



# **INTERCONNECTION FACILITIES STUDY REPORT**

GEN-2016-016

IFS-2016-001-07

Published December 2019

By SPP Generator Interconnections Dept.

## REVISION HISTORY

---

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION
09/18/2019	SPP	Initial draft report issued.
10/21/2019	SPP	Final report issued.
12/13/2019	SPP	Final report revised. Removed all Shared NUs and Previous NU in Table 3 and 4 per DISIS-2016-001-5 restudy. Table 5 costs updated accordingly.

# CONTENTS

---

Revision History.....	i
Summary.....	1
Introduction .....	1
Phase(s) of Interconnection Service .....	1
Credits/Compensation for Amounts Advanced for Network Upgrade(s).....	1
Interconnection Customer Interconnection Facilities .....	2
Transmission Owner Interconnection Facilities and Non-Shared Network Upgrade(s).....	2
Shared Network Upgrade(s) .....	4
Previous Network Upgrade(s).....	4
Affected System Upgrade(s) .....	5
Conclusion.....	5
Appendices.....	6
A: Transmission Owner’s Interconnection Facilities Study Report and Network Upgrades Report(s) .....	7

## SUMMARY

---

### *INTRODUCTION*

This Interconnection Facilities Study (IFS) for Interconnection Request GEN-2016-016/IFS-2016-001-07 is for a 78.2 MW generating facility located in Edwards County, Kansas. The Interconnection Request was studied in the DISIS 2016-001 Impact Study for Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS). The Interconnection Request was restudied in the DISIS 2016-001-1, DISIS-2016-001-2, and DISIS-2016-001-3 for ERIS only. The Interconnection Customer's original requested Commercial Operation Date is 12/01/2017 and the revised Commercial Operation Date in the Facilities Study Agreement is 12/01/2018.

The interconnecting Transmission Owner, Midwest Energy Inc. (MIDW), performed a detailed IFS at the request of SPP. The full report is included in Appendix A. SPP has determined that full Interconnection Service will be available after the assigned transmission owner interconnect facilities (TOIF), non-shared network upgrades, shared network upgrades, previously allocated, and affected system upgrades that are required for full interconnection service are completed.

The primary objective of the IFS is to identify necessary Transmission Owner Interconnection Facilities, Network Upgrades, other direct assigned upgrades, cost estimates, and associated upgrade lead times needed to grant the requested Interconnection Service.

### *PHASE(S) OF INTERCONNECTION SERVICE*

It is not expected that Interconnection Service will occur in phases. However, full Interconnection Service will not be available until all Interconnection Facilities and Network Upgrade(s) can be placed in service.

### *CREDITS/COMPENSATION FOR AMOUNTS ADVANCED FOR NETWORK UPGRADE(S)*

Interconnection Customer shall be entitled to compensation in accordance with Attachment Z2 of the SPP OATT for the cost of SPP creditable-type Network Upgrades, including any tax gross-up or any other tax-related payments associated with the Network Upgrades, that are not otherwise refunded to the Interconnection Customer. Compensation shall be in the form of either revenue credits or incremental Long Term Congestion Rights (iLTCR).

### ***INTERCONNECTION CUSTOMER INTERCONNECTION FACILITIES***

The Generating Facility is proposed to consist of thirty four (34) GE 2.3-116 MW wind turbine generators for a total generating nameplate capacity of 78.2 MW.

The Interconnection Customer's Interconnection Facilities to be designed, procured, constructed, installed, maintained, and owned by the Interconnection Customer at its sole expense include:

- 34.5 kV underground cable collector circuits;
- 34.5 kV to 115 kV transformation substation with associated 34.5 kV and 115 kV switchgear;
- One (1) 34.5/115 kV, 54/72/90 MVA (ONAN/ONAF/ONAF) step-up transformer to be owned and maintained by the Interconnecting Customer at the Interconnection Customer's substation;
- A six (6) mile overhead 115 kV line to connect the Interconnection Customer's substation to the Point of Interconnection ("POI") at the 115 kV bus at a new substation in close proximity to existing Transmission Owner substation North Kinsley 115 kV that is owned and maintained by Transmission Owner;
- All transmission facilities required to connect the Interconnection Customer's substation to the POI;
- Equipment at the Interconnection Customer's substation necessary to maintain a composite power delivery at continuous rated power output at the high-side of the generator substation at a power factor within the range of 95% lagging and 95% leading in accordance with Federal Energy Regulatory Commission (FERC) Order 827. Additionally, approximately 2.7 Mvars<sup>1</sup> of reactors will be required to compensate for injection of reactive power into the transmission system under no/reduced generating conditions. The Interconnection Customer may use inverter manufacturing options for providing reactive power under no/reduced generation conditions. The Interconnection Customer will be required to provide documentation and design specifications demonstrating how the requirements are met.

