Report R164-08

MHEB Group TSR System Impact Study Near-Term Requests

Prepared for

Midwest ISO

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Executive Summary

Long term firm transmission service requests have been requested under the Midwest ISO's Open Access Transmission and Energy Markets Tariff. This report presents the results of a system impact study performed to evaluate the requests for transmission service shown in Table E-1, which seek to reserve 440 MW of transmission service from Manitoba Hydro. These near-term requests are four of sixteen requests being evaluated in the MHEB Group TSR System Impact Study. The requests are evaluated based on 2009 system conditions. Rollover rights, if any, will be evaluated along with the remaining twelve (out-year) requests.

Table E-1: MHEB Group TSR Near-Term Requests

Oasis Ref No	Service Type	Start Time	Stop Time	POR	POD	Requested Capacity	Queue Date	Study Number
76703520	P-to-P	May 2007	May 2009	MHEB-MISO	CIN	80 MW	11/15/06	A339
76703521	P-to-P	May 2007	May 2009	MHEB-MISO	NSP	80 MW	11/15/06	A340
76703535	Network	April 2008	April 2013	MHEB-MISO	NSP	30 MW	01/26/07	A351
76703685	P-to-P	Nov. 2009	Nov. 2014	MHEB-MISO	NSP	250 MW	02/04/08	A406
					Total:	440 MW		

Analyses have been performed for the near term period to assess the impacts the proposed transfers would have on the transmission system.

A339 (80 MW MHEB-MISO to CIN)

A339 is a request for 80 MW of point-to-point transmission service from MHEB-MISO to CIN. For A339, the following flowgates have been identified as constraints to the transfer in the flow-based analysis. Note that minimum posted available transfer capacity on the MHEX_S flowgate is 100 MW, of which 57 MW corresponds to the Midwest ISO allocation.

Table E-2: A339 Flow-Based Constraints

Flowgate Name	Limiting Constraint	Contingency	Rating (MVA)	Lowest Available Flowgate Capacity (pre-transfer)	TDF
MHEX_S	Letellier - Drayton 230 kV Dorsey - Roseau 500 kV Richer - Roseau 230 kV Glenboro - Rugby 230 kV	Base Case	1972	57 out of 100	100.00%
BREWHEJEFROC	Breed - Wheatland 345 kV	Jefferson-Rockport 765 kV	786	-150	26.39%
COOPER_S	Cooper - St. Joe 345 kV Cooper - Fairport 345 kV	Base Case	670	-472	17.62%
FTCAL_S	Fort Calhoun South	Base Case	451	-101	11.18%

A340 (80 MW MHEB-MISO to NSP)

A340 is a request for 80 MW of point-to-point transmission service from MHEB-MISO to NSP. The MHEX_S flowgate has been identified as a constraint to the transfer in both the network analysis and the flow-based analysis. Note that if A339 proceeds, then there is no available transfer capability along this flowgate for A340 and thus service could not be granted without transmission improvements.

Table E-3: A340 Flow-Based Analysis Constraints

Flowgate Name	Limiting Constraint	Contingency	Rating (MVA)	Lowest Available Flowgate Capacity (pre-transfer)	TDF
MHEX_S	Letellier - Drayton 230 kV Dorsey - Roseau 500 kV Richer - Roseau 230 kV Glenboro - Rugby 230 kV	Base Case	1972	-23 [1]	100.00%

Note 1: AFC assuming A339 proceeds

A351 (30 MW MHEB-MISO to NSP)

A351 is a request for 30 MW of network transmission service from MHEB-MISO to NSP. The The MHEX_S flowgate has been identified as a constraint to the transfer in both the network analysis and the flow-based analysis. Note that if A339 or A340 proceeds, then there is no available transfer capability along this flowgate for A351 and thus service could not be granted without transmission improvements.

