Appendix C NDEX Wind Injection

| Mon File - Con File - Exc File - | C:\MP-MH-EHV\Wark\Bison-Zion\MUST-Input\MP_MH_EHV.sub C:\MP-MH-EHV\Wark\Bison-Zion\MUST-Input\MP-MH.mon C:\MP-MH-EHV\Wark\Bison-Zion\MUST-Input\MP_MH_EHV-W1A.con | | Transfer To: EAST_MISO Transfer Level: 2000 MW Transfer Goal: 2000 MW System Intact DF 5.% | MW*DF as % of Line Rating Cutof | f: 9999.% |
|--|---|--|---|--|-----------|
| | | | Contingency DF 5.% | | |
| Transfer MW | Limiting Facility | Outage | DF% | Remedy | SM |
| -3560 | Roseau N-Roseau S Series Caps 500 kV at 110% of 1732 MVA (2000 amps) Owner(s): XCEL | Open 601061 DBCOMPN 500 667500 DORSEY 2 | 500 1 10.7 | DC Runback | 0 |
| | Zero Miles Roseau N-Roseau S Series Caps 500 kV | | | - | |
| -3490 | at 110% of 1732 MVA (2000 amps) Owner(s): XCEL | Open 601060 BISON 500 601062 DBCOMPS 5 | 001 10.7 | DC Runback | o |
| | Zero Miles Roseau N-Roseau S Series Caps 500 kV | | | | |
| -3490 | at 110% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | Open 501051 DBCOMPN 500 501052 DBCOMPS | 500 1 10.7 | DC Runback | ٥ |
| | Roseau N-Roseau S Series Caps 500 kV | The second se | | | - |
| -235 | at 110% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | Open 501045 ALEXSS3 345 501057 BISON 3 34 Open 501045 ALEXSS3 345 501057 BISON 3 34 | | DC Runback | ø |
| | Roseau N-Roseau S Series Caps 500 kV | | | | - |
| 185 | at 110% of 1732 MVA (2000 amps) Owner(s): XCEL | Open 601046 ALEXSS3 345 601047 QUARRY3 3 Open 601046 ALEXSS3 345 601047 QUARRY3 3 | | DC Runback | 0 |
| | Zero Miles Quarry-St. Cloud 115-kV | | | | 1 |
| 355 | at 100% of 239 MVA (1200 amps) Owner(s): XCEL | Open 501010 MNTCELO3 345 501047 QUARRY3 Open 501010 MNTCELO3 345 501047 QUARRY3 | | DC Runback | ٥ |
| | 19 Miles Roseau N-Roseau S Series Caps - 500 KV | | | | |
| 430 | at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | System Intact | 15.1 | Construct Bison-Brookings 345 kV line (to get 545.1 MW transfer) \$270M | \$270.0 |
| | Broadland 345/230 kV bx | | | | |
| 495 | at 120% of 400 MVA Owner(s): 559 | Open 652505 FTTHOMP3 345 659105 LELANDO3 | 345 1 7.3 | Upgrade To 572 MVA | \$8.00 |
| 510 | Huron-Broadland 230 kV at 120% of 400 MVA (1004 amps) Owner(s): WAPA | Open 652506 FTTHOMP3 345 659105 LELANDO3 | 345 1 7.3 | Upgrade to 1479 Amps (795 ACSS) | \$4.80 |
| | *3 Miles | | | | |
| 590 | Roseau N-Roseau S Series Caps: 500 kV at 110% of 1732 MVA (2000 amps) Owner(5): XCEL | Open 601046 ALEXSS3 345 601047 QUARRY3 3 Open 601046 ALEXSS3 345 601047 QUARRY3 3 | | | |
| | Zero Miles | a series of a second | · · · · · · · · · · · · · · · · · · · | - | |
| 377- | Quarry-St. Cloud 115 kV at 100% of 239 MVA (1200 amps) | Open 501010 MNTCELO3 345 501047 QUARRY3 | 345 1 | 1 | -0 |
| 700 | Owner(s): XCEL -9 Miles | Open 501010 MNTCELO3 345 501047 QUARRY3 | | DC Runback | 0 |
| | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) | | | | |
| 705 | Owner(s): XCEL | System Intact | 13.7 | Roseau Series Cap 2000 A Limit | |
| | Zero Miles Broadland 345/23D kV tx | | | | |
| 710 | at 120% of 400 MVA Owner(s): 659 | Open 659105 LELANDO3 345 659160 GROTON 3 | 3451 5.7 | | |
| | Arpin 345/138 kV Tx | Longer Contractor | | | 1.440 |
| 855 | at 113% of 336 MVA Owner(s): 591 Broadland 35/230 kV tx | Open Arpin-Rocky run 345 kV | 5.0 | Upgrade To 550 MVA | \$7.50 |
| 870 | at 100% of 400 MVA | System Intact | 5.3 | | |
| 22 | Owner(s): 559 | | | - | |
| 880 | Broadland 345/230 kV tx at 100% of 400 MVA | System Intact | 5.3 | | |
| | Owner(s): 659 | | | | - |
| 885 | Huron-Broadland 230 kV at 100% of 400 MVA (1004 amps) Owner(s): WAPA | System Intact | 5.3 | | |
| | ~3 Miles Huron-Broadland 230 kV | | | | - |
| 930 | at 120% of 400 MVA (1004 amps) Owner(s): WAPA | Open 559105 LELANDO3 - 345 659160 GROTON 3 | 3451 E.2 | | |
| | -3 Miles Coon Creek-Kohlman Lake 345 kV | | | 6 | 1 |
| 960 | at 100% of 717 MVA (1200 amps) Owner(s): XCEL ~15 Miles | Open Coon Creek-Terminal 345 kV | 6.9 | Upgrade (Terminal Equipment) | 5.50 |
| | "15 Milles Sigel-Arpin 138 kV" | | | P | |
| 1095 | at 100% of 287 MVA (1201 amps) Owner(s): 691 | Open Arpin-Rocky run 345 kV | 51 | Upgrade to 1394 Amps (795 ACSS) | \$7.85 |
| | 5.23 Miles Bismarck-Glenham 230 kV | | | | |
| 1120 | at 110% of 240 MVA (502 amps) Owner(s): WAPA ~97 Miles | Open 552505 FTTHOMP3 345 659105 LELANDO3 | 345 1 5.0 | Upgrade to 774 Amps (336 ACSS) | \$151.3 |
| | -97 Miles Quarry-St. Cloud 115 kV | Open 501010 MNTCELO3 345 601047 QUARRY3 | 345 1 | | |
| 1165 | at 100% of 239 MVA (1200 amps) Owner(s): XCEL | Open 501010 MNTCELO3 345 501047 QUARRY3 Change bus 557033 DORSEYS4 230 load by | 345 2 | Upgrade to 1704 Amps (954 ACSS) | \$9.09 |
| | "9 Miles Roseau N-Roseau S Series Caps 500 kV | dispatch | | | 1 |
| 1165 | at 210% of 1732 MVA (2000 amps) Owner(s)- XCEL | Open Ridgeway-Richer 230 kV | 14.2 | | 11.7 |
| | Zero Miles Roseau N-Roseau S Series Caps 500 kV | | - | £ | - |
| 1195 | at 110% of 1732 MVA (2000 amps) Owner(s): XCEL | Open Shannon-Running 230 kV | 14.2 | - | |
| | Zero Miles Roseau N-Roseau S Series Caps 500 kV | | | - | 1 |
| 1235 | kolselu n-kolseau Saries Laps Subikv at 110% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | Open 501045 ALEXSS3 345 501047 QUARRV3 3 Open 501045 ALEXSS3 345 501057 BISON 3 34 Open Alexandria 345/115 kV Tx | | Roseau Series Cap 2000 & Limit | |

| 1305 | Antelope Valley-Broadland 345 kV at 110% of 478 MVA (800 amps) Owner(s): 559 ~198 Miles | Open 552506 FTTHOMP3 345 659105 LELANDO3 345 1 | 5.9 | Upgrade to 1200 Amp (Terminal Equipment) | \$1.00M |
|------|---|--|------|--|-----------|
| 1435 | 652470 BISON 4 230 561047 HETINGR4 230 3 at 100% of 216.1 MVA (542 amps) Owner(s): WAPA | Open 552505 FTTHOMP3 345 659105 LELANDO3 345 1 | 5.6 | Upgrade to 522 Amps (266 ACSS) | \$\$7.35M |
| 1560 | Quarry 345/115 KV Tx at 115% of 448 MVA Dwner(s): XCEL | Open 501010 MNTCELO3 345 501047 QUARRY3 345 1 Open 501010 MNTCELO3 345 501047 QUARRY3 345 2 | 7.7 | DC Runback | o. |
| 1595 | Broadland 345/230 kV bx at 120% of 400 MVA Owner(s): 559 | Open 552529 WATERTN3 345 559150 GROTON 3 345 1 | 5.8 | | |
| 1605 | Huron-Forosciland 230 kV at 120% of 400 MVA (1004 amps) Owner(s): WAPA "3 Miles | Open 552529 WATERTN3 345 659160 GROTON 3 345 1 | 5.B | | 1.2 |
| 1635 | 52470 BISON 4 230 561047 HETINGR4 230 1 at 100% of 216.1 MVA (542 amps) Owner(s): WAPA | Open Antelope Valley-Broadland 345 kV | 5.4 | | |
| 1635 | 652470 BISON 4 230 661047 HETINGR4 230 1 at 100% of 215.1 MVA (542 amps) Owner(s): WAPA -37 Miles | Open Broadland 345/230 kV b: | 5.4 | | |
| 1635 | 65.470 BISON 4 230 661047 HETINGRA 230 3 at 100% of 215.1 MVA (542 amps) Owner(s): WAPA -37 Miles | Open Broadland 345/230 KV b: | 5,4 | | |
| 1635 | 652470 6ISON 4 230 561047 HETINGR4 230 1 at 100% of 215.1 MVA (542 amps) Owner (s): WAPA | Open Huron-Broadland 230 kV | 5.4 | | 1.7 |
| 1635 | Broadland 345/230 kV tx at 120% of 400 MVA Owner(s): 559 | Open Buffalo-Jamestown 345 kV | \$.7 | | |
| 1535 | Coon Creek-Kohiman Lake 345 kV at 100% of 717 MVA (1200 amps) Owner(s): XCEL -15 Miles | Open Coon Creek-Terminal 345 kV Open 601034 TERMINIA 345 60588 TERMID19 11010 Open 603110 TERMINIT 115 60588 TERMID19 11010 Open 605515 TERTER19 34.5 505585 TERMID19 11010 | 6,9 | | |
| 1650 | Electric Jct-Nelson 345 kV at 100% of 1234 MVA (2065 amps) Owner(s): N/A ~55 Miles | Open AS King-Eau Claire 345 kV Open Eau Claire-Argin 345 kV Open 7-corners-Wien 115 kV Open Council Creek-Timberwolf 59 kV Open Mauston-Hilltop 59 kV | 12.9 | Upgrade to (2-795 ACSS) | \$159.04 |
| 1650 | Huron-Broadland 230 kV at 120% of 400 MVA (1004 amps) Owner(s): WAPA -3 Miles | Open Buffalo-Jamestown 345 KV | 5.7 | | 11 |
| 1655 | Antelope Valley-Broadland 345 kV at 110% of 478 MVA (800 amps) Dwner(s): 559 | Open 559105 LELANDO3 345 659160 GROTON 3 345 1 | £.2 | | |
| 1650 | Electric Jct-Nelson 345 kV at 100% of 1234 MVA (2005 amps) Owner(s): NA | Open Eau Claire-Arpin 345 kV Open T-Corners-Wien 135 kV Open Council Creek-Timberwalf 59 kV Open Maustan-Hilltop 59 kV | 12.9 | | 1 |
| 1675 | Electric Jct-Nelson 345 KV at 100% of 1234 MVA (2065 amps) Owner(s): N/A ~55 Miles | Open AS King-Eau Claire 345 kV Open EB2 Claire-Arpin 345 kV Open ES2705 WIEN 115 ES9710 STRATFRO 115 1 Open Council Creek-Timberwolf 65 kV Open Maustan-Hiltop 95 kV Open 880242 UBLIN 59 0 880505 LAKEHEAD 69.0 1 | 12.7 | | |
| 1675 | Electric Jct-Nelson 345 kV at 100% of 1234 MVA (2065 amps) Owner(s): N/A ~SS Miles | Open AS King-Eau Claire 345 kV Open E89 Claire-Arpin 345 kV Open 699 700 KVTKN 115 599 710 STRATFRD 115 1 Open Council Creek-Timberwolf 59 kV Open Maustan-Hiltop 59 kV Open 880 242 UBUIN 59 0 580 505 LAKEHEAD 59.0 1 | 12.7 | | Л |
| 1700 | Electric Jct-Nelson 345 KV at 100% of 1234 MVA (2065 amps) Owner(s): N/A ~55 Miles | Open Eau Claire-Arpin 345 kV Open 599705 WIEN 115 599710 STRATFRD 115 1 Open Council Creek-Timberwolf 59 kV Open Mauston-Hilltop 59 kV Open 680242 (UBLIN 59 05 680505 LAKEHEAD 59:01 | 12,7 | | |
| 1780 | Broadland 345/230 kV tx at 120% of 400 MVA Owner(s): 559 | Open Jamestown-Center 345 kV | 5.5 | | |
| 1795 | Huron-Broadland 230 kV at 20% of 400 MVA (1004 amps) Owner(s): WAPA "3 Miles | Open Jamestown-Center 345 kV | 5.6 | | |
| 1805 | Whitlock-Glenham 230 kV at 10% of 240 MVA (502 amps) Owner(s): WAPA -39 Miles | Open 552506 FTTHOMP3 345 559105 LELANDO3 345 1 | 5,6 | Upgrade to 590 Amps (336 ACSS) | \$60.84M |
| 1875 | Sully Buttes-Whitlock 230 kV a1 10% of 240 MVA (602 amps) Owner(s): WAPA ~22 Miles | Open 552505 FTTHOMP3 345 559105 LELANDO3 345 1 | 5.9 | Upgrade to 681 Amps (336 ACSS) | \$34.32 |
| 1955 | Oshe-Sully Buttes 230 kV at 10% of 240 MVA (602 amps) Owner(s): WAPA ~20 Miles | Open 652506 FTTHOMP3 345 659105 LELANDO3 345 1 | 6.2 | Upgrade to 670 Amps (336 ACSS) | \$31.200 |
| 1995 | Chisago County 500/345/34.5 KV Tx #10 st 115% of 1203 MVA Owner(s): XCEL | Open Chisago County 500/345/34.5 KV Tx #9 | 14,1 | Upgrade To Beyond Single Tx | \$25.004 |
| 1995 | Chisago County 500/345/34.5 KV Tx #9 at 115% of 1203 MVA Owner(s): XCEL | Open Chikago County 500/345/34.5 kV Tx #10 | 14.1 | Upgrade To Beyond Single Tx | \$25.006 |

