



**Facility Study
For
Generation Interconnection
Request
GEN-2014-051
(IFS-2014-002-18)**

***SPP Generator
Interconnection Studies***

***(#GEN-2014-051)
(#IFS-2014-002-18)***

July 2015

Revision History

Date	Author	Change Description
6/23/2015	SPP	Draft Facility Study Report Revision 0 Issued
7/24/2015	SPP	Facility Study Report Revision 0 Issued

Summary

Westar Energy, Inc. (WERE) performed a detailed Facility Study at the request of Southwest Power Pool (SPP) for Generation Interconnection request GEN-2014-051/IFS-2014-002-18 (174.00 MW/Wind) located in Nemaha County, Kansas. The Interconnection Customer's originally proposed in-service date for GEN-2014-051/IFS-2014-002-18 is December 31, 2016. SPP has proposed the full interconnection service in-service date will be after the assigned Interconnection Facilities and Non-Shared Network upgrades are completed. Full Interconnection Service will require the Network Upgrades listed in the "Other Network Upgrades" section. The request for interconnection was placed with SPP in accordance with SPP's Open Access Transmission Tariff, which covers new generation interconnections on SPP's transmission system.

Phases of Interconnection Service

It is not expected that interconnection service will require phases however, interconnection service will not be available until all interconnection facilities and network upgrades can be placed in service.

Interconnection Customer Interconnection Facilities

The Interconnection Customer's generation facility consists of eighty-seven (87) General Electric (G.E.) 2.0 MW wind turbines for a total generation nameplate capacity of 174.00 MW. The 34.5kV collector system for this wind facility is planned to be connected to one (1) 345/34.5kV Interconnection Customer owned and maintained transformers at the Interconnection Customer owned substation. An approximate twenty-five (25) mile 345kV transmission circuit will connect GEN-2014-051/IFS-2014-002-18 to the Point of Interconnection (POI) at the existing WERE owned 345kV bus at the Jeffrey Energy Center (JEC) Substation. The Interconnection Customer will be responsible for all of the transmission facilities connecting the Interconnection Customer owned substation to the Point of Interconnection (POI).

The Interconnection Customer will be responsible for any equipment located at the Customer substation necessary to maintain a power factor of 0.95 lagging to 0.95 leading at the POI, including approximately 25.4 Mvar¹ of reactors to compensate for injection of reactive power into the transmission system under reduced generating conditions. Also, the Interconnection Customer will need to coordinate with the Transmission Owner for relay, protection, control, and communication system configurations.

Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades

To allow interconnection the Transmission Owner will construct a new rung to the existing breaker-and-a-half configuration, two (2) new 345kV breakers, five (5) disconnect switches, one (1) new 345kV terminal position, and associated terminal equipment for acceptance of the Interconnection Customer's Interconnection Facilities. Currently, WERE estimates an Engineering and Construction (E&C) lead time of approximately ninety (90) weeks after a

¹ This approximate amount of reactors is an approximate minimum amount needed for the configuration of the wind farm studied in DISIS-2014-002 Group 13 Reduced Wind Analysis. This approximate amount of reactors is subject to change based on results of modification study discussed above.

fully executed Generator Interconnection Agreement (GIA) for the completion of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, GEN-2014-051/IFS-2014-002-18 is responsible for \$18,802,941 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. Table 1 displays the estimated costs for Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades.

Table 1: GEN-2014-051/IFS-2014-002-18 TOIF and Non-Shared Network Upgrades

Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades Description	Allocated Cost (\$)	Allocated Percent (%)	Total Cost (\$)
Interconnection Substation - Transmission Owner Interconnection Facilities 345kV Substation work for a new line terminal position, disconnect switch, station post insulators, arrestors, dead end structure, and relay panels	\$600,000	100%	\$600,000
Interconnection Substation - Network Upgrades 345kV Substation work for building a new rung, 2- 345kV breakers, 4 disconnect switches, communication, revenue metering, line arrestors, breaker control panels, and associated siting.	\$18,202,941	100%	\$18,202,941
Total	\$18,802,941	100%	\$18,802,941