Table E-4: A351 Flow-Based Analysis Constraints

Flowgate Name	Limiting Constraint	Contingency	Rating (MVA)	Lowest Available Flowgate Capacity (pre-transfer)	TDF
MHEX_S	Letellier - Drayton 230 kV Dorsey - Roseau 500 kV Richer - Roseau 230 kV Glenboro - Rugby 230 kV	Base Case	1972	-103 [1]	100.00%

Note 1: AFC assuming A339 and A340 proceed

A406 (250 MW MHEB-MISO to NSP)

A406 is a request for 250 MW of point-to-point transmission service from MHEB-MISO to NSP. Request A406 can not be accepted without system improvements. Constraints identified in the network analysis and flow-based analysis are shown in Table E-5 and Table E-6, respectively. Note that if A339, A340 or A351 proceeds, then there is no available transfer capability along the MHEX_S flowgate for A406.

Table E-5: A406 Network Analysis Thermal Constraints

Date Upgrade Needed	Facility to be upgraded/built	Minimum Capacity Required (MVA)
Before Service can commence	Dorsey 500/230/46 kV xfmr #52	1274.4
	Dorsey 500/230/46 kV xfmr #51	1274.4

Table E-6: A406 Flow-Based Analysis Constraints

Flowgate Name	Limiting Constraint	Contingency	Rating (MVA)	Lowest Available Flowgate Capacity (pre-transfer)	TDF
MHEX_S	Letellier - Drayton 230 kV Dorsey - Roseau 500 kV Richer - Roseau 230 kV Glenboro - Rugby 230 kV	Base Case	1972	-133 [1]	100.00%

Note 1: AFC assuming A339, A340 and A351 proceed

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Section

1

Introduction

This report presents the results of a system impact study performed to evaluate the requests for transmission service shown in Table 1-1. These requests are four of 16 requests being evaluated in the MHEB Group TSR System Impact Study. These near-term requests are evaluated based on 2009 system conditions. Rollover rights, if any, will be evaluated along with the remaining twelve (out-year) requests.

Table 1-1: MHEB Group TSR Near-Term Requests

Oasis Ref No	Service Type	Start time	Stop Time	POR	POD	Requested Capacity	Queue Date	Study Number
76703520	P-to-P	May 2007	May 2009	MHEB-MISO	CIN	80 MW	11/15/06	A339
76703521	P-to-P	May 2007	May 2009	MHEB-MISO	NSP	80 MW	11/15/06	A340
76703535	Network	April 2008	April 2013	MHEB-MISO	NSP	30 MW	01/26/07	A351
76703685	P-to-P	Nov. 2009	Nov. 2014	MHEB-MISO	NSP	250 MW	02/04/08	A406
					Total:	440 MW		

This study was performed by Siemens PTI under the direction of Midwest ISO and an Ad Hoc Study Group consisting of American Transmission Company (ATC LLC), Basin Electric Power Cooperative (BEPC), Dairyland Power Cooperative (DPC), Great River Energy (GRE), Manitoba Hydro (MHEB), Minnesota Power (MP), Minnkota Power Cooperative (MPC), Otter Tail Power (OTP) and Xcel Energy (XEL).

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Section
2

Steady-State Analysis

2.1 Methodology

A benchmark power flow model representing system conditions in 2009 was created without the requested transmission service. A study case was created by modeling the requested transmission service in the benchmark case. A nonlinear (ac) contingency analysis was performed on both the benchmark and study case and the incremental impact of the requested transmission service was evaluated by comparing flows and voltages without and with the service.

Linear (dc) analysis was used to calculate distribution factors for each TSR. These distribution factors and the results of the nonlinear contingency analysis were used to calculate the loading of impacted facilities before and after each TSR.

2.2 Computer Programs

Analysis was performed using PSS®E version 30.3 and PSS®MUST version 8.3.2.

2.3 Model Development

2.3.1 Near-term Benchmark Case

A near-term benchmark case without the study TSRs was developed from a summer peak case provided by Midwest ISO. This case represents 2009 summer peak conditions and was developed from the MRO 2007 series models as described herein.