| ase File - ub File - fon File - on File - xc File - | C:\MP-MH-EHV\Work\Bison-Zion\Bison-Zion\PF\MH_SUPK_B_Y1BssND.sav C:\MP-MH-EHV\Work\Bison-Zion\MUST-hput\MP_MH_EHV.sub C:\MP-MH-EHV\Work\Bison-Zion\MUST-hput\MP_MH_EHV-Y1B.con C:\MP-MH-EHV\Work\Bison-Zion\MUST-hput\MP_MH_EHV-Y1B.con C:\MP-MH-EHV\Work\Bison-Zion\MUST-hput\MP-MH_Exclude.exc | | Transfer From: NDEX-Load Transfer To: EAST_MISC Transfer Level: 2000 MW Transfer Goal: 2000 MW System Infact DF 5.% Contingency DF 5.% | | ff: 9999.% |
|---|--|---|---|--|------------|
| Transfer MW | Limiting Facility | Outage | DF% | Remedy | SM |
| 665 | Chisago County 500/345/34.5 kV Tx #10 at 115% of 1203 MVA | Once Chicago County EOD/24E/24 E MITH #0 | 120 | Linnada Ta Bayand Carda Tu | 535 0044 |
| 665 | Owner(s): XCEL | Open Chisago County 500/345/34.5 kV Tx #9 | 12,0 | Upgrade To Beyond Single Tx | \$25.00M |
| 665 | Chicago County 500/345/34.5 kV Tx 29 at 115% of 1203 MVA | Open Chisago County 500/345/34.5 KV Tx #10 | 12.0 | Upgrade To Beyond Single Tx | \$25.00M |
| 665 | Owner(s): XCEL | open charge county see stars at 1 x 20 | | epgrade to beyond single th | 525.000 |
| 685 | Broadland 345/230 kV tx at 120% of 400 MVA | Open 552505 FTTHOMP3 345 659105 LELANDO3 | 345 1 7.6 | Upgrade To 672 MVA | \$8.00M |
| | Owner(s): 659 | | 0.042 | | - ALCONY |
| - A - | Huron-Broadland 230 kV at 120% of 400 MVA (1804 amps) | and manufactures and been a second | | and the second second second second | 10000 |
| 695 | Owner(s): WAPA *3 Miles | Open 652505 FTTHOMP3 345 659105 LELANDO3 | 345 1 7.6 | Upgrade to 1453 Amps (795 ACSS) | \$4.80M |
| | Broadland 345/230 kV tx | | Seat 1 Links | | |
| 890 | at 120% of 400 MVA Owner(s): 659 | Open 659105 LELANDO3 345 659160 GROTON 3 | 3451 7.0 | | |
| | Huron-Broadland 230 kV | | 21 - 17 Page | | |
| 905 | at 120% of 400 MVA (1004 amps) Owner(s): WAPA | Open 659105 LELANDO3 345 659160 GROTON 3 | 345 1 7,0 | | |
| | *3 Miles Recording 345/380 W/tv | | | | |
| 915 | Broadland 345/230 kV tx at 100% of 400 MVA | System Intact | 5.B | | 1.1.1.1 |
| | Owner(s): 659 Huron-Broadland 230 kV | | | | |
| 930 | at 100% of 400 MVA (1004 amps) | System Intact | 5.8 | | |
| | Owner(s): WAPA ~3 Miles | | | 1 | |
| | Blackberry-Boswell 230 2 | | 11 20 | and a ball of the | 1 Autor |
| 1060 | at 110% of 399 MVA (1002 amps) Owner(s): MP | Open Blackberry-Boswell 230 1 | 5.8 | Upgrade to 1235 Amps (636 ACSS) | 528.62M |
| | - 18 Miles Bismarck-Glenham 230 kV | | | | |
| 1185 | at 110% of 240 MVA (602 amps) | Open 552506 FTTHOMP3 345 559105 LELANDO3 | 345 1. 5.6 | Upgrade to 777 Amps (336 ACSS) | \$151.32M |
| 0000 | Owner(s): WAPA -97 Miles | | (C.D.) | | |
| 1230 | Arpin 345/138 kV Tx at 113% of 336 MVA | Open Arpin-Rocky run 345 KV | 5.6 | Upgrade To 448 MVA | \$5.00M |
| | Owner(s): 691 | open alpha nacey ten ses tr | | Spanner in separate | |
| 1.70 | Antelope Valley-Broadland 345 kV at 110% of 478 MVA (800 amps) | Section of the section of the section of the | aba linat | | 10000 |
| 1295 | Owner(s): 659 | Open 552505 FTTHOMP3 345 659105 LELANDO3 | 345 1 7.6 | Upgrade to 1200 Amp (Terminal Equipment) | \$1.00M |
| | ~198 Miles 652470 BISON 4 230 661047 HETINGR4 230 1 | | | | - |
| 1465 | at 100% of 216.1 MVA (542 amps) Owner(s)- WAPA | Open 652506 FTTHOMP3 345 659105 LELANDO3 | 345 1 5.9 | Upgrade to 622 Amps (266 ACSS) | \$57.35M |
| | ~37 Miles | | | | |
| 1495 | Broadland 345/230 kV tx at 120% of 400 MVA. | Open 552529 WATERTN3 345 659160 GROTON 3 | 3451 5.5 | | |
| | Owner(s): 659 Huron-Broadland 230 kV | | | | - |
| 1505 | at 120% of 400 MVA (1004 amps) | Open 652529 WATERTN3 345 659160 GROTON 3 | 3451 6.5 | | |
| | Owner(s): WAPA ~3 Miles | | | | |
| | Antelope Valley-Broadland 345 kV | | - 14 H | - C | |
| 1555 | at 110% of 478 MVA (800 amps) Owner(s): 559 | Open 659105 LELANDO3 345 659160 GROTON 3 | 3451 7.0 | | |
| - | ~198 Miles Bismarck-Glenham 230 KV | | | | - |
| 1630 | at 110% of 240 MVA (502 amps) | Open Antelope Valley-Broadland 345 kV | 51 | | |
| | Owner(s): WAPA ~97 Miles | | | | |
| | Bismarck-Glenham 230 KV at 210% of 240 MVA (602 amps) | the second second | 1 | | |
| 1630 | Owner(s): WAPA | Open Broadland 345/230 kV tx | 5.1 | | |
| | ~97 Miles Bismarck-Glenham 230 kV | | | | 1 |
| 1630 | at 110% of 240 MVA (602 amps) Owner(s): WAPA | Open Broadland 345/230 kV tx | 5.1 | | |
| 211 | -97 Miles | | | | - |
| - 222 | Bismarck-Glenham 230 kV at 110% of 240 MVA (502 amps) | 1 | 101 | | |
| 1635 | Owner(s): WAPA -97 Miles | Open Huron-Broadland 230 kV | 5.1 | | |
| - | 652470 BISON 4 230 661047 HETINGR4 230 1 | | | | |
| 1650 | at 100% of 215.1 MVA (542 amps) Owner(s): WAPA | Open Antelope Valley-Broadland 345 kV | 5.7 | | |
| | -37 Miles 652470 BISON 4 230 651047 HETINGR4 230 1 | | | | |
| 1650 | at 100% of 216.1 MVA (542 amps) | Open Broadland 345/230 kV tx | 5.7 | | |
| 1000 | Owner(s): WAPA ~37 Miles | | 2.7 | | |
| | 652470 BISON 4 230 561047 HETINGR4 230 1 | | - | - | |
| 1650 | at 100% of 215.1 MVA (542 amps) Owner(s): WAPA | Open Broadland 345/230 KV tx | 5.7 | | |
| | ~37 Miles 652470 BISON 4 230 551047 HETINGR4 230 9 | | | | |
| 1650 | at 100% of 215.1 MVA (542 amps) | Open Huron-Broadland 230 kV | 5.7 | | |
| 0.000 | Owner(s): WAPA ~37 Miles | Contraction of the second s | | | |
| 1680 | Broadland 345/230 KV tx at 120% of 400 MVA | Open Buffalo-Jamestown 345 kV | 5.0 | | |
| 1000 | Owner(s): 659 | Sken pundursanitstawn 343 KV | 2.0 | S | 1000 |
| No. | Huron-Broadland 230 kV at 120% of 400 MVA (1004 amps) | | | | |
| 1590 | Owner(s): WAPA | Open Buffalo-Jamestown 345 KV | 5.0 | | 1.0.00 |

| 1770 | Electric Jct-Neison 345 kV at 100% of 1234 MVA (2065 amps) Owner(s): N/A -55 Miles | Open AS King-Esa Ukine 345 KV Open Esa Ukine-Arpin 345 KV Open 7-Corners-Wien 115 kV Open Council Creek-Timberwolf 69 kV Open Mauston-Hiltico 59 kV | 12.7 | Upgrade to (2-795 ACSS) | \$159.04 |
|------|--|---|------|--------------------------------|----------|
| 1775 | Electric Ict-Nelson 345 kV at 100% of 1234 MVA (2065 amps) Owner(s): N/A ~55 Miles | Open Eau Claire-Arpin 345 KV Open T-Corners/Wien 115 KV Open Council Creek-Timberwolf 65 KV Open Muston-Hilliop 69 KV | 12.7 | | |
| 1780 | Broadland 345/230 kV tx at 120% of 400 MVA Dwner(s): 559 | Open Bismarck-Glenham 230 KV | 6,4 | | |
| 1790 | Electric Jct-Nelson 345 kV at 100% of 1234 MVA (2065 amps) Owner(s): N/A ~56 Miles | Open AS King-Eau Claire 345 kV Open Eau Claire-Arpin 345 kV Open 699706 WICH 115 699710 STRATFRD 315 1 Open Council Creek-Timberwolf 59 kV Open Mauston-Hilliop 59 kV Open 680242 LUBLIN 55.0 680505 LAKEHEAD 59.0 1 | 12.5 | | |
| 1790 | Huron-Broadland 230 kV at 120% of 400 MVA (1004 amps) Owner(s): WAPA -3 Miles | Open Bismarck-Glenham 230 kV | 6.4 | | |
| 1790 | Whitlock-Glenham 230 kV at 110% of 240 MVA (502 amps) Owner(s): WAPA "39 Miles | Open 552505 FTTHOMP3 345 659105 LELANDO3 345 1 | 5.2 | Upgrade to 595 Amps (336 ACSS) | \$50.841 |
| 1810 | Electric Jct-Nelson 345 kV at 100% of 1234 MVA (2065 amps) Owner(s): N/A -56 Miles | Open Eau Claire-Arpin 345 kV Open E99706 WIRN 115 699710 STRATFRD 115 1 Open Council Creek-Timberwolf 59 kV Open Mauston-Hillop 69 kV Open 6800474 LUBLIN 55.0 680505 LAKEHEAD 69.0 1 | 12.5 | | |
| 1850 | Sully Buttes-Whitlock 230 kV at 110% of 240 MVA (602 amps) Owner(s): WAPA ~22 Miles | Open 652506 FTTHOMP3 345 659105 LELANDO3 345 1 | 5.5 | Upgrade to 587 Amps (336 ACSS) | \$34.32 |
| 1855 | Electric Int-Nelson 345 kV at 100% of 1334 MVA (2065 amps) Owner(s): N/A ~56 Miles | Open Arrowhead-Stone Lake 345 KV | 12.2 | | |
| 1925 | Garrison-Jamestown 230 kV at 110% of 318 MVA (798 amps) Owner(s): WAPA -138 Milles | Open 552441 GARRISN4 250 559284 HILKEN 4 230 1 Open Garrison-Leland Okis 230 kV | 5.1 | Upgrade to 888 Amps (477 ACSS) | \$175.26 |
| 1925 | Oahe-Sully Buttes 230 kV at 110% of 240 MVA (602 amps) Owner(s): WAPA ~20 Miles | Open 552505 FTTHOMP3 345 659305 LELANDO3 345 1 | 5,8 | Upgrade to 576 Amps (336 ACSS) | \$31.20 |

Appendix D Costs

The costs used in this study are based on engineering judgment. Costs used in various studies were updated based on feedback of actual construction costs from various sources. The costs used are in 2012 dollars.

