☐ **Non Public Document – Contains Trade Secret Data**
☐ **Public Document – Trade Secret Data Excised**
☒ **Public Document**

Xcel Energy
Docket No.: E002/M-16-777
Response To: Department of Commerce Information Request No. 1

Requestor: Steve Rakow
Date Received: November 2, 2016

Question:
For each project included in Xcel's October 24, 2016 Petition: Wind Generation Acquisition (Docket No. E002/M-16-777) please provide the information requested by the Company's Wind Resources: Request For Proposals at Appendix A – 10/20/16 Bidder Forms tabs 3, 5, 6, 7, 8, 9, 11, 12, and 14 assuming a "Build-Own-Transfer" proposal. The form is available at:

https://www.xcelenergy.com/staticfiles/xe-responsive/Working%20With%20Us/Renewable%20Developers/Wind-generation-RFP-Attachment-A-Bidder%20Forms.xlsx

Response:

Please see the following Attachments:

Attachment A – Foxtail

Additional Attachments referenced in Tab 11-Interconnection Details (see enclosed CD)

Attachment A1-MISO DPP 2014 August West Area Study
Attachment A2- Addendum for MISO DPP 2014 August West Area Restudy
Attachment A3-MISO Project J316 Phase II Network Upgrade Facilities Study, North Dakota – TRADE SECRET IN ENTIRETY
Attachment A4-Generator Interconnection Agreement (GIA) Project No. J316

Additional Attachments referenced in Tab 14-Siting Environmental-BOT (see enclosed CD)
Folders (ALL ARE TRADE SECRET IN THEIR ENTIRETY):

1.02 Project Site Map

1.04 Development Schedule
2.01 Land Lease and Wind Easement Completeness
2.02 Agreement Documents
2.05 Landowner Diaries
2.07 Non Participant Landowners
3.02 Local Government Interaction
5.00 Environmental Studies
6.01 Project Boundaries
6.02 Site and Turbine Layout
6.03 Turbine Coordinate Information
6.04 Access Roads
6.05 Site Substation Feeder Lines and Gen Tie
6.07 Unique Site Features and Setback Risks
6.08 Lease and Easement Polygons
6.09 Collector and Transmission Line Locations
6.10 Environmental Data
8.01 Third Party Energy Production Report
8.02 Guarantee

Attachment B – Blazing Star I

Additional Attachments referenced in Tab 14-Siting Environmental-BOT (see enclosed CD)

Folders (ALL ARE TRADE SECRET IN THEIR ENTIRETY):

1.02 Project Site Map
2.01 Land Lease and Wind Easement Completeness
2.02 Agreement Documents
2.04 Other Agreements
2.06 Sub Site Acquisition
5.00 Environmental Studies
6.01 Project Boundaries
6.02 Site and Turbine Layout
6.03 Turbine Coordinate Information Gen-Tie
6.04 Access Roads
6.05 Site Substation, Feeder Lines and Gen-tie
6.07 Unique Site Features and Setback Risks
6.08 Lease and Easement Polygons
6.09 Collector and Transmission Line Locations
8.01 Third Party Energy Production Report
8.02 Guarantee

Attachment C – Blazing Star II

Additional Attachments referenced in Tab 14-Siting Environmental-BOT (see enclosed CD)

Folders (ALL ARE TRADE SECRET IN THEIR ENTIRETY):

1.02 Project Site Map
2.01 Land Lease and Wind Easement Completeness
2.02 Agreement Documents
2.04 Other Agreements
2.06 Sub Site Acquisition
2.10 Transmission Line Agreements
6.01 Project Boundaries
6.02 Site and Turbine Layout
6.03 Turbine Coordinate Information – Location of Gen-Tie
6.04 Access Roads
6.05 Site Substation, Feeder Lines and Gen-tie
6.07 Unique Site Features and Setback Risks
6.08 Lease and Easement Polygons
6.09 Collector and Transmission Line Locations
8.01 Third Party Energy Production Report
8.02 Guarantee

Attachment D – Freeborn

Additional Attachments referenced in Tab 11-Interconnection Details (see enclosed CD)

Attachment D1-MISO DPP 2015 February West Area Study
Attachment D2-Addendum for MISO DPP-2015-FEB-West Definitive Planning Phase-PJM Affected Systems

Additional Attachments referenced in Tab 14-Siting Environmental-BOT (see enclosed CD)

Folders (ALL ARE TRADE SECRET IN THEIR ENTIRETY):

1.02 Project Site Map
2.01 Land Lease and Wind Easement Completeness
2.02 Agreement Documents
2.04 Other Agreement
2.10 Transmission Line Agreements
5.00 Environmental Studies
6.01 Project Boundaries
6.02 Site and Turbine Layout
6.03 Turbine Coordinate Information Generation Tie
6.07 Unique Site Features and Setback Risks
6.08 Lease and Easement Polygons

6.10 Environmental Data
8.01 Third Party Energy Production Report
8.02 Guarantee

Portions of the Attachments are "NOT PUBLIC" as they contain information the Company considers to be trade secret data as defined by Minn. Stat. §13.37(1)(b). The red font and gray shading indicate that data is NOT PUBLIC. This data includes confidential pricing and other contract terms and project details that are competitively sensitive. This information has independent economic value from not being generally known to, and not being readily ascertainable by, other parties who could obtain economic value from its disclosure or use. We have also marked information as "NOT PUBLIC" trade secret where the knowledge of such information in conjunction with public information in our Petition could adversely impact future contract negotiations, potentially increasing costs for these services for our customers. Thus, the Company maintains this information as a trade secret.

Preparer: Frank Qie
Title: Director, Engineering, Design and Document Services
Department: Engineering & Construction
Telephone: 612-330-5651

Preparer: David M. Adams
Title: Managing Attorney
Department: General Counsel
Telephone: 612-215-4668

Preparer: Randall Oye
Title: Transmission Analyst
Department: Market Operations
Telephone: 612-330-2886

Preparer: John Valerius
Title: Manager, Business Development
Department: Corporate Development
Telephone: 612-215-4572

Preparer: Timothy Rogers
Title: Manager, Siting & Land Rights
Department: Siting & Land Rights-North
Telephone: 612-330-1955

Preparer: Patrick Flowers
Title: Manager, Environmental Services & Media Compliance
Department: Water
Telephone: 612-330-6278

Date: December 5, 2016

Bid Cover Sheet

1) **Project / Facility Name:** Foxtail Wind

2) **Project Location (City, County, State):**

City, County, State: Townships of Grandview, German, Whitestone & Spring Valley in Dickey County, ND

Latitude, Longitude: 46.103 °N -98.864 °W
(decimal format; accurate to three (3) decimal places)

3) **Bidder Contact:**

The individual whose name appears as the Bidder Contact will be the person designated by the bid respondent to receive and respond to communications regarding this bid.

Name: Frank Qie
Company: Xcel Energy
Address: 414 Nicollet Mall, 2nd Floor, Minneapolis, MN 55401
Phone / Fax: 612-330-5651
email: frank.s.qie@xcelenergy.com

4) **Alternate Contact:**

Name: Bradley Morrison
Company: Xcel Energy
Address: 414 Nicollet Mall, 2nd Floor, Minneapolis, MN 55401
Phone / Fax: 612-330-6283
email: bradley.morrison@xcelenergy.com

5) **Facility Nameplate Capacity *** 150 **MW** **Capacity Factor (%):** REDACTED

* Unless noted otherwise, kW, kWh, MW, MWh refer to AC power and energy.

6) **Annual Generation:** REDACTED **MWh**

7) **Commercial Operation Date:** September 2, 2019 **8) PPA Term (years) :**

9) **Proposed Structure** x NSP Ownership __ PPA
__ Other

10) **Estimated Useful Life of Facility at Commercial Operation Date (Years):** 25

11) **Proposed Facility Status:** __ Qualifying Facility __ Sale from Greenfield Facility
__ Exempt Wholesale Generator __ Sale from Existing Facility
__ Sale from Modification of Existing Facility
x Other NSP MN owned generation

12) **Point of Interconnection Description:** Montana-Dakota Ellendale-Foxtail transmission line

13) **Point of Interconnection is on the:** __ NSP Transmission System __ NSP Distribution System
x Other Montana-Dakota Utility transmission system

14) **Name of Utility Providing Retail Service at Proposed Location:** Dakota Valley Electric Cooperative

15) **MISO Capacity Zone Location:** Zone Number (ex. 1, 2, 3) 1

16) **MISO Interconnection State** State (MN, ND, SD, WI, MI) ND

Pricing and Quantity - BOT or Ownership

If bidder proposes more than one pricing option, a separate bid must be submitted.

All pricing is expected to be fully compliant with NSP's Wind Farm Technical Requirements (Attachment B) and NSP's Model Term Sheet for the Purchase and Sale of an Operational Wind Project (Attachment C). Proposal pricing should include the cost to fully construct and must include the full cost for all transmission interconnection and system upgrade costs previously identified or anticipated to be identified by MISO. Exceptions should be noted in Section (C) Notes to BOT or Ownership pricing.

(A) Expected Generation - Provide expected generation levels for each year of the project's expected life, net of expected degradation impacts, if any. Expected generation should be estimated at the Point of Interconnection.

(B) Schedule of Payments - Provide a schedule and amount of payments from NSP to the bidder that separately identifies payments for, 1) engineering, procurement & construction costs, 2) land and easement costs 3) transmission interconnection and network upgrade cost (including potential contingency costs that are anticipated to be NSP's responsibility, 4) optional items available for selection at NSP's discretion, and 5) all other project related payments to be made by NSP. Payments can be made in a periodic or single lump sum manner. All dollar amounts should be entered in nominal dollars.

(C) Notes to BOT or Ownership Generation and Pricing - Include pricing assumptions related to this bid. This should include assumptions regarding federal tax incentives applicable to the proposed project on the proposed in-service date. Also identify if these incentives are due to expire or decline during the term of the proposed agreement.

(A) Expected Generation

Year	MWh
2019	REDACTED
2020	
2021	
2022	
2023	
2024	
2025	
2026	
2027	
2028	
2029	
2030	
2031	
2032	
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(B) Schedule of Payments

Date (dd/mm/yyyy)	Engineering, Procurement & Construction Costs	Land and Easement Costs	Transmission Interconnection and Network Upgrade Costs (Include Estimated Contingency Costs)	Optional Items Available for Selection at NSP's Discretion	All Other Project Related Payments to be Made by NSP	Total
REDACTED						

(C) Notes to Ownership Generation and Pricing:

O&M & Ongoing Capital Expenditures BOT

Provide expected O&M and ongoing capital investment requirements for projects, in as much detail as possible, for the period of 25 years following the anticipated transfer of ownership date of the project to the Company.

1) Does the project have a Service Maintenance Agreement (SMA)? Yes

2) What is the term of the SMA? (Years) 3

3) If SMA provides for an availability bonus payment, describe how the bonus is calculated. REDACTED

4) Does the turbine supply agreement (TSA) include OEM diagnostic software equivalent to the software used by the vendor's technicians? Yes

5) If OEM diagnostic software is not included in the TSA, provide the cost of this software.

Year	Service Management Agreement (SMA)	SMA Bonus	Easement	Other Operating (Excluding Major Component Replacements)	Total Operating (before Major Component Replacements)	Major Component Replacements
2019	REDACTED					
2020						
2021						
2022						
2023						
2024						
2025						
2026						
2027						
2028						
2029						
2030						
2031						
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2040						
2041						
2042						
2043						

Notes to O&M and Ongoing Capital Expenditures:

Construction Milestones

Insert the proposed date for each milestone shown here, as would be found on the detailed Development Schedule provided with the proposal. Milestones should be based on the requirements to achieve the proposed commercial operation date. See the NSP Wind Power Purchase Agreement (Attachment A) for defined terms.

