 | 18,700 |
| line terms at Lyon Co and Franklin @ \$1,000 each | <u>2,000</u> |
| | 20,700 |
| Less: 8 mi between Milroy & Sheridan already built for load serving purposes | <u>2,800</u> |
| | 17,900 |

Southwest Minnesota-->Twin Cities EHV Development

Base Configuration--Big Stone-Canby-Hazel 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

| Key | SW MN Buffalo Ridge Area Generation | | | Limiting Facility | Contingency | distribution factor | Limiting factor | Remedy | qty | Installed Cost, \$1,000's | | MVA old rating | MVA new rating | Revised MW limit |
|-----|-------------------------------------|--------------|-----------------|--|--|---------------------|-----------------|---------------------|---------|---------------------------|------------|----------------|----------------|------------------|
| | TLTG Limit MW | Base Case MW | System Limit MW | | | | | | | 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 | 139 | 310 | 8108 |
| | -1395 | 1200 | -195 | Wilmarth-Eastwood 115 kV @ 110% of 194 | Wilmarth-Dome 115 | 0.0339 | Conductor | Reconductor | 4.4 mi | 528 | 948 | 194 | 310 | 3569 |
| 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 | 139 | 310 | 8210 |
| 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 | 78 | 310 | 14119 |
| | -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 | 100 | 150 | 3052 |
| 3 | -541 | 1200 | 659 | Paynesville-Roscoe 69 @ 110% of 47 | Paynesville-Wakefield 115 | 0.0180 | Conductor | (Opt 31A facility) | | 0 | 5,867 | 47 | 84 | 2920 |
| 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 | 78 | 310 | 12464 |
| 7 | -302 | 1200 | 898 | Roscoe-Munson 69 @ 110% of 47 | Paynesville-Wakefield 115 | 0.0180 | Conductor | (Opt 31A facility) | | 0 | 11,012 | 47 | 84 | 3159 |
| | -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 | | | 100 | 150 | 3098 |
| 8 | -270 | 1200 | 930 R | Grant Co-Morris 115 @ 110% of 96 | Wahpeton-Fergus Fls 230 | 0.0241 | | | | 3,180 | 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 | 96 | 150 | 3395 |
| 11 | -51 | 1200 | 1149 | Farm Tp-Munson Tp @ 110% of 47 | Paynesville-Wakefield 115 | 0.0180 | Conductor | (Opt 31A facility) | | 0 | 17,192 | 112 | 140 | 2436 |
| 20 | 19 | 1200 | 1219 | Burnsville-Dakota Hgts @ 110% of 139 | Airlake-Lk Marion 115 | 0.0223 | Conductor | Reconductor | 3.6 mi | 432 | 17,624 | 47 | 84 | 3410 |
| 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 | 139 | 310 | 9654 |
| 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 | 388 | 620 | 4200 |
| 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 | 1165 | 1864 | 3432 |
| 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 | 97 | 200 | 2600 |