The cost used for line rebuilds and reconductor is shown below.

| kV | \$M/mile |
|------|----------|
| 0 | 0.2 |
| 41.6 | 0.4 |
| 69 | 0.75 |
| 115 | 0.75 |
| 138 | 0.8 |
| 161 | 1 |
| 230 | 1.3 |
| 345 | 2.8 |
| 500 | 4 |
| 765 | 5 |

The cost used for transformer replacement is shown below.

| MVA | \$M |
|------|-----|
| 0 | 1.2 |
| 70 | 1.4 |
| 112 | 1.6 |
| 187 | 2 |
| 224 | 4 |
| 336 | 6 |
| 448 | 7.5 |
| 550 | 8 |
| 672 | 9 |
| 800 | 20 |
| 1203 | 25 |
| 9999 | 30 |

The build out cost for the Fargo and Iron Range Options are shown below:

| West Option | Units | Cost \$M | Total | East Option | Units | Cost \$M | Total |
|--|-------|----------|-------|--|-------|----------|--------|
| WIA | | | | A1A | | | |
| Dorsey-Bison 500 kV line 50% series compensated | 250 | 3.3 | 825 | Dorsey-Blackberry 500 kV line 50% series compensated | 275 | 3.3 | 907.5 |
| Bison 500/345 kv Tx #1 & #2 | 2 | 80 | 16 | Blackberry 500/345 kV Tx #1 & #2 | 2 | 80 | 16 |
| | | | 0 | Blackberry-Arrowhead 345 kv lines #1 & #2 | 20 | 2.5 | 175 |
| | | | 0 | Blackberry 345/230 kV TX | 1 | 9 | 9 |
| Bison-Alexandria-Quarry-Monticello 345 kV line #2 | 203.2 | 0.5 | 101.6 | Bison-Alexandria-Quarry-Monticello 345 kV line #2 | 203.2 | 0.5 | 101.6 |
| | | | | | | | |
| Total | | | 942.6 | Total | | | 1206.1 |
| WIAP | | | | _ | | | |
| W1 with phase shirt transformer (PST) on Glenboro-Harvey 230 kV line at Glenboro | 1 | 10 | 10 | - | 1 | 10 | 10 |
| Dorsey-Bison 500 kV line 50% series compensated | 250 | 3.3 | 825 | Dorsey-Blackberry 500 kV line 50% series compensated | 275 | 3.3 | 907.5 |
| Bison 500/345 kv Tx #1 & #2 | 2 | 80 | 16 | Blackberry 500/345 kVTx #1 & #2 | 2 | 80 | 16 |
| | | | 0 | Blackberry-Arrowhead 345 kv lines #1 & #2 | 20 | 2.5 | 175 |
| | | | _ | | H | 9 | _ |
| Bison-Alexandria-Quarry-Monticello 345 kV line #2 | 203.2 | 0.5 | 101.6 | Bison-Alexandria-Quarry-Monticello 345 kV line #2 | 203.2 | 0.5 | 101.6 |
| Total | | | 952.6 | Total | | | 1216.1 |
| W1B | | | | YIB | | | |
| W1 without Bison-Alexandria-Quarry-Monticello 345 kV line #2 | | | 0 | Y1 without Bison-Alexandria-Quarry-Monticello 345 kV line #2 | | | 0 |
| Dorsey-Bison 500 kV line 50% series compensated | 250 | 3.3 | 825 | Dorsey-Blackberry 500 kV line 50% series compensated | 275 | 3,3 | 907.5 |
| Bison 500/345 kv Tx #1 & #2 | 2 | 80 | - | | 2 | 80 | 16 |
| | | | 0 | 1221 | 20 | 2.5 | 17 |
| | | | | Blackberry 345/230 kV TX | 1 | 9 | 9 |
| | | | 0 | | | | |
| Total | | | 841 | Total | | | 1104.5 |
| WIC | | | | Y1C | | | |
| W1 with MVP not already in case added | | | 0 | Y1 with MVP not already in case added | | | 0 |
| Dorsey-Bison 500 kV line 50% series compensated | 250 | 3.3 | 825 | Dorsey-Blackberry 500 kV line 50% series compensated | 275 | 3.3 | 907.5 |
| Bison 500/345 kv Tx #1 & #2 | 2 | 8 | 16 | Blackberry 500/345 kVTx #1& #2 | 2 | 80 | 16 |
| | | | 0 | Blackberry-Arrowhead 345 kv lines #1 & #2 | 70 | 2.5 | 175 |
| | | | 0 | Blackberry 345/230 kV TX | 1 | 9 | 9 |
| Bison-Alexandria-Quarry-Monticello 345 kV line #2 | 203.2 | 0.5 | 101.6 | Bison-Alexandria-Quarry-Monticello 345 kV line #2 | 203.2 | 0.5 | 101.6 |
| Total | | | 942.6 | Total | | | 1206.1 |
| W2A | | | | Y2A | | | |
| Dorsey-Bison 500 kV line 50% series compensated | 250 | 3.3 | 825 | Dorsey-Blackberry 500 kV line 50% series compensated | 275 | 3.3 | 907.5 |
| Bison 500/345 kv Tx #1 | F | 80 | 80 | Blackberry 500/345 kV Tx #1 & #2 | 2 | 80 | 16 |
| | | | 0 | Blackberry-Arrowhead 345 kv lines #1 & #2 | 70 | 2.5 | 175 |
| | | | 0 | Blackberry 345/230 kV TX | -1 | 9 | 9 |
| Bison-Brookings County 500 kV line 50% series compensated | 180 | 3.3 | 594 | - | 180 | 3.3 | 594 |
| Brooking County 500/345 kV Tx #1 & #2 | 2 | 8 | 16 | Brooking County 500/345 kV Tx #1 & #2 | 2 | 8 | 16 |

| 1014 | | | 2444 | 0181 | | | P-47 /T |
|---|-----|-----|--------|---|-----|-----|---------|
| W2B | | | | Y2B | | | |
| Dorsey-Bison 500 kV line 50% series compensated | 250 | 3.3 | 825 | Dorsey-Blackberry 500 kV line 50% series compensated | 275 | 3.3 | 907.5 |
| Bison 500/345 kv Tx #1 | 1 | 80 | 80 | Blackberry 500/345 kVTx #1 & #2 | 2 | 80 | 16 |
| | | | 0 | Blackberry-Arrowhead 345 kv lines #1 & #2 | 70 | 2.5 | 175 |
| | | | 0 | Blackberry 345/230 kV TX | 1 | 9 | 9 |
| Bison-Brookings County345 kV line | 180 | 1.5 | 270 | Bison-Brookings County 345 kV line | 180 | 1.5 | 270 |
| Total | | | 1103 | Total | | | 1374.5 |
| W6A | | | | YEA | | | Ì |
| Dorsey-Bison 500 kV line 50% series compensated | 250 | 3.3 | 825 | Dorsey-Blackberry 500 kV line 50% series compensated | 275 | 3.3 | 907.5 |
| Bison 500/345 kv Tx #1 | 1 | 80 | 80 | Blackberry 500/345 kVTx#1 & #2 | 2 | 80 | 16 |
| | | | 0 | Blackberry-Arrowhead 345 kv lines #1 & #2 | 70 | 2.5 | 175 |
| | | | 0 | Blackberry 345/230 kV TX | H | 9 | 9 |
| Bison-Brookings County 500 kV line 50% series compensated | 180 | 3.3 | 594 | Bison-Brookings County 500 kV line 50% series compensated | 180 | 3.3 | 594 |
| Brooking County 500/345 kV Tx #1 & #2 | 2 | 80 | 16 | Brooking County 500/345 kV Tx #1 & #2 | 2 | 80 | 16 |
| Brooking County-Split Rock 500 kV line | 60 | m | 180 | Brooking County-Split Rock 500 kV line | 60 | æ | 180 |
| Split Rock 500/345 kV TX #1 & #2 | 2 | 80 | 16 | Split Rock 500/345 kV TX #1 & #2 | 2 | 80 | 16 |
| Bison-Alexandria-Quarry-Monticello 345 kV line #2 | 203 | 0.5 | 101.5 | Bison-Alexandria-Quarry-Monticello 345 kV line #2 | 203 | 0.5 | 101.5 |
| Hazel Creek-Panther-McLeod-Blue Lake 345 kV line #1 & #2 | III | 2.5 | 277.5 | Hazel Creek-Panther-McLeod-Blue Lake 345 kV line #1 & #2 | 111 | 2.5 | 277.5 |
| Corridor Txs | 2 | m | 9 | Corridor Txs | 2 | m | 9 |
| Brookings County-Lyon County 345 kV line #2 | 50 | 0.5 | 25 | Brookings County-Lyon County 345 kV line #2 | 50 | 0.5 | 25 |
| Helena-Lake Marion-Hampton Corner 345 kV line #2 | 198 | 0.5 | 66 | Helena-Lake Marion-Hampton Corner 345 kV line #2 | 198 | 0.5 | 66 |
| Total | | | 2148 | Total | | | 2419.5 |
| W6B | | | | Y6B | | | |
| Dorsey-Bison 500 kV line 50% series compensated | 250 | 3.3 | 825 | Dorsey-Blackberry 500 kV line 50% series compensated | 275 | 3.3 | 907.5 |
| Bison 500/345 kv Tx #1 | 1 | 80 | 80 | Blackberry 500/345 kV Tx #1 & #2 | 2 | 80 | 16 |
| | | | | Blackberry-Arrowhead 345 kv lines #1 & #2 | 70 | 2.5 | 175 |
| | | | - | Blackberry 345/230 kV TX | 1 | 9 | 9 |
| Bison-Alexandria-Quarry-Monticello 345 kV line #2 | 203 | 0.5 | 101.5 | Bison-Alexandria-Quarry-Monticello 345 kV line #2 | 203 | 0.5 | 101.5 |
| Hazel Creek-Panther-McLeod-Blue Lake 345 kV line #1 & #2 | III | 2.5 | 277.5 | Hazel Creek-Panther-McLeod-Blue Lake 345 kV line #1 & #2 | 111 | 2.5 | 277.5 |
| Corridor Txs | 2 | m | 9 | Corridor Txs | 2 | m | 9 |
| Brookings County-Lyon County 345 kV line #2 | 57 | 0.5 | 28.5 | Brookings County-Lyon County 345 kV line #2 | 57 | 0.5 | 28.5 |
| Helena-Lake Marion-Hampton Corner 345 kV line #2 | 80 | 0.5 | 40 | Helena-Lake Marion-Hampton Corner 345 kV line #2 | 80 | 0.5 | 40 |
| Total | | - | 1286.5 | Total | | | 1558 |

Appendix E Iron Range Option With Fargo Tap Sensitivity

E.1 Summary

The scenario of a tap on the Winnipeg-Iron Range line going to Fargo was added to the eastern configuration and studied.

E.1.1 Fargo Injection

The most limiting first contingency incremental transfer for the Fargo wind injection is shown in Table E.1-1.

| Option | MW | Limiting Facility | Outage | Case |
|---------------------|------|-------------------------------|---|------|
| West | -240 | Bison-Maple River 230 kV line | Bison-Maple River 345 kV line | W1B1 |
| East | 670 | Bison-Maple River 230 kV line | Bison-Maple River 345 kV line Maple River 345/230 kV tx 2 Maple River 345/230 kV tx 1 | Y1B1 |
| East with Fargo Tap | -340 | Stone Lake 345/161 kV Tx | Stone Lake-Gardner Park 345 kV line | T1B1 |

Table E.1-1 Worst Case Limiters Fargo Wind Injection

Eastern 500 kV Line with Fargo Tap

The Eastern 500 kV with Fargo Tap provides a path that balances the 500 kV lines from Manitoba better than without the Fargo Tap. The tap line provides a path parallel to the CapX Fargo-Twin Cities to get wind injection out of the Red River Valley. Higher levels of wind injection can be reached before additional transmission lines are required. Being the power has a more direct connection to the Arrowhead area, the Roseau capacitors and Stone Lake transformers need upgrading, which is not required without the Fargo Tap line.

E.1.2 Fargo/Brookings County Injection

The most limiting first contingency incremental transfer for the Fargo/Brookings wind injection is shown in Table E.1-2.

| Option | MW | Limiting Facility | Outage | Case |
|---------------------|------|-------------------------------|----------------------------------|------|
| West | -530 | Bison-Maple River 230 kV line | Bison-Maple River 345 kV line | W1B2 |
| East | 1130 | Split Rock-White 345 kV line | Brookings Co-Lyon Co 345 kV line | Y1B2 |
| East with Fargo Tap | 1125 | Split Rock-White 345 kV line | Brookings Co-Lyon Co 345 kV line | T1B2 |

Table E.1-2 Worst Case Limiters Fargo/Brookings Wind Injection

Eastern 500 kV Line with Fargo Tap

The Eastern Line with Fargo Tap provides for more wind injection with less transmission improvements then the western line but slightly less than the eastern line without the tap. The benefit of the eastern line with the Fargo tap is it ties the Red River Valley into the eastern side of Minnesota for wind injection while providing Manitoba power to the Red River Valley when needed.

E.2 Study Options

For the purpose of this study, there were three main transmission options: the west (Bison) or east (Blackberry) 500 kV lines coming out of Dorsey and the east (Blackberry) 500 kV line with a 345 kV line from Fargo tapping the Dorsey to Blackberry 500 kV line. The cases studied are listed in Table E.2-1 Study Options. With the wind injection at the Bison 345 kV bus or at the Bison and Brooking County 345 kV buses.

| Fargo Option | Iron Range Option | Iron Range with Fargo Tap Option |
|---|--|--|
| W1A | Y1A | TIA |
| Dorsey-Bison 500 kV line 50% series compensated Bison 500/345 kv Tx #1 & #2 Bison-Alexandria-Quarry-Monticello 345 kV line #2 | Dorsey-Blackberry 500 kV line 50% series compensated Blackberry 500/345 kV Tx #1 & #2 Blackberry-Arrowhead 345 kv lines #1 & #2 Blackberry 345/230 kV TX Bison-Alexandria-Quarry-Monticello 345 kV line #2 | Dorsey-Blackberry 500 kV line 50% series compensated Blackberry 500/345 kV Tx #1 & #2 Blackberry-Arrowhead 345 kv lines #1 & #2 Blackberry 345/230 kV TX Bison-Alexandria-Quarry-Monticello 345 kV line #2 T Tap-Bison 345 kv lines #1 & #2 |
| | The second s | T Tap 345/230 kV TX |
| W1AP W1 with phase shirt transformer (PST) on Glenboro-Harvey 230 kV line at Glenboro | Y1AP Y1 with phase shirt transformer (PST) on Glenboro-Harvey 230 kV line at Glenboro | |
| Dorsey-Bison 500 kV line 50% series compensated Bison 500/345 kv Tx #1 & #2 | Dorsey-Blackberry 500 kV line 50% series compensated Blackberry 500/345 kV Tx #1 & #2 Blackberry-Arrowhead 345 kv lines #1 & #2 Blackberry 345/230 kV TX | |
| Bison-Alexandria-Quarry-Monticello 345 kV line #2 | Bison-Alexandria-Quarry-Monticello 345 kV line #2 | |
| W1 Without Bison-Alexandria-Quarry-Monticello 345 kV line #2 | Y1B Y1 without Bison-Alexandria-Quarry-Monticello 345 kV line #2 | T1B Y1 without Bison-Alexandria-Quarry-Monticello 345 kV line #2 + T Tap |
| Dorsey-Bison 500 kV line 50% series compensated Bison 500/345 kv Tx #1 & #2 | Dorsey-Blackberry 500 kV line 50% series compensated Blackberry 500/345 kV Tx #1 & #2 Blackberry-Arrowhead 345 kv lines #1 & #2 Blackberry 345/230 kV TX | Dorsey-Blackberry 500 kV line 50% series compensated Blackberry 500/345 kV Tx #1 & #2 Blackberry-Arrowhead 345 kv lines #1 & #2 Blackberry 345/230 kV TX T Tap-Bison 345 kv lines #1 & #2 T Tap 345/230 kV TX |
| W1C | YIC | |
| W1 with MVP not already in case added | Y1 with MVP not already in case added | / |
| Dorsey-Bison 500 kV line 50% series compensated | Dorsey-Blackberry 500 kV line 50% series compensated | |