PPA Bids:

Construction Milestone Date	Construction Milestones
XX/XX/20XX	Seller and all required counterparties have executed major procurement contracts, the Construction Contract, any operating agreements, and the Interconnection Agreement needed to commence construction of the Facility.
XX/XX/20XX	Seller shall have achieved closing on financing for the Facility or provided Company with proof of financial capability to construct the Facility.
XX/XX/20XX	Seller shall have laid the foundation for all Facility buildings, generating facilities and step-up transformation facilities.
XX/XX/20XX	The turbine(s)/generator(s)/step-up transformer shall have been delivered to, and installed at, the Site.
XX/XX/20XX	Seller shall have constructed Seller's Interconnection Facilities and such facilities are capable of being energized.
XX/XX/20XX	Start-up testing of the Facility commences.
XX/XX/20XX	Seller shall make all applications and/or filings required by Applicable Law for REC accreditation and for the provision of such RECs to Company.
XX/XX/20XX	Commercial Operation Milestone.
XX/XX/20XX	All final documentation and as-builts.

BOT Bids:

Development or Construction Milestone Date	Development/Construction Milestones

REDACTED

09/02/19	Project Substantial Completion. (All generators connected to the grid and available for generation)
12/02/19	Project Completion.

Technical Description

The proposal must include all pertinent technical information for the project including detailed turbine information and facility information.

Turbine Level Information

Manufacturer:	REDACTED
Model #:	
Nameplate Capacity per Turbine (MW):	
Rotor Diameter (meters):	
Tower Height (meters):	
Lower Operating Temperature, standard package (° C):	
Lower Operating Temperature, cold weather package (° C):	
Indicate whether or not pricing includes Cold Weather Package	

Facility Level Information

Number of Turbines:	REDACTED
Annual Plant Availability (%):	
Annual Expected Forced Outages Rate%	
Expected Average Annual Maintenance Requirements (days/year)	
Estimated Land Area (acres):	16,000 acres

Turbine Site Suitability Study

x Yes
___ No

3rd Party Pre-Construction Energy Production Reports

Bidders are requested to provide any 3rd party wind reports providing pre-construction energy production details. Information of particular interest includes:

- Turbine layout coordinates
- Power and thrust curves including air density value assumptions
- Met tower locations
- Validated data and/or description of validation criteria and monthly wind speeds
- Description of remote sensing data used if applicable
- Description of adjustments made to the data; why; how (i.e. Wake, DFW, TI, etc.)
- MCP methods, long-term wind speeds at each mast, chosen reference station and correlations. If modeled datasets are used, the time series used in the assessment.
- Assumed wind rose
- Frequency distribution used in energy capture
- Modeling/energy capture software used
- Gross and net energy; array average wind speed
- Loss factors and description of losses

Additional Notes Regarding Technical Description:
REDACTED

Energy Production Profile - Annual and Monthly

Assuming the facility had been in commercial operation during 2013, 2014, and 2015 estimate annual energy production for each of these years utilizing whatever historical meteorological data available for the site, or a nearby site with similar meteorological characteristics. If the facility has been in commercial operation, provide actual generation data for this period.

Provide the average expected hourly generation from the proposed project for each month. Estimated energy production should be net of any expected plant degradation over time. Time is hour ending, Central Standard Time; do not adjust for daylight savings time.

Explain fully the meteorogical data, and source, used for the annual estimates.

Calendar Year	Estimated Annual Energy Production (MWh)
2013	REDACTED
2014	
2015	

Maximum expected hourly generation (MWh)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
max	REDACTED											

Average (P50) expected hourly generation (MWh)

HE (CST)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	REDACTED											
2												
3												
4												
5												
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23												
24												
sum												

	Yearly Total
Days in Mo	REDACTED
Total MWH/Mo	
% of Yearly	

Notes to Energy Production Profile:
REDACTED

Interconnection Details

Proposals must include all pertinent MISO interconnection or bidder prepared studies including generator interconnection request information, generation interconnection study information, generation interconnection agreement information, MISO document links and information, general project transmission information, congestion and curtailment analyses, and a point of contact for all transmission related information.

Bidders must also provide a summary of all anticipated interconnection and/or system upgrade costs included in their proposal pricing including financial analyses related to any costs expected to be incurred with regard to interconnection, including the cost of installing the interconnection facilities, the network upgrades, distribution upgrades, affected system upgrades, and system protection facilities that have been identified, and a discussion of any unknown or contingent network upgrades for which the project may be responsible.

To the extent that bidders actual transmission interconnection and/or system upgrade costs are lower *or higher* than projections included in the pricing in their proposal(s), bidders must also provide a proposed bid price adjustment mechanism. For BOTs, bidders are expected to provide a bid *decrease* ~~reduction~~ value in terms of dollars per $1,000,000 *for unanticipated incremental or decremental* ~~in avoided~~ transmission costs. For PPAs, bidders are expected to provide a bid *increase value and a bid decrease* ~~reduction~~ value in terms of $/MWh per $1,000,000 in *higher or lower actual* ~~avoided~~ transmission costs. For example, PPA bidders could specify that the PPA purchase price will be ~~reduced~~ *increased and* by $2/MWh for every $1,000,000 in avoided transmission costs *above or below amounts factored into the initial bid* .

Bidders are requested to attach third party studies on projected interconnection/system upgrade costs for all projects.

1) Generator Interconnection Request Information

Project Name	Foxtail
MISO Project Number	J316
MW Requested	150 MW
Point of Interconnection (detailed description)	Foxtail 230 kV substation tapping the Merricourt Ellendale 230 kV line
Point of Interconnection Voltage	230 kV
Location of Point of interconnection (Latitude/Longitude)	46.087247/-98.903011
Interconnection Transmission Owner	Montana Dakota Utility
State/County	North Dakota
Interconnection Service Type	NRIS
MISO Local Resource Zone (LRZ) number	Zone 1

2) Generator Interconnection Study Information

MISO Study Cycle/Group	DPP-August-2014
MISO Study Status (ongoing, completed, etc.)	Complete
Has MISO deliverability study been completed?	Yes
Identify MW NRIS and MW ERIS from study	150 MW NRIS 150 MW ERIS
Conditions for NRIS and date NRIS effective	Conditional GIA until the Big Stone – Ellendale MVP is in service in 2020 and the Dubuque Iowa – Madison MVP is in service in 2021. Likely to pass Annual Interim Deliverablity Study criteria for 2020/2021.

3) Generator Interconnection Agreement Information

GIA Execution Date	8/30/2016
Was GIA filed unexecuted (yes/no)	No
Is GIA provisional? (yes/no)	No
Status of project (under construction, operating, etc.)	Under development
Is the project in service? (yes/no)	No
COD (actual or proposed)	9/2/2019

4) MISO document links (provide URL for the following or attach hard copy if not publically available)

System Impact Study or Restudies	See Attachments A1 and A2 to this response.
Facility Studies	Available facility studies are attached (Attachment A3). WAPA facility study is still outstanding
Optional or Other Studies	N/A
Generator Interconnection Agreement	See Attachment A3 to this response.

5) Project Transmission Information

Location of collector substation (state/county)	North Dakota/Dickey County
Location of Collector Station (Latitude/Longitude)	46.097368/-98.879451
Provide collector step-up transformer Rated MVA and Impedance on 100 MVA base	TBD
Provide transmission line characteristics between collector substation and interconnection substation including length, conductor and impedance	1.5 miles of 230 kV transmission line. Additional characteristics are to be determined
Provide routing details, permit information or studies performed for transmission line between collector substation and interconnection substation	A 230 kV transmission line connection is a necessary component of the windfarm project. A route for the line has not been finalized yet, but the line will likely be over one mile in length, and therefore a NDPSC Certificate of Corridor Compatibility and Route Permit will be required. The permit application will be filed with the NDPSC in the summer of 2017, with PSC approval and Order by the end of the year, 2017.
Identify all equipment required to meet FERC Order Number 827 for Reactive Power Requirements for Non-Synchronous Generation and provide any supporting studies	To be determined
Provide power factor	To be determined
Total MW at Point of Interconnection (following all losses)	To be determined

6) Network Upgrade Information

Provide a list of all Network Upgrades, Affected System Upgrades and Shared Network Upgrades (as defined by MISO) included in your proposal that are required for interconnection	Upgrade WAPA Mandan - Ward 230 kV line;Upgrade MDU Foxtail - Ellendale 230 kV line
Provide cost estimates for the Network Upgrades, Affected System Upgrades and Shared Network Upgrades included in your proposal and identify whether these costs where shared with other MISO projects (i.e. J1234)	REDACTED

Provide a description and associated costs for all Interconnection Facilities included in your proposal that are required for interconnection	REDACTED
Provide all studies supporting the Network Upgrades, Affected System Upgrades and Shared Network Upgrades included in your proposal that are required for interconnection	N/A
Identify the MISO study group model used for the evaluation and list all MISO projects added or removed to the studies	N/A

7) Project Congestion/Curtailment Information

Provide CPNode or CPNodes nearest to plant for LMP analysis purposes.	MDU.TATANKA1
Provide an analysis and discussion of the issues surrounding congestion and expected curtailments pertaining to the project, or if this is an operating project, historical curtailment data for the project.	REDACTED

8) Wind Turbine Generator Information

Manufacturer	REDACTED
Model #	
Nameplate Capacity per Turbine (MW)	
Number of Turbines	
Turbine Voltage	
Turbine Type for generic dynamic stability models	
Turbine Step Up Transformer Rated MVA and Impedance on 100 MVA base	
Collector Voltage	

9) Point of Contact for Transmission Information

Contact Name	Randall Oye
Contact Phone Number	612-330-2886
Contact e-mail	randall.l.oye@xcelenergy.com

10) Proposed Bid Price Adjustment Mechanism for Transmission Cost Uncertainty

Bidder's estimated interconnection and/or upgrade cost included in bid price ($/MWH for PPA, $ for BOT)	REDACTED
Price reduction for each $1,000,000 in actual transmission interconnection or upgrade costs below bid price projection ($/MWH for PPA, $ for BOT)	
Price increase for each $1,000,000 in actual transmission interconnection or upgrade costs above bid price projection ($/MWH for PPA, $ for BOT)	

Project Financing, Credit Worthiness, and Legal Claims

1) Project Financing

Describe the financial and legal organizational structure including any subsidiaries. In addition please enclose an ownership structure showing the legal name and the percentage of ownership of each owner.	NSP will acquire 100% of the ownership interests in the project company holding the assets of the project. Following closing, the project company will be merged into NSP.
Describe the financing or funding plan, equity participants and any project financing guarantees.	NSP will own the 100% of project and will finance the acquistion utilizing existing financing sources. No project specific financing will be required.

REDACTED

Disclose any threshold requirements that must be met prior to having access to the various components of the financing or funding plan described above.	
Do you foresee any issues in obtaining and maintaining a security fund per the requirements described in NSP's Model Wind Power Purchase Agreement (Attachment A) and NSP's Model Term Sheet for the Purchase and Sale of an Operational Wind Project (Attachment C)?	Because NSP would own the project, no security would be needed.
Please identify the guarantor	Not applicable
Provide the current credit rating of the guarantor.	Not applicable
Is the guarantor on credit watch?	Not applicable

2) Credit Worthiness

Describe any credit issues (e.g. bankruptcy, events of default, etc.) for any participant who will have a more than a 20% share of the equity position in the project.	None

3) Legal Claims

Disclose any past, current, or anticipated future litigation related to projects owned or managed by the bidder or any of its affiliates in the United States.	None

Siting Environmental - BOT

1) Project Description

Overview of Project	150 MW Wind Farm in Dickey County, North Dakota.
Project Site Map and Geospatial Data : Illustrate physical location of project as related to other area features, including roads, county boundaries, State or Federal Owned properties and transmission facilities	See folder labeled 1.02 Project Site Map
Legal Description: Describe project location by Section(s), Township(s) and Range(s)	REDACTED
Timeline: Provide an overall project acquisition plan, permitting plan and schedule for the project.	