| 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 | 320 | 380 | 3255 |
| | | | 1892 | | | | | | | | 27,346 | 113 | 224 | 4235 |
| 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 | 1165 | 1864 | 4196 |
| | 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 | 40,102 | 448 | 672 | 5285 |
| 19 | 764 | 1200 | 1964 R | Wilmarth-Lakefield Gen 345 @ 110% of 1165 | Franklin-Helena 345 | 0.3314 | | | | 0 | 40,102 | 1165 | 1864 | 4284 |
| 22 | 772 | 1200 | 1972 | McLeod-Panther 230 @ 110% of 388 | Franklin-Helena 345 | 0.0870 | Conductor | Reconductor | 28.2 mi | 3,384 | 43,486 | 388 | 620 | 4905 |
| | 777 | 1200 | 1977 | Sheyenne-Audubon 230 @ 110% of 320 | Wahpeton-Fergus Falls 230 | 0.0356 | Conductor | Reconductor | 43.9 mi | 5,268 | 48,754 | 320 | 380 | 3831 |
| | 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 | 448 | 672 | 2931 |
| 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 | 144 | 200 | 2424 |
| | | | 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 | 320 | 380 | 3906 |
| 24 | 1101 | 1200 | 2301 | Wilmarth-Helena 345 @ 110% of 1165 | Franklin-Helena 345 | 0.3131 | Conductor | Reconductor | 39.0 mi | 7,020 | 67,938 | 1165 | 1864 | 4757 |
| | 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 | 388 | 620 | 6506 |
| 1 | 1149 | 1200 | 2349 | Granite Falls-Willmar 230 @ 110% of 388 | Minn Valley-Panther 230 | 0.0668 | Conductor | Reconductor | 31.0 ea | 3,720 | 71,958 | 388 | 620 | 6169 |
| | 1227 | 1200 | 2427 | Winnebago-Winnebago S 161 @ 110% of 167 | Prairie Island-Byron 345 | 0.0224 | ?? | | | 0 | 71,958 | | | |
| | 1233 | 1200 | 2433 | Ft Ridgely-Franklin 115 @ 110% of 139 | Franklin-Helena 345 | 0.0280 | Conductor | Reconductor | 25.7 mi | 3,084 | 75,042 | 139 | 224 | 5772 |
| | 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 | 86,042 | 310 | 620 | 9667 |
| | 1326 | 1200 | 2526 | Ortonville-Johnson Jct 230 @ 110% of 390 | Hazel-Canby 230 | 0.0540 | Conductor | Install larger wire | 24.7 mi | 1,235 | 87,277 | 390 | 500 | 4767 |
| | 1335 | 1200 | 2535 | Minn Valley-Hazel 230 @ 110% of 388 | Lyon Co-Franklin 345 | 0.0962 | Conductor | Install larger wire | 8.0 mi | 400 | 87,677 | 388 | 620 | 5188 |
| | 1551 | 1200 | 2765 R | Brookings Co 345/115 tx @ 100% of 448 | (system intact) | 0.1700 | transformers | | | 0 | 87,677 | | | 2765 |
| | 1559 | 1200 | 2759 | Johnson Jct-Morris 230 @ 110% of 390 | Hazel-Canby 230 | 0.0540 | Conductor | Install larger wire | 15.4 mi | 770 | 88,447 | 390 | 500 | 5000 |
| | 1573 | 1200 | 2773 | Triboji-Spencer 161 @ 110% of 195 | Wilmarth-Lakefield 345 | 0.0372 | Conductor | Reconductor | 4.0 mi | 480 | 88,927 | 195 | 224 | 3631 |
| | 1600 | 1200 | 2800 | (none) | | | | | | 0 | 88,927 | | | |