The Interconnection Customer shall coordinate relay, protection, control, and communication system configurations and schemes with the Transmission Owner.

### ***TRANSMISSION OWNER INTERCONNECTION FACILITIES AND NON-SHARED NETWORK UPGRADE(S)***

To facilitate interconnection, the interconnecting Transmission Owner will perform work as shown below necessary for the acceptance of the Interconnection Customer's Interconnection Facilities.

**Table 1** and **Table 2** lists the Interconnection Customer's estimated cost responsibility for Transmission Owner Interconnection Facilities (TOIF) and Non-Shared Network Upgrade(s) and provides an estimated lead time for completion of construction. The estimated lead time begins when the Generator Interconnection Agreement has been fully executed.

---

<sup>1</sup> This approximate minimum reactor amount is needed for the current configuration of GEN-2016-016 as studied in the DISIS-2016-001 Impact Study and Restudies.

Table 1: Transmission Owner Interconnection Facilities (TOIF)

Transmission Owner Interconnection Facilities (TOIF)	Total Cost Estimate (\$)	Allocated Percent (%)	Allocated Cost Estimate (\$)	Estimated Lead Time
<b><u>MIDW New Substation near North Kinsley 115 kV Interconnection Substation:</u></b> Construct one (1) 115 kV line terminal, line switches, dead end structure, line relaying, communications, revenue metering, line arrestor, and all associated equipment and facilities necessary to accept transmission line from Interconnection Customer’s Generating Facility.	\$969,270	100%	\$969,270	24 Months
<b>Total</b>	<b>\$969,270</b>		<b>\$969,270</b>	

Table 2: Non-Shared Network Upgrade(s)

Non-Shared Network Upgrades Description	Z2 Type <sup>2</sup>	Total Cost Estimate (\$)	Allocated Percent (%)	Allocated Cost Estimate (\$)	Estimated Lead Time
<b><u>MIDW New Substation near North Kinsley 115 kV Interconnection Substation:</u></b> Construct a ring bus configuration, install three (3) 115kV 2000 continuous ampacity breakers, control panels, line relaying, re-terminate existing 115 kV line from St. John into new substation*, line relaying, communication equipment, acquire land, disconnect switches, structures, foundations, conductors, insulators, and all other associated work and materials.	non-creditable	\$3,791,744	100%	\$3,791,744	24 Months
<b><u>MIDW Structure Replacement:</u></b> Replace one H-Frame transmission structure between North Kinsley to Pawnee-Edwards Jct.	creditable	\$30,520	100%	\$30,520	24 Months
<b>Total</b>		<b>\$3,822,264</b>		<b>\$3,822,264</b>	

\* Refer to the attached TO report for more detail.

<sup>2</sup> Indicates the method used for calculating credits impacts under Attachment Z2 of the Tariff.

**SHARED NETWORK UPGRADE(S)**

The Interconnection Customer’s share of costs for Shared Network Upgrades is estimated in **Table 3** below.

*Table 3: Interconnection Customer Shared Network Upgrades*

Shared Network Upgrades Description	Z2 Type	Total Cost Estimate (\$)	Allocated Percent (%)	Allocated Cost Estimate (\$)	Estimated Lead Time
None	N/A	\$0	N/A	\$0	N/A
<b>Total</b>		<b>\$0</b>		<b>\$0</b>	

All studies have been conducted assuming that higher-queued Interconnection Request(s) and the associated Network Upgrade(s) will be placed into service. If higher-queued Interconnection Request(s) withdraw from the queue, suspend or terminate service, the Interconnection Customer’s share of costs may be revised. Restudies, conducted at the customer’s expense, will determine the Interconnection Customer’s revised allocation of Shared Network Upgrades.