2) Site Control

Overall Land Lease and Acquisition Document Completeness: Provide an overview of the lease and acquisition process for turbine sites, access roads, collector lines. Include status of agreements (signed, in process, declined), timeline to complete and any potential issues and include on a corresponding map.	REDACTED
Documents: Provide copies of all signed agreements, provide copies of any draft agreements, and any easement templates	Copies of signed agreements were provided by the devleoper. See folder 2.02 Agreement Documents for agreement copies including: - Memorandum of Option and Easements - Meteorological Agreement - Sodar Agreement - Wind Farm Easement Agreements
Existing Property Easements/Programs: Describe any parcels that have state or federal agency conservation easements, including the USFWS, state DNR, Dept. of Agriculture Conservation Programs	REDACTED
Other Agreements: Provide a discussion of additional agreement types other than Land Lease and Wind Easements and provide on map. (Example: Setback or Neighbor Agreements)	
Records Related to Land Owner Meetings: Provide landowner diaries	

Siting Environmental - BOT

	REDACTED
Itemized Costs of Long-term Land Leases For the Site: Provide overview of the long term payment commitments to landowners	
Land Ownership Agreements for O&M Building and Substation: Provide land ownership or option agreements for O&M building, substation, laydown yard, and batch plant. Non Participant Land Owner Risks: Provide overview of any known non-participants opposed to the project.	
Land Title/Tax Risks: Provide an overview of any impacts to landowner tax payments that may fall to owner. Describe any potential title issues identified.	No property tax increase is expected for the landowners. The county assessor may assess a personal property tax on the Operator for wind farm improvements.
Collector Lines and Substation: Provide copies of all signed agreements, provide copies of any draft agreements	Collection line agreements are included in the Wind Farm Easement Agreements. Refer to "Documents" section. Refer to "Land Ownership Agreemetns for O&M Building and Substation" section for substation agreement information.
Generation Tie Line: Provide copies of all signed agreements, provide copies of any draft agreements	No gen-tie line agreements at this time.
Project Transmission Line Easement: Complete list of Transmission Easement Agreements signed and targeted. Include copies of signed Transmission Easement Agreements and Transmission Easement compensation schedules	Because two locations are being considered for the collector sub location the transmission line route has not been finalized.
Underground Utility Crossing Risks: Please provide all consent agreements for all foreign utility crossings	Utility crossings will be identified in the title curative process.

3) Local Permitting

	REDACTED
Local Zoning/Permits: Provide an overview of any local zoning permit requirements, timeline to acquire, and the status of acquiring those permits.	
Local Government Interactions: Provide an overview of local government interactions, describe any local support and include all correspondence from county and townships as well as project notes	
Roadway Improvement Agreements: Provide a summary of any discussions with the local governments regarding road use and commitments to repair after construction. Include any draft or final documents.	

4) State Permits, Overall Permit Requirements

	REDACTED
State Site Permits: Provide an overview of any State Site permit requirements and the status of acquiring those permits	

Siting Environmental - BOT

REDACTED

Overall State Permit Document Completeness: Please provide Site Permit application and supporting data.	
Permitting Analysis: Provide an analysis of all permits required for the project, including, but not limited to any state permits, local permits, take permits, wetland permits, stream crossing permits, storm water permits. Include timeline to acquire permits and expected cost.	

5) Environmental studies, agency consultation and permit analysis

REDACTED

Site Environmental Studies: Provide a general summary of environmental studies related to project.	
Potential Project Risks: Provide a summary of any environmental permitting risks, possible impact to project and expected.	PSC Certificate of Site Compatibility process ongoing.
Site Assessments: Provide any Phase I ESAs for the project.	A new Phase I ESA is pending; to be completed within 180 days of closing.
History and Background: Provide any past environmental issues related to the project site	A Phase I ESA was completed in 2009 and identified no Recognized Environmental Conditions for the project.

REDACTED

Cultural Resource Studies: Please provide copies of state historic preservation consultation and literature survey reports for the project.	
Environmental Siting Analysis: Please provide copies Tier 1 and Tier 2 reports in accordance with USFWS Land Based Wind Energy Guidance	To be incorporated into Wildlife Conservation Plan (or BBCS); an interim report summarizing the WEG Tier I/II analysis will be provided late November 2016.
Avian Studies: Please provide copies of avian surveys, or avian survey study plans, if completed. Provide any determinations that may require mitigation.	Fall 2014 and Spring 2015 Avian Survey Report prepared by Tetra Tech and dated October 13, 2015.See folder 5.00 Environmental Reports, Document 5.1 Fall 2016 avian surveys completed and report to be finalized December 2016.

REDACTED

Bat Studies: Please provide copies of bat surveys, or bat survey study plans, if completed.	
Raptor Studies: Please provide copies of raptor surveys, or raptor survey study plans, if completed.	Final Eagle Report by Tetra Tech, dated November 2015 detailed eagle use survey conducted between August 2014 and September 2015. See folder 5.00 Environmental Reports, Document 5.2. A raptor nest survey was completed (to 10-mile buffer for eagles) in Spring 2016; additional nest surveys will be completed in 2017.

REDACTED

T&E and State Projected Species: Please provide copies of T&E and T&E Critical Habitat surveys completed. Provide a summary of any T&E species that may require additional follow-up work or mitigation	
Agency Consultation: Provide status of discussions with permitting agencies including those listed in this section.	
USFWS Consultation: Provides copies of all USFWS correspondence to date	NextEra has met with USFWS twice to discuss the project.
State DNR Consultation: Provides copies of all State DNR correspondence to date	NextEra has met with North Dakota Gas & Fish twice to discuss the project.
Army Corps of Engineers: Please provide any 404 jurisdictional determination obtained by the project, if needed.	To be determined; wetland surveys currently underway.
Wetlands: Provide an overview of potential wetland impacts and any completed wetland delineation reports	To be determined; wetland surveys currently underway.
Noise Model: Please provide any noise modeling report developed for the project.	To be completed Fall 2017.
Flicker Studies: Provide any flicker studies	To be completed Fall 2017.
Other Environmental Issues and Risks: Provide a summary and documentation regarding any other potential environmental concerns or risks.	NextEra is completing voluntary tribal consultation based on the proximity to tribal land and the potential presence of cultural resources.

6) Geospatial Data

Provide the following information in ESRI GIS Shape files. This list may include information previously identified.

Project Boundaries	Xcel Energy has received all relevant shapefiles from the project developer, and can send individual files upon request. See folder labeled 6.01 Project Boundaries.
Site and Turbine Layout	Xcel Energy has received all relevant shapefiles from the project developer, and can send individual files upon request. See folder labeled 6.02 Site and Turbine Layout.
Turbine Coordinate Information - Location of generation tie	Xcel Energy has received all relevant shapefiles from the project developer, and can send individual files upon request. See folder labeled 6.03 Turbine Coordinate Information.

Siting Environmental - BOT

Access roads	Xcel Energy has received all relevant shapefiles from the project developer, and can send individual files upon request. See folder labeled 6.04 Access Roads.
Site substation, feeder lines and Gen-tie	Xcel Energy has received all relevant shapefiles from the project developer, and can send individual files upon request. See folder labeled 6.05 Site Substation Feeder Lines and Gen Tie.
Site layout design optimization potential	The site will be optimized based on specific wind resource characteristics, turbine technology and environmental constraints. We will be working with developers, wind consultants and turbine suppliers to fully explore the optimization potential of the project site. We will drive the design optimization process during the development and implementation phase of the project, in order to maximize the value of the asset for our customers.
Unique Site features and Setback risks - Identify acquired easements, expired easements	Xcel Energy has received all relevant shapefiles from the project developer, and can send individual files upon request. See folder labeled 6.07 Unique Site Features and Setback Risks; for easements see folder labeled 6.08 Lease and Easement Polygons.
Lease & Easement polygons	Xcel Energy has received all relevant shapefiles from the project developer, and can send individual files upon request. See folder labeled 6.08 Lease and Easement Polygons.
Collector and transmission line locations	Xcel Energy has received all relevant shapefiles from the project developer, and can send individual files upon request. See folder labeled 6.09 Collector and Transmission Line Locations.
Environmental data	Xcel Energy has received all relevant shapefiles from the project developer, and can send indidividual files upon request. See folder labeled 6.10 Environmental Data.

7) Legal Claims

Disclose any past, current, or anticipated future litigation related to projects owned or managed by the bidder or any of its affiliates in the United States.	None.

Report Number: R090-15

MISO DPP 2014 August West Area Study

Prepared for

MISO

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Revision History

Date	Rev.	Description
11/17/2015	A	Initial Draft
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Contents

Legal Notice ..... **vii**

Executive Summary ..... **ix**

1.1 Project List ix
1.2 Total Network Upgrades for all Projects ix
1.3 Per Project Summary x
1.3.1 J285 Summary xi
1.3.2 J289 Summary xi
1.3.3 J316 Summary xi
1.3.4 J320 Summary xi
1.3.5 J329 Summary xi
1.3.6 J343 Summary xii
1.3.7 J344 Summary xii
1.3.8 J382 Summary xii
1.4 Study Compliance with NERC FAC-002-1 Standard xii

Introduction **1**

Section 2 – Steady-State Analysis **2-1**

2.1 Study Procedure 2-1
2.1.1 Computer Programs 2-1
2.1.2 Study Methodology 2-1
2.2 Model Development 2-1
2.2.1 Study Cases 2-1
2.2.2 Benchmark Cases 2-3
2.3 Contingency Criteria 2-3
2.4 Monitored Elements 2-3
2.5 Performance Criteria 2-5
2.6 Reactive Power Requirement Analysis 2-5
2.6.1 Reactive Power Requirements for 2017 Summer Shoulder 2-5
2.6.2 Reactive Power Requirements for 2024 Summer Shoulder 2-6
2.7 2017 Contingency Analysis Results 2-6
2.8 2024 Contingency Analysis Results 2-6

2.8.1 2024 Summer Shoulder Contingency Analysis Results....2-6
2.8.2 2024 Summer Peak Contingency Analysis Results....2-8
2.9 Network Upgrades Identified in MISO ERIS Analysis for 2024 Scenario....2-8

Section 3 – Affected System Steady-State Analysis....3-1
3.1 SAF Analysis for MAPP Companies....3-1
3.2 PJM Affected System AC Contingency Analysis....3-3
3.2.1 Study Methodology....3-3
3.2.2 Study Results....3-3
3.2.3 Study Summary....3-4
3.3 SPP Affected System AC Contingency Analysis....3-5

Section 4 – Stability Analysis....4-1
4.1 Procedure....4-1
4.1.1 Computer Programs....4-1
4.1.2 Study Methodology....4-1
4.2 Case Development....4-1
4.2.1 Study Cases....4-1
4.2.2 Benchmark Cases....4-2
4.3 Disturbance Criteria....4-2
4.4 Performance Criteria....4-9
4.5 Stability Results....4-9
4.5.1 2017 Stability Analysis Results and Mitigations....4-10
4.5.2 2024 Stability Analysis Results....4-10
4.6 Network Upgrades Identified in Stability Analysis for 2024 Scenario....4-16

Section 5 – MWEX Voltage Stability Study....5-1

Section 6 – Short Circuit Analysis....6-1
6.1 Introduction....6-1
6.2 J285 Short Circuit Facilities Study Performed by MEC....6-1
6.3 J289 Short Circuit Facilities Study Performed by MEC....6-1
6.4 J316 Short Circuit Facilities Study....6-1
6.5 J320 Short Circuit Facilities Study....6-1
6.6 J329 Short Circuit Facilities Study Performed by MEC....6-2
6.7 J343 Short Circuit Facilities Study Performed by MEC....6-2
6.8 J344 Short Circuit Facilities Studies Performed by MEC & ITCM....6-2

Section 7 – Deliverability Study 7-1

7.1 Project Description 7-1
7.2 Introduction 7-1
7.3 Study Methodology 7-1
7.4 Determining the MW restriction 7-1
7.5 Study Result 7-2
7.5.1 2017 Deliverability Study Results 7-2
7.5.2 2024 Deliverability Study Results 7-2