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).

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: | | qty | each | totals |
|-----------------------------|--|---------|--------|---------|
| | 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-and 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 capacit | 1.0 ea | 750 | 750 |
| | Lyon Co: upgrade 2 x 40 -->2 x 40 MVAR shunt c | 2.0 ea | 25 | 50 |
| | 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 4 x 30 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 txs | 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: add 3 x 60 MVAR 230 kV shunt ca | 3.0 ea | 1,000 | 3,000 |
| | 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 bus | 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 bus | 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 kV ri | 1.0 ea | 4,500 | 4,500 |
| | Hampton Corner Sw Stn: new site development | 1.0 ea | 1,500 | 1,500 |
| | Blue Lk Sub: add 1 x 80 MVAR 115 kV shunt cap | 1.0 ea | 850 | 850 |
| | McLeod Sub: add 4 x 30 MVAR 115 kV shunt cap | 4.0 ea | 750 | 3,000 |
| | Various: relaying revisions for new configurations | 1.0 ea | 2,000 | 2,000 |
| | Subtotal (stations) | | | 109,250 |
| | Grand Total | | | 304,530 |

Southwest Minnesota-->Twin Cities EHV Development

Base Configuration--Big Stone-Canby-Hazel 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 | | | | | | | | | | 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 | -1546 | 1200 | -346 | Lake Marion-Kenrick 115 @ 110% of 139 | Airlake-Lk Marion 115 | 0.0224 | Conductor | Reconductor | 3.5 mi | 420 | 420 |
| | -1392 | 1200 | -192 | Wilmarth-Eastwood 115 kV @ 110% of 194 | Wilmarth-Dome 115 | 0.0339 | Conductor | Reconductor | 4.4 mi | 528 | 948 |
| 9 | -1119 | 1200 | 81 | Kenrick-Dakota Heights 115 @ 110% of 139 | Airlake-Lk Marion 115 | 0.0226 | Conductor | Reconductor | 4.7 mi | 564 | 1,512 |
| 4 | -484 | 1200 | 716 | Maynard-Kerkhoven Tp 115 @ 110% of 78 | Granite Falls-Willmar 230 | 0.0209 | Conductor | Rebuild | 14.7 mi | 5,145 | 6,657 |
| 3 | -485 | 1200 | 715 | Paynesville-Roscoe 69 @ 110% of 47 | Paynesville-Wakefield 115 | 0.0176 | Conductor | (Opt 31A facility) | | 0 | 6,657 |
| 7 | -246 | 1200 | 954 | Roscoe-Munson 69 @ 110% of 47 | Paynesville-Wakefield 115 | 0.0176 | Conductor | (Opt 31A facility) | | 0 | 6,657 |
| | -63 | 1200 | 1137 | Morris 230/115 tx @ 2 @ 130% of 100 | Granite Falls-Morris 230 & Morris-Moorhead 230 & Morris 230/115 tx # 1 | 0.0240 | transformer | install larger tx | 1.0 ea | | |
| 6 | -54 | 1200 | 1146 | Grant Co-Morris 115 @ 110% of 96 | Wahpeton-Fergus Fls 230 & Maple River-Wahpeton 230 & Wahpeton 230/115 tx | 0.0251 | Conductor | Reconductor | 26.5 mi | 400 | 7,057 |
| | | | | | | | | | | 3,180 | 10,237 |
| 10 | -43 | 1200 | 1157 | Willmar 115/69 tx @ 130% of 112 | Granite Falls-Willmar 230 | 0.0221 | Transformer | Install 2nd tx | 1.0 ea | 3,000 | 13,237 |
| 14 | -24 | 1200 | 1176 | Minn Valley-Panther 230 @ 110% of 388 | Lyon Co-Franklin 345 | 0.0848 | Conductor | Reconductor | 30.2 mi | 3,624 | 16,861 |
| 20 | -7 | 1200 | 1193 | Burnsville- Dakota Hgts @ 110% of 139 | Airlake-Lk Marion 115 | 0.0226 | Conductor | Reconductor | 3.6 mi | 432 | 17,293 |
| 8 | -7 | 1200 | 1193 R | Grant Co-Morris 115 @ 110% of 96 | Wahpeton-Fergus Fls 230 | 0.0232 | | | | 0 | 17,293 |
| 11 | 8 | 1200 | 1208 | Farm Tp-Munson Tp @ 110% of 47 | Paynesville-Wakefield 115 | 0.0176 | Conductor | (Opt 31A facility) | | 0 | 17,293 |
