

Midwest ISO (2006-8)

Technical Report

System Impact Study for Long-Term Firm Transmission Service

MISO Project A319
OASIS Reference 76433058



Performed by the American Transmission Company LLC

Miso

System Impact Study

Request**MISO****Oasis #****76433058****Start****1/1/2012****End****1/1/2052****From****ALTE****To****ALTE****MW****300****Available Customer Options:**

1. The customer will be offered a Facilities Study Agreement for OASIS request 76433058.

MISO Action Item:

2. Tender the customer a Facilities Study Agreement for OASIS request 76433058.

System Impact Study Report

Models used in this study correlated with the summer peaks of 2012 and 2015. The results for later years are estimated from the 2015 model. Projects identified to resolve stability and injection limits in the Generator Interconnection System Impact Study report (MISO queue # 38625-01) dated August 8, 2006, have been included in the base case models.

The following sections of this report show the results of the System Impact Study (SIS) for MISO OASIS request number **76433058**, requesting 300 MW of transfer from the Source in ALTE to ALTE from 1/1/2012 to 1/1/2052. This transfer has been studied for both the 138kV and 345kV connection option of the Source. In order to grant full transmission service all network limits, flow based limits, and voltage violations must be resolved.

Network Analysis – 138kV Connection Option

Summer 2012 results: Results show that with the Source connected using the 138kV connection option zero MW of transfer capability is available from the Source to ALTE without reinforcements. The limiting facilities for this transfer are listed below.

Owner	Limiting Element	Worst Contingency	DF %	MVA Rating	Loading %
ATC	Portage-Trienda 138kV X-19	Portage-Trienda 138kV X-67	8.7	240	123.4
ATC	Portage-Trienda 138kV X-67	Portage-Trienda 138kV X-19	8.8	287	103.6
ATC	Portage 138/69 kV Tr.	Columbia 138/69 kV Tr. T31	3.4	105	101.5

Summer 2015 results: Results show that with the Source connected using the 138kV connection option zero MW of transfer capability is available from the Source to ALTE without reinforcements. The limiting facilities for this transfer are listed below.

Owner	Limiting Element	Worst Contingency	DF %	MVA Rating	Loading %
ATC	Portage-Trienda 138kV X-19	Portage-Trienda 138kV X-67	17.2	240	141.5
ATC	Portage-Trienda 138kV X-67	Portage-Trienda 138kV X-19	17.3	287	117.8
ATC	Kilbourn 138/69 kV Tr. T32	Kilbourn 138/69 kV Tr. T31	3.6	65	112.4
ATC	Portage 138/69 kV Tr.	Columbia 138/69 kV Tr. T31	4.7	105	108.0
ATC	Marine-Colley Rd 138kV	NW Beloit Tap-Paddock 138kV	5.3	287	100.5

Flow-based Analysis – 138kV Connection Option

The start date of the requested service is not within the 12 month AFC horizon. This service will not be restricted based on AFC Flow-based Analysis.

Voltage Analysis – 138kV Connection Option

Summer 2012 results: Results show that with the Source connected using the 138kV connection option the transfer of 300 MW from the Source in ALTE to ALTE results in three base case voltages and no post-contingent voltages outside of the acceptable range criteria. The voltage violations are listed below.

Bus Name	Bus Voltage	Worst Contingency	Pre-Cont. Voltage (p.u.)	Post-Cont. Voltage (p.u.)	Change in highlighted voltage (p.u.) due to transfer under study
N.Beaver Dam	138 kV	Base Case	0.9278	N/A	0.0102
E.Beaver Dam	138 kV	Base Case	0.9273	N/A	0.0101
Fox Lake	138 kV	Base Case	0.9464	N/A	0.0100

Summer 2015 results: Results show that with the Source connected using the 138kV connection option the transfer of 300 MW from the Source to ALTE results in two base case voltages and no post-contingent voltages outside of the acceptable range criteria. The voltage violations are listed below.

