

Manitoba Hydro Group TSR Study

Midwest ISO – St. Paul

Nov 2, 2009

Agenda

- Introductions
- Status Update - MISO
- Scope of additional study work - All
- Discuss use of SPS for mitigation - All
- CapX presentation on 500 kV Facilities Study - CapX
- Next steps

Study Requests

MH-US South bound TSRs

TSR	POR	POD	Start Date	Stop Date	MW
76703536	MHEB	GRE	11/1/2014	11/1/2024	200
76703671	MHEB	WPS	6/1/2017	6/1/2027	500
76703672	MHEB	MP	6/1/2017	6/1/2037	250
76703686	MHEB	NSP	6/1/2017	6/1/2027	50
76703687	MHEB	WEC	6/1/2017	6/1/2027	100
Total					1100

Study Requests

US-MH North bound TSRs

TSR	POR	POD	Start Date	Stop Date	MW
76703483	WPS	MHEB	6/1/2017	6/1/2027	500
76703480	MP	MHEB	6/1/2017	6/1/2037	250
76703690	GRE	MHEB	11/1/2014	11/1/2024	100
76703688	GRE	MHEB	11/1/2014	11/1/2024	100
76703696	WEC	MHEB	6/1/2017	6/1/2027	50
76703698	ALTE	MHEB	6/1/2017	6/1/2027	50
76703697	ALTE	MHEB	6/1/2017	6/1/2027	50
Total					1100

Where are we at?

- Facilities Study Agreements and initial deposits have been received
 - One customer chose to withdraw their TSR
- After the RFP was sent to OTP, it was determined that due to an incorrect rating the constraint was no longer valid, and thus a FS is no longer required.
- Scoping calls have been scheduled with ATC, GRE and XEL
- As discussed in the Sept 1st meeting, a RFP has been sent to the CAPX Group for the facilities study of the new 500 kV Options and a proposal is expected November 13.

Additional Analyses Required

- Refer to the Draft Scope provided (WORD document)

Discussion on issues surrounding use of HVDC runback as mitigation measure

System Impact Study

- Thermal and transient stability analyses performed on two 500 kV AC transmission options (Option 1 and Option 3)
- Simulated HVDC reduction by existing SPS for loss of existing 500 kV and 230 kV tie lines
 - Acceptable system performance observed even with the added transmission and transfers.

Thermal Steady-state analyses

- Identified constraints, mitigation & cost estimate
- Required mitigation does not include additional triggers to existing HVDC SPS.

Transient Stability analyses

- Studied regional disturbances including faults on new 500 kV lines
- Various faults did result in criteria violations
- HVDC reduction for loss of new 500 kV lines considered as mitigation
- Indicative alternative mitigation not relying on new HVDC reduction also identified but not fully developed

Mitigation using HVDC reduction

- Existing HVDC runback assumed to be triggered by the loss of the new 500 kV lines
- Runback assumed to be 100% of pre-disturbance flow on the new lines:
 - Dorsey – Maple River 500 kV (Option 1)
 - Dorsey – King 500 kV (Option 3)
- HVDC reduction mitigates violations resulting from outage of new 500 kV facilities

Performance without HVDC reduction

- Issues observed without using HVDC reduction for new facilities will require significant transmission improvements.
- The following improvements at Forbes 500 kV were tested :
 - 400 MVAR fast-switched shunt capacitors for Option 1
 - 600 MVAR fast-switched shunt capacitors for Option 3
- These additions provide a working starting model. Additional reinforcements would be required to entirely mitigate the problems observed.

HVDC Runback Summary

Observations:

- HVDC reduction amounts required in the transfer case are lower than those required in the benchmark case
 - HVDC reduction for loss of any existing MH-US tie-line is lower with the new transmission Options modeled.
 - HVDC reduction required for the loss of the new tie-lines is lower than the reduction caused by the existing triggers.
- In general, the study transfers along with the added transmission facilities do not seem to degrade transmission reliability.

Illustrative HVDC reduction amounts

Tie Line	kV	Pre-Benchmark	Benchmark	Option 1	Option 3
Dorsey-Maple River	500	-	-	1459 MW	-
Dorsey-King	500	-	-	-	1361 MW
M602F @ Riel	500	1855 MW	1777 MW	1545 MW	1583 MW
L20D @ Letellier	230	238 MW	287 MW	236 MW	268 MW
R50M @ Richer	230	142 MW	139 MW	128 MW	134 MW
G82R @ Glenboro	230	-62 MW	-28 MW	-61 MW	-36 MW