**PREVIOUS NETWORK UPGRADE(S)**

Certain Previous Network Upgrades are **currently not the cost responsibility** of the Interconnection Customer but will be required for full Interconnection Service.

*Table 4: Interconnection Customer Previous Network Upgrade(s)*

Previous Network Upgrade(s) Description	Current Cost Assignment	Estimated In-Service Date
None	\$0	N/A

Depending upon the status of higher- or equally-queued customers, the Interconnection Request’s in-service date is at risk of being delayed or Interconnection Service is at risk of being reduced until the in-service date of these Previous Network Upgrades.

**AFFECTED SYSTEM UPGRADE(S)**

To facilitate interconnection, the Affected System Transmission Owner will be required to perform the facilities study work as shown below necessary for the acceptance of the Interconnection Customer’s Interconnection Facilities. **Table 5** displays the current impact study costs provided as part of the Affected System Impact review. The Affected System facilities study could provide revised costs and will provide each Interconnection Customer’s allocation responsibilities for the upgrades.

*Table 5: Interconnection Customer Affected System Upgrade(s)*

Affected System Upgrades Description	Total Cost Estimate (\$)	Allocated Share (%)	Allocated Cost Estimate (\$)
None	\$0	N/A	\$0
<b>Total</b>	<b>\$0</b>		<b>\$0</b>

**CONCLUSION**

After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for 78.2 MW can be granted. Full Interconnection Service will be delayed until the transmission owner interconnect facilities (TOIF), non-shared network upgrades, shared network upgrades, previously allocated, and affected system upgrades that are required for full interconnection service are completed. The Interconnection Customer’s estimated cost responsibility is summarized in the table below.

*Table 6: Cost Summary*

Description	Allocated Cost Estimate
Transmission Owner Interconnection Facilities	\$969,270
Network Upgrades	\$3,822,264
<b>Total</b>	<b>\$4,791,534</b>

A draft Generator Interconnection Agreement will be provided to the Interconnection Customer consistent with the final results of this IFS report. The Transmission Owner and Interconnection Customer will have 60 days to negotiate the terms of the GIA consistent with the SPP Open Access Transmission Tariff (OATT).



# APPENDICES

---

# **A: TRANSMISSION OWNER'S INTERCONNECTION FACILITIES STUDY REPORT AND NETWORK UPGRADES REPORT(S)**

---

See next page for the Transmission Owner's Interconnection Facilities Study Report and Network Upgrades Report(s).



**Midwest Energy Inc.**

---

***Interconnection Facilities Study  
for GEN-2016-016***



**September 20, 2017**

## **Contents**

---

Study Overview .....	3
Interconnection Facilities and Network Upgrades .....	3
Project Timeline .....	6
Fault Analysis.....	6

## **Study Overview**

At the request of Southwest Power Pool (SPP), Midwest Energy (Midwest) developed this generation Interconnection Facilities Study (IFS) for request GEN-2016-016 based on the results of Definitive Interconnection System Impact Study 2016-001 (DISIS-2016-001). As studied in DISIS-2016-001, GEN-2016-016 consists of Thirty-four (34) GE 2.3 MW wind turbines for a total of 78.2 MW of generation interconnecting to the North Kinsley 115 kV bus. The proposed commercial operation date of the generation is December 1, 2018 according to the IFS Agreement.

The purpose of this study is to provide estimated costs of facilities required for interconnection of the proposed generation to Midwest's transmission system and to identify scope and estimated costs for network upgrades required on Midwest's transmission system to allow the generation to run at the full requested capacity. Additional network upgrades required for facilities of other transmission owners are not included in this study and will be identified by SPP.

## **Interconnection Facilities and Network Upgrades**

GEN-2016-016 has proposed to interconnect at Midwest's North Kinsley 115 kV substation. North Kinsley is presently served by a radial 115 kV line connected to a single source at the St. John 115 kV substation. Load is also served from additional taps on the radial 115 kV line at Edwards, Pawnee, and Larned 115 kV substations. A map of the area 115 kV system can be found in Figure 1.