Bus Name	Bus Voltage	Worst Contingency	Pre-Cont. Voltage (p.u.)	Post-Cont. Voltage (p.u.)	Change in highlighted voltage (p.u.) due to transfer under study
N.Beaver Dam	138 kV	Base Case	0.9354	N/A	0.0109
E.Beaver Dam	138 kV	Base Case	0.9361	N/A	0.0107

Proposed Solutions – 138kV Connection Option

The following facilities, or their electrical equivalents as determined by ATCLLC, are required to be in-service prior to June 1, 2012 in order to resolve network analysis limits and grant service. These projects also resolve the voltage analysis violations identified in the 2012 summer peak case. This list is subject to change pending the final Facilities Study for this request; the list below is provided as the best determination of required facilities at this time. The list of facilities determined in the final Facilities Study will take precedence over all other lists.

1. Uprate Portage-Trienda 138kV line X-19 to 339 MVA. This project has been proposed¹ for completion in 2008 and has an estimated cost of \$1.1 million.
2. Uprate Portage-Trienda 138kV line X-67 to 373 MVA. This project is provisional² for 2014 and has an estimated cost of \$1.5 million.
3. Create Yahara River 69kV bus and install a 138/69kV transformer. Loop Deforest – Token Creek 69kV line into the Yahara River substation. This project is provisional² for 2011 and has an estimated cost of \$5.6 million.

¹ “Proposed” indicates that the ATC planning process is underway, but the project has not yet received final approval.

² “Provisional” indicates that the ATC planning process is not yet underway for this project, but this project has been identified as one possible solution to a future system need and is being used as a placeholder until a final resolution to the need is determined.

The following facilities, or their electrical equivalents as determined by ATC, are required to be in-service prior to June 1, 2015 in order to resolve network analysis limits and grant service.

4. Replace Kilbourn 138/69 kV transformer T32 with a 100 MVA unit. This project has not entered the ATC planning process. The requested transmission service requires an in-service date of June 1, 2015. The estimated cost of this project is \$2.5 million. This cost estimate has been developed using the reference table in Appendix B.
5. Replace terminal equipment at Colley Road substation to increase Colley Road-Marine 138kV line rating to 332 MVA summer emergency rating, at minimum. This project has not entered the ATC planning process. The requested transmission service requires an in-service date of June 1, 2015. The estimated cost of this project is \$450,000. This cost estimate has been developed using the reference table in Appendix B.
6. Replace Portage 138/69 kV transformer T32 with 115 MVA unit. This project has not entered the ATC planning process. The requested transmission service requires an in-service date of June 1, 2015. The estimated cost of this project is \$2.5 million. This cost estimate has been developed using the reference table in Appendix B.
7. Install a second 138/69-kV transformer at Wautoma. This project is provisional² for 2015 and has an estimated cost of \$2.9 million.
8. Replace circuit breaker at Portage substation to achieve line conductor rating of 373 MVA on the Portage-Trienda 138kV line X-19. This project has not entered the ATC planning process. The requested transmission service requires an in-service date of June 1, 2015. The estimated cost of this project is \$390,000. This cost estimate has been developed using the reference table in Appendix B.

- OR -

8. Construct Monroe County-Council Creek 161-kV line & install a 161/138-kV transformer at Council Creek. This project is provisional² for 2010 and has an estimated cost of \$12.6 million. If this project is constructed, it will sufficiently relieve the loading on the Portage-Trienda 138kV line X-19 without replacing the breaker at Portage. The Facilities Study for this request may provide further clarity regarding the resolution of this overload.

The following facilities, or their electrical equivalents as determined by ATC, are required to be in-service prior to June 1, 2015 in order to resolve voltage analysis violations and grant service.

9. Install 2-24.5 MVAR 138-kV capacitor banks at North Beaver Dam. This project is provisional² for 2009 and has an estimated cost of \$1.4 million.

² "Provisional" indicates that the ATC planning process is not yet underway for this project, but this project has been identified as one possible solution to a future system need and is being used as a placeholder until a final resolution to the need is determined.

Network Analysis – 345kV Connection Option

Summer 2012 results: Results show 300 MW of transfer capability is available from the Source to ALTE without reinforcements with the Source connected using the 345kV connection option.

Summer 2015 results: Results show zero MW of transfer capability is available from the Source to ALTE without reinforcements with the Source connected using the 345kV connection option. The limiting facilities for this transfer are listed below.