Section 8 – Shared Network Upgrades Analysis 8-1

Section 9 – Cost Allocation 9-1

9.1 Cost Assumptions for Network Upgrades 9-1
9.2 ERIS Network Upgrades Proposed for DPP West Area Projects 9-1
9.2.1 ERIS Network Upgrades for 2017 Scenario 9-2
9.2.2 ERIS Network Upgrades for 2024 Scenario 9-2
9.3 Cost Allocation Methodology 9-3
9.4 Cost Allocation 9-4

Appendix A – Model Development for Steady-State and Stability Analysis A-1

A.1 DPP 2014 August Generation Projects A-2
A.2 DPP 2014 February Generation Projects A-4
A.3 DPP 2013 August Generation Projects A-5
A.4 DPP 2013 February Generation Projects A-6
A.5 DPP 2012 August Generation Projects A-7
A.6 Network Upgrades Identified in DPP 2012 August West Area Restudy A-9
A.7 Network Upgrades Identified in DPP 2013 February West Area Restudy A-10
A.8 Network Upgrades Identified in DPP 2013 August West Area Restudy A-11
A.9 PJM Generation Projects and NUs Modeled A-13
A.10 Model Review Comments A-16
A.11 MISO Market as the Study Sink A-20
A.12 PJM Market as PJM Projects Sink A-21
A.13 SPP Market as SPP Projects Sink A-22
A.14 Contingency Files used in Steady-State Analysis A-23

Appendix B – Model Data B-1

B.1 Power Flow Model Data B-1
B.2 Dynamic Model Data B-15
B.3 Slider Diagrams B-40

Appendix C – Reactive Power Requirement Analysis Results C-1
C.1 Reactive Power Requirement Results for 2017 Summer Shoulder C-1
C.2 Reactive Power Requirement Results for 2024 Summer Shoulder C-3

Appendix D – 2017 Contingency Analysis Results D-1
D.1 2017 Summer Shoulder (SH) Constraints D-1
D.2 2017 Summer Peak (SPK) Constraints D-3

Appendix E – 2024 Contingency Analysis Results E-1
E.1 2024 Summer Shoulder (SH) Constraints E-1
E.2 2024 Summer Peak (SPK) Constraints E-3

Appendix F – Affected System Contingency Analysis Results F-1
F.1 MAPP Companies SAF Results F-1
F.2 PJM Affected System Study Results F-3
F.3 SPP Affected System Study Results F-5

Appendix G – Transient Stability Results G-1
G.1 2017 Shoulder Study Case G-1
G.2 2024 Shoulder Study Case G-1

Appendix H – MWEX Voltage Study Details H-1

Appendix I – Short Circuit Analysis I-1
I.1 J285 Short Circuit Analysis Report by MEC I-1
I.2 J289 Short Circuit Analysis Report by MEC I-1
I.3 J316 Short Circuit Analysis Report by Siemens PTI I-1
I.4 J329 Short Circuit Analysis Report by MEC I-1
I.5 J343 Short Circuit Analysis Report by MEC I-1
I.6 J344 Short Circuit Analysis Report by MEC & ITCM I-1

Appendix J – 2017 Cost Allocation Results J-1
J.1 Distribution Factor (DF) and MW Contribution Results for Cost Allocation J-1
J.2 Cost Allocation Details J-3

Appendix K – 2024 Cost Allocation Results K-1

K.1 Distribution Factor (DF) and MW Contribution Results for Cost Allocation in 2024 ..... K-1
K.2 Cost Allocation Details K-3

Appendix L – Results for 2017 Scenario L-1

L.1 Results Summary for 2017 Scenario L-1
L.2 Reactive Power Requirement Analysis for 2017 Scenario L-4
L.3 Steady-State Analysis for 2017 Scenario L-4
L.4 Affected System Steady-State Analysis in 2017 Scenario L-11
L.5 2017 Stability Analysis Results L-13
L.6 2017 Deliverability Study Results L-18
L.7 Cost Allocation for 2017 Scenario L-21

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Executive Summary

This report presents results of a System Impact Study (SIS) performed to evaluate the interconnection of the 2014 August West Area DPP Group (West Area DPP) generating facilities. The results for 2024 scenario are summarized below, and the results for 2017 scenario can be found in Appendix L.

1.1 Project List

The West Area DPP study group has eight (8) generation projects with a combined nameplate rating of 897.3 MW. The West Area DPP generating facilities are listed in Table ES-1. The approximate location of each Point of Interconnection (POI) is shown in Appendix B.3.

Table ES-1: Generating Facilities in DPP 2014 August West Area Group

MISO Project #	Service Type	TO	County, State	Point Of Interconnection	Fuel Type	Max Output	SH Output	SPK Output	Stability Output
J285	NR	MEC	O'Brien, IA	O'Brien County 345 kV sub	Wind	250	250	50	250
J289	NR	MEC	Madison, IA	Winterset Junction-Creston 161 kV	Wind	20	20	4	20
J316	NR	MDU	Dickey, ND	Tatanka-Ellendale 230 kV	Wind	150	150	30	150
J320	ER	Xcel	Ramsey, MN	High Bridge 115 kV sub	CC	55	27.5	55	55
J329	NR	MEC	Marion, IA	Pella West Sub	Hydro	55	55	55	55
J343	NR	MEC	Adams, IA	Creston-Clarinda 161 kV	Wind	150	150	30	150
J344	NR	ITCM	Mahaska, IA	Poweshiek-Oskaloosa 161 kV	Wind	169	169	33.8	169
J382[1]	NRIS Only	ATC	Cambridge, WI	Cambridge	Gas	48.3	0	48.3	0

Note 1: J382 requests NRIS Only for the existing MISO generation

1.2 Total Network Upgrades for all Projects

The cost allocation of Network Upgrades for the study group reflects responsibilities for mitigating system impacts based on Interconnection Customer-elected level of Network Resource Interconnection Service as of the System Impact Study report date. The total cost of network upgrades in the interconnection plan required for each generation project is listed in Table ES-2 for the 2024 scenario. The costs for Network Upgrades are planning level estimates and subject to be revised in the facility studies.

Table ES-2: Total Cost of Network Upgrades for Generation Projects in 2024 Scenario

Project Num	ERIS Network Upgrades ($)			Actual NRIS Network Upgrades ($)	Interconnection Facilities ($)		Shared Network Upgrade	Total Cost ($)
	Steady-State & Voltage Stability	Transient Stability	Short-circuit	Deliverability	TO Network Upgrades	TO - Owned Direct assigned		
J285	$0	$0	$0	$0	$1,422,000	$1,422,000	$0	$2,844,000
J289	$300,000	$0	$0	$0	$3,145,000	$160,000	$32,953	$3,637,953
J316	$12,000,000	$0	$0	$22,125,000	$5,151,300	$775,500	$0	$40,051,800
J320	$0	$0	$0	$0	$0	$0	$0	$0
J329	$0	$0	$0	$0	$874,450	$180,000	$0	$1,054,450
J343	$295,000	$0	$0	$0	$2,320,000	$220,000	$0	$2,835,000
J344	$325,000	$0	$0	$0	$4,768,036	$469,504	$8,771	$5,571,311
J382	$0	$0	$0	$0	$0	$0	$0	$0
Total ($)	**$12,920,000**	**$0**	**$0**	**$22,125,000**	**$17,680,786**	**$3,227,004**	**$41,724**	**$55,994,514**

The study was performed under the direction of MISO by Siemens PTI and an ad hoc study group. The ad hoc study group was formed to review the study scope, methodology, models and results. The ad hoc study group consisted of representatives from the interconnection customers and the following utility companies – Ameren, American Transmission Company, Basin Electric Power, Central Iowa Power Cooperative, Commonwealth Edison, Corn Belt Power Cooperative, Dairyland Power, Great River Energy, ITC Midwest, Lincoln Electric System, Manitoba Hydro, MidAmerican Energy Company, MISO, Minnesota Power, Minnkota Power, Missouri River Energy Services, Montana-Dakota Utilities Co., Muscatine Power & Water, Nebraska Public Power District, Northwestern Public Service, Omaha Public Power District, Otter Tail Power, PJM, Southern Minnesota Municipal Power Agency, SPP, Western Area Power Administration, and Xcel Energy.

1.3 Per Project Summary

This section provides estimated cost of Network Upgrades on a per project basis for the 2024 scenario. The shared cost of Network Upgrades for all the generation projects are listed below.

The Interconnection Customers are only required to mitigate the constraints observed from the 2024 scenario. Constraints that are mitigated by modeling the entire Multi Value Project portfolio do not require mitigation. However, if there are near term stability constraints and the Interconnection Customers desire to bring the projects online earlier, then a near term stability study will be required and further mitigation may be needed.

1.3.1 J285 Summary

Network Upgrade	Cost	J285
Not Required	$0	$0
Total Cost Per Project for Actual NRIS Elections for each Project		**$0**

1.3.2 J289 Summary

Network Upgrade	Total Cost	J289
630388 WINCOR 8 69.0 630389 WINMUNI8 69.0 1	$300,000	$300,000
J274 POI-Creston 161 kV	$175,000	$32,953
Total Cost Per Project for Actual NRIS Elections for each Project		**$332,953**

1.3.3 J316 Summary

Network Upgrade	Total Cost	J316
11117 J316_SUB 230 661098 ELLENDLMVP4 230 1	$12,000,000	$12,000,000
661053 MANDAN 4 230 652296 WARD 4 230 1	$7,000,000	$7,000,000
661043 HESKETT7 115 661054 MANDAN 7 115 1	$125,000	$125,000
661093 MERRCRT4 230 661098 ELLENDLMVP4 230 1	$15,000,000	$15,000,000
Total Cost Per Project for Actual NRIS Elections for each Project		**$34,125,000**

1.3.4 J320 Summary

Network Upgrade	Total Cost	J320
Not Required	$0	$0
Total Cost Per Project for Actual NRIS Elections for each Project		**$0**

1.3.5 J329 Summary

Network Upgrade	Cost	J329
Not Required	$0	$0
Total Cost Per Project for Actual NRIS Elections for each Project		**$0**

1.3.6 J343 Summary

Network Upgrade	Cost	J343
541251 MARYVLE5 161 635034 CLRNDA 5 161 1	$225,000	$225,000
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	$70,000	$70,000
Total Cost Per Project for Actual NRIS Elections for each Project		**$295,000**

1.3.7 J344 Summary

Network Upgrade	Cost	J344
11128 J344_SUB 161 635870 BEACON 5 161 1	$325,000	$325,000
Jasper-Newton 161 kV	$50,000	$8,771
Total Cost Per Project for Actual NRIS Elections for each Project		**$333,771**

1.3.8 J382 Summary

Network Upgrade	Cost	J382
Not Required	$0	$0
Total Cost Per Project for Actual NRIS Elections for each Project		**$0**

1.4 Study Compliance with NERC FAC-002-1 Standard

This DPP 2014 August West Area study was completed in compliance with NERC FAC-002-1:

R1.1: Evaluation of the reliability impact of the new facilities and their connections on the interconnected transmission systems.

Section 2 covers steady-state analysis results which include thermal and voltage constraints impacted by the DPP West Area generating facilities. Thermal and voltage upgrades required to interconnect the new generating facilities are also identified.

Section 3.1 covers Significantly Affected Facilities (SAF) in MAPP affected systems, which are impacted by the new generating facilities. Network Upgrades required to interconnect the new generating facilities are also identified.

Section 3.2 covers reliability impact of the new generating facilities in the PJM affected systems. Network Upgrades required to interconnect the new generating facilities are also identified.

Section 3.3 covers reliability impact of the new generating facilities in the SPP affected systems.

Section 4 covers transient stability analysis results. No additional Network Upgrades are required for transient stability in the 2024 scenario.

Section 5 covers voltage stability (PV) analysis on the MWEX System Operating Limit (SOL) under the AS King-Eau Claire-Arpin 345 kV line contingency. No additional Network Upgrades are required.

Section 6 covers short circuit reliability impact of the new generating facilities.

Section 7 covers Deliverability reliability impact of the new NRIS generating facilities.

R1.2: Ensurance of compliance with NERC Reliability Standards and applicable Regional, subregional, Power Pool, and individual system planning criteria and facility connection requirements.