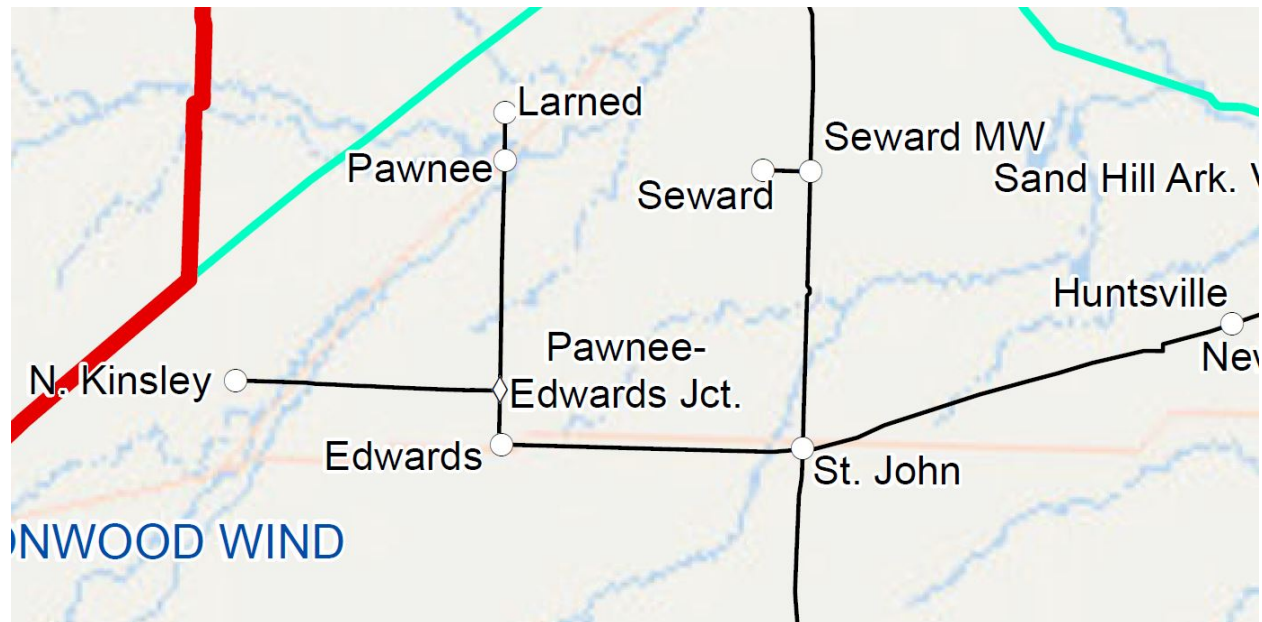
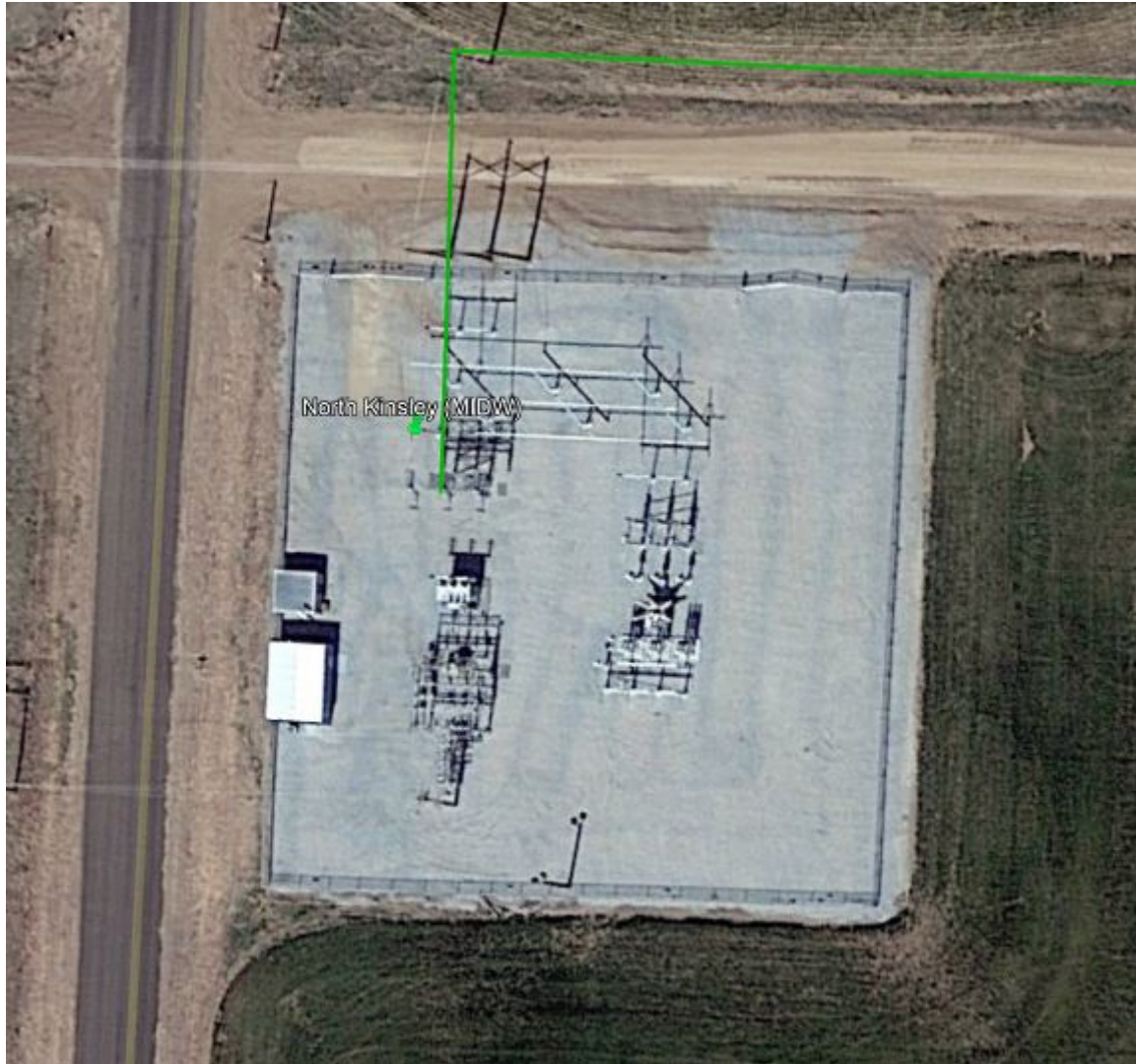