Owner	Limiting Element	Worst Contingency	DF %	MVA Rating	Loading %
ATC	Portage-Trienda 138kV X-19	Portage-Trienda 138kV X-67	13.0	240	136.7
ATC	Portage-Trienda 138kV X-67	Portage-Trienda 138kV X-19	12.9	287	113.7
ATC	Kilbourn 138/69 kV Tr. T32	Kilbourn 138/69 kV Tr. T31	3.0	65	108.9
ATC	Columbia 345/138 kV Tr. T22	Columbia 345/138 kV Tr. T21 & T23	19.1	478	104.1
ATC	Marine-Colley Rd 138kV	NW Beloit Tap-Paddock 138kV	5.2	287	100.2
ATC	North Randolph-Fox Lake 138kV	Jefferson-Crawfish River 138kV	3.8	165	100.6

Flow-based Analysis – 345kV Connection Option

The start date of the requested service is not within the 12 month AFC horizon. This service will not be restricted based on AFC Flow-based Analysis.

Voltage Analysis – 345kV Connection Option

Summer 2012 results: Results show that with the Source connected using the 345kV connection option the transfer of 300 MW from the Source to ALTE results in no base case or post-contingent voltages outside of the acceptable range criteria.

Summer 2015 results: Results show that with the Source connected using the 345kV connection option the transfer of 300 MW from the Source to ALTE results in no base case or post-contingent voltages outside of the acceptable range criteria.

Proposed Solutions – 345kV Connection Option

The following facilities, or their electrical equivalents as determined by ATC, are required to be in-service prior to June 1, 2015 in order to resolve network analysis limits and grant service. This list is subject to change pending the final Facilities Study for this request; the list below is provided as the best determination of required facilities at this time. The list of facilities determined in the final Facilities Study will take precedence over all other lists.

1. Construct a Rubicon-Hustiford 138kV line. This project has been proposed¹ for completion in 2008 and has an estimated cost of \$4.8 million.
2. Uprate Portage-Trienda 138kV line X-19 to 339 MVA. This project has been proposed¹ for completion in 2008 and has an estimated cost of \$1.1 million.
3. Uprate Portage-Trienda 138kV line X-67 to 373 MVA. This project is provisional² for 2014 and has an estimated cost of \$1.5 million.
4. Uprate Columbia 345/138 kV transformer T22 terminal equipment. This project is provisional² for 2009 and has an estimated cost of \$114,800.
5. Replace Kilbourn 138/69 kV transformer T32 with a 100 MVA unit. This project has not entered the ATC planning process. The requested transmission service requires an in-service date of June 1, 2015. The estimated cost of this project is \$2.5 million. This cost estimate has been developed using the reference table in Appendix B.
6. Replace terminal equipment at Colley Road substation to increase Colley Road-Marine 138kV line rating to 332 MVA summer emergency rating, at minimum. This project has not entered the ATC planning process. The requested transmission service requires an in-service date of June 1, 2015. The estimated cost of this project is \$450,000. This cost estimate has been developed using the reference table in Appendix B.

¹ “Proposed” indicates that the ATC planning process is underway, but the project has not yet received final approval.

² “Provisional” indicates that the ATC planning process is not yet underway for this project, but this project has been identified as one possible solution to a future system need and is being used as a placeholder until a final resolution to the need is determined.

Summary for the Request

A Facilities Study is required to determine the time and cost to implement the proposed solutions to the network and voltage analysis limits. At the conclusion of the Facilities Study, the service may be conditionally granted dependent upon completion of required facilities.

A Facility Study will be offered for MISO request #**76433058** (300 MW; 1/1/2012 – 1/1/2052; Source in ALTE to ALTE).

YEAR	1/1/2012 – 6/1/2015	6/1/2015 & Beyond
MW Service (138 kV)	0*	0*
MW Service (345 kV)	300	0*

*Service pending completion of TSR Facilities Study.

Appendix A: Study Parameters

Base Cases:

MISO Seasonal Models, July Build: Summer Peak 2010 and Summer Peak 2015
2012 Case created from MISO Summer Peak 2010 Case.