Sections 2.3-2.5, Section 3, and Section 4 all cover NERC Reliability Standards TPL-001-0, TPL-002-0, and TPL-003-0.

Section 2.8.1.3 and Section 2.8.2 cover individual system planning criteria and facility connection requirements (MEC, ITCM, CIPCO, and MPW).

Section 3.1 covers MAPP system planning criteria.

Section 3.2 covers PJM system planning criteria.

Section 3.3 covers SPP system planning criteria.

Section 5 (voltage stability analysis) covers individual system planning criteria (ATC).

Section 7 covers MISO system planning criteria.

R1.4: Evidence that the assessment included steady-state, short-circuit, and dynamics studies as necessary to evaluate system performance under both normal and contingency conditions in accordance with Reliability Standards TPL-001-0, TPL-002-0, and TPL-003-0.

Section 2 covers MISO steady-state assessment including NERC category A and B contingencies. Reliability impacts on MEC, ITCM, CIPCO, and MPW systems under NERC category C contingencies are also assessed (TPL-001-0, TPL-002-0, and TPL-003-0).

Section 3.1 covers MAPP steady-state assessment including NERC category A, B, and C contingencies (TPL-001-0, TPL-002-0, and TPL-003-0).

Section 3.2 covers PJM steady-state assessment including NERC category A, B, and C contingencies (TPL-001-0, TPL-002-0, and TPL-003-0).

Section 3.3 covers SPP steady-state assessment including NERC category A, B, and C contingencies (TPL-001-0, TPL-002-0, and TPL-003-0).

Section 4 covers transient stability studies under NERC category A, B, C, and D contingencies (TPL-001-0, TPL-002-0, TPL-003-0, and TPL-004-0).

Section 6 covers short-circuit assessment.

Section 7 covers MISO deliverability study (steady-state assessment) including NERC category A and B contingencies (TPL-001-0, TPL-002-0).

R1.5: Documentation that the assessment included study assumptions, system performance, alternatives considered, and jointly coordinated recommendations.

Section 2.2, Section 2.3, Section 2.4, Section 2.5, Section 4.2, Section 4.3, and Section 4.4 cover study assumptions and system performance criteria.

Alternatives considered can be found in Appendix L (2017 scenario).

Jointly coordinated recommendations can be found in Sections 3.1 (MISO and MAPP), Section 3.2 (MISO and PJM), Section 3.3 (MISO and SPP), and Section 5 (MISO and ATC). Results in Section 2, 3, 4, 6, and 7 have also been reviewed by PJM, MAPP, and SPP.

Section
1

Introduction

Eight (8) generation projects, listed in Appendix A.1, Table A-1, have requested to interconnect to the MISO transmission network in the West Area and have advanced to the Definitive Planning Phase (DPP) 2014 August study (DPP West Area). Generating facility J320 has requested Energy Resource Interconnection Service (ERIS), J382 is an existing MISO generator that has requested Network Resource Interconnection Service (NRIS), and other generating facilities have requested both ERIS and NRIS.

This report presents the study results of a System Impact Study (SIS) performed to evaluate the interconnection of the generating facilities in the DPP West Area group.

The study was performed under the direction of MISO by Siemens PTI and an ad hoc study group. The ad hoc study group was formed to review the study scope, methodology, models and results. The ad hoc study group consisted of representatives from the interconnection customers and the following utility companies – Ameren, American Transmission Company, Basin Electric Power, Central Iowa Power Cooperative, Commonwealth Edison, Corn Belt Power Cooperative, Dairyland Power, Great River Energy, ITC Midwest, Lincoln Electric System, Manitoba Hydro, MidAmerican Energy Company, MISO, Minnesota Power, Minnkota Power, Missouri River Energy Services, Montana-Dakota Utilities Co., Muscatine Power & Water, Nebraska Public Power District, Northwestern Public Service, Omaha Public Power District, Otter Tail Power, PJM, Southern Minnesota Municipal Power Agency, SPP, Western Area Power Administration, and Xcel Energy.

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Section
2

Steady-State Analysis

Steady-state analysis was performed to identify thermal and voltage upgrades required to interconnect the generating facilities in the DPP 2014 August group to the transmission system.

2.1 Study Procedure

2.1.1 Computer Programs

Steady-state analyses were performed using PSS®E version 32.2.4 and PSS®MUST version 10.2.

2.1.2 Study Methodology

Study cases representing near-term (2017) and out-year (2024) summer shoulder (SH) and summer peak (SPK) system conditions with generating facilities in the DPP 2014 August West Area group were created from the preliminary models used for the MISO 2014 Transmission Access Planning (TAP) studies, which were developed from MTEP14 models. Benchmark cases were created by removing the DPP West Area generating facilities from the study cases. Nonlinear (AC) contingency analysis was performed on the benchmark and study cases, and the incremental impact of the DPP West Area generating facilities was evaluated by comparing the steady-state performance of the transmission system in the benchmark and study cases. Network upgrades were identified to mitigate any constraints.

2.2 Model Development

2.2.1 Study Cases

Power flow study cases representing near-term (2017) and out-year (2024) summer shoulder and summer peak conditions were developed from the TAP models, which were developed from MTEP14 models.

The study cases for DPP 2014 August study were created as follows:

- DPP 2012 August generation projects in Appendix A.5 were modeled and dispatched. The output was sunk to the MISO market (Appendix A.11, Table A-24), where generation was scaled in proportion to Pgen – Pmin.
- Network Upgrades (NU) required for generation projects in the DPP 2012 August West Area study group were modeled (Appendix A.6).
- DPP 2013 February generation projects in Appendix A.4 were modeled and dispatched. The output was sunk to the MISO market, where generation was scaled in proportion to Pgen – Pmin.

- Network Upgrades (NU) required for generation projects in the DPP 2013 February West Area study group were modeled (Appendix A.7).
- DPP 2013 August generation projects in Appendix A.3 were modeled and dispatched. The output was sunk to the MISO market, where generation was scaled in proportion to Pgen – Pmin.
- Network Upgrades (NU) required for generation projects in the DPP 2013 August West Area study group were modeled (Appendix A.8).
- DPP 2014 February generation projects in Appendix A.2 were modeled and dispatched. The output was sunk to the MISO market, where generation was scaled in proportion to Pgen – Pmin.
- DPP 2014 August generation projects in the Central Area (Table A-3), East Area (Table A-4), and South Area (Table A-5) were modeled and dispatched. The output was sunk to the MISO market, where generation was scaled in proportion to Pgen – Pmin.
- Generation projects J371, J372, and J374 (Table A-3) have requested external NRIS to MISO market from PJM market. Their generation was redispatched from PJM market (Appendix A.12) to MISO market (Appendix A.11) at the required external NRIS generation level.
- DPP 2014 August generation projects in the West Area (West Area DPP, Table A-1) were modeled and dispatched. The output was sunk to the MISO market, where generation was scaled in proportion to Pgen – Pmin.
- PJM generation projects (Appendix A.9, Table A-21) were modeled and dispatched. Their required Network Upgrades (Table A-22) were also modeled. The generation output was sunk to the PJM market (Appendix A.12, Table A-25), where generation was scaled in proportion to Pgen – Pmin.
- The Briggs Road – North Madison – Cardinal 345 kV line (MVP project) was also included in the 2017 models; the Briggs Road-Cardinal 345 kV line project has an in-service date of 12/31/2018.
- The following generation and transmission projects were added in the 2024 cases: MH Keeyask generation, MH HVDC bipole #3, MH Glenboro-Rugby phase shifting transformer, and MP Great Northern Transmission Line (GNTL) project.
- Models were further reviewed by the Ad Hoc study members (transmission owners and customers). Model corrections and changes were made based on the comments and feedback. These modeling changes are listed in Appendix A.10.
- Adjusted Square Butte DC to match the total output of the Bison wind farms.
- Adjusted CU DC to match the total output of Coal Creek generation units #1 and #2.
- Set MHEX interface transfer level at 1848 MW for 2017 cases; Set MHEX interface transfer level at 2431 MW for 2024 cases.

The study power flow cases were solved with transformer tap adjustment enabled, area interchange disabled, phase shifter adjustment enabled and switched shunt adjustment enabled.

The interface transfer levels in the 2017 and 2024 study cases are summarized in Table 2-1.

Table 2-1: Interface Transfer Levels in 2017 & 2024 Steady State Study Cases

Interface	2017 SH Case (MW)	2017 SPK Case (MW)	2024 SH Case (MW)	2024 SPK Case (MW)
MHEX	1849	1849	2431	2431
MWEX	1527	583	1553	601
Arrowhead – Stone Lake 345 kV	648	226	702	265

2.2.2 Benchmark Cases

Benchmark cases are used to benchmark system performance without the West Area DPP generating facilities, and were created by removing the West Area DPP generating facilities from the study cases. The MISO market was used for power balance, where generation was scaled in proportion to Pmax - Pgen.

2.3 Contingency Criteria

A variety of contingencies were considered for steady-state analysis:

- NERC Category A with system intact (no contingencies)
- NERC Category B contingencies
  - Single element outages, at buses with a nominal voltage of 69 kV and above, in the following areas: CWLD (area 333), AMMO (area 356), AMIL (area 357), WEC (area 295), WEC MI (area 296), XCEL (area 600), MP (area 608), SMMPA (area 613), GRE (area 615), OTP (area 620), ITCM (area 627), MPW (area 633), MEC (area 635), MDU (area 661), MHEB (area 667), DPC (area 680), ALTE (area 694), WPS (area 696), MGE (area 697), UPPC (area 698), CE(area 222), NPPD (area 640), OPPD (area 645), LES (area 650), WAPA (area 652), AECI (area 330), MIPU(area 540), KCPL (area 541), KACY (area 542), INDN (area 545).
  - multiple-element outages initiated by a fault with normal clearing such as multi-terminal lines, in Dakotas, Illinois, Iowa, Manitoba, Minnesota, Missouri, and Wisconsin. These specified Category B contingencies are listed in Appendix A.14.
- NERC Category C
  - Selected NERC Category C events provided by the Ad Hoc Study Group, in the study region of Dakotas, Illinois, Iowa, Manitoba, Minnesota, Missouri, and Wisconsin. These specified Category C contingencies are listed in Appendix A.14.

For all contingency and post-disturbance analyses, cases were solved with transformer tap adjustment enabled, area interchange adjustment disabled, phase shifter adjustment disabled (fixed) and switched shunt adjustment enabled.

2.4 Monitored Elements

The study area is defined in Table 2-2. Facilities in the study area were monitored for system intact and contingency conditions. Under NERC category A conditions (system intact) branches were monitored for loading above the normal (PSS®E rate A) rating. Under NERC

category B and C conditions, branches were monitored for loading as shown in the column labeled "Post-Disturbance Thermal Limits".

Table 2-2: Monitored Elements

Owner / Area	Monitored Facilities	Thermal Limits [1]		Voltage Limits [2]	
		Pre-Disturbance	Post-Disturbance	Pre-Disturbance	Post-Disturbance
AECI	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
AMIL	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
AMMO	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
ATCLLC	69 kV and above	95% of Rate A	95% of Rate B	1.05/0.95	1.1/0.9
CWLD	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
CE	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
DPC	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
GRE	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.92
INDN	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
ITCM	69 kV and above	100% of Rate A	100% of Rate B	1.07/1.05/0.95	1.07/1.05/0.93
KACY	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
KCPL	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
LES	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
MDU	57 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
MEC	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.96/0.95	1.05/0.96/0.95
MHEB	69 kV and above	100% of Rate A	100% of Rate B	1.12/1.1/1.07/1.05/1.04/ 0.99/0.97/0.96/0.95	1.15/1.1/0.94/0.9
MIPU	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
MP	69 kV and above	100% of Rate A	100% of Rate B	1.05/1.0	1.1/0.95
MPW	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.05/0.95
NPPD	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
OPPD	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
OTP	40 kV and above	100% of Rate A	100% of Rate B	1.07/1.05/0.97	1.1/0.92
SMMPA	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
WAPA	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
XEL	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.05/0.92

Notes

1: PSS®E Rate A, Rate B or Rate C

2: Limits dependent on nominal bus voltage

2.5 Performance Criteria

A branch is considered as a thermal injection constraint if the branch is loaded above its applicable normal or emergency rating for the post-change case, and any of the following conditions are met:

1) the generator (NR/ER) has a larger than 20% DF on the overloaded facility under post contingent condition or 5% DF under system intact condition, or
2) the megawatt impact due to the generator is greater than or equal to 20% of the applicable rating (normal or emergency) of the overloaded facility, or
3) the overloaded facility or the overload-causing contingency is at generator's outlet.