Figure 1 - Area 115 kV Map

## ***Interconnection Facilities Study for GEN-2016-016***

The North Kinsley 115 kV bus is a radial or straight bus configuration containing the 115 kV line from St. John, one 115/34.5 kV transformer, and one 115 kV capacitor bank. There is no 115 kV breaker or other interrupting device on the 115 kV line, and the 115/34.5 kV transformer has only fuses. The 115 kV bus is also bounded closely by roads on the west and north sides. An aerial image of the North Kinsley 115 kV substation can be found in Figure 2.



**Figure 2 - North Kinsley 115 kV substation**

Because of the 115 kV physical bus arrangement, electrical arrangement with lack of protection and control devices, and physical constraints around the substation, Midwest believes it will be necessary to construct a new site for interconnection of GEN-2016-016. The new interconnection station would be constructed as a three-position ring bus in close proximity to the existing North Kinsley 115/34.5 kV substation. The existing 115 kV line from St. John would be re-terminated into the new ring bus, and a tie from the new ring bus to the existing North Kinsley substation would be constructed. The proposed arrangement of the new interconnection station is shown in Figure 3.

## Interconnection Facilities Study for GEN-2016-016

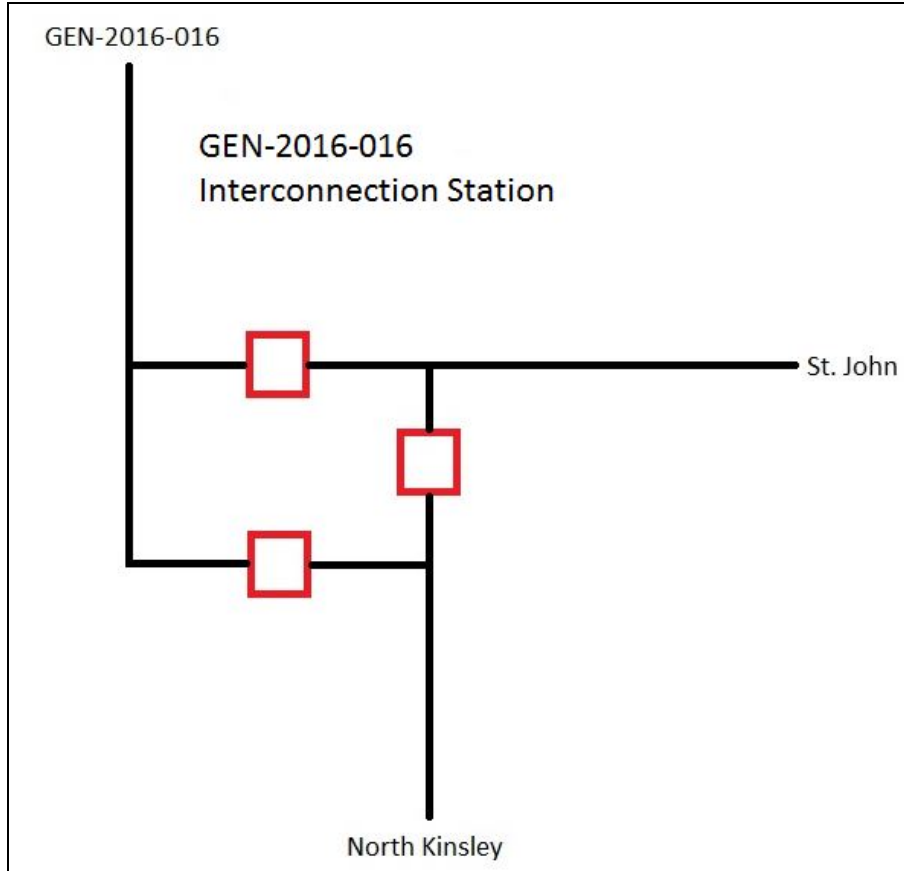


Figure 3 - Proposed GEN-2016-016 Interconnection Station

Additional Network Upgrades will be required for the existing 115 kV transmission line and the 115 kV line terminal at the St. John substation. The capacity of the 115 kV line between North Kinsley and Pawnee-Edwards Jct. is currently 76 MVA due to ground clearance limitations which will not support the full 78.2 MW requested generation. In order to increase ground clearance, one H-Frame transmission structure will need to be replaced to allow Midwest to increase the rating of the 115 kV line to 83 MVA which is the maximum Normal Rating allowed by Midwest's Facility Rating Method in compliance with NERC Reliability Standard FAC-008-3.