Table E.2-1 Study Options

| Bison 500/345 kv Tx #1 & #2 Bison-Alexandria-Quarry-Monticello 345 kV line #2 | Blackberry 500/345 kV Tx #1 & #2 Blackberry-Arrowhead 345 kv lines #1 & #2 Blackberry 345/230 kV TX Bison-Alexandria-Quarry-Monticello 345 kV line #2 | |
|---|---|--|
| W2A | YZA | |
| Dorsey-Bison 500 kV line 50% series compensated Bison 500/345 kv Tx #1 Bison-Brookings County 500 kV line 50% series compensated Brooking County 500/345 kV Tx #1 & #2 | Dorsey-Blackberry 500 kV line 50% series compensated Blackberry 500/345 kV Tx #1 & #2 Blackberry-Arrowhead 345 kv lines #1 & #2 Blackberry 345/230 kV TX Bison-Brookings County 500 kV line 50% series compensated Brooking County 500/345 kV Tx #1 & #2 | |
| W2B | У2В | Т2В |
| Dorsey-Bison 500 kV line 50% series compensated Bison 500/345 kv Tx #1 Bison-Brookings County345 kV line | Dorsey-Blackberry 500 kV line 50% series compensated Blackberry 500/345 kV Tx #1 & #2 Blackberry-Arrowhead 345 kv lines #1 & #2 Blackberry 345/230 kV TX Bison-Brookings County 345 kV line | Dorsey-Blackberry 500 kV line 50% series commenced end Blackberry 500/345 kV Tx #1 & #2 Blackberry-Arrowhead 345 kv lines #1 & #2 Blackberry 345/230 kV TX Bison-Brookings County 345 kV line T Tap-Bison 345 kv lines #1 & #2 T Tap 345/230 kV TX |
| W6A | Y6A | |
| Dorsey-Bison 500 kV line 50% series compensated Bison 500/345 kv Tx #1 | Dorsey-Blackberry 500 kV line 50% series compensated Blackberry 500/345 kV Tx #1 & #2 Blackberry-Arrowhead 345 kv lines #1 & #2 Blackberry 345/230 kV TX | |
| Bison-Brookings County 500 kV line 50% series compensated | Bison-Brookings County 500 kV line 50% series compensated | |
| Brooking County 500/345 kV Tx #1 & #2 | Brooking County 500/345 kV Tx #1 & #2 | |
| Brooking County-Split Rock 500 kV line | Brooking County-Split Rock 500 kV line | |
| Split Rock 500/345 kV TX #1 & #2 | Split Rock 500/345 kV TX #1 & #2 | |
| Bison-Alexandria-Quarry-Monticello 345 kV line #2 | Bison-Alexandria-Quarry-Monticello 345 kV line #2 | |
| Hazel Creek-Panther-McLeod-Blue Lake 345 kV line #1 & #2 | Hazel Creek-Panther-McLeod-Blue Lake 345 kV line #1 & #2 | |

| Corridor Txs Brookings County-Lyon County 345 kV line #2 Helena-Lake Marion-Hampton Corner 345 kV line #2 | Corridor Txs Brookings County-Lyon County 345 kV line #2 Helena-Lake Marion-Hampton Corner 345 kV line #2 | |
|---|---|--|
| W6B | Y6B | |
| Dorsey-Bison 500 kV line 50% series compensated | Dorsey-Blackberry 500 kV line 50% series compensated | |
| Bison 500/345 kv Tx #1 | Blackberry 500/345 kV Tx #1 & #2 | |
| | Blackberry-Arrowhead 345 kv lines #1 & #2 | |
| | Blackberry 345/230 kV TX | |
| Bison-Alexandria-Quarry-Monticello 345 kV line #2 | Bison-Alexandria-Quarry-Monticello 345 kV line #2 | |
| Hazel Creek-Panther-McLeod-Blue Lake 345 kV line #1 & #2 | Hazel Creek-Panther-McLeod-Blue Lake 345 kV line #1 & #2 | |
| Corridor Txs | Corridor Txs | |
| Brookings County-Lyon County 345 kV line #2 | Brookings County-Lyon County 345 kV line #2 | |
| Helena-Lake Marion-Hampton Corner 345 kV line #2 | Helena-Lake Marion-Hampton Corner 345 kV line #2 | |

Maps showing the options studied are included in Figure E.2-2 and Figure E.2-3.

Figure E.2-2 T1A and T1B Map

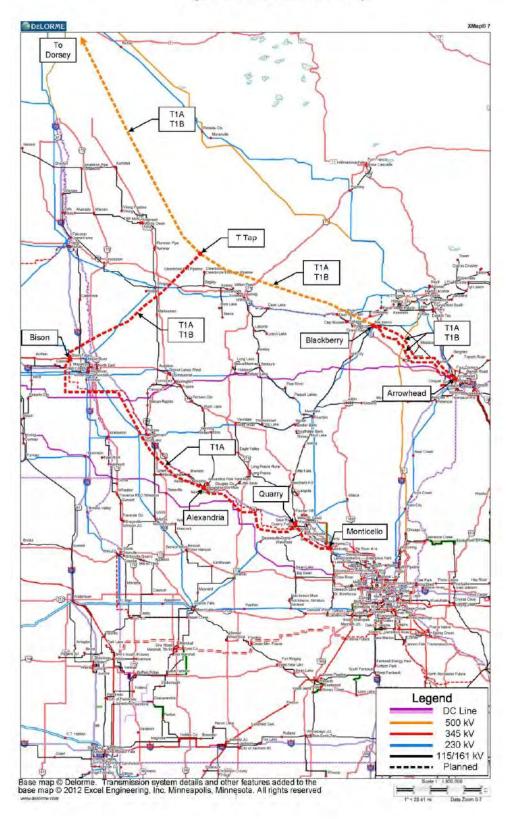
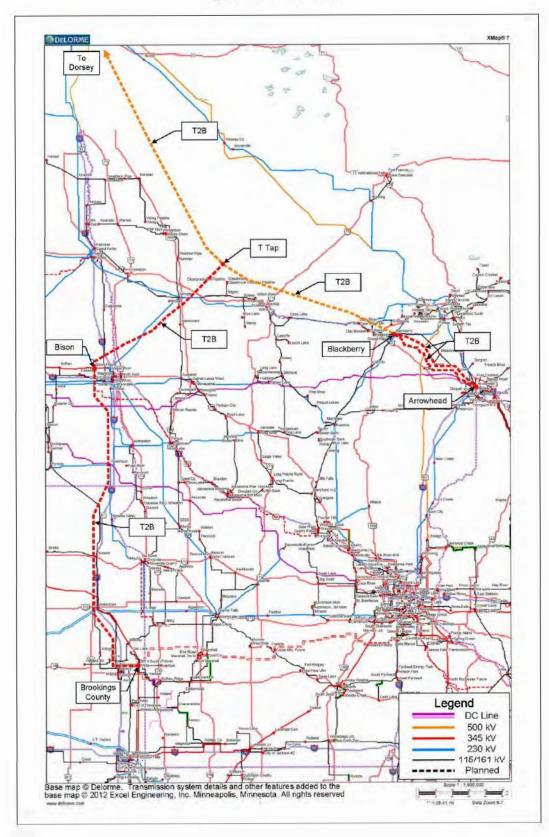


Figure E.2-3 T2B Map



E.3 Results

All comparisons were done using incremental costs. When a phase shifter was added to the Harvey-Glenboro 230 kV line, it made minimal differences in the overall results. The phase shifter was too far west of the injected areas to have a major effect on the study area.

E3.1 Fargo Wind Injection Results

Eastern Option with Fargo Tap Fargo Wind Injection

The eastern option with the Fargo tap scenarios all have a 500 kV line from Dorsey to the Blackberry with 50% series compensation with the line tapped (T-Tap) south of the series compensation, a double circuit 345 kV line from T-Tap to Bison, a double circuit 345 kV line from the Blackberry to Arrowhead, two 500/345 kV transformers at Blackberry, one 345/230 kV transformer at Blackberry, and one 500/345 kV transformers at T-Tap. Only three scenarios were evaluated for this option, T1A, T1B, and T2B. With these scenarios, the Manitoba power and the wind injection are entering the 345 kV system at totally different points but are tied together. Most of the same upgrades due to CapX line outage are still required but at higher wind injection. Some occur after the 2000 MW cutoff. The Roseau capacitors overload for two of the three scenarios and the Stone Lake 345/161 kV transformer overloads for all of the three scenarios. The best performing scenario was the T1A which can go to the 2000 MW transfer level without the Roseau series capacitors system intact overloads. The Roseau series capacitors system intact overloads occur at higher transfer levels than the Fargo option.

The Bison-Maple River 345 kV, Bison-Maple River 230 kV, Maple River-Sheyenne 230 kV, Fargo-Moorhead 230 kV, Maple River-Frontier 230 kV, and Sheyenne-Audubon 230 kV lines and the Maple River 345/230 kV transformers overload for the loss of Bison-Alexandria 345 kV line are over 1000 MW wind injections when there is not an additional outlet for the wind injection out of the Fargo area. These lines still overload for some other scenarios but at higher wind injection levels. When the loss is the Alexandria-Quarry 345 kV, line the 115 kV system in the Alexandria area in addition to the Fargo area 230 kV system overloads. For T1A scenario, it occurs before the Fargo area overloads, -150. For a loss of the Quarry-Monticello 345 kV line, the 115 kV system in the St. Cloud area, Alexandria, and Fargo 230 and 115 kV system overloads. The overload output for all scenarios ran is in Appendix E.

The scenario with the lowest incremental cost is T2B but it only allows a transfer of 1820 MW. The second lowest incremental cost is T1A which is the Fargo Tap option and it is able to transfer 2000 MW. A chart showing the incremental cost is in Figure E3.1-1. The scenario with the highest incremental cost is T1B.

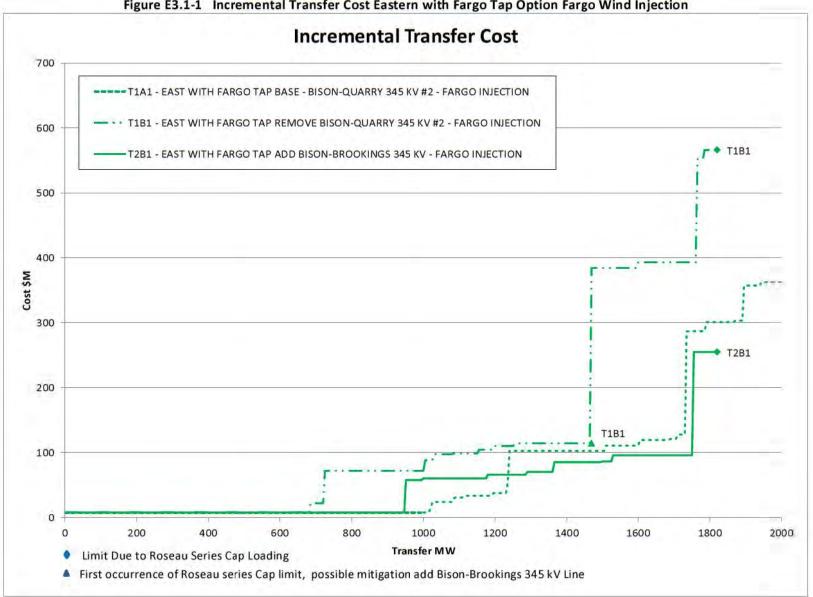


Figure E3.1-1 Incremental Transfer Cost Eastern with Fargo Tap Option Fargo Wind Injection

Comparison of Options Fargo Wind Injection

The least incremental cost scenario is Y2A, eastern option with 500 kV line Bison-Brookings County. The 500 kV line only goes from Bison to Brookings County with transformers required at both ends. It provides to two independent outlets from Fargo for the wind injection. The east option with only 345 kV line instead is ranked fourth. The eastern option with the tap overloads the east transmission more. The second least cost incremental is Y2B which includes Stone Lake and Chisago Country #1 and #2 transformers upgrades. T2B is not the least cost option, but it provides for three independent outlets for wind injection from Bison and provides for a tie to North Dakota for the Manitoba generation, but it only has a 1820 MW transfer capability. A table showing the incremental cost is in Table E3.1-1.

The most costly incremental is Y1A, there are no additional independent outlets for the wind injections and upgrades to the 115 and 230 kV system are extensive. The Fargo options are not capable of getting the 2000 MW transfer. The chart comparing the wind injection options is shown in Figure E3.1-2. In order to compare easier the following charts have the data separated into individual options with both the Fargo wind injection and the Fargo/Brookings wind injection Figure E3.1-3 to Figure E3.1-5.

The eastern option has the first limiters occurring at higher wind injection than the other two options. For the eastern option with the Fargo Tap Stone Lake 345/161 kV transformer is a negative number for the Fargo wind injection. For the western option the first limiter is the Roseau capacitor banks. See Table E3.1-6 for the complete list of first limiters.