Shared Network Upgrades

The Interconnection Customer was studied within the DISIS-2014-002 Impact Study and the DISIS-2014-002-1 Impact Restudy as Energy Resource Interconnection Service (ERIS). At this time, the Interconnection Customer is allocated \$0 for Shared Network Upgrades. If higher queued interconnection customers withdraw from the queue, suspend or terminate their GIA, restudies will have to be conducted to determine the Interconnection Customers' allocation of Shared Network Upgrades. All studies have been conducted on the basis of higher queued interconnection requests and the upgrades associated with those higher queued interconnection requests being placed in service. At this time, the Interconnection Customer is allocated the following cost for Shared Network Upgrade:

Table 2: GEN-2014-051/IFS-2014-002-18 Shared Network Upgrades

Shared Network Upgrades Description	Allocated Cost (\$)	Allocated Percent (%)	Total Cost (\$)
<u>Currently, GEN-2014-051 is not allocated any Shared Network Upgrades</u>	\$0	n/a	\$0
Total	\$0	n/a	\$0

Other Network Upgrades

Certain Other Network Upgrades are currently not the cost responsibility of the Customer but will be required for full Interconnection Service. Currently, no Other Network Upgrades are assigned to GEN-2014-051/IFS-2014-002-18.

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

Additional Operational and Cost Estimate Considerations

Due to the sensitive nature of additional generation interconnecting at JEC, The Customer should be aware of additional operational and cost estimate consideration.

In the DISIS-2014-002 Impact Study, transient instability of the existing JEC units was observed for the addition of the GEN-2014-051 generation for prior outage conditions. These N-1-1 constraints will need to be mitigated by generator curtailment of GEN-2014-051 to 0MW. Additionally, other events in real time may cause the need to reduce GEN-2014-051/IFS-2014-002-18 to 0 MW for mitigation. WERE, SPP, and the Interconnection Customer will coordinate on the development of operational procedures and mitigations during the Generation Interconnection Agreement (GIA) negotiations.

In order to build a new rung and new terminal position at JEC, WERE will have to request outages to existing transmission lines near the JEC switchyard. The outage of transmission lines at JEC will require the existing JEC generation to reduce generation amounts during construction. The specific generation reductions will be determined at the time of construction. These associated costs for derating generation are not included in the current cost estimate for GEN-2014-051/IFS-2014-002-18 Interconnection. More detailed consideration for costs estimate can be reviewed in the Transmission Owner (T.O.) Facilities Study.

Conclusion

Interconnection Service for GEN-2014-051/IFS-2014-002-18 will be delayed until the Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades are constructed. The Interconnection Customer is responsible for \$18,802,941 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, the Interconnection Customer is allocated \$0 for Shared Network Upgrades. After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for 174.00 MW, as requested by GEN-2014-051/IFS-2014-002-18, can be allowed.

At this time the total allocation of costs assigned to GEN-2014-051/IFS-2014-002-18 for interconnection Service are estimated at \$18,802,941.



Generation Interconnection Facility Study

For

**Generation Interconnection Request
SPP-GEN-2014-051**

June 04, 2015

Introduction

This report summarizes the results of a Generation Interconnection Facility Study performed for the Southwest Power Pool (SPP) by Westar Energy (WR) to evaluate a generation interconnection (GI) request by the Interconnection Customer for 174 MW of wind-powered generation in north central, Kansas, to the Westar Energy (WR) owned Jeffrey Energy Center (JEC) 345 kV substation. A System Impact Study has been completed for this project. The requested in-service date of the generating facility is December, 2016.

Project Location and Existing Facilities

The project is located in Nemaha County in north central Kansas. The proposed interconnection is approximately 25 miles southwest of this location on the WR transmission system by way of the existing JEC 345 kV substation. Figure 1 shows the approximate location of the project.

GEN-2014-051 Operational Considerations

Per the results of Definitive Interconnection System Impact Study 2014-002, the interconnection of GEN-2014-051 creates new instabilities for prior outage events (N-1-1) involving JEC transmission lines. All events can be mitigated through curtailment of GEN-2014-051 to 0 MW. Operational procedures and mitigation for these events will be developed in coordination with SPP and the Interconnection Customer (IC) during the generation interconnection agreement negotiations.

Interconnection Facilities

Interconnection to the WR transmission system will be by way of the JEC 345 kV substation. System Protection setting changes at JEC 345 kV substation will be required.

345 kV Substation Work at JEC

Network Upgrades

The estimated cost includes adding a rung to the JEC 345 kV breaker-and-a-half substation, relocating an existing lay-down yard, adding a minor amount of new fence on the Northwest corner of the JEC 345 kV substation. The estimated cost also includes the purchase and installation of two (2) 345 kV, 3000 Amp breakers, four (4) 345 kV 3000 Amp GOAB disconnect switches, sixty-two (62) 345 kV Station Post Insulators, two (2) breaker control panels, and all associated site, yard and conduit work. The existing control enclosure will be used to house relay and control panels.