Network Upgrades will also be required for the 115 kV line terminal at St. John. The existing 115 kV line serves only load, and the electromechanical relays at St. John consisting of step-distance protection are not adequate to protect the line with the added generation source at North Kinsley. Power line carrier communication will also need to be installed between St. John and the new interconnection station to allow implementation of a directional comparison blocking scheme to ensure the line does not trip at St. John for faults on the GEN-2016-016 generator lead.

A summary of costs for both Interconnection Facilities and Midwest identified Network Upgrades can be found in Table 1.

## **Interconnection Facilities Study for GEN-2016-016**

**Table 1 - Interconnection Facility and Network Upgrade Cost Estimate**

<b>Description</b>	<b>Total Cost</b>
<b>Interconnection Facilities</b>	<b>\$ 969,270</b>
<b>Midwest Energy Network Upgrades</b>	
Interconnection Station (in addition to Interconnection Facilities)	<b>\$ 3,509,856</b>
Re-terminate 115 kV line into New Interconnection Station	<b>\$ 40,626</b>
St. John Substation Upgrades	<b>\$ 241,262</b>
115 kV Line Ground Clearance Upgrades to Increase Rating	<b>\$ 30,520</b>
<b>Total Interconnection Facilities and Network Upgrades</b>	<b>\$ 4,791,534</b>

### ***Project Timeline***

The GEN-2016-016 IFS Agreement states the proposed commercial operation date is December 1, 2018 with the generator step-up transformer receiving back feed power September 15, 2018. Midwest does not believe the proposed timeline is feasible due to the extensive nature of the Network Upgrades required in this IFS. Specific construction schedule and milestones will be determined during the Generator Interconnection Agreement negotiations.

### ***Fault Analysis***

In addition to the power flow and stability analyses detailed in DISIS-2016-001, Midwest conducted a fault study to determine if the addition of the proposed generation and contingent system upgrades caused fault levels on the Midwest Energy transmission system to exceed interrupting device capabilities. The results of the fault analysis indicate that fault levels in the area are not significantly increased by the addition of GEN-2016-016. There are no system fault levels that exceed fault interrupting ratings of existing equipment on Midwest's transmission system.