The eastern options have fewer system intact overloads than the western options. Also they occur at higher wind injection levels. The eastern options with the Fargo tap have even few system intact overloads than without the tap. A table showing the system intact overloads is in Table E3.1-7.

| | FARGO 500 MW | IRON RANGE 500 MW | IRON RANGE w/T Tap 500 MW | FARGO 1000 MW | IRON RANGE 1000 MW | IRON RANGE w/T Tap 1000 MW | FARGO 1500 MW | IRON RANGE 1500 MW | IRON RANGE w/T Tap 1500 MW | FARGO 2000 MW | IRON RANGE 2000 MW | IRON RANGE w/T Tap 2000 MW |
|--|----------------------|-------------------------|------------------------------------|----------------------|-----------------------------|--|----------------------|-----------------------------|--|---------------------|-----------------------------|--|
| 1A Base Bison-Quarry #2 | (273 @ 490 MW) | 0 | 8 | NA | 42.5 | 8 | NA | 176 | 103 | N/A | 604 | 363 |
| 1A 60% 60% Series Comp new 500 kV | 294 | N/A | N/A | (294 @ 670 MW) | NA | N/A | NA | NA | N/A | N/A | N/A | N/A |
| 1AP Add Glenboro Phase Shifter | 284 | 0 | N/A | (284 @ 680 MW) | 48 | N/A | NA | 177 | N/A | N/A | 604 | N/A |
| 1B Remove Bison-Quarry #2 | (285 @ 50 MW) | 0 | 8 | N/A | 43 | 72 | NA | 304 | 384 | N/A | 558 | (565 @ 1820 MW) |
| 1B 60% 60% Series Comp new 500 kV | N/A | 0 | N/A | N/A | 91 | N/A | NA | 360 | N/A | N/A | 614 | N/A |
| 1C Add All MVP | 294 | O | N/A | (294 @ 630 MW) | 41 | N/A | N/A | 169 | N/A | N/A | 251 | N/A |
| 2A Add Bison-Brookings 500 kV with SC | (0 @ 375 MW) | 0 | N/A | N/A | 0 | N/A | N/A | 9 | N/A | N/A | 193 | N/A |
| 2B Add Bison-Brookings 345 kV | (0 @ 0MW) | o | 8 | N/A | 14 | 60 | N/A | 50 | 86 | N/A | 280 | (255 @ 1820 MW) |
| 6A Add Corridor Project Add Bison-Split Rock 500 kV with SC | 0 | o | N/A | 8 | o | N/A | (15 @ 1355 MW) | 6 | N/A | N/A | 190 | N/A |
| 6B Add Corridor Project | 287 | D | N/A | (287 @ 580 MW) | 36 | N/A | N/A | 180 | N/A | N/A | 615 | N/A |

Table E3.1-1 Cost Comparison Fargo Wind Injection

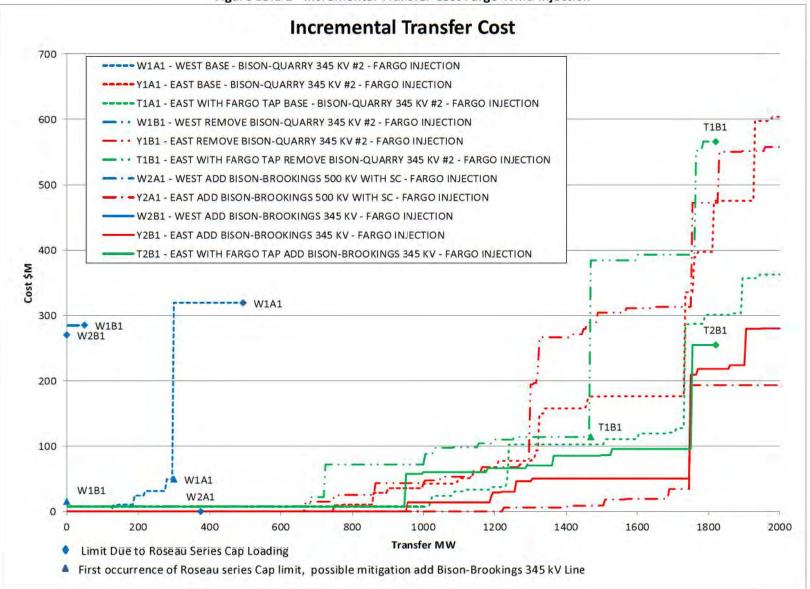


Figure E3.1-2 Incremental Transfer Cost Fargo Wind Injection

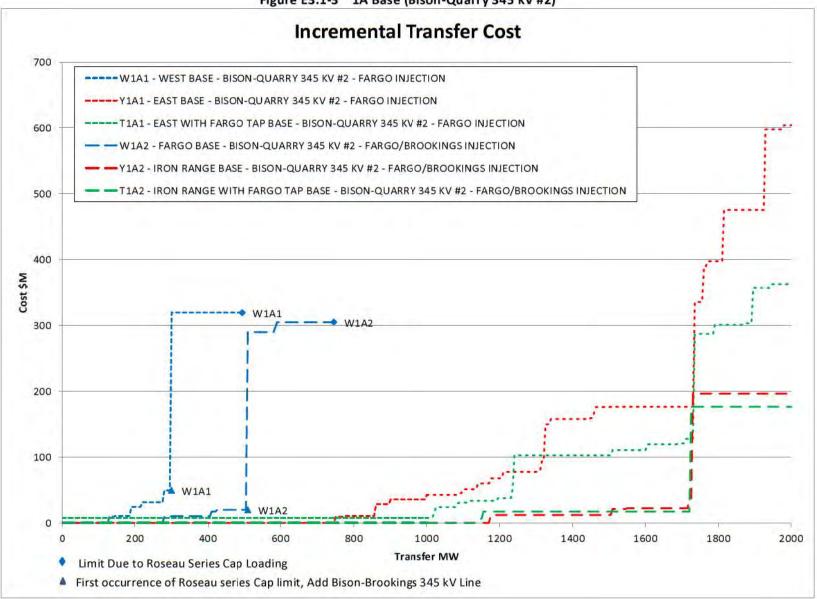


Figure E3.1-3 1A Base (Bison-Quarry 345 kV #2)

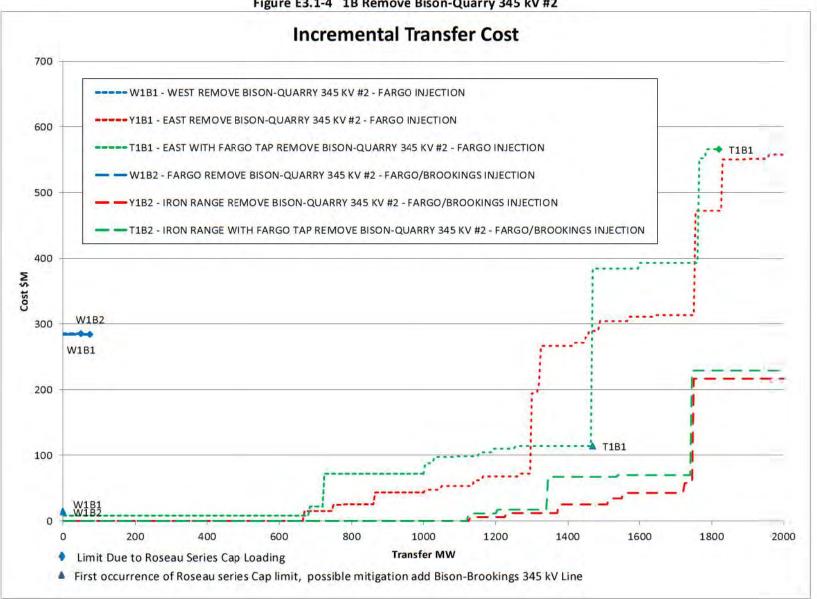


Figure E3.1-4 1B Remove Bison-Quarry 345 kV #2

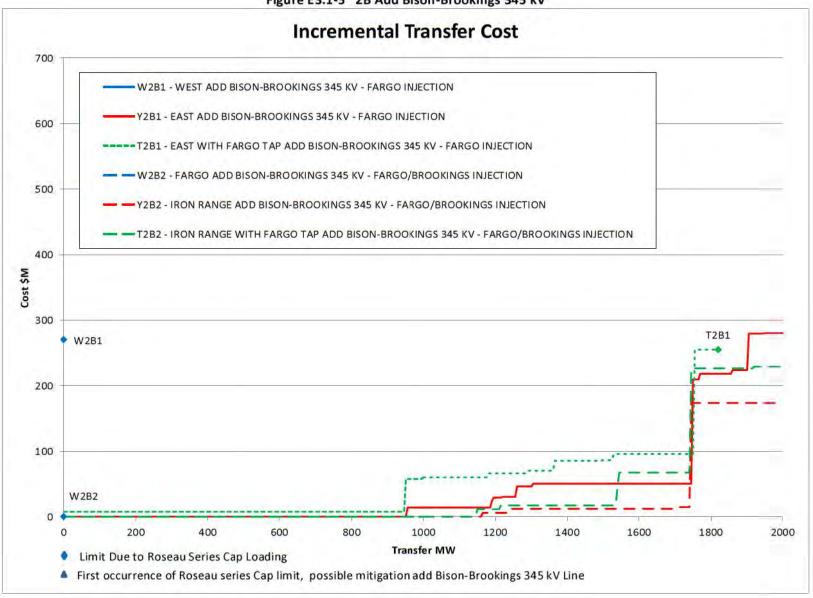


Figure E3.1-5 2B Add Bison-Brookings 345 kV

| Fargo O | otion | | | Iron Ra | nge Option | | | Iron Ra | nge with Fargo Tap Option | | |
|--------------------|--|------------|--|-------------------------|--|-----------|--|--------------------|--|--------------|---|
| Trans fer MW | Limiting Facility | DF% | Outage | Trans fer MW | Limiting Facility | DF% | Outage | Trans fer MW | Limiting Facility | DF% | Outage |
| W1A | Fargo - Base - Bison-Qu | arry 345 k | V #2 | Y1A | Iron Range - Base | - Bison-C | Quarry 345 kV #2 | TIA | Iron Range with Fargo Tap - | Base - Bisor | Quarry 345 kV #2 |
| W1A1 | Fargo Wind Injection | | | Y1A1 | Fargo Wind Inject | tion | | T1A1 | Fargo Wind Injection | | |
| 190 | Bison-Maple River 230 kV at 100% of 520 MVA (1305 amps) Owner(s): MPC 10.37 Miles | 23.0 | Open Bison-Maple River 345 kV | 750 | Sheyenne- Maple River 230 at 110% of 459 MVA (1152 amps) Owner(s): XCEL ~7 Miles | 38.5 | Open 601046 ALEXSS3 345 601067 BISON 3 345 1 Open 601046 ALEXSS3 345 601067 BISON 3 345 2 | -205 | 602017 ST LAKE5 161 699450 ST LAKE 345 1 at 125% of 336 MVA Owner(s): N/A | 5.5 | Open Stone Lake- Gardner Park 345 kV |
| W1A2 | Fargo/Brookings Wind | njection | | Y1A2 | Fargo/Brookings | Wind Inje | ection | T1A2 | Fargo/Brookings Wind Inject | ion | |
| -255 | Roseau N-Roseau S Series Caps 500 kV at 110% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 19.0 | Open 601046 ALEXSS3 345 601067 BISON 3 345 1 Open 601046 ALEXSS3 345 601067 BISON 3 345 2 | 1175 | Split Rock- White 345 kV line 1 at 100% of 717 MVA (1200 amps) Owner(s): XCEL ~60 Miles | 28.6 | Open 601031 BRKNGCO3 345 601048 LYON CO 3 345 1 | 1145 | Arpin 345/138 kV Tx at 113% of 336 MVA Ownēr(š): 691 | 5.6 | Open Arpin-Rocky run 345 kV |
| W1A6 0 | Fargo - Base - Bison-Qu compensation on new ! | | The second second second second second | | | | | | | | |
| W1A1 60 | Fargo Wind Injection | | | | | | | | | | |
| 105 | Bison-Maple River 230 kV at 100% of 520 MVA (1305 amps) Owner(s): MPC 10.37 Miles | 22.3 | Open Bison-Maple River 345 kV | | | | | | | | |
| W1A2 | | i Auri | 1 | | | | | | - | | |
| 60 | Fargo/Brookings Wind | njection | | 12.1 | | | | | | 2.2 | |
| W1A | DID NOT RUN | | | | 0 | | | | | 1 | 1. |
| Р | Fargo - Add Glenboro P | hase Shift | er | Y1AP | Iron Range - Add | Glenboro | Phase Shifter | T1AP | Iron Range with Fargo Tap - | Add Glenbo | ro Phase Shifter |
| W1A P1 280 | Fargo Wind Injection Bison-Maple River 230 kV at 100% of 520 MVA (1305 amps) Owner(s): MPC 10.37 Miles | 23.0 | Open Bison-Maple River 345 kV Open Maple River 345/230 kV tx 2 Open Maple River 345/230 kV tx 1 | Y1AP 1 745 | Fargo Wind Inject Sheyenne- Maple River 230 at 110% of 459 MVA (1152 amps) Owner(s): XCEL ~7 Miles | 38.5 | Open 601046 ALEXSS3 345 601067 BISON 3 345 1 Open 601046 ALEXSS3 345 601067 BISON 3 345 2 | 1 1 | Fargo Wind Injection | | |