Customer Side of Meter Equipment

The estimated cost includes adding a line terminal for the windfarm GI. This will include one (1) 345 kV 3000 Amp MOAB disconnect switch, three (3) 345 kV station post insulators, three (3) 345 kV lightning arresters, one (1) heavy dead end DE01 and anchor bolt cages, bus and jumpers, and two (2) line relay panels.

Metering Equipment

The estimated cost includes adding metering equipment for the wind farm GI. This includes adding three (3) 345 kV voltage transformers, three (3) 345 kV current transformers, three (3) 345 kV station post insulators, bus supports, bus and jumpers, and metering panel.

Transmission Line Work

Routing the GEN-2014-051 generator lead into the JEC substation will require significant modifications to the existing transmission lines already interconnected at JEC to allow the generator lead to exit JEC property to the northeast. The Transmission Line Work portion of the cost estimate is based on the following

- The GEN-2014-051 generator lead will utilize the corridor identified in Figure 2 for exiting JEC property.
 - Final generator lead alignment will be mutually agreed upon between Westar and the IC.
 - Easements across JEC property will be required and are not included in this estimate.
- The GEN-2014-051 generator lead will cross under all five (5) of the JEC transmission lines on their existing alignments.
 - Structures will be raised on all existing lines to accommodate the generator lead.
 - Generator lead crossings will be mid-span and will not share structures with any of the existing transmission lines.
 - The generator lead static wire height will not exceed 75 feet.
- All property and crop damages due to construction of the generator lead will be paid by the IC.

General Estimate Considerations

Additional consideration should be given to the following items:

- Transmission line outages will be required to construct crossings for the GEN-2014-051 generator lead. Obtaining these outages on any of the existing JEC transmission lines while all three (3) units are online will require a derate to the plant. The MW derate will be determined by Westar Transmission Operations in coordination with SPP. Costs incurred by Westar due to any derate will be charged to the IC. These costs are not included in this estimate.
- Estimates do not include costs for any transmission or distribution line crossings outside of JEC property identified in Figure 2.
- Estimates do not include costs for potential infrastructure impacts or relocations on JEC property beyond those identified in the 345 kV Substation Work at JEC and Transmission Line Work sections of this report.
- All estimated costs are for standard equipment and construction lead times as identified. Accelerating the construction schedule could result in increased costs to be paid by the IC.

The total cost estimate for the Stand Alone Network Upgrades (345 kV Substation Work at JEC) is:

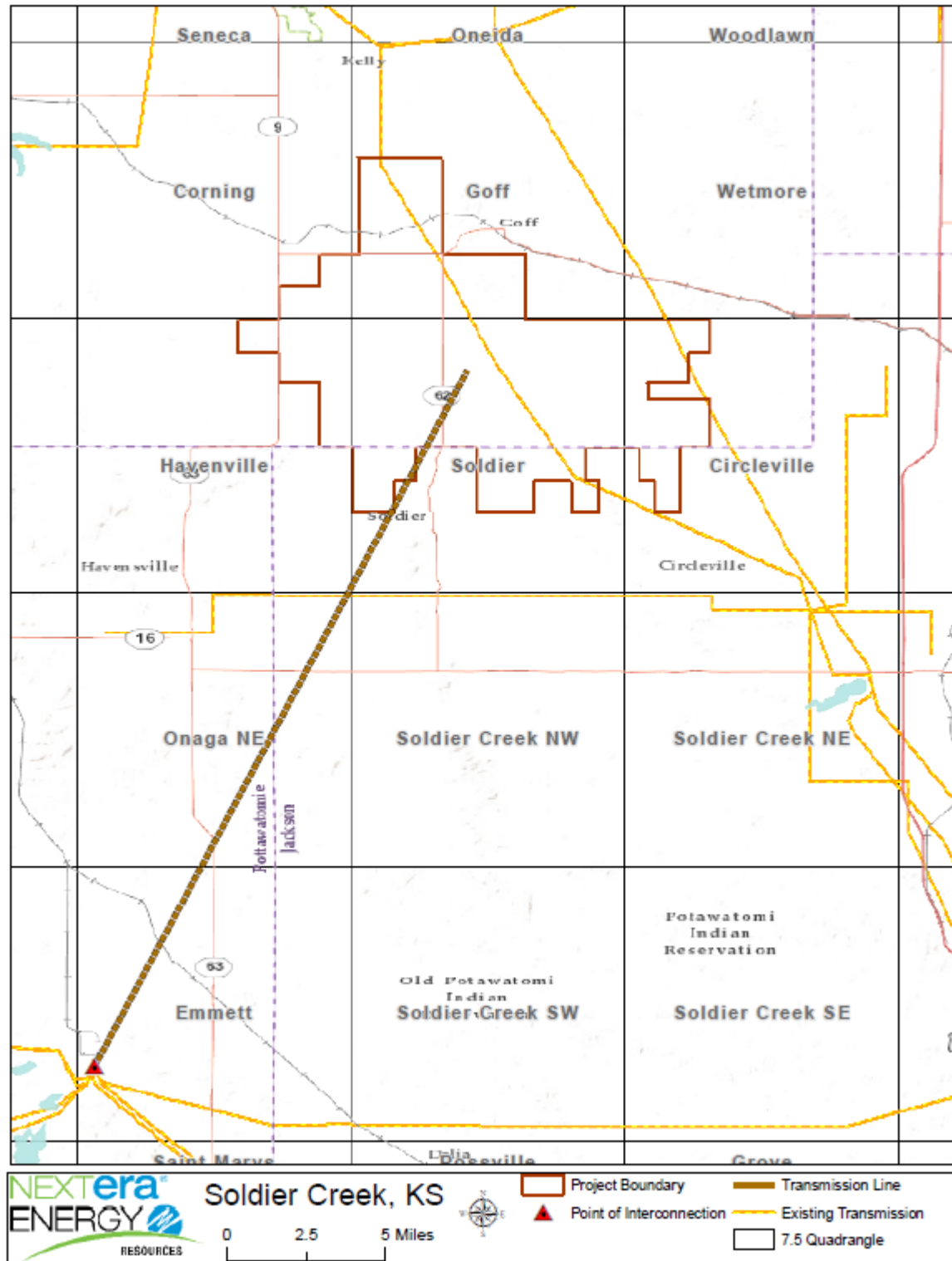
\$ 8,672,968	345 kV Substation Work at JEC
\$ 5,553,043	Transmission Line Work
\$ 893,401	AFUDC
<u>\$ 3,683,529</u>	Contingency
\$ 18,802,941	

This estimate is accurate to +/- twenty (20) percent, based on current prices, in accordance with Attachment A of Appendix 4 of the Interconnection Facilities Study Agreement. However, cost fluctuations in materials can vary significantly, and the accuracy of this estimate at the time of actual settings cannot be assured.

20 weeks	Engineering Time
40 weeks	Procurement Time
30 weeks	Construction Time
90 weeks	Total

Westar Energy also maintains its own Facility Connection Requirements, which may be found at (<http://www.oasis.oati.com/WR/index.html>).

Figure 1 – Interconnection Map



The proposed interconnection project is at JEC 345 kV substation.