A bus is considered a voltage constraint if both of the following conditions are met. All voltage constraints must be resolved before a project can receive interconnection service.

1) the bus voltage is outside of applicable normal or emergency limits for the post-change case, and
2) the change in bus voltage is greater than 0.01 per unit.

All DPP 2014 August study generators must mitigate thermal injection constraints and voltage constraints in order to obtain unconditional Interconnection Service.

Further, all generators requesting Network Resource Interconnection Service (NRIS) must mitigate constraints found by using the deliverability algorithm, to meet the system performance criteria for NERC category A, B and selected C events, if the constraint demonstrates an incremental flow caused by the generator equal to or greater than 5% of the generator's maximum dispatch level in each case.

2.6 Reactive Power Requirement Analysis

FERC Order 661-A dictates the required performance characteristics of wind farms for low voltage ride through and reactive power support. An analysis was performed to study the reactive power requirement for each wind generation project and solar generation project in the DPP West Area group. The analysis was performed as follows:

- Set the reactive power limits of wind and solar generation projects to 0 MVAR.
- Check if voltages in the area around each wind and solar generation project remain within the range required by TOs for category A conditions and for loss of outlet facilities;
- If voltages remain within range, then no specific reactive power range is required. If voltages do not stay within the range, then a power factor range of +/- 0.95 is required.

2.6.1 Reactive Power Requirements for 2017 Summer Shoulder

Details of reactive power requirement analysis results for the 2017 summer shoulder scenario can be found in Appendix C.1.

2.6.2 Reactive Power Requirements for 2024 Summer Shoulder

Appendix C.2 lists reactive power requirement analysis results in the 2024 summer shoulder scenario. The results are summarized as following:

- Low voltage violations were observed in the area of J343. Project J343 is required to have ±0.95 power factor to meet FERC Order 661-A.
- No specific reactive power range is required for wind generation projects J285, J289, J316, or J344 to meet FERC Order 661-A.

2.7 2017 Contingency Analysis Results

Details of contingency analysis results for the 2017 scenario can be found in Appendix L.3.

2.8 2024 Contingency Analysis Results

The incremental impact of the proposed interconnection on individual facilities was evaluated by comparing flows and voltages between benchmark cases (without DPP West Area projects) and study cases (with DPP West Area projects). Analysis was performed in the 2024 summer shoulder and summer peak scenarios using PSS®MUST and PSS®E.

2.8.1 2024 Summer Shoulder Contingency Analysis Results

2.8.1.1 System Intact Conditions

No thermal or voltage constraints were identified for NERC category A (system intact) conditions (Table E-1, Table E-2).

2.8.1.2 Category B Contingencies

The results in this Section are for analysis of conditions following NERC Category B contingencies. All category B contingencies were converged.

For category B contingencies in the 2024 summer shoulder scenario, thermal constraints are listed in Table E-3. No voltage constraints were identified.

2.8.1.3 Category C Contingencies

The results in this Section are for analysis of conditions following NERC category C contingencies. MEC, ITCM, CIPCO, and MPW require mitigation of any thermal and voltage constraints on their transmission systems under category C contingencies.

Five category C contingencies (Table E-7) were not converged. They were not converged in the benchmark or study cases. No mitigation plan is required for the study projects for these contingencies.

For category C contingencies in the 2024 summer shoulder scenario, thermal constraints are listed in Table E-5. No voltage constraints were identified.

2.8.1.4 Worst Thermal Violations

Table 2-3 lists worst thermal violations in the 2024 summer shoulder scenario.

Table 2-3: 2024 Shoulder Thermal Constraints, Maximum Screened Loading

Constraint	Rating	Owner	Worst Loading		Contingency	Cont Type	Generator
			(MVA)	(%)			
11117 J316_SUB 230 661098 ELLENDLMVP4 230 1	343.0	MDU	399.4	116.4	B2.ELM-MRC4 MERRCRT4 230 - ELLENDLMVP4 230 1	B	J316
11128 J344_SUB 161 635870 BEACON 5 161 1	261.0	MEC ITCM	266.3	102.0	OTTUMW1G REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0	B	J344
11128 J344_SUB 161 635870 BEACON 5 161 1	261.0	MEC ITCM	324.2	124.2	ITCM-C501-TR OTTUMWA5 161 - OTTUMWA3 345 1 REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0	C	J344
541251 MARYVLE5 161 635034 CLRNDA 5 161 1	168.0	MEC GMO	190.4	113.4	CRESTON5 161 - 5MARYVL 161 1	B	J343
541251 MARYVLE5 161 635034 CLRNDA 5 161 1	168.0	MEC GMO	184.3	109.7	ITCM-C304-SW CRESTON5 161 - 5MARYVL 161 1 MCKSBRG 3 161 - CRESTON5 161 1 CRESTON5 161 - CRESTON8 69.0 - CRESTON29 13.8 1	C	J343
630388 WINCOR 8 69.0 630389 WINMUNI8 69.0 1	40.0	CIPCO	43.6	108.9	CIPC-102 MCKSBRG 3 161 - CRESTON5 161 1 WNTRST 5 161 - NORWLK5 161 1	C	J289
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	163.7	106.3	CBLUFFS5 161 - RIVRBND5 161 1	B	J343
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	157.5	102.3	P23:161:MEC:Bunge 802 BUNGE 5 161 - HASTING5 161 1 RIVRBND5 161 - BUNGE 5 161 1	C	J343

2.8.2 2024 Summer Peak Contingency Analysis Results

No thermal or voltage constraints were identified for NERC category A (system intact) conditions.

All category B contingencies were converged. For category B contingencies, no thermal or voltage constraints were identified.

Five category C contingencies (Table E-15) were not converged. They were not converged in the benchmark or study cases. No mitigation plan is required for the study projects for these contingencies.

For category C contingencies in the 2024 summer peak scenario, no thermal or voltage constraints were identified in MEC, ITCM, CIPCO, or MPW systems.

2.9 Network Upgrades Identified in MISO ERIS Analysis for 2024 Scenario

Based on the MISO steady state analyses, the highest loading of each facility that violates criteria in the 2024 scenario (SH, SPK) is shown in Table 2-4. Potential network upgrades are also included.

Costs of the network upgrades identified in the MISO steady state analysis for the 2024 scenario are listed in Table 2-5.

Table 2-4: Network Upgrades for Thermal Constraints in 2024 Scenario, Maximum Screened Loading

Generator	Constraint	Rating	Owner	Worst Loading		Contingency	Cont Type	Scenario	Mitigation
				(MVA)	(%)				
J316	J316 Sub-Ellendale 230 kV	343.0	MDU	399.4	116.4	B2.ELM-MRC4 MERRCRT4 230 - ELLENDLMVP4 230 1	B	2024 SH	Rebuild line with 795 ACSS conductor
J344	J344 Sub-Beacon 161 kV	261.0	MEC ITCM	266.3	102.0	OTTUMW1G REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0	B	2024 SH	MEC - Beacon terminal requires replacement of line drops to achieve an acceptable Ring Closed rating: $25k; ITCM - Planning level estimate of $300k for sag mitigation
J344	J344 Sub-Beacon 161 kV	261.0	MEC ITCM	324.2	124.2	ITCM-C501-TR OTTUMWA5 161 - OTTUMWA3 345 1 REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0	C	2024 SH	MEC - Beacon terminal requires replacement of line drops to achieve an acceptable Ring Closed rating: $25k; ITCM - Not loss of a single element: Mitigation not required
J343	Maryville-Clarinda 161 kV	168.0	MEC GMO	190.4	113.4	300097 5MARYVL 161 652560 CRESTON5 161 1 CRESTON5 161 - 5MARYVL 161 1	B	2024 SH	MidAmerican's section is clearance and terminal limited. Structure replacements and terminal equipment replacements with an estimated cost of $225k would provide a rating of 199 MVA for MidAmerican's section.
J343	Maryville-Clarinda 161 kV	168.0	MEC GMO	184.3	109.7	ITCM-C304-SW CRESTON5 161 - 5MARYVL 161 1 MCKSBRG 3 161 - CRESTON5 161 1 CRESTON5 161 - CRESTON8 69.0 - CRESTON29 13.8 1	C	2024 SH	MidAmerican's section is clearance and terminal limited. Structure replacements and terminal equipment replacements with an estimated cost of $225k would provide a rating of 199 MVA for MidAmerican's section.

Generator	Constraint	Rating	Owner	Worst Loading		Contingency	Cont Type	Scenario	Mitigation
				(MVA)	(%)				
J289	Wincor-Wincor Muncipal 69 kV	40.0	CIPCO	43.6	108.9	CIPC-102 MCKSBRG 3 161 - CRESTON5 161 1 WNTRST 5 161 - NORWLK5 161 1	C	2024 SH	CIPCO - Approx. 1 mile of 3/0 ACSR will need to be rebuilt
J343	Clarinda-Brooks 161 kV	154.0	MEC	163.7	106.3	635001 CBLUFFS5 161 635030 RIVRBND5 161 1 CBLUFFS5 161 - RIVRBND5 161 1	B	2024 SH	MidAmerican's rating is clearance limited. Structure replacements with an estimated cost of $70k would provide a rating of 167 MVA limited by terminal equipment.
J343	Clarinda-Brooks 161 kV	154.0	MEC	157.5	102.3	P23:161:MEC:Bunge 802 BUNGE 5 161 - HASTING5 161 1 RIVRBND5 161 - BUNGE 5 161 1	C	2024 SH	MidAmerican's rating is clearance limited. Structure replacements with an estimated cost of $70k would provide a rating of 167 MVA limited by terminal equipment.

Table 2-5: Network Upgrades and Cost Identified in MISO Steady State Analysis for 2024 Scenario

Constraint	Owner	Mitigation	Cost ($)
J316 Sub-Ellendale 230 kV	MDU	Rebuild line with 795 ACSS conductor	$12,000,000
J344 Sub-Beacon 161 kV	MEC ITCM	MEC - Beacon terminal requires replacement of line drops to achieve an acceptable Ring Closed rating: $25k; ITCM - Planning level estimate of $300k for sag mitigation	$325,000
Maryville-Clarinda 161 kV	MEC GMO	MidAmerican's section is clearance and terminal limited. Structure replacements and terminal equipment replacements with an estimated cost of $225k would provide a rating of 199 MVA for MidAmerican's section.	$225,000
Wincor-Wincor Muncipal 69 kV	CIPCO	CIPCO - Approx. 1 mile of 3/0 ACSR will need to be rebuilt	$300,000
Clarinda-Brooks 161 kV	MEC	MidAmerican's rating is clearance limited. Structure replacements with an estimated cost of $70k would provide a rating of 167 MVA limited by terminal equipment.	$70,000

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Section
3

Affected System Steady-State Analysis

Steady state analyses were performed to identify constraints on affected systems.

3.1 SAF Analysis for MAPP Companies

Per "MAPP Design Review Subcommittee Policies and Procedures" (Version 2.1, Nov. 2012), Significantly Affected Facilities (SAF) were screened for affected MAPP companies (WAPA, MPC, BEPC, CIPCO, CBPC). The SAF list contains any transmission facilities for which all of the following three (3) conditions exist:

1) the branch is loaded above its applicable normal or emergency rating for the post-change case, and
2) the generator has a larger than 3% DF on the overloaded facility under post contingent condition or 5% DF under system intact condition, and
3) the loading increase of the overloaded facility is greater than 1 MVA compared with that in the pre-change case under system intact or contingency conditions.