| 15 | 197 | 1200 | 1397 | Helena-Blue Lk 345 @ 110% of 1165 | Helena-Lk Marion 345 | 0.3905 | Conductor | Reconductor | 15.0 mi | 2,700 | 19,993 |
| | 473 | 1200 | 1673 | Canby-Burr 115 @ 110% of 97 | Brookings Co-Toronto 115 | 0.1105 | Conductor | Rebuild | 4.8 mi | 1,680 | 21,673 |
| 18 | 621 | 1200 | 1821 | St Cloud TpW-Wakefield 115 @ 110% of 113 | Franklin-Helena 345 | 0.0497 | Conductor | Reconductor | 13.8 mi | 1,518 | 23,191 |
| | | | 1879 | | | | | | | 0 | 23,191 |
| 17 | 680 | 1200 | 1880 | Wilmarth-Lakefield Gen 345 @ 110% of 1165 | Lyon Co-Franklin 345 | 0.3349 | Conductor | Reconductor | 54.2 mi | 9,756 | 32,947 |
| 22 | 680 | 1200 | 1880 | McLeod-Panther 230 @ 110% of 388 | Franklin-Helena 345 | 0.0849 | Conductor | Reconductor | 28.2 mi | 3,384 | 36,331 |
| | 714 | 1200 | 1914 | Eden Prairie 345/115 tx #9 @ 130% of 448 | Parkers Lk-Blue Lk & Parkers Lk-Eden Pr 345 kV & Eden Pr 345/115 #10 | 0.0743 | transformer | Replace tx | 1.0 ea | | |
| | | | | | | | | | | 3,000 | 39,331 |
| 21 | 747 | 1200 | 1947 | Henning-Fergus FI 230 @ 110% of 320 | Audubon-Hubbard 230 & Hubbard tx | 0.0440 | Term equip | Replace equip | 2 ea | 200 | 39,531 |
| 19 | 767 | 1200 | 1967 R | Wilmarth-Lakefield Gen 345 @ 110% of 1165 | Franklin-Helena 345 | 0.3321 | Conductor | | | 0 | 39,531 |
| | 782 | 1200 | 1982 | Brookings Co 345/115 tx 1 or 2 @ 130% of 44 | Brookings Co 345/115 tx # 2 or 1 | 0.3089 | | Install larger txs | 2.0 ea | 2,000 | 41,531 |
| 16 | 813 | 1200 | 2013 | Toronto-Burr 115 @ 110% of 144 | Brookings Co-Toronto 115 | 0.1500 | Conductor | Reconductor | 24.7 mi | 2,964 | 44,495 |
| | | | 2145 | | | | | | | 0 | 44,495 |
| | 946 | 1200 | 2146 | Sheyenne-Audubon 230 @ 110% of 318 | Wahpeton-Fergus Fls 230 | 0.0360 | Conductor | Reconductor | 43.9 mi | 5,268 | 49,763 |
| | 977 | 1200 | 2177 | Loon Tp-Eastwood 115 @ 110% of 310 | Lk Marion 345/115 tx | 0.0391 | Conductor | Add 2nd tx | 1.0 ea | 7,000 | 56,763 |
| | 1000 | 1200 | 2200 | Winnebago-Winnebago S 161 @ 110% of 16 | Prairie Island-Byron 345 | 0.0225 | ?? | | | 0 | 56,763 |
| | 1014 | 1200 | 2214 | Ft Ridgely-Franklin 115 @ 110% of 139 | Franklin-Helena 345 | 0.0280 | Conductor | Reconductor | 25.7 mi | 3,084 | 59,847 |
| | | | 2285 | | | | | | | 0 | 59,847 |
| 24 | 1086 | 1200 | 2286 | Wilmarth-Helena 345 @ 110% of 1165 | Franklin-Helena 345 | 0.3135 | Conductor | Reconductor | 39.0 mi | 7,020 | 66,867 |
| | 1225 | 1200 | 2425 | Winnebago-Winnebago S 161 @ 110% of 16 | Prairie Island-Byron 345 | 0.0347 | ?? | | | 0 | 66,867 |
| 1 | 1229 | 1200 | 2429 | Granite Falls-Willmar 230 @ 110% of 388 | Lyon Co-Franklin 345 | 0.0673 | Conductor | Reconductor | 31.0 mi | 3,720 | 70,587 |
| | 1289 | 1200 | 2489 | Loon Tp-Eastwood 115 @ 110% of 310 | Helena-Blue Lk 345 | 0.0477 | Conductor | Rebuild to 600 MV, | 22.0 mi | 11,000 | 81,587 |
| | 1303 | 1200 | 2503 | Ortonville-Johnson Jct 230 @ 110% of 390 | Hazel-Canby 230 | 0.0555 | Conductor | Install larger wire | 24.7 mi | 1,235 | 82,822 |
| | 1318 | 1200 | 2518 | Wahpeton-Fergus Fls 230 @ 110% of 320 | Sheyenne-Audubon 230 | 0.0420 | Term Equip | Replace equip | 2.0 ea | 200 | 83,022 |
| | 1518 | 1200 | 2718 | Johnson-Morris 230 @ 110% of 390 | Hazel-Canby 230 | 0.0555 | Conductor | Install larger wire | 15.4 | 770 | 83,792 |
| | 1555 | 1200 | 2755 | Triboji-Spencer 161 @ 110% of 195 | Wilmarth-Lakefield Gen 345 | 0.0373 | Conductor | Reconductor | 4.0 mi | 480 | 84,272 |
| | 1600 | 1200 | 2800 | (none) | | | | | | 0 | 84,272 |