Table E3.1-6 First Limiters For All Options

| imiting Facility argo/Brookings Wind Ir ison-Maple River 30 kV at 100% of 520 MVA | DF% | Outage | Trans fer MW | Limiting | - | 1 | Trans | | | |
|---|--|--|---|---|--|--|--|---|---|--|
| ison-Maple River 30 kV | njection | | Y1AP | Facility | DF% | Outage | fer MW T1AP | Limiting Facility | DF% | Outage |
| ison-Maple River 30 kV | | | 2 | Fargo/Brookings | Wind Inje | ction | 2 | Fargo/Brookings Wind Injectio | on | |
| 1305 a mps) Dwner(s): MPC 0.37 Miles | 10.2 | Open Bison-Maple River 345 kV Open Maple River 345/230 kV tx 2 Open Maple River 345/230 kV tx 1 | 1160 | Split Rock- White 345 kV line 1 at 100% of 717 MVA (1200 amps) Owner(s): XCEL ~60 Miles | 28.6 | Open 601031 BRKNGCO3 345 601048 LYON CO 3 345 1 | | DID NOT RUN | | |
| argo - Remove Bison-Q | uarry 345 | kV #2 | Y1B | Iron Range - Rem | ove Bison | Quarry 345 kV #2 | T1B | Iron Range with Fargo Tap - Re | emove Bis | on-Quarry 345 kV #2 |
| The local sector is a sector of the | | | 1 | | 3.1 | | 1.2 | CARLING IN | | |
| argo Wind Injection | | | Y1B1 | | ion | | T1B1 | Fargo Wind Injection | - | 1 |
| lson-Maple River 30 kV at 100% of 520 MVA 1305 amps) 9wner(s): MPC 0.37 Miles | 27.6 | Open Bison-Maple River 345 kV | 670 | Bison-Maple River 230 kV at 100% of 520 MVA (1305 amps) Owner(s): MPC 10.37 Miles | 42.6 | Open Bison-Maple River 345 kV Open Maple River 345/230 kV tx 2 Open Maple River 345/230 kV tx 1 | -340 | 602017 ST LAKE5 161 699450 ST LAKE 345 1 at 125% of 336 MVA Owner(s): N/A | 6.1 | Open Stone Lake- Gardner Park 345 k |
| argo/Brookings Wind Ir | njection | | ¥182 | | Wind Inje | ction | T1B2 | Fargo/Brookings Wind Injection | on | |
| ison-Maple River 30 kV at 100% of 520 MVA 1305 amps) Dwner(s): MPC 0.37 Miles | 12.6 | Open Bison-Maple River 345 kV | 1130 | Split Rock- White 345 kV line 1 at 100% of 717 MVA (1200 amps) Owner(s): XCEL ~60 Miles | 29.1 | Open Brookings Co - Lyon Co 345 kV | 1125 | Split Rock-White 345 kV line 1 at 100% of 717 MVA (1200 amps) Owner(s): XCEL ~4 Miles | 28.4 | Open Brookings Co Lyon Co 345 kV |
| | | · · · · · · · · · · · · · · · · · · · | ¥186 | Iron Range - Rem | ove Bison | Quarry 345 kV #2, use | 10. C | | 1 | |
| | | | 0 | 60% series compe | ensation | n new 500 kV line | - | | | |
| | | | Y1B1 60 | | ion | | | | | |
| | | | 670 | Bison-Maple River 230 kV at 100% of 520 MVA (1305 amps) Owner(s): MPC 10.37 Miles | 42.6 | Open Bison-Maple River 345 kV | | | | |
| | | | Y1B2 60 | Fargo/Brookings | Wind Inie | ction | | | | |
| a 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 | rgo Wind Injection son-Maple River 0 kV 100% of 520 MVA 305 amps) vner(s): MPC .37 Miles rgo/Brookings Wind In son-Maple River 0 kV 100% of 520 MVA 305 amps) vner(s): MPC | rgo Wind Injection son-Maple River 0 kV 100% of 520 MVA 105 amps) vner(s): MPC .37 Miles 27.6 27.6 27.6 27.6 27.6 27.6 20.0 | ion-Maple River 0 kV 100% of 520 MVA 305 amps) vner(s): MPC .37 Miles rgo/Brookings Wind Injection ion-Maple River 0 kV 100% of 520 MVA 305 amps) vner(s): MPC | rgo Wind Injection Y1B1 son-Maple River 0 kV 100% of 520 MVA 305 amps) vner(s): MPC .37 Miles Vind Injection Y1B2 rgo/Brookings Wind Injection Y1B2 ion-Maple River 0 kV 100% of 520 MVA 305 amps) vner(s): MPC .37 Miles 12.6 Open Bison-Maple River 345 kV 1130 V1B6 0 Y1B6 0 Y1B1 Frookings Vind Injection Y1B2 V1B2 V1B6 0 Frookings Vind Injection Y1B6 0 Y1B6 0 Frookings Vind Injection Y1B6 0 Frookings Vind Injection Y1B6 0 Frookings Vind Injection Y1B6 0 Y1B1 Frookings Vind Injection Y1B2 Y1B1 | rgo - Remove Bison-Quarry 345 kV #2 rgo Wind Injection kon-Maple River 0 kV 100% of 520 MVA 105 amps) vner(s): MPC .37 Miles 27.6 Open Bison-Maple River 345 kV 0 pen Bison-Maple River 345 kV 0 pen Bison-Maple River 345 kV 1120 0 pen Bison-Maple River 345 kV 1130 12.6 0 pen Bison-Maple River 345 kV 0 pen Bison-Maple River 345 kV 1130 | rgo - Remove Bison-Quarry 345 kV #2 Y1B Iron Range - Remove Bison rgo Wind Injection Fargo Wind Injection Fargo Wind Injection Open Bison-Maple River 345 kV Open Bison-Maple River 345 kV Fargo/Brookings Wind Injection Fargo Wind | rgo - Remove Bison-Quarry 345 kV #2 Y1B Iron Range - Remove Bison-Quarry 345 kV #2 rgo Wind Injection Down Maple River O kV ID0% of \$20 MVA I00% of \$20 MVA I0 | rgo - Remove Bison-Quarry 345 kV #2 Y1B Iron Range - Remove Bison-Quarry 345 kV #2 T1B rgo Wind Injection Y1B Fargo Mind Injection T1B1 oon-Maple River 0 kV 0 kV 00 pen Bison-Maple River 345 kV Y1B1 Fargo Mind Injection T1B1 100% of 520 MVA 100% of 520 MVA 305 amps) 27.6 Open Bison-Maple River 345 kV Open Bison-Maple River 345 kV 42.6 Open Maple River 345/23 0 kV tx 2 -340 on-Maple River 345/23 0 kV tx 1 0.37 Miles Y1B2 Fargo/Brookings Wind Injection T1B2 rgo/Brookings Wind Injection Y1B2 Fargo/Brookings Wind Injection T1B2 on-Maple River 0 kV 12.6 Open Bison-Maple River 345 kV 1130 Split Rock- White 345 kV line 1 Open Brookings Co- Lyon Co 345 kV 1125 37 Miles 12.6 Open Bison-Maple River 345 kV 1130 Affician 29.1 Open Brookings Co- Lyon Co 345 kV 1125 37 Miles 12.6 V1B6 Fargo Wind Injection 1125 Open Bison-Maple River 30 kV at 100% of 520 mps) Open Bison-Maple River 345 kV 0 Open Bison-Maple River 345 kV 1125 60% series compensation on new 500 kV line 60% series compensation on new 500 kV line 0 0 71B2 0mer(s): MPC 0.07 0/182 0 0 | rgo - Remove Bison-Quarry 345 kV #2 Y1B Iron Range - Remove Bison-Quarry 345 kV #2 T1B Iron Range with Fargo Tap - River 730 kV #2 rgo Wind Injection v1B1 Fargo Wind Injection T1B1 Fargo Wind Injection 0 KV 0 pen Bison-Maple River 345 V1B1 Fargo Wind Injection 602017 5T LARES 161 0 Sy amps) 0 pen Bison-Maple River 345 670 42.6 Open Maple River 345 kV 602017 5T LARES 151 0 Sy amps) 0 pen Kison Maple 0 pen Bison-Maple River 345 42.6 0 pen Maple River 345 kV 602017 5T LARES 151 0 pen Bison-Maple River 37 Wiles 0 pen Bison-Maple River 345 42.6 0 pen Maple River 345 kV -340 61250 633 6MVA 0 AV 100% of 520 MVA 12.6 Open Bison-Maple River 345 1130 501 RARE 42.6 0 pen Bison-Maple River 345 kV 1120 kV tz 2 0 AV 12.6 Open Bison-Maple River 345 1130 1130 1130 0 f 717 MVA (1200 amps) 0 AV 12.6 Open Bison-Maple River 345 1130 1130 670 Range - Remove Bison-Quarry 345 kV #2, use 60% series compensation on new 500 kV line 1125 Split Rock-White 345 kV line 1 100% of 520 MVA 12.6 Fargo Wind Injection 1126 1125 1125 1126 100% of 520 MVA | rgo - Remove Bison-Quarry 345 kV #2 Y1B From Range - Remove Bison-Quarry 345 kV #2 T1B Iron Range with Fargo Tap - Remove Bison-Maple River 30 kV rgo Wind Injection Y1B1 Fargo Wind Injection T1B1 Fargo Wind Injection 0.W 0.W 0.W 0.W 0.W 0.W 0.W 0.W |

| Fargo O | ption | | | Iron Ra | nge Option | | | Iron Ra | nge with Fargo Tap Option | | |
|--------------------|---|-------------|--|--------------------|--|-----------|--|--------------------|--|-------------|---|
| Trans fer MW | Limiting Facility | DF% | Outage | Trans fer MW | Limiting Facility | DF% | Outage | Trans fer MW | Limiting Facility | DF% | Outage |
| | | | | - | DID NOT RUN | | 1 | | | | |
| wic | Fargo - Add All MVP | | | YIC | Iron Range - Add | | | TIC | Iron Range with Fargo Tap - / | Add All MV | Р |
| W1C1 | Fargo Wind Injection | | | ¥1C1 | Fargo Wind Inject | tion | | TICI | Fargo Wind Injection | | |
| 125 | Bison-Maple River 230 kV at 100% of 520 MVA (1305 amps) Owner(s): MPC 10.37 Miles | 23.5 | Open Bison-Maple River 345 kV | 775 | Sheyenne- Maple River 230 at 110% of 459 MVA (1152 amps) Owner(s): XCEL ~7 Miles | 38.0 | Open 601046 ALEXSS3 345 601067 BISON 3 345 1 Open 601046 ALEXSS3 345 601067 BISON 3 345 2 | | DID NOT RUN | | |
| W1C2 | Fargo/Brookings Wind | Injection | | ¥1C2 | Fargo/Brookings | Wind Inje | ction | T1C2 | Fargo/Brookings Wind Inject | ion | |
| | DID NOT RUN | I = I | | 1 - 1 | DID NOT RUN | | | | DID NOT RUN | | |
| W2A | Fargo - Add Bison-Broo | kings 500 k | V with SC | YZA | Iron Range - Add | Bison-Bro | ookings 500 kV with SC | T2A | Iron Range with Fargo Tap - / SC | Add Bison-I | Brookings 500 kV with |
| W2A1 | Fargo Wind Injection | | | Y2A1 | Fargo Wind Inject | tion | | T2A1 | Fargo Wind Injection | | |
| 375 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 16.6 | System Intact | 1225 | Arpin 345/138 kV Tx at 113% of 336 MVA Owner(s): 691 | 5.7 | Open Arpin-Rocky run 345 kV | | DID NOT RUN | | |
| W2A2 | Fargo/Brookings Wind | Injection | | Y2A2 | Fargo/Brookings | Wind Inje | ection | T2A2 | Fargo/Brookings Wind Inject | ion | 0 |
| 465 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 13.4 | System Intact | 1190 | Split Rock- White 345 kV line 1 at 100% of 717 MVA (1200 amps) Owner(s): XCEL ~60 Miles | 31.3 | Open 601031 BRKNGCO3 345 601048 LYON CO 3 345 1 | | DID NOT RUN | | |
| W2B | Fargo - Add Bison-Broo | kings 345 k | v | Y2B | Iron Range - Add | Bison-Bro | ookings 345 kV | T2B | Iron Range with Fargo Tap - / | Add Bison-I | Brookings 345 kV |
| W2B1 | Fargo Wind Injection | | 1 | Y2B1 | Fargo Wind Inject | ion | | T2B1 | Fargo Wind Injection | 1 | |
| -1145 | Roseau N-Roseau S Series Caps 500 kV at 110% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 6.7 | Open Bison 500/345 kV Tx #1 Change bus 667033 DORSEYS4 230 load by 454.5 MW dispatch | 955 | Bison-Maple River 230 kV at 100% of 520 MVA (1305 amps) Owner(s): MPC 10.37 Miles | 31.2 | Open Bison-Maple River 345 kV Open Maple River 345/230 kV tx 2 Open Maple River 345/230 kV tx 1 | -315 | 602017 ST LAKE5 161 699450 ST LAKE 345 1 at 125% of 336 MVA Owner(s): N/A | 5.4 | Open Stone Lake- Gardner Park 345 k ¹ |
| W2B2 | Fargo/Brookings Wind | Injection | | Y2B2 | Fargo/Brookings | Wind Inie | ection | T282 | Fargo/Brookings Wind Inject | ion | |
| | - Bel - s sumBe trille | | | | | and inge | | | Beterenings it in a lifett | | |

| Fargo O | ption | | | Iron Ra | nge Option | | | Iron Ra | nge with Fargo Tap Option | | |
|--------------------|---|-------------|--|--------------------|---|------------|--|--------------------|--|------|------------------------------------|
| Trans fer MW | Limiting Facility | DF% | Outage | Trans fer MW | Limiting Facility | DF% | Outage | Trans fer MW | Limiting Facility | DF% | Outage |
| -30 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 14.2 | System Intact | 1165 | Split Rock- White 345 kV line 1 at 100% of 717 MVA (1200 amps) Owner(s): XCEL ~60 Miles | 30.3 | Open 601031 BRKNGCO3 345 601048 LYON CO 3 345 1 | 1150 | Split Rock-White 345 kV line 1 at 100% of 717 MVA (1200 amps) Owner(s): XCEL ~4 Miles | 28.5 | Open Brookings C Lyon Co 345 kV |
| | Constant and the second | | and an | | Concerning the second se | | Project and Bison-Split | 1 | Iron Range with Fargo Tap - Add Corridor Project and Bison- | | |
| W6A | Fargo - Add Corridor Pr | oject and E | Bison-Split Rock 500 kV with SC | Y6A | Rock 500 kV with | SC | | T6A | Split Rock 500 kV with SC | | |
| W6A1 | Fargo Wind Injection | | | Y6A1 | Fargo Wind Inject | tion | | T6A1 | Fargo Wind Injection | 2 | |
| 760 | Arpin 345/138 kV Tx at 113% of 336 MVA Owner(s): 691 | 6.0 | Open Arpin-Rocky run 345 kV | 1115 | Arpin 345/138 kV Tx at 113% of 336 MVA Owner(s): 691 | 5.7 | Open Arpin-Rocky run 345 kV | | DID NOT RUN | | |
| W6A2 | Fargo/Brookings Wind | Injection | | Y6A2 | Fargo/Brookings | Wind Inje | ction | TGAZ | Fargo/Brookings Wind Injection | | |
| 1000 | DID NOT RUN | | | 1 | DID NOT RUN | | | - | DID NOT RUN | | |
| W6B | Fargo - Add Corridor Pr | oject | | Y6B | Iron Range - Add | Corridor I | Project | T6B | Iron Range with Fargo Tap - Add Corridor Project | | |
| W6B1 | Fargo Wind Injection | | | Y6B1 | Fargo Wind Inject | tion | | T681 | Fargo Wind Injection | | |
| 165 | Bison-Maple River 230 kV at 100% of 520 MVA (1305 amps) Owner(s): MPC 10.37 Miles | 23.2 | Open Bison-Maple River 345 kV | 745 | Sheyenne- Maple River 230 at 110% of 459 MVA (1152 amps) Owner(s): XCEL ~7 Miles | 38.5 | Open 601046 ALEXSS3 345 601067 BISON 3 345 1 Open 601046 ALEXSS3 345 601067 BISON 3 345 2 | | DID NOT RUN | | |
| W682 | Fargo/Brookings Wind | Injection | | Y6B2 | Fargo/Brookings | Wind Inie | ction | T6B2 | Fargo/Brookings Wind Injectio | m | |
| | DID NOT RUN | | | | DID NOT RUN | | | | DID NOT RUN | | |

| Table E3.1-7 | System Intact Overloads for All Options | |
|--------------|---|--|
| | | |