AC contingency analysis was performed for the SAF analysis, using the DPP 2014 August West Area benchmark (pre-change) cases and post-DPP 2014 August study (post-change) cases for the 2017 and 2024 summer peak and shoulder scenarios. All NERC category A, B and C contingencies described in Section 2.3 were simulated. The affected MAPP systems (WAPA, MPC, BEPC, CIPCO, and CBPC) were monitored.

The Significantly Affected Facilities (SAF) in the affected MAPP systems are listed in Appendix F.1. These include the SAF list for the 2017 and 2024 summer peak and shoulder scenarios. Whether these SAF will be mitigated or not will be determined by the affected transmission owning company's local planning criteria.

The MAPP SAF with their highest loadings and potential network upgrades are listed in Table 3-1 for the 2024 summer shoulder scenario. No MAPP SAF constraints were identified in the 2024 summer peak scenario.

Table 3-1: MAPP Significantly Affected Facilities (SAF) and their Highest Loadings in 2024 Shoulder Scenario

Constraint	Rating	Owner	Worst Loading		Cont Type	Generator	Mitigation	Cost ($)
			(MVA)	(%)				
640386 TWIN CH4 230 652565 SIOUXCY4 230 1	320.0	WAPA NPPD	381.1	119.1	B	J285	Constraint was identified in DPP 2012 Aug study. Build a second 25 miles line with sub expansion (NPPD owned, $30M). MAPP (WAPA) portion of the upgrade cost is $0	$0
640386 TWIN CH4 230 652565 SIOUXCY4 230 1	320.0	WAPA NPPD	478.0	149.4	C	J285	Constraint was identified in DPP 2012 Aug study. Build a second 25 miles line with sub expansion (NPPD owned, $30M). MAPP (WAPA) portion of the upgrade cost is $0	$0

3.2 PJM Affected System AC Contingency Analysis

The PJM affected system analysis details can be found in Appendix F.2.

3.2.1 Study Methodology

PJM performed the contingency analysis to evaluate the impact of MISO DPP 2014 August generating facilities on PJM systems.

The analyses were performed in both PJM summer peak case (PJM Z1 2017SP) and light load case (PJM Z1 2016LL). All DPP 2014 August generation projects and previous DPP generation projects were added to the cases. PJM performed contingency analyses with all PJM category B and C contingencies.

3.2.2 Study Results

3.2.2.1 Summer Peak Analysis Results

In the summer peak scenario, no PJM impacts were identified for DPP 2014 Aug West Area generation projects.

3.2.2.2 Light Load Analysis Results

In the light load scenario, PJM impacts were identified (Table 3-2) for the J285 and J344 generation projects. No other generation projects in the DPP 2014 August West Area impact the PJM system.

Table 3-2: PJM Impacts in Light Load

Name	Name	CKT	KVs	Areas	Rating	FN AC Flow	FN AC %	Cont Label	Cont Type	J285	J344
CORDO; B	NELSO; B	1	345	ComEd	1528	1593.79	104.31	'345-L0404___-R'	single	23.5	25.15
QUAD3-11	H471 ;	1	345	ComEd	1528	1599.7	104.69	'345-L15503_B-R'	single	23.51	25.11
H471 ;	NELSO; B	1	345	ComEd	1528	1598.8	104.63	'345-L15503_B-R'	single	23.51	25.11

Note 1: All the three constraints will be mitigated by existing PJM baseline upgrades B2692.1 & B2692.2, which are planned to be in service by summer 2019.

Note 2: Two projects J285 and J344 in the MISO DPP 2014 Cycle contribute loading to these three overloads. These projects can wait until B2692.1 & B2692.2 are placed into service or the projects can pay an advancement cost to place B2692.1 & B2692.2 into service earlier, if feasible per ComEd.

To mitigate the violations, there are two mitigation options:

1. MISO MVP Option

MISO MVP project Fargo-Sandburg-Oak Grove 345kV was tested and proved to alleviate all identified overloads.

2. Existing PJM Baseline Upgrades

Table 3-3: Existing PJM Baseline Upgrades

PJM Facilities	Upgrade Description	Planning-Level Cost Estimate
Cordova–Nelson 345 kV line	Existing PJM baseline upgrades B2692.1 & B2692.2 are planned to be put into service by summer 2019. B2692.1 & B2692.2 will upgrade the Cordova - Nelson 345 kV line. The new line ratings will be 1679 / 2058 / 2280 MVA (SN/SE/SLD)	Existing PJM baseline upgrades
Quad Cities–ESS H471 345 kV line	Existing PJM baseline upgrades B2692.1 & B2692.2 are planned to be put into service by summer 2019. B2692.1 & B2692.2 will upgrade the Quad Cities – ESS H471 345 kV line. The new line ratings will be 1679/2011/2280 MVA (SN/SE/SLD)	Existing PJM baseline upgrades
ESS H471–Nelson 345 kV line	Existing PJM baseline upgrades B2692.1 & B2692.2 are planned to be put into service by summer 2019. B2692.1 & B2692.2 will upgrade the ESS H471 - Nelson 345 kV line. The new line ratings will be 1679/2011/2280 MVA (SN/SE/SLD)	Existing PJM baseline upgrades

Two projects J285 and J344 in the MISO DPP 2014 Cycle contribute loading to these three overloads. These projects can wait until B2692.1 & B2692.2 are placed into service or the projects can pay an advancement cost to place B2692.1 & B2692.2 into service earlier, if feasible per ComEd.

3.2.3 Study Summary

Two projects J285 and J344 in the MISO DPP 2014 Cycle contribute loading to the three overloads in PJM systems. These two projects can wait until B2692.1 & B2692.2 are placed into service or the projects can pay an advancement cost to place B2692.1 & B2692.2 into service earlier, if feasible per ComEd.

3.3 SPP Affected System AC Contingency Analysis

Southwest Power Pool (SPP) conducted an Affected System Interconnection System Impact Study to evaluate potential impacts to the SPP Transmission System related to the interconnection of generators on the Mid-Continent Independent System Operation (MISO) Transmission System.

Power flow analysis results indicate that for the power flow cases studied, the SPP Transmission System is impacted from the interconnection of the MISO Customer generation. Energy Resource Interconnection Service (ERIS) constraints can be mitigated by the curtailment of generation and transmission reinforcements are not required. NRIS constraints must be mitigated by the delay of NRIS until such time that the Nebraska City – Sibley 345 kV can be place in service in 2017.

If additional analysis is required it will be performed under an executed Affected System Facility Study. The purpose of the Affected System Facility Study is to perform additional analysis required to refine the scope, cost estimates, and expected time of construction of system facilities identified as Network Upgrades that would be placed under the SPP Open Access Transmission Tariff.

The SPP affected system analysis results for this study are in Appendix F.3.

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Section
4

Stability Analysis

Stability analysis was performed to evaluate the transient stability and impact on the region of the generating facilities in the DPP 2014 August West Area group.

4.1 Procedure

4.1.1 Computer Programs

Stability analysis was performed using PSS®E revision 32.2.4.

4.1.2 Study Methodology

Study cases representing near-term (2017) and out-year (2024) summer shoulder (SH) conditions with generating facilities in the DPP 2014 August West Area group were created from the preliminary models used for the MISO 2014 Transmission Access Planning (TAP) studies, which were developed from MTEP14 models. Benchmark cases were created by removing the DPP West Area generating facilities from the study cases. Disturbances were simulated to evaluate the transient stability and impact on the region of the generating facilities. If a simulation for the study case violates NERC transient stability criteria or local TOs' planning criteria, the simulation was repeated on the benchmark case to assess the impact of the generating facilities on the violation.

4.2 Case Development

4.2.1 Study Cases

Study cases representing near-term (2017) and out-year (2024) shoulder (SH) high transfer conditions were developed from the TAP models, which MISO developed from MTEP14 models.

The stability study cases for DPP 2014 August study were created as described in Section 2.2.1. The interface transfer levels are summarized in Table 4-1.

Table 4-1: Interface Transfer Levels in 2017 & 2024 Stability Study Cases

Interface	2017 SH Case (MW)	2024 SH Case (MW)
MHEX	1849	2431
MWEX	1535	1603
Arrowhead – Stone Lake 345 kV	658	716

4.2.2 Benchmark Cases

The West Area DPP generating facilities as described in Table A-1 (Appendix A.1) were removed from the study cases. MISO market was used for power balance, where generation was scaled in proportion to Pmax - Pgen.

4.3 Disturbance Criteria

The stability simulations performed as part of this study considered all the regional and local contingencies listed in Table 4-2. For local contingencies, generic clearing times (Table 4-3) were used, and local fault admittances for single line to ground faults (SLG) were estimated by assuming that the Thevenin impedance of the positive, negative and zero sequence networks at the fault point are equal.

Table 4-2: Regional and Local Disturbance Descriptions

Disturbance Name	Description	NERC Cat.	Area
0682_w_gre__c4__ei2_coalcreek	CU DC Permanent Bipole fault with tripping of both Coal Creek units	C4	GRE
0689_w_gre__c7__eq1_coalcreek	SLGBF Coal Creek 230 kV; clear CU HVDC #1; Coal Creek Gen #2	C7	GRE
0710_w_itcm_b2__cmvp_lakefld3_winnebag_fr	3PH fault; generic clearing; on Lakefield-Winnebago; at Lakefield 345 kV	B2	ITCM
0716_w_itcm_b2__mont_bond	3ph fault at Montezuma 345 kV bus with normal clearing on Montezuma-Bondurant 345 kV line	B2	ITCM
0728_w_itcm_c8__lakefield_nobles_bk8160	SLG fault on Lakefield-Nobles 345 kV with failed Lakefield bk 8160. dly clr on Lakefield 345/161 1	C8	ITCM
0732_w_itcm_c8__ottumwa_wapello_bk879	SLG fault on Ottumwa-Wapello 161 kV 1 with failed Ottumwa breaker 879. delayed clearing on Ottumwa 345/161 kV	C8	ITCM
0754_w_mec__b2__cmvp_sheldon__burt_____fr	3ph fault; generic clearing; on Obrien Co-Kossuth; at Obrien Co 345 kV	B2	MEC
0760_w_mec__c3__ia-n4-1c3_at_raun-sioux_city	3PH fault at Raun on Raun-Sioux City 345 kV line; prior outage of Obrien-Lakefield 345 kV line	C3	MEC
0761_w_mec__c3__ia-n4-2c3_at_raun-ft_calhoun	3ph fault at Raun on Raun-Ft. Calhoun 345 kV line; Prior outage of Raun-Hoskins 345 kV line	C3	MEC
0762_w_mec__c3__ia-ws4-1c3_at_cbec-fallow	3ph fault at Council Bluffs on Council Bluffs-Fallow 345 kV line; Prior outage of Rolling Hills-Madison Co 345 kV line	C3	MEC
0764_w_mec__c8__ia-gd-1d_at_se_polk	SLG fault at SE Polk on high side of 345-161 kV xfmr stuck brkr 901, dly clr; Prior outage of Sycamore-Bondurant	C8	MEC
0767_w_mec__c8__ia-n4-1d_at_raun-lakefield	SLG fault at Raun on Raun-Lakefield, stuck brkr; clear Raun-Lehigh; prior outage of Raun-Sioux City 345 kV	C8	MEC
0769_w_mec__c8__sb_gct_near_635016_atchsn2w	SLG fault at Booneville on the Booneville-Grimes line; trip at 4 cyc; stuck brkr; generic clearing at 16 cyc	C8	MEC