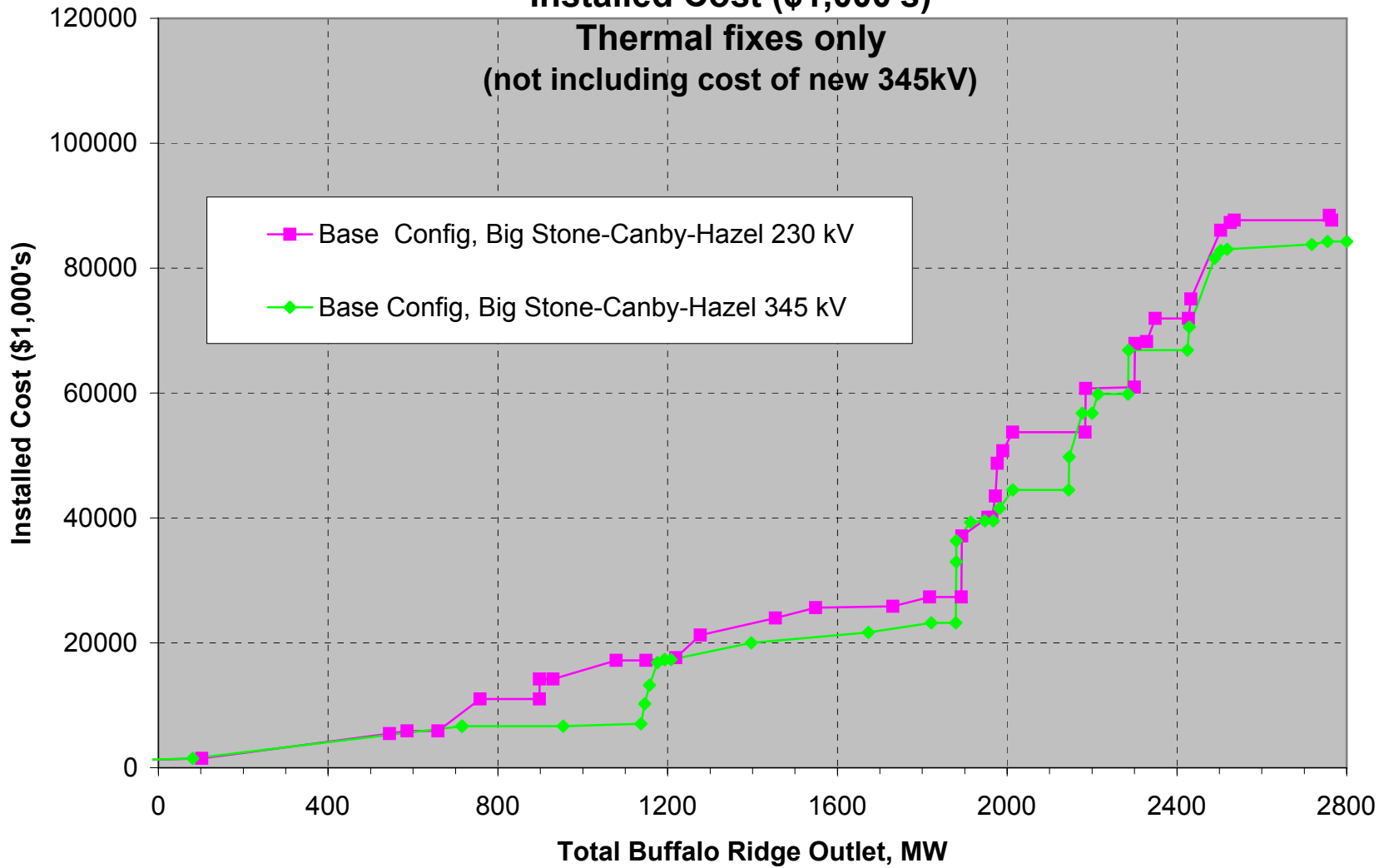
Notes

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).

R Gonzalez, PE

10/7/2005

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



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

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

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

| 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 |
| 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 M 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 tx | 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 | Winnnebago-Winnnebago S 161 @ 110% of 167 | Prairie Island-Byron 345 | 0.0244 | ?? | | | |
| | 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-Granite Falls/Minn Valley 230 kV.
8. Wilmarth-Helena 345 outage presumed to result in tripping of Wilmarth Calpine gen (cross-tripping scheme).