2.3.1.1 Midwest ISO Transmission Expansion Plan 2008 (MTEP08) Projects

Table 2-1 shows the MTEP08 projects that were added to the near-term benchmark case using response files provided by Midwest ISO.

Table 2-1: MTEP Projects Added to the Near-term Case

TO	PrjID	Project Name
ATC LLC	352	Cranberry-Conover 115 kV
ATC LLC	345	Clintonville-Werner West 138
ATC LLC	177	Gardner Park-Highway 22 345 kV line projects
ITCM	1761	Readlyn-Tripoli 69kV Rebuild
ITCM	1757	Cambridge REC-Maxwell 69kV Rebuild
ITCM	1753	Winnebago Jct south 161/69kV
ITCM	1739	Arnold-Vinton-Dysart-Washburn 161kV Reconductor
ITCM	1619	Grnd Mnd 161-69kV 2nd Xfmr & 161kV loop
ITCM	1618	Hrn Lk-Lkfld 161kV Ckt 1 Rbld
ITCM	1342	Lewis Fields 161 kV substation which taps the SwampFX - Coggon 115 kV line
ITCM	1289	Marshalltown - Toledo - Belle Plaine - Stoney Point 115 kV line rebuild
ITCM	1287	Replace Salem 345/161 kV transformer with 448 MVA unit
MP/GRE	1021	Embarass to Tower 115 kV Line
XEL	1959	Yankee Doodle interconnection
XEL	1956	Blue Lake - Wilmarth 345 kV line capacity upgrade
XEL	1549	Eau Claire - Hydro Lane 161 kV Conversion
XEL	1548	La Crosse Area Capacitor banks
XEL	1489	Woodbury - Tanners Lake upgrade
XEL	1457	G287, 37642-03. Upgrades for G287
XEL	1373	Ft. Ridgeley - Searles Jct 115 new line and Searles Jct - New Ulm 69 Reconductor
XEL	1370	Convert/Relocate the 69 kV Rush River substation to existing 161 kV line from Pine Lake - Crystal Cave
XEL	1369	Osceola - Sand Lake 69 Reconductor
XEL	1368	Three Lakes 115/69 kV substation
XEL/GRE	1545	Mankato 115 kV loop

2.3.1.2 Midwest ISO TSRs and Confirmed Requests

Table 2-2 shows Midwest ISO TSRs and confirmed requests that were added to the near-term benchmark case using sources and sinks provided by Midwest ISO. The near-term benchmark case includes all existing firm commitments on the MHEX_S interface.

Table 2-2: Midwest ISO TSRs Added to the Near-term Case

OASIS	OASIS #	STUDY	POR	POD	CAPACITY REQUESTED (MW)	START	STOP
MISO	75690165	A168	MP	NSP	20	6/1/2006	6/1/2026
MISO	75690167	A168	MP	NSP	15	6/1/2006	6/1/2026
MISO	75884042	A201	NSP	NSP	19	12/1/2007	11/1/2029
MISO	75884044	A201	NSP	NSP	19	1/1/2008	1/1/2033
MISO	76541075	A204	MP	MP	25	2/1/2008	2/1/2009
MISO	76109095	A230	WAUE	GRE	18 (Note 1)	1/1/2008	1/1/2036
MISO	76198084	A259	GRE	GRE	13	9/1/2005	9/1/2025
MISO	76703518	A304	MHEB	MP	50	5/1/2009	5/1/2015
MISO	76463020	A329	OTP	OTP	21	2/1/2007	1/1/2028
MISO	76480654	A335	GRE	GRE	80 (Note 2)	4/1/2009	4/1/2029
MISO	76659803	-	MP-ONT	MP	150	11/01/2008	11/01/2013
MISO	76414212	-	MP	GRE	100	06/01/2006	06/01/2010

Note 1: The transfer size has been increased to 61 MW

Note 2: The transfer size has been reduced to 68 MW

2.3.1.3 WAPA TSRs

The following proposed generating facilities have TSRs in study on the WAPA OASIS and are modeled in the near-term case.