Presentation by CapX on Facilities Study approach for 500 kV transmission

Appendix

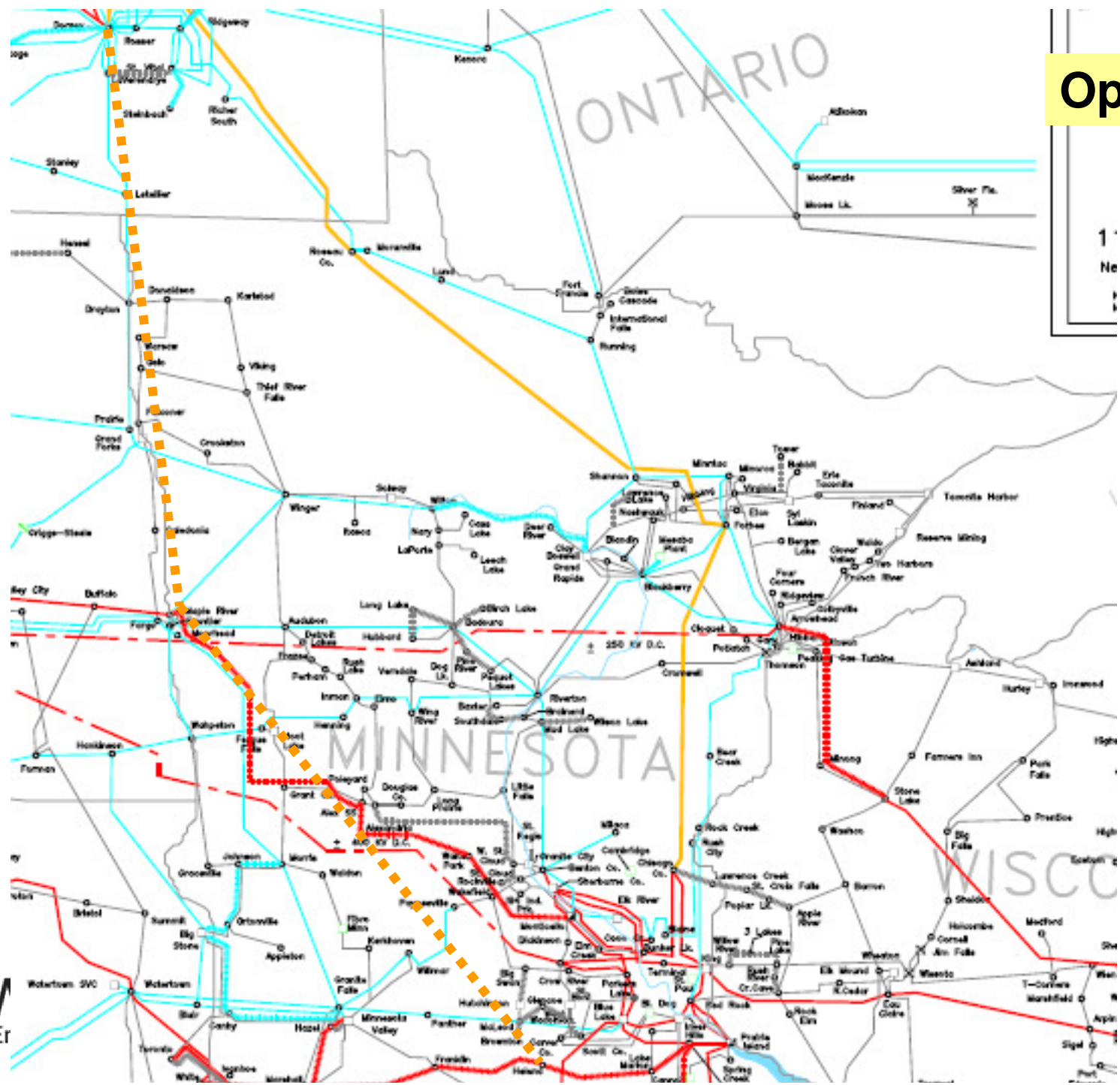
- Maps and details of the two transmission upgrade options

Proposed Transmission Upgrades

Option 1

- Dorsey - Maple River - Helena 500 kV
 - 500 kV single circuit with series capacitors (located at Prairie), with HVDC reduction for the loss of the line
- Option assumes use of Helena - Lake Marion – North Rochester – North La Crosse 345 kV
CAPX 2020 facilities