| Fargo Option | | | Iron Range Option | | | T Tap Option | | |
|-----------------|--|---------|----------------------|---|---------|-----------------|--|---------|
| Transfer MW | Limiting Facility | DF % | Transfer MW | Limiting Facility | DF % | Transfer MW | Limiting Facility | DI % |
| W1A | Fargo - Base - Bison-Quarry 345 kV #2 | | Y1A | Iron Range - Base - Bison- Quarry 345 kV #2 | | T1A | Iron Range with Fargo Tap - Base - Bison-Quarry 345 kV #2 | |
| W1A1 | Fargo Wind Injection | | Y1A1 | Fargo Wind Injection | | T1A1 | Fargo Wind Injection | 1 |
| 300 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 21.8 | 1785 | Maple River 345/230 kV tx 1 at 100% of 336 MVA Owner(s): OTP | 15.7 | | NONE | |
| 490 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL after Bison-Brookings 345 kV added | 18.8 | 1785 | Maple River 345/230 kV tx 2 at 100% of 336 MVA Owner(s): OTP | 15.7 | | | |
| 1495 | Maple River 345/230 kV tx 1 at 100% of 336 MVA Owner(s): OTP | 9.2 | 1870 | Sheyenne-Maple River 230 at 100% of 459 MVA (1152 amps) Owner(s): XCEL ~7 Miles | 21.6 | | | |
| 1500 | Maple River 345/230 kV tx 2 at 100% of 336 MVA Owner(s): OTP | 9.2 | 1940 | Bison-Maple River 345 kV at 100% of 720 MVA (1205 amps) Owner(s): MPC ~10 Miles | 31.4 | | | |
| 1700 | Sheyenne-Maple River 230 at 100% of 459 MVA (1152 amps) Owner(s): XCEL ~7 Miles | 12.9 | | | | | | |
| 1755 | Bison-Maple River 345 kV at 100% of 720 MVA (1205 amps) Owner(s): MPC ~3 Miles | 18.4 | | | | | | |
| W1A2 | Fargo/Brookings Wind Injection | | ¥1A2 | Fargo/Brookings Wind Injection | | T1A2 | Fargo/Brookings Wind Injection | |

| Fargo Option | | | Iron Range Option | | | T Tap Option | | |
|-----------------|--|---------|----------------------|-------------------|---------|-----------------|-------------------|------------|
| Transfer MW | Limiting Facility | DF % | Transfer MW | Limiting Facility | DF % | Transfer MW | Limiting Facility | 0 F 200 |
| 510 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 12.8 | | NONE | | | NONE | |
| 740 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL after Bison-Brookings 345 kV added | 12.4 | | | | | | |
| 1970 | Split Rock-White 345 kV line 1 at 100% of 717 MVA (1200 amps) Owner(s): XCEL ~4 Miles | 22.9 | | | | | | |
| W1A160 | 60% Series Comp New 500 kV Line | | | | | | | |
| W1A160 | FargoWind Injection | | | | | | | |
| 440 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 22.8 | | DID NOT RUN | | | DID NOT RUN | |
| 670 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL after Bison-Brookings 345 kV added | 19.7 | | | | | | |
| 1425 | Maple River 345/230 kV tx 1 at 100% of 336 MVA Owner(s): OTP | 9.0 | | | | | | |
| 1430 | Maple River 345/230 kV tx 2 at 100% of 336 MVA Owner(s): OTP | 9.0 | | | | | | |

| Fargo Option | | | Iron Range Option | | | T Tap Option | | 1 |
|-----------------|--|---------|----------------------|---|---------|-----------------|---|---------|
| Transfer MW | Limiting Facility | DF % | Transfer MW | Limiting Facility | DF % | Transfer MW | Limiting Facility | DF % |
| 1645 | Sheyenne-Maple River 230 at 100% of 459 MVA (1152 amps) Owner(s): XCEL ~7 Miles | 12.6 | | | | | | |
| 1695 | Bison-Maple River 345 kV at 100% of 720 MVA (1205 amps) Owner(s): MPC ~3 Miles | 18.0 | | | | | | |
| W1A260 | Fargo/Brookings Wind Injection | | | | | | | |
| | DID NOT RUN | | | | | | | |
| W1AP | Fargo - Add Glenboro Phase Shifter | | Y1AP | Iron Range - Add Glenboro Phase Shifter | | T1AP | Iron Range with Fargo Tap - Add Glenboro Phase Shifter | |
| W1AP1 | Fargo Wind Injection | | Y1AP1 | Fargo Wind Injection | - (j | T1AP1 | Fargo Wind Injection | |
| 460 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 21.8 | 1790 | Maple River 345/230 kV tx 1 at 100% of 336 MVA Owner(s): OTP | 15.7 | | DID NOT RUN | |
| 680 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL after Bison-Brookings 345 kV added | 18.8 | 1790 | Maple River 345/230 kV tx 2 at 100% of 336 MVA Owner(s): OTP | 15.7 | | | |
| 1600 | Maple River 345/230 kV tx 1 at 100% of 336 MVA Owner(s): OTP | 9.2 | 1890 | Sheyenne-Maple River 230 at 100% of 459 MVA (1152 amps) Owner(s): XCEL ~7 Miles | 21.5 | | | |
| 1600 | Maple River 345/230 kV tx 2 at 100% of 336 MVA Owner(s): OTP | 9,2 | 1945 | Bison-Maple River 345 kV at 100% of 720 MVA (1205 amps) Owner(s): MPC ~10 Miles | 31.4 | | | |

| Fargo Option | | | Iron Range Option | | | T Tap Option | | |
|-----------------|--|------|----------------------|--|------|-----------------|---|------|
| Transfer | Lawrence and the | DF | | La contra de la co | DF | Transfer | | DF |
| MW 1830 | Limiting Facility Sheyenne-Maple River 230 at 100% of 459 MVA (1152 amps) Owner(s): XCEL ~7 Miles | 12.9 | Transfer MW | Limiting Facility | % | MW | Limiting Facility | % |
| 1860 | Bison-Maple River 345 kV at 100% of 720 MVA (1205 amps) Owner(s): MPC ~3 Miles | 18.4 | | | | | | |
| W1AP2 | Fargo/Brookings Wind Injection | | Y1AP2 | Fargo/Brookings Wind Injection | | T1AP2 | Fargo/Brookings Wind Injection | [] |
| 785 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 12.8 | | NONE | | | DID NOT RUN | |
| 1030 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL after Bison-Brookings 345 kV added | 12.4 | | | | | | |
| 1980 | Split Rock-White 345 kV line 1 at 100% of 717 MVA (1200 amps) Owner(s): XCEL ~4 Miles | 22.9 | | | | | | |
| W1B | Fargo - Remove Bison-Quarry 345 kV #2 | | Y1B | Iron Range - Remove Bison- Quarry 345 kV #2 | | T1B | Iron Range with Fargo Tap - Remove Bison-Quarry 345 kV #2 | |
| W1B1 | Fargo Wind Injection | | Y1B1 | Fargo Wind Injection | 1 | T1B1 | Fargo Wind Injection | |
| -135 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 26.2 | 1265 | Maple River 345/230 kV tx 1 at 100% of 336 MVA Owner(s): OTP | 19.6 | 1470 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 12.9 |
| 50 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) | 22.0 | 1265 | Maple River 345/230 kV tx 2 at 100% of 336 MVA Owner(s): OTP | 19.6 | 1475 | Maple River 345/230 kV tx 1 at 100% of 336 MVA Owner(s): OTP | 12.9 |

| Fargo Option | | | Iron Range Option | | | T Tap Option | | |
|-----------------|---|---------|----------------------|---|---------|-----------------|--|---------|
| Transfer MW | Limiting Facility | DF % | Transfer MW | Limiting Facility | DF % | Transfer MW | Limiting Facility | DF % |
| | Owner(s): XCEL after Bison-Brookings 345 kV added | | | | | | | |
| 930 | Maple River 345/230 kV tx 1 at 100% of 336 MVA Owner(s): OTP | 10.6 | 1340 | Sheyenne-Maple River 230 at 100% of 459 MVA (1152 amps) Owner(s): XCEL ~7 Miles | 26.8 | 1480 | Maple River 345/230 kV tx 2 at 100% of 336 MVA Owner(s): OTP | 12.9 |
| 930 | Maple River 345/230 kV tx 2 at 100% of 336 MVA Owner(s): OTP | 10.6 | 1385 | Bison-Maple River 345 kV at 100% of 720 MVA (1205 amps) Owner(s): MPC ~10 Miles | 39.1 | 1580 | Sheyenne-Maple River 230 at 100% of 459 MVA (1152 amps) Owner(s): XCEL ~7 Miles | 18. |
| 1130 | Sheyenne-Maple River 230 at 100% of 459 MVA (1152 amps) Owner(s): XCEL ~7 Miles | 14.9 | 1740 | Frontier-Maple River 230 kV at 100% of 265 MVA (665 amps) Owner(s): MPC ~11 Miles | 13.0 | 1665 | Bison-Maple River 345 kV at 100% of 720 MVA (1205 amps) Owner(s): MPC ~3 Miles | 25. |
| 1155 | Bison-Maple River 345 kV at 100% of 720 MVA (1205 amps) Owner(s): MPC ~3 Miles | 21.3 | 1745 | Wahpeton-Frontier 230 kV at 100% of 265 MVA (665 amps) Owner(s): MPC ~44 Miles | 13.0 | | | |
| 1785 | Frontier-Maple River 230 kV at 100% of 265 MVA (665 amps) Owner(s): MPC ~11 Miles | 7.6 | | | | | | |
| 1810 | Wahpeton-Frontier 230 kV at 100% of 265 MVA (665 amps) Owner(s): MPC ~44 Miles | 7.6 | | | | | | |
| W1B2 | Fargo/Brookings Wind Injection | | Y1B2 | Fargo/Brookings Wind Injection | | T1B2 | Fargo/Brookings Wind Injection | |
| -235 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 15.2 | | | | | | |

| Fargo Option | | | Iron Range Option | | | T Tap Option | | |
|-----------------|--|---------|----------------------|---|---------|-----------------|-------------------|----------|
| Transfer MW | Limiting Facility | DF % | Transfer MW | Limiting Facility | DF % | Transfer MW | Limiting Facility | DF 30 |
| 75 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL after Bison-Brookings 345 kV added | 14.4 | | | | | | |
| 1755 | Maple River 345/230 kV tx 1 at 100% of 336 MVA Owner(s): OTP | 5.6 | | | | | | |
| 1755 | Maple River 345/230 kV tx 2 at 100% of 336 MVA Owner(s): OTP | 5.6 | | | | | | |
| 1855 | Split Rock-White 345 kV line 1 at 100% of 717 MVA (1200 amps) Owner(s): XCEL ~4 Miles | 23.4 | | NONE | | 1 | NONE | |
| 1.00 | | | VIDCO | 60% Series Comp New 500 kV | 1.01 | - | | |
| | | | ¥1B60 | Line | | | 6 | |
| - | 6 | - | Y1B160 | Fargo Wind Injection | | | 6 | |
| | | | 1265 | Maple River 345/230 kV tx 1 at 100% of 336 MVA Owner(s): OTP | 19.6 | | | |
| | | | 1265 | Maple River 345/230 kV tx 2 at 100% of 336 MVA Owner(s): OTP | 19.6 | | | |
| | | | 1340 | Sheyenne-Maple River 230 at 100% of 459 MVA (1152 amps) Owner(s): XCEL ~7 Miles | 26.8 | | | |
| | | | 1385 | Bison-Maple River 345 kV at 100% of 720 MVA (1205 amps) Owner(s): MPC ~3 Miles | 39,1 | | | |
| | | | 1750 | Frontier-Maple River 230 kV at 100% of 265 MVA (665 amps) Owner(s): MPC ~11 Miles | 13.0 | | | |

| Fargo Option | | | Iron Range Option | | | T Tap Option | | |
|-----------------|--|------|----------------------|--|------------------|-----------------|--|----|
| Transfer | 1 faulting Profiling | DF | | I fandafara Pandidan | DF | Transfer | T far taken Transition | D |
| MW | Limiting Facility | % | Transfer MW | Limiting Facility Wahpeton-Frontier 230 kV at 100% of 265 MVA (665 amps) Owner(s): MPC ~44 Miles | <u>%</u> 13.0 | MW | Limiting Facility | 9 |
| | | | Y1B260 | Fargo/Brookings Wind Injection | | | | |
| | | _ | | DID NOT RUN | 100 | | | - |
| W1C | Fargo - Add All MVP | | Y1C | Iron Range - Add All MVP | | | Iron Range with Fargo Tap - Add All MVP | |
| W1C1 | Fargo Wind Injection | | ¥1C1 | Fargo Wind Injection | | T1C1 | Fargo Wind Injection | 11 |
| 425 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 21.3 | 1735 | Maple River 345/230 kV tx 1 at 100% of 336 MVA Owner(s): OTP | 15.9 | | DID NOT RUN | |
| 630 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL after Bison-Brookings 345 kV added | 18.4 | 1735 | Maple River 345/230 kV tx 2 at 100% of 336 MVA Owner(s): OTP | 15.9 | | | |
| 1390 | Maple River 345/230 kV tx 1 at 100% of 336 MVA Owner(s): OTP | 9.4 | 1870 | Sheyenne-Maple River 230 at 100% of 459 MVA (1152 amps) Owner(s): XCEL ~7 Miles | 21.5 | | | |
| 1390 | Maple River 345/230 kV tx 2 at 100% of 336 MVA Owner(s): OTP | 9.4 | 1885 | Bison-Maple River 345 kV at 100% of 720 MVA (1205 amps) Owner(s): MPC ~10 Miles | 31.8 | | | |
| 1645 | Bison-Maple River 345 kV at 100% of 720 MVA (1205 amps) Owner(s): MPC ~3 Miles | 18.8 | | | | | | |
| 1650 | Sheyenne-Maple River 230 at 100% of 459 MVA (1152 amps) Owner(s): XCEL | 13.0 | | | | н. | | |