- Culbertson Project (130 MW)
- GI-0704 (240 MW)
- GI-0714 (100 MW)

The generating facilities are dispatched against generation at Big Bend and Ft. Randall. Groton Unit 1 and Unit 2 are dispatched at 125 MW each.

2.3.1.4 Miscellaneous Updates and Corrections

Table 2-3 shows other miscellaneous model updates.

Table 2-3: Miscellaneous Updates and Corrections

Area	Description
ATC LLC	Update system topology, load forecast, and generation dispatch for ATC LLC companies
MH	Net flow on MH-SPC ties reduced to 0 MW
MH	Brandon 5 turned off; Kelsey uprate and Wuskwatim generating facility added
MH	Flow on the MH dc line set at 2910 MW in preparation for sourcing the 440 MW study transfer at Dorsey.

The power flow case was solved with transformer tap adjustment enabled, area interchange enabled (ties and load), phase shifter adjustment enabled before contingency and locked after contingency, and switched shunt adjustment enabled.

2.3.2 Near-term Study Case

A near-term TSR study case was developed by adding the near-term requests shown in Table 1-1 to the benchmark case described in Section 2.3.1. The TSR sources and sinks are masked.

Table 2-4: Near Term TSR sink

Bus #	Bus Name	MW
Masked		

2.4 Contingency Criteria

A variety of system conditions are considered for the steady-state analysis.

- NERC Category A with system intact (no contingencies)
- NERC Category B contingencies
  - Outage of single element (B.2 and B.3) associated with single contingency event in the following areas: ATCLLC (WEC, ALTE, WPS, MGE, UPPC), DPC, GRE, ITC Midwest, MH, MP, OTP, SMMPA, WAPA, XEL
  - Outage of multiple-elements (B.2 and B.3) associated with single contingency event in the Dakotas, Manitoba, Minnesota, Wisconsin

2.5 Monitored Facilities

Monitored facilities and associated thermal and voltage limits are shown in Table 2-5.

Table 2-5: Monitored Facilities and Limits

Owner/ Area	Monitored Facilities	Thermal Limits [1]		Voltage Limits
		Pre-Disturbance	Post-Disturbance	
ATC LLC	69 kV and above	95% of Rate A	95% of Rate B	1.10/0.90
BEPC	69 kV and above	100% of Rate A	100% of Rate A	1.10/0.90
DPC	69 kV and above	100% of Rate A	100% of Rate A	1.10/0.90
GRE	69 kV and above	100% of Rate A	100% of Rate B	1.10/0.92/0.90 [2]
ITCMW	69 kV and above	100% of Rate A	100% of Rate B	1.10/0.90
MDU	69 kV and above	100% of Rate A	100% of Rate B	1.10/0.90
MEC	69 kV and above	100% of Rate A	100% of Rate A	1.10/0.90
MH	69 kV and above	100% of Rate A	100% of Rate A	1.15/1.10/0.94/0.90 [3]
MP	69 kV and above	100% of Rate A	100% of Rate B	1.10/0.90
MPC	69 kV and above	100% of Rate A	100% of Rate A	1.10/0.90
MRES	69 kV and above	100% of Rate A	100% of Rate A	1.10/0.90
NWPS	69 kV and above	100% of Rate A	100% of Rate A	1.10/0.90
OTP	69 kV and above	100% of Rate A	100% of Rate B	1.10/0.90
RPU	69 kV and above	100% of Rate A	100% of Rate A	1.10/0.90
SMMPA	69 kV and above	100% of Rate A	100% of Rate B	1.10/0.90
SPC	69 kV and above	100% of Rate A	100% of Rate A	1.10/0.90
WAPA	69 kV and above	100% of Rate A	100% of Rate A	1.10/0.90
XEL	69 kV and above	100% of Rate A	100% of Rate B	1.10/0.90

Note 1: PSSE Rate A, Rate B or Rate C
Note 2: 0.92 limit applies to load serving buses
Note 3: Limits dependent on nominal bus voltage

2.6 Reliability Margins

Capacity benefit margin (CBM) and transmission reliability margin (TRM) are accounted for in the flowgate definitions. All other system elements were monitored as shown in Table 2-5.