Option 1



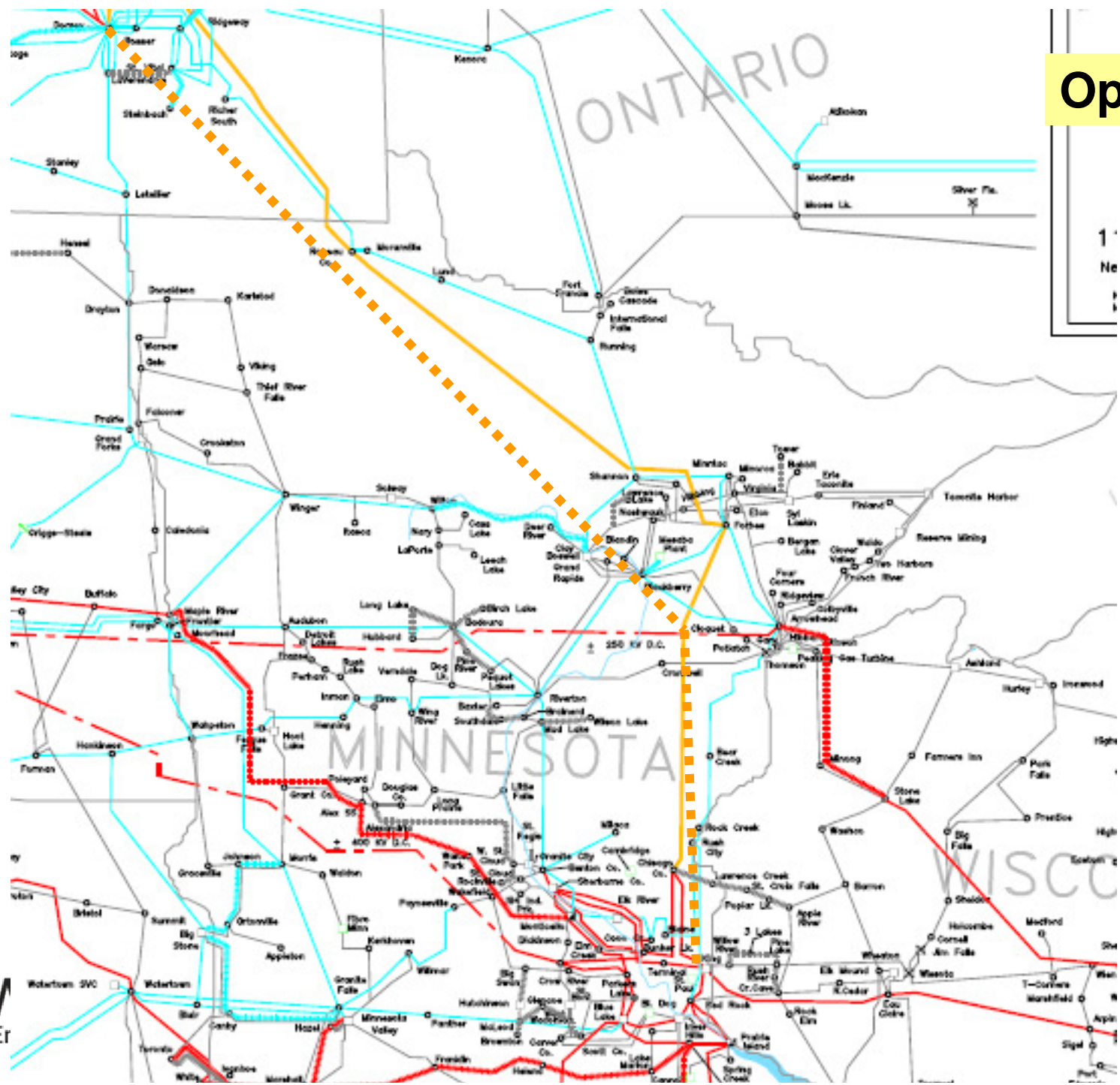
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Proposed Transmission Upgrades

Option 3

- Another 500 kV from Dorsey to King, parallel to the path of the existing 500 kV line
 - 500 kV single circuit, series compensated; HVDC reduction for the loss of the line
- Option assumes use of Helena - Lake Marion – North Rochester – North La Crosse 345 kV CAPX 2020 facilities

Option 3



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Impacts on existing HVDC reduction schemes (examples)

Fault	Description	Reduction	Pre-Benchmark	Benchmark	Option 1 ^{Note}	Option 3 ^{Note}
<i>cts</i>	SLG fault at Chisago 345 with breaker failure	100% M602F	1856 MW	1777 MW	1545 MW	1583 MW
<i>em3</i>	3PH fault at Letellier 230 on L20D	100% L20D	239 MW	288 MW	236 MW	268 MW
<i>mc3</i>	3PH fault at Richer 230 on R50M	100% R50M	142 MW	140 MW	129 MW	134 MW
<i>mis</i>	Bipole 2 block , cross trip MH-OH ties	100% (K21W+K22W)	200 MW	200 MW	199 MW	199 MW
<i>nad</i>	3PH fault at Forbes 500 on M602F	100% M602F	1856 MW	1777 MW	1545 MW	1583 MW
<i>nmz</i>	3PH fault at Chisago 500 on F601C	100% M602F	1856 MW	1777 MW	1545 MW	1583 MW
<i>pas</i>	SLG fault at Forbes 500 with breaker failure	100% M602F	1856 MW	1777 MW	1545 MW	1583 MW

HVDC Reduction flo of new 500 kV lines

- Assumed cross trip of Dorsey-Maple River for outage of Maple River-Helena or Helena 500-345 kV transformer
- Assumed new SPS will initiate HVDC reduction for events shown below

Option	Initiating Event	Flow Measurement	% Reduction
1	Dorsey-Maple River 500 kV line trip	Dorsey-Maple River	100%
1	Maple River 500/345 kV transformer trip	Dorsey-Maple River	None
1	Maple River-Helena 500 kV line trip	Dorsey-Maple River	100%
1	Helena 500/345 kV transformer trip	Dorsey-Maple River	100%
3	Dorsey-King 500 kV line trip	Dorsey-King	100%
3	King 500/345 kV transformer trip	Dorsey-King	100%