Figure 2 – GEN-2014-051 Generator Lead Corridor

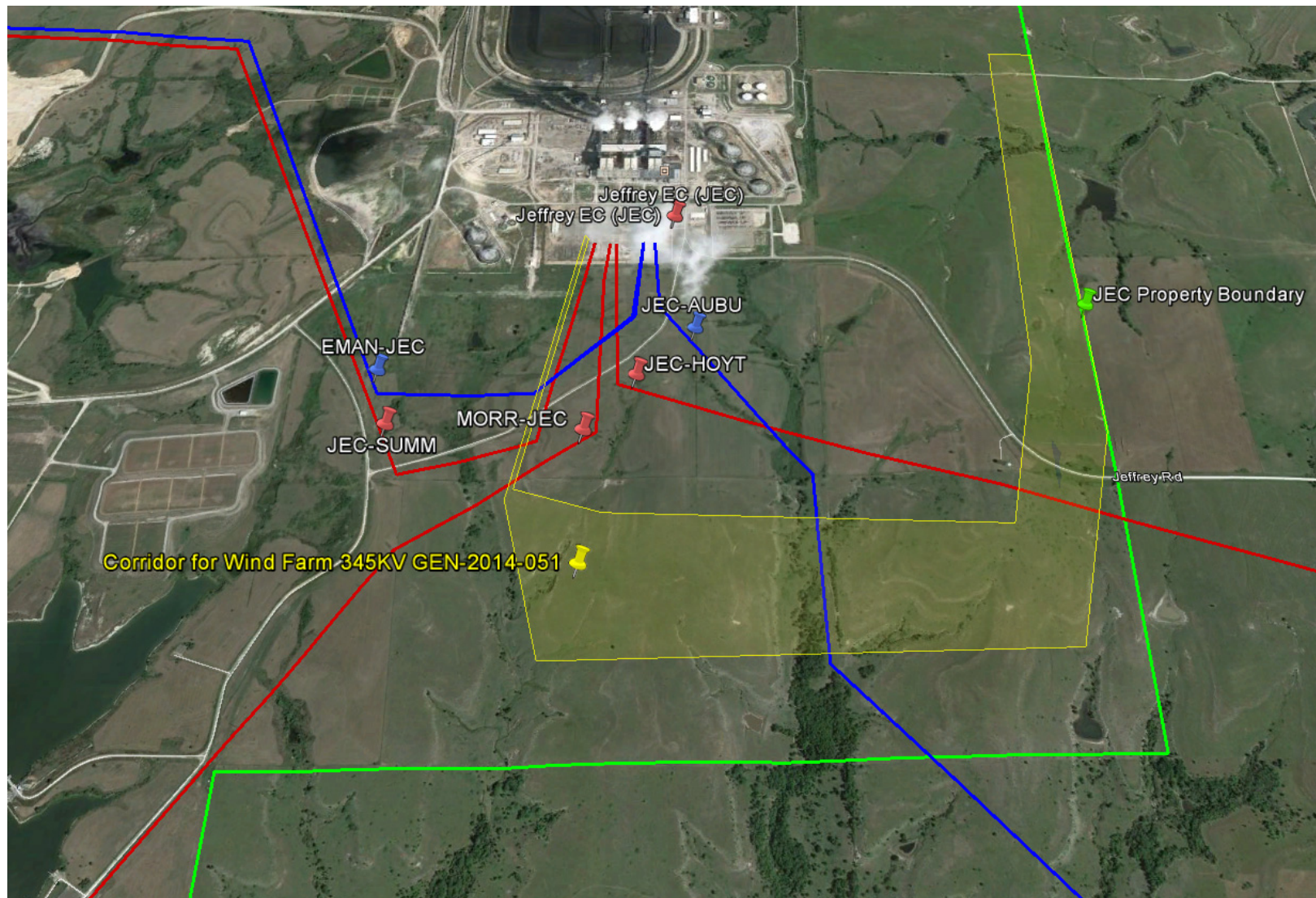


Figure 3 – JEC Substation Upgrades One-line

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**Available to
Interconnection Customer
Upon Request**

GROUP: 1 LINES USER: TOPEKA CAD FILE NO:JEFFREYENERGYCENTER-S01100 REF

Redacted for CEII

**Available to
Interconnection Customer
Upon Request**

Results of Short Circuit Analysis

As a part of this Facility Study, a short circuit study was performed to determine the available fault current at the interconnection bus (JEC 345 kV) using PSS/E's activity SCMU. The 2016 and 2020 Summer Peak cases from the 2015 Series MDWG Classical, Max Fault Short-Circuit models were used. All GEN-2014-051 Wind Farm generation was taken out of service for this analysis and all other transmission facilities are in service. As a result, the numbers generated represent the available utility interconnection fault current:

2016 Summer:

- For a 3-Phase fault at bus number 532766 (JEC 345 kV), the fault current is estimated to be 24071 Amps.
- For a Phase-to-Ground fault at bus number 532766 (JEC 345 kV), the fault current is estimated to be 27219 Amps.

THEVENIN IMPEDANCE, X/R (OHM) Z+:0.398+j8.836, 22.20062 Z-:0.399+j8.835, 22.16922 Z0:0.252+j5.771, 22.87445

2020 Summer:

- For a 3-Phase fault at bus number 532766 (JEC 345 kV), the fault current is estimated to be 24442 Amps.
- For a Phase-to-Ground fault at bus number 532766 (JEC 345 kV), the fault current is estimated to be 27649 Amps.

THEVENIN IMPEDANCE, X/R (OHM) Z+:0.395+j8.722, 22.05897 Z-:0.396+j8.720, 22.02449 Z0:0.258+j5.688, 22.02927