2.7 Performance Criteria

A branch or flowgate is considered a significantly affected facility if both of the following conditions are met:

1) the branch is loaded above its applicable normal or emergency rating for the post-change case, and
2) the power transfer distribution factor (PTDF) is greater than 5% or the outage transfer distribution factor (OTDF) is greater than 3%.

Distribution factors for each TSR are calculated using linear (dc) analysis.

A voltage impact is considered significant if both of the following conditions are met:

1) the bus voltage is outside of applicable normal or emergency limits for the post-disturbance case,
2) the impact of the service on bus voltage is greater than 0.01 per unit.

2.8 Network Analysis Results

Facilities on which one or more TSR have a significant thermal impact are shown in Appendix A, Table A-1. A thermal impact is considered significant if the facility loading exceeds the limit shown in Table 2-5 and the impact has a PTDF greater than 5% or an OTDF greater than 3%. There are no significant voltage impacts.

The power flow solution converges in the benchmark case following outage of the Tioga-Boundary Dam 230 kV line but does not converge in the study case. The solution in the study case converges if the fictitious capacitor added at Dorsey in the study case is increased from 200 Mvar to 300 Mvar and no significant thermal or voltage impacts are identified. This issue is related to the ultimate TSR source and is not considered a constraint to the MISO service.

2.8.1 A339 (80 MW MHEB-MISO to CIN)

A339 is a request for 80 MW of point-to-point transmission service from MHEB-MISO to CIN. For A339, the Blackberry-Boswell 230 kV line is the only significantly affected facility as shown in Table 2-6. Blackberry-Boswell is not a constraint because the Boswell special protection system will automatically reduce generation at the Clay Boswell plant to mitigate this contingent overload.

2.8.2 A340 (80 MW MHEB-MISO to NSP)

A340 is a request for 80 MW of point-to-point transmission service from MHEB-MISO to NSP. For A340, the Blackberry-Boswell 230 kV line and MHEX_S flowgate have been identified as

significantly affected facilities as shown in Table 2-7. Blackberry-Boswell is not a constraint because the Boswell special protection system will automatically reduce generation at the Clay Boswell plant to mitigate this contingent overload. The MHEX_S flowgate is a constraint to the transfer.

2.8.3 A351 (30 MW MHEB-MISO to NSP)

A351 is a request for 30 MW of network transmission service from MHEB-MISO to NSP. For A351, the Blackberry-Boswell 230 kV line and MHEX_S flowgate have been identified as significantly affected facilities as shown in

Table 2-8. Blackberry-Boswell is not a constraint because the Boswell special protection system will automatically reduce generation at the Clay Boswell plant to mitigate this contingent overload. The MHEX_S flowgate is a constraint to the transfer.

2.8.4 A406 (250 MW MHEB-MISO to NSP)

A406 is a request for 250 MW of point-to-point transmission service from MHEB-MISO to NSP. Multiple constraints have been identified for request A406 as shown in Table 2-9. The MHEX_S flowgate and contingent overloads of the Dorsey transformers are constraints to the transfer.