138kV Source Subsystem:

```
SUBSYSTEM COL138_EX           // If internal to MISO use source CA for source
  AREA 364
  SCALE ALL FOR EXPORT INCLUDE OFFLINE
END
```

345kV Source Subsystem:

```
SUBSYSTEM COL345_EX           // If internal to MISO use source CA for source
  AREA 364
  SCALE ALL FOR EXPORT INCLUDE OFFLINE
END
```

Sink Subsystem:

```
SUBSYSTEM ALTE_IM             // If internal to MISO use STUDY_IM areas for sink
  AREA 364
  AREA 365
  AREA 366
  AREA 367
  SCALE ALL GENERATION
END
```

Study Export Subsystem:

```
SUBSYSTEM STUDY_EX           // MISO areas that are heavily impacted
  AREA 364
  AREA 365
  AREA 366
  AREA 367
  SCALE ALL FOR EXPORT INCLUDE OFFLINE
END
```

Study Import Subsystem:

```
SUBSYSTEM STUDY_IM           // MISO areas that are heavily impacted
  AREA 364
  AREA 365
  AREA 366
  AREA 367
  SCALE ALL GENERATION
END
```

Study Region:

```
SUBSYSTEM STUDY_REGION       // MISO and non-MISO CA's to be monitored
  AREA 363
  AREA 364
  AREA 365
  AREA 366
  AREA 367
  AREA 680  SCALE ALL GENERATION
END
```

Appendix B: Cost Estimating Table

Approximate cost estimates determined using this reference table are supplied for informational purposes only.

Table 3.3: Reference Cost Estimates for typical transmission upgrades.

Facility Upgrade	Approximate Cost	
New 345 kV single circuit line	\$1,600,000	/Mile
New 345 kV single circuit line (urban)	\$2,200,000	/Mile
New 345 kV double circuit line	\$3,000,000	/Mile
New 345 kV double circuit line (urban)	\$3,600,000	/Mile
New 345 kV single circuit underground line (w/ terminals)	\$10,000,000	/Mile
New 138 kV single circuit line	\$630,000	/Mile
New 138 kV single circuit line (urban)	\$800,000	/Mile
New 138 kV double circuit line	\$900,000	/Mile
New 138 kV double circuit line (urban)	\$1,100,000	/Mile
New 138 kV single circuit underground line (w/ terminals)	\$3,300,000	/Mile
New 69 kV single circuit line	\$450,000	/Mile
New 69 kV single circuit line (urban)	\$585,000	/Mile
New 69 kV double circuit line	\$650,000	/Mile
New 69 kV double circuit line (urban)	\$770,000	/Mile
New 69 kV single circuit underground line (w/ terminals)	\$2,400,000	/Mile
Rebuild 138 kV at 138 kV	\$530,000	/Mile
Rebuild 138 kV at 138 kV (urban)	\$700,000	/Mile
Rebuild 138 kV at 138 kV double circuit	\$800,000	/Mile
Rebuild 138 kV at 138 kV double circuit (urban)	\$1,000,000	/Mile
Rebuild 69 kV to 138 kV, single circuit	\$350,000	/Mile
Rebuild 69 kV to 138 kV, single circuit (urban)	\$375,000	/Mile
Reconductor 138 kV or 115 kV line, single circuit	\$210,000	/Mile
Reconductor 69 kV line, single circuit	\$117,000	/Mile
Uprate 69 kV circuit	\$150,000	/Mile
Uprate 138 kV circuit	\$200,000	/Mile
345 kV substation terminal ¹	\$550,000	Each
345 kV gas circuit breaker ²	\$754,000	Each
138 kV or 115 kV substation terminal ¹	\$ 450,000	Each
138 kV gas circuit breaker ²	\$ 390,000	Each
69 kV substation terminal ¹	\$ 375,000	Each
69 kV gas circuit breaker ²	\$ 310,000	Each
345/138 kV transformer ³	\$5,000,000	Each
138/69 kV transformer ⁴	\$2,500,000	Each
100 Mvar Statcom	\$10,000,000	Each

Notes:

All substation costs are in year 2006 dollars.

1. Includes dead end structure, line switch, and line terminal relays
2. includes breaker, two maintenance switches, breaker failure relay, controls
3. Assumes 500 MVA unit, includes high and low side breakers
4. Assumes 100 MVA unit, includes high and low side breakers