| Fargo Option | | | Iron Range Option | | 01:10 | T Tap Option | | |
|-----------------|---|------|----------------------|-----------------------------------|-------|-----------------|---------------------------------|-----|
| Transfer | The second second | DF | | | DF | Transfer | 1 | DF |
| MW | Limiting Facility | % | Transfer MW | Limiting Facility | % | MW | Limiting Facility | % |
| | ~7 Miles | | | | | | | |
| W1C2 | Fargo/Brookings Wind Injection | | ¥1C2 | Fargo/Brookings Wind Injection | | T1C2 | Fargo/Brookings Wind Injection | |
| | DID NOT RUN | - | | DID NOT RUN | - | | DID NOT RUN | 111 |
| | Fargo - Add Bison-Brookings | | | Iron Range - Add Bison- | | and a | Iron Range with Fargo Tap - Add | |
| W2A | 500 kV with SC | | Y2A | Brookings 500 kV with SC | | T2A | Bison-Brookings 500 kV with SC | |
| W2A1 | Fargo Wind Injection | | Y2A1 | Fargo Wind Injection | | T2A1 | Fargo Wind Injection | |
| 375 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 16.6 | | NONE | | | DID NOT RUN | |
| 1605 | Maple River 345/230 kV tx 1 at 100% of 336 MVA Owner(s): OTP | 8.6 | | | | | | |
| 1605 | Maple River 345/230 kV tx 2 at 100% of 336 MVA Owner(s): OTP | 8.6 | | | | 1 | | |
| 1860 | Sheyenne-Maple River 230 at 100% of 459 MVA (1152 amps) Owner(s): XCEL ~7 Miles | 11.9 | | | | | | |
| 1885 | Bison-Maple River 345 kV at 100% of 720 MVA (1205 amps) Owner(s): MPC ~10 Miles | 17.1 | | | | | | |
| 1945 | Split Rock-White 345 kV line 1 at 100% of 717 MVA (1200 amps) Owner(s): XCEL ~4 Miles | 19.2 | | | | | | |
| W2A2 | Fargo/Brookings Wind Injection | | Y2A2 | Fargo/Brookings Wind Injection | | T2A2 | Fargo/Brookings Wind Injection | 1 |

| Fargo Option | | | Iron Range Option | | | T Tap Option | | |
|-----------------|---|---------|----------------------|---|---------|-----------------|---|--------|
| Transfer MW | Limiting Facility | DF % | Transfer MW | Limiting Facility | DF % | Transfer MW | Limiting Facility | D y |
| 465 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 13.4 | 1990 | Split Rock-White 345 kV line 1 at 100% of 717 MVA (1200 amps) Owner(s): XCEL ~4 Miles | 25.6 | | DID NOT RUN | |
| 1550 | Split Rock-White 345 kV line 1 at 100% of 717 MVA (1200 amps) Owner(s): XCEL ~4 Miles | 24.0 | | | | | | |
| W2B | Fargo - Add Bison-Brookings 345 kV | | Y2B | Iron Range - Add Bison- Brookings 345 kV | | T2B | Iron Range with Fargo Tap - Add Bison-Brookings 345 kV | |
| W2B1 | Fargo Wind Injection | | Y2B1 | Fargo Wind Injection | | T2B1 | Fargo Wind Injection | |
| -20 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 21.6 | 1675 | Maple River 345/230 kV tx 1 at 100% of 336 MVA Owner(s): OTP | 14.9 | 1820 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 10 |
| 965 | Maple River 345/230 kV tx 1 at 100% of 336 MVA Owner(s): OTP | 10.8 | 1680 | Maple River 345/230 kV tx 2 at 100% of 336 MVA Owner(s): OTP | 14.9 | 1945 | Maple River 345/230 kV tx 1 at 100% of 336 MVA Owner(s): OTP | 10 |
| 965 | Maple River 345/230 kV tx 2 at 100% of 336 MVA Owner(s): OTP | 10.8 | 1785 | Sheyenne-Maple River 230 at 100% of 459 MVA (1152 amps) Owner(s): XCEL ~7 Miles | 20.4 | 1945 | Maple River 345/230 kV tx 2 at 100% of 336 MVA Owner(s): OTP | 10 |
| 1160 | Sheyenne-Maple River 230 at 100% of 459 MVA (1152 amps) Owner(s): XCEL ~7 Miles | 15.0 | 1840 | Bison-Maple River 345 kV at 100% of 720 MVA (1205 amps) Owner(s): MPC ~10 Miles | 29.8 | | | |
| 1185 | Bison-Maple River 345 kV at 100% of 720 MVA (1205 amps) Owner(s): MPC ~10 Miles | 21.5 | | | | | | |
| 1800 | Frontier-Maple River 230 kV at 100% of 265 MVA (665 amps) Owner(s): MPC ~11 Miles | 7.6 | | | | | | |

| Fargo Option | | | Iron Range Option | | | T Tap Option | | 1 |
|-----------------|---|---------|----------------------|---|---------|-----------------|--|--------------|
| Transfer MW | Limiting Facility | DF % | Transfer MW | Limiting Facility | DF % | Transfer MW | Limiting Facility | DF % |
| 1825 | Wahpeton-Frontier 230 kV at 100% of 265 MVA (665 amps) Owner(s): MPC ~44 Miles | 7.6 | | | | | | |
| W2B2 | Fargo/Brookings Wind Injection | | Y2B2 | Fargo/Brookings Wind Injection | | T2B2 | Fargo/Brookings Wind Injection | <u> </u>] = |
| -30 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 14.2 | | NONE | | | NONE | |
| 1815 | Maple River 345/230 kV tx 1 at 100% of 336 MVA Owner(s): OTP | 5.7 | | | | | | |
| 1820 | Maple River 345/230 kV tx 2 at 100% of 336 MVA Owner(s): OTP | 5.7 | | | | | | |
| 1870 | Split Rock-White 345 kV line 1 at 100% of 717 MVA (1200 amps) Owner(s): XCEL ~4 Miles | 23.4 | | | | | | |
| W6A | Fargo - Add Corridor Project and Bison-Split Rock 500 kV with SC | | ¥6А | Iron Range - Add Corridor Project and Bison-Split Rock 500 kV with SC | | T6A | Iron Range with Fargo Tap - Add Corridor Project and Bison-Split Rock 500 kV with SC | |
| W6A1 | Fargo Wind Injection | | Y6A1 | Fargo Wind Injection | (| T6A1 | Fargo Wind Injection | |
| 1355 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 13.0 | | NONE | | | DID NOT RUN | |
| W6A2 | Fargo/Brookings Wind Injection | | Y6A2 | Fargo/Brookings Wind Injection | | T6A2 | Fargo/Brookings Wind Injection | |
| | DID NOT RUN | | | DID NOT RUN | | | DID NOT RUN | (- |
| W6B | Fargo - Add Corridor Project | | Y6B | Iron Range - Add Corridor Project | | т6в | Iron Range with Fargo Tap - Add Corridor Project | |
| W6B1 | Fargo Wind Injection | | Y6B1 | Fargo Wind Injection | | T6B1 | Fargo Wind Injection | |

| Fargo Option | | | Iron Range Option | | | T Tap Option | | |
|-----------------|--|---------|----------------------|---|---------|-----------------|--------------------------------|---------|
| Transfer MW | Limiting Facility | DF % | Transfer MW | Limiting Facility | DF % | Transfer MW | Limiting Facility | DF % |
| 315 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL Zero Miles | 21.4 | 1750 | Maple River 345/230 kV tx 1 at 100% of 336 MVA Owner(s): OTP | 15.7 | | DID NOT RUN | |
| 580 | Roseau N-Roseau S Series Caps 500 kV at 100% of 1732 MVA (2000 amps) Owner(s): XCEL after Bison-Brookings 345 kV added | 18.2 | 1750 | Maple River 345/230 kV tx 2 at 100% of 336 MVA Owner(s): OTP | 15.7 | | | |
| 1525 | Maple River 345/230 kV tx 1 at 100% of 336 MVA Owner(s): OTP | 9,3 | 1825 | Sheyenne-Maple River 230 at 100% of 459 MVA (1152 amps) Owner(s): XCEL ~7 Miles | 21.6 | | | |
| 1525 | Maple River 345/230 kV tx 2 at 100% of 336 MVA Owner(s): OTP | 9.3 | 1900 | Bison-Maple River 345 kV at 100% of 720 MVA (1205 amps) Owner(s): MPC ~10 Miles | 31.4 | | | |
| 1705 | Sheyenne-Maple River 230 at 100% of 459 MVA (1152 amps) Owner(s): XCEL ~7 Miles | 13.1 | | | | · | | |
| 1780 | Bison-Maple River 345 kV at 100% of 720 MVA (1205 amps) Owner(s): MPC ~3 Miles | 18.6 | | | | | | |
| W6B2 | Fargo/Brookings Wind Injection | | ¥6B2 | Fargo/Brookings Wind Injection | | T6B2 | Fargo/Brookings Wind Injection | 164 |
| | DID NOT RUN | 1 | | DID NOT RUN | 1 (tr | | DID NOT RUN | |

E3.2 Fargo and Brookings Wind Injection Results

The Fargo/Brookings wind injection did not have as many cases that were ran as for the Fargo only wind injection. The wind injection is split 50/50 between Fargo and Brookings Co sites. The same amount of maximum power of 2000MW was used.

Eastern Option with Fargo Tap Fargo/Brookings Wind Injection

The eastern Fargo tap scenarios all have a 500 kV line from Dorsey to the Blackberry with 50% series compensation with the line tapped (T-Tap) south of the series compensation, a double circuit 345 kV line from T-Tap to Bison, a double circuit 345 kV line from the Blackberry to Arrowhead, two 500/345 kV transformers at Blackberry, one 345/230 kV transformer at Blackberry, and one 500/345 kV transformers at T-Tap. Only three scenarios were run for this option: T1A, T1B, and T2B. With these scenarios the Manitoba power and the Fargo wind injection are entering the 345 kV system at totally different points but are tied together. Being one half the wind injection is at Brookings Co, only the Bison-Maple River 230 kV line upgrade due to CapX line outages still required. The Chisago 500/345 kV transformer #1 and #2 upgrades are required for loss of the other transformer except for T1A which has the double circuit CapX Fargo-Twin Cities. The Roseau capacitors or the Stone Lake 345/161 kV transformer do not overload with only half the wind being injected at Fargo. The best performing scenario was the T1A; it provides for an independent outlet from Bison but does not tie the Bison and Brookings Co. wind injection areas together directly.

The scenario with the lowest incremental cost is T1A (Fargo Tap option with CapX Fargo-Twin Cites 345 kV double circuit line). The other two scenarios are the same cost. A chart showing the incremental cost is in Figure E3.2-1. The scenario with the highest incremental cost is T1A.

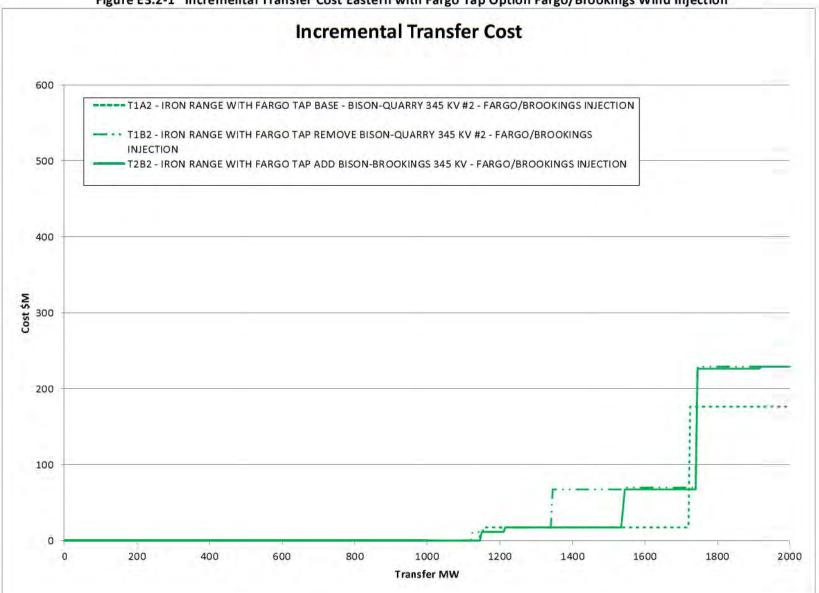


Figure E3.2-1 Incremental Transfer Cost Eastern with Fargo Tap Option Fargo/Brookings Wind Injection

Comparison of Options Fargo/Brookings Wind Injection

The least incremental cost scenario is Y2A, eastern option with 500 kV line Bison-Brookings County. The 500 kV line only goes from Bison to Brookings County with transformers required at both ends. It provides to two independent outlets from Fargo for the wind injection. The eastern option with a 345 kV line is a very close second. The eastern option with the tap T1A ties the Manitoba power and both wind injection sites together, overloading the Split Rock-White 345 kV line requiring an upgrade. T1A also includes Stone Lake and Chisago Country #1 and #2 transformers upgrades. A chart showing the incremental cost is in Figure E3.2-3. A table with the incremental costs is shown in Table E3.2-2.

The most costly incremental is W1A, there are no additional independent outlets for the wind injections and upgrades to the 230 kV system in the Red River Valley.

The eastern option has the first limiters occurring at higher wind injection than the other two options. For the eastern option with and without the tap the Split Rock-White 345 kV line is usually the first limiter. For the western option the Roseau capacitor bank is the first limiter. See Table E3.1-6 for the complete list of first limiters.

The eastern option only had one system intact overload, Y2A, Split Rock-White 345 kV line at 1990 MW. The eastern option with the Fargo tap had none. The western option had the Roseau capacitor bank and Split Rock-White 345 kV line for some of the scenarios. A table showing the system intact overloads is in TableE3.1-7.

| | FARGO 500 MW | IRON RANGE 500 MW | IRON RANGE w/ T Tap 500 MW | FARGO 1000 MW | IRON RANGE 1000 MW | IRON RANGE w/ T Tap 1000 MW | FARGO 1500 MW | IRON RANGE 1500 MW | IRON RANGE w/ T Tap 1500 MW | FARGO 2000 MW | IRÓN RANGE 2000 MW | IRON RANGE w/ T Tap 2000 MW |
|---|------------------|-------------------------|-------------------------------------|-------------------|--------------------------|--------------------------------------|--------------------|--------------------------|---|---------------------|-----------------------------|---|
| 1A :Base Bison-Quarry #2 | 3 | 0 | 0 | (273 @ 740 MW) | 0 | o | N/A | 12 | 17 | N/A | 196 | 176 |
| 1AP Add Glenboro Phase Shifter | 0 | 0 | N/A | 292 | 0 | N/A | (292 @ 1030 MW) | 26 | N/A | N/A | 209 | N/A |
| 1B Remove Bison-Quarry #2 | (284 @ 75 MW) | 0 | 0 | N/A | 0 | o | N/A | 25 | 67 | N/A | 217 | 229 |
| 2A Add Bison-Brookings 500 kV with SC | (0 @ 465 MW) | 0 | N/A | N/A | o | N/A | N/A | 12 | N/A | N/A | 171 | N/A |
| 2B Add Bison-Brookings 345 kV | (0 @ 0 MW) | 0 | o | N/A | 0 | 0 | N/A | 12 | 17 | N/A | 174 | 229 |

Table E3.2-2 Cost Comparison Fargo/Brookings Wind Injection