Table 2-6: A339 Thermal Constraints (80 MW; MHEB-MISO to CIN)

Monitored Branches	Owner	Rating	Pre TSR Loading (%)	Post TSR Loading (%)	DF (%)	Contingency	Category
61625 BLCKBRY4 230 61626 BOSWELL4 230 2[1]	MP	438.0	138.8	139.5	3.7	BLCKBRY4 230 - BOSWELL4 230 1	B

Note 1: Boswell special protection system will automatically reduce generation at the Clay Boswell plant to mitigate this contingent overload

Table 2-7: A340 Thermal Constraints (80 MW MHEB-MISO to NSP)

Monitored Branches	Owner	Rating	Pre TSR Loading (%)	Post TSR Loading (%)	DF (%)	Contingency	Category
61625 BLCKBRY4 230 61626 BOSWELL4 230 2 [1]	MP	438.0	139.5	140.1	3.4	BLCKBRY4 230 - BOSWELL4 230 1	B
6002:MHEX_S		1972.0	97.7	101.8	100.0	Base Case	A

Note 1: Boswell special protection system will automatically reduce generation at the Clay Boswell plant to mitigate this contingent overload

Table 2-8: A351 Thermal Constraints (30 MW MHEB-MISO to NSP)

Monitored Branches	Owner	Rating	Pre TSR Loading (%)	Post TSR Loading (%)	DF (%)	Contingency	Category
61625 BLCKBRY4 230 61626 BOSWELL4 230 2 [1]	MP	438.0	140.1	140.3	3.6	BLCKBRY4 230 - BOSWELL4 230 1	B
6002:MHEX_S		1972.0	101.8	103.3	100.0	Base Case	A

Note 1: Boswell special protection system will automatically reduce generation at the Clay Boswell plant to mitigate this contingent overload

Table 2-9: A406 Thermal Constraints (250 MW MHEB-MISO to NSP)

Monitored Branches	Owner	Rating	Pre TSR Loading (%)	Post TSR Loading (%)	DF (%)	Contingency	Category
61625 BLCKBRY4 230 61626 BOSWELL4 230 2 [1]	MP	438.0	140.3	142.6	3.4	BLCKBRY4 230 - BOSWELL4 230 1	B
67564 DORSEY 2 500 67566 DORSEYM4 230 52	MH	1200.0	93.4	106.2	47.5	DSY BK51 DORSEY 4 230 - DORSY2M4 230 51 DORSEY 2 500 - DORSY2M4 230 51 DORSY2T9 46.0 - DORSY2M4 230 51 Change bus 67503 DORSEY 4 230 load by 882.0 MW dispatch	B
67564 DORSEY 2 500 67598 DORSY2M4 230 51	MH	1200.0	94.1	106.2	47.9	DSY BK52 DORSEY 4 230 - DORSEYM4 230 52 DORSEY 2 500 - DORSEYM4 230 52 DORSEYT9 46.0 - DORSEYM4 230 52 Change bus 67503 DORSEY 4 230 load by 882.0 MW dispatch	B
6002:MHEX_S		1972.0	103.3	115.8	100.0	Base Case	A

Note 1: Boswell special protection system will automatically reduce generation at the Clay Boswell plant to mitigate this contingent overload

2.9 AFC Analysis

The AFC values for Midwest ISO and MAPP flowgates are posted for the next 36 months. For any flowgate impacted by the study transfers, the AFC values of those flowgates are considered. Note that minimum posted available transfer capacity on the MHEX_S flowgate is 100 MW, of which 57 MW corresponds to the Midwest ISO allocation. If A339 proceeds, the MHEX_S flowgate will not have sufficient transfer capability available for A340, and likewise if A340 proceeds, there would be no available capacity on the MHEX_S flowgate for A351 and A406.

2.9.1 A339 (80 MW MHEB-MISO to CIN)

For A339, the following flowgates have been identified as constraints to the transfer in the flow-based analysis. Note that minimum posted available transfer capacity on the MHEX_S flowgate is 100 MW, of which 57 MW corresponds to the Midwest ISO allocation.

Table 2-10: A339 Flow-Based Constraints

Flowgate Name	Limiting Constraint	Contingency	Rating (MVA)	Lowest Available Flowgate Capacity (pre-transfer)	TDF
MHEX_S	Letellier - Drayton 230 kV Dorsey - Roseau 500 kV Richer - Roseau 230 kV Glenboro - Rugby 230 kV	Base Case	1972	57 out of 100	100.00%
BREWHEJEFROC	Breed - Wheatland 345 kV	Jefferson-Rockport 765 kV	786	-150	26.39%
COOPER_S	Cooper - St. Joe 345 kV Cooper - Fairport 345 kV	Base Case	670	-472	17.62%
FTCAL_S	Fort Calhoun South	Base Case	451	-101	11.18%

2.9.2 A340 (80 MW MHEB-MISO to NSP)

For A340 the following flowgates are constraints to the transfer. Note that if A339 proceeds, then there is no available transfer capability along this flowgate for A340 and thus service could not be granted without transmission improvements.

Table 2-11: A340 Flow-Based Analysis Constraints

Flowgate Name	Limiting Constraint	Contingency	Rating (MVA)	Lowest Available Flowgate Capacity (pre-transfer)	TDF
MHEX_S	Letellier - Drayton 230 kV Dorsey - Roseau 500 kV Richer - Roseau 230 kV Glenboro - Rugby 230 kV	Base Case	1972	-23 [1]	100.00%

Note 1: AFC assuming A339 proceeds

2.9.3 A351 (30 MW MHEB-MISO to NSP)

For A351 the following flowgates are constraints to the transfer. Note that if A339 or A340 proceeds, then there is no available transfer capability along this flowgate for A351 and thus service could not be granted without transmission improvements.

Table 2-12: A351 Flow-Based Analysis Constraints

Flowgate Name	Limiting Constraint	Contingency	Rating (MVA)	Lowest Available Flowgate Capacity (pre-transfer)	TDF
MHEX_S	Letellier - Drayton 230 kV Dorsey - Roseau 500 kV Richer - Roseau 230 kV Glenboro - Rugby 230 kV	Base Case	1972	-103 [1]	100.00%

Note 1: AFC assuming A339 and A340 proceed

2.9.4 A406 (250 MW MHEB-MISO to NSP)

For A406 the following flowgates are constraints to the transfer. Note that if A339 or A340 proceeds, then there is no available transfer capability along this flowgate for A406 and thus service could not be granted without transmission improvements.

Table 2-13: A406 Flow-Based Analysis Constraints

Flowgate Name	Limiting Constraint	Contingency	Rating (MVA)	Lowest Available Flowgate Capacity (pre-transfer)	TDF
MHEX_S	Letellier - Drayton 230 kV Dorsey - Roseau 500 kV Richer - Roseau 230 kV Glenboro - Rugby 230 kV	Base Case	1972	-133	100.00%

Note 1: AFC assuming A339, A340 and A351 proceed

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Appendix

A

Network Analysis Results

Table A-1: Significantly Impacted Facilities

Monitored Branches	Owner	Rating	Benchmark Loading (%)	Post TSR Loading (%)	Contingency	Category
6002:MHEX_S		1972.0	93.7	115.8	Base Case	A
61625 BLCKBRY4 230 61626 BOSWELL4 230 2	MP	438.0	138.8	142.6	BLCKBRY4 230 - BOSWELL4 230 1	B
67564 DORSEY 2 500 67566 DORSEYM4 230 52	MH	1200.0	86.0	106.2	DSY BK51 DORSEY 4 230 - DORSY2M4 230 51 DORSEY 2 500 - DORSY2M4 230 51 DORSY2T9 46.0 - DORSY2M4 230 51 Change bus 67503 DORSEY 4 230 load by 882.0 MW dispatch	B
67564 DORSEY 2 500 67598 DORSY2M4 230 51	MH	1200.0	86.7	106.2	DSY BK52 DORSEY 4 230 - DORSEYM4 230 52 DORSEY 2 500 - DORSEYM4 230 52 DORSEYT9 46.0 - DORSEYM4 230 52 Change bus 67503 DORSEY 4 230 load by 882.0 MW dispatch	B

Benchmark loading is loading in the benchmark case without study TSRs. Post TSR loading includes impact of all four near-term requests