Disturbance Name	Description	NERC Cat.	Area
0771_w_mec__c8__sb_gct_near_635213_neal_3g	slg fault @ Raun 345 kV on the Raun-Sub 3451 line; trip at 4 cyc; stuck brkr; generic clearing at 13.5 cyc	C8	MEC
0800_w_mp___b2__fds_sqbutte	5.0 cy 3 ph flt at Square Butte 230 kV on Stanton line clr Square Butte end at 4 cy, Stanton end at 5 cy	B2	MP
0803_w_mp___b2__yb3_at_arrowhead-stonelk	3PH fault at Arrowhead 345 kV, clear the Arrowhead-Stone Lake 345 kV line	B2	MP
0810_w_mp___c8__yas_at_arrowhead	SLG fault at Arrowhead 230 kV on Arrowhead-Gardner Park ckt 1; Arrowhead brkr stuck, clear by tripping Arrowhead-Gardner Park bus section	C8	MP
0822_w_otp__b2__eb3_center	3PH Center 345 kV; clear Center-Jamestown 345 kV line	B2	OTP
0825_w_otp__b2__evs_sqbutte_dc	3PH Square Butte DC Pole #1; clear Square Butte DC Pole #1; Ramp Square Butte Pole 2 > 1100 Amps	B2	OTP
0826_w_otp__c7__eb4_at_center-jamestown	4.5 cy SLG fault at Center 345 kV on Jamestown line, Center breaker 3235 or 3245 stuck, clear Center at 12.5 cy, trip Coyote at 16 cy	C7	OTP
0830_w_otp__c7__fd4_sqbutte	SLGBF Square Butte 230 kV; clear Square Butte end fault line; breaker 17 stuck, trip Square Butte-Stanton 230 kV, both dc poles restart at 17 cycles	C7	OTP
BigStone_Blair-Fault	3PH fault at Big Stone 230 kV on Blair; Cleared at 5 cycles, trip Big Stone-Blair 230 kV line	B2	OTP
BigStone_BrownsValley-Fault	3PH fault at Big Stone 230 kV on Hankinson; Cleared at 6 cycles, trip Big Stone-Browns Valley-Hankinson 230 kV line	B2	OTP
BigStone_BusDiff-Fault	3PH fault at Big Stone 230 kV bus; Bus differential relay failure; Trip Big Stone-Browns Valley-Hankinson 230 kV, Big Stone-HWY12-Ortonville 230 kV at 26 cycles; Trip Big Stone-Blair 230 kV, Big Stone-Mariett-Burr 230 kV, Canby-Burr 230 kV, Big Stone xfmr, and clear the fault at 96 cycles	D4	OTP
BigStoneSouth_Brookings-Fault	3PH fault at Big Stone South 345 kV on Brookings Co; Cleared at 6 cycles, trip Big Stone South-Brookings Co 345 kV line	B2	OTP
BigStoneSouth_Ellendale-Fault	3PH fault at Big Stone South 345 kV on Ellendale; Cleared at 6 cycles, trip Big Stone South-Ellendale 345 kV line	B2	OTP
0867_w_xel__b2__cmvp_hmpt_cnr_lkmarion_fr	3ph fault; generic clearing; on Hampton Corner-Lake Marion; at Hampton Corner 345 kV	B2	XEL
0879_w_xel__b2__hn3_hamptoncorner	3ph Hampton Corner 345; clear Hampton Corner-North Rochester 345 kV	B2	XEL
0883_w_xel__b2__lgs_lakefieldgen	3PH Lakefield Gen 345 kV; clear Lakefield Gen-Lakefield Jct. 345 kV, bypass Fieldon series compensator at 6 cycles	B2	XEL

Disturbance Name	Description	NERC Cat.	Area
0885_w_xel__b2__ljs_lakefieldjct	3PH Lakefield Jct. 345 kV; clear Lakefield gen-Lakefield Jct. 345 kV, bypass Fieldon series compensator at 6 cycles.	B2	XEL
0886_w_xel__b2__lnz_lakefieldjct	3PH Lakefield Jct. 345 kV; clear Lakefield Jct.-Nobles 345 kV	B2	XEL
0888_w_xel__b2__nmz_chisagoco	3PH Chisago Co 500kV; clear Chisago Co-Forbes 500kV line; 100% dc reduction	B2	XEL
0889_w_xel__b2__pas_forbes	SLGBF Forbes 500kV; clear Forbes-Dorsey 500kV line; Forbes-Chisago Co	B2	XEL
0890_w_xel__b2__pc3_at_king-eauclaire	3PH fault on King–Eau Claire line, cross trip Eau Claire-Arpin	B2	XEL
0900_w_xel__b2__vts_lakefieldgen	3PH Lakefield Gen 345 kV; clear Wilmarth-Fieldon 345 kV, bypass Fieldon series cap at 5 cyc	B2	XEL
0915_w_xel__c7__lns_lakefieldjct	SLGBF Lakefield Jct. 345 kV; clear Lakefield Jct.-Nobles 345 kV; Lakefield Jct. breaker stuck, Lakefield Jct. 345/161 tx 2 trip	C7	XEL
0917_w_xel__c7__mts	SLGBF fault at Monticello with 8n6 stuck	C7	XEL
0919_w_xel__c7__pcs	SLG fault at King-Eau Claire line with a breaker failure at King	C7	XEL
0921_w_xel__c7__pri_8h8	SLG fault at Prairie Island with stk breaker; normal clear Prairie Island-N Rochester 345 kV; Delayed clear Prairie Island-Red Rock 345 kV	C7	XEL
0930_w_xel__c9__edp-8m45	13.75 cycle SLG fault at Eden Prairie 345 kV bus with failure of 8m45; trip Eden Prairie-Parkers Lake/-Blue Lake	C9	XEL
0931_w_xel__d12_mad_dorsey	3PH Dorsey 500 kV; clear Dorsey-Forbes 500 kV line	D12	XEL
0932_w_xel__d12_nad_forbes	3PH Forbes 500 kV; clear Forbes-Dorsey 500 kV line; 100% dc reduction	D12	XEL
0979_x_wapa_b2__aw3_alexandria	3ph Alexandria SS 345 kV; clear Waite Park-Alexandria SS 345 kV	B2	WAPA
0984_x_wapa_c7__ah1_Leland-Groton	SLG fault at Leland 345 kV; trip Leland-Groton 345 kV, Leland-Leland Tie 345 kV	C7	WAPA
0985_x_wapa_c7__cf1_at_antelopev-lelandolds	4 cy SLG fault at Antelope Valley 345 on Leland Olds 2 line, lo brkr 2196 stk, clr at 11 cy by tripping faulted line & Leland Olds 2 xfmr	C7	WAPA
D01_w_mec_b2_Ottumwa-Montezuma	4 cycle 3PH fault at Ottumwa 345 kV on Montezuma, trip Ottumwa-Montezuma	B2	MEC
D02_w_mec_c8_Ottumwa-Montezuma	SLG fault at Ottumwa 345 kV on Montezuma line. Stuck breaker at Ottumwa. Clear Montezuma end of line at 4 cycle. Clear Ottumwa end of line at 13.5 cycle	C8	MEC
D03_w_mec_b2_Beacon-TriCounty	5 cycle 3PH fault at Beacon 161 kV on Tri-county, trip Beacon-Tri-county	B2	MEC

Disturbance Name	Description	NERC Cat.	Area
D04_w_mec_c8_Beacon-TriCounty	SLG fault at Beacon 161 kV on Tri-county line. Stuck breaker at Beacon. Clear Tri-county end of line at 5 cycle. Clear Beacon end of line and trip Beacon 161/69 kV #1 TX at 16.5 cycle	C8	MEC
D05_w_mec_b2_Beacon-J344	5 cycle 3PH fault at Beacon 161 kV on Poweshiek, trip Beacon-J344 Sub	B2	MEC
D06_w_mec_c7_Beacon-Poweshiek	SLG fault at Beacon 161 kV on Poweshiek line. Stuck breaker at Beacon. Clear J344 sub end of line at 5 cycle. Clear Beacon end of line and trip Beacon 161/69 kV #2 TX at 16.5 cycle	C7	MEC
D07_w_mec_b2_Poweshiek-Reasnor	5 cycle 3PH fault at Poweshiek 161 kV on Reasnor, trip Poweshiek-Reasnor	B2	MEC
D08_w_mec_c8_Poweshiek-Reasnor	SLG fault at Poweshiek 161 kV on Reasnor line. Stuck breaker (872) at Poweshiek. Clear Reasnor end of line at 5 cycle. Clear Poweshiek end of line and trip Poweshiek-Parnell 161 kV line at 16.5 cycle	C8	MEC
D09_w_mec_b2_Poweshiek-Parnell	5 cycle 3PH fault at Poweshiek 161 kV on Parnell, trip Poweshiek-Parnell	B2	MEC
D10_3ph_PellaSESS-Beacon	3PH fault at Pella SESS 69 kV on the Pella SESS-Beacon 69 kV line. Clear Pella SESS end of line at 4.33 cycles. Clear Beacon end of line at 47 cycles.	B2	J329
D11_SLG__PellaSESS-Beacon	SLG fault at Pella SESS 69 kV on the Pella SESS-Beacon 69 kV line. Stuck breaker at Pella SESS. Clear Pella SESS end of line and trip Pella SESS-Pella East 69 kV line at 16.37 cycles. Clear Beacon end of line at 47 cycles.	C8	J329
D12_3ph_PellaSESS-PellaEast	6 cycle 3PH fault at Pella SESS 69 kV on the Pella SESS-Pella East 69 kV line. Clear Pella SESS end of line at 4.33 cycles. Clear Pella East end of line at 7.33 cycles	B2	J329
D13_SLG_PellaSESS-PellaEast	SLG fault at Pella SESS 69 kV on Pella East line. Stuck breaker at Pella SESS. Clear Pella East end of line at 7.33 cycle. Clear Pella SESS end of line and trip Pella SESS - Beacon 69 kV line at 16.37 cycle	C8	J329
D14_3ph_PellaSESS-PellaWest	3PH fault at Pella SESS 69 kV on the Pella SESS-Pella West 69 kV line. Clear Pella SESS end of line at 4.33 cycles. Clear Pella West end of line at 7.33 cycles	B2	J329
D15_SLG__PellaSESS-PellaWest	SLG fault at Pella SESS 69 kV on Pella West line. Stuck breaker at Pella SESS. Clear Pella West end of line at 7.33 cycle. Clear Pella SESS end of line and trip Pella SESS-Pella Clark St. 69 kV line at 16.37 cycle	C8	J329
D16_3ph_PellaSESS-PellaClark	3PH fault at Pella SESS 69 kV on the Pella SESS-Pella Clark St. 69 kV line, Clear Pella SESS end of line at 4.33 cycles. Clear Pella Clark St. end of line at 7.33 cycles	B2	J329

Disturbance Name	Description	NERC Cat.	Area
D17_SLG_PellaSESS-PellaClark	SLG fault at Pella SESS 69 kV on Pella Clark St. line. Stuck breaker at Pella SESS. Clear Pella Clark St end of line at 7.33 cycle. Clear Pella SESS end of line and trip Pella SESS - Pella West 69 kV line at 16.37 cycle	C8	J329
D18_3ph_PellaWest-PellaSESS	3PH fault at Pella West 69 kV on the Pella West-Pella SESS 69 kV line. Clear Pella West end of line at 4.33 cycles. Clear Pella SESS end of line at 7.33 cycles	B2	J329
D19_SLG_PellaWest-PellaSESS	SLG fault at Pella West 69 kV on Pella SESS line. Delayed clearing at Pella West. Clear Pella SESS end of line at 4.33 cycle. Clear Pella West end of line at 24.33 cycle	C8	J329
D20_3ph_PellaWest-PellaNorth	3PH fault at Pella West 69 kV on the Pella West-Pella North Plant 69 kV line. Clear Pella West end of line at 4.33 cycles. Clear Pella North Plant end of line at 7.33 cycles	B2	J329
D21_SLG_PellaWest-PellaNorth	SLG fault at Pella West 69 kV on Pella North Plant line. Delayed clearing at Pella West. Clear Pella North Plant end of line at 4.33 cycle. Clear Pella West end of line at 24.33 cycle	C8	J329
D22_3PH_PellaWest-PrairieCity	3PH fault at Pella West 69 kV on the Prairie City—Pella West 69 kV line. Clear Pella West end of line at 4.33 cycles. Clear Prairie City end of line at 47 cycles.	B2	J329
D24_PO_3ph_PellaSESS-PellaEast	Prior Outage: Pella SESS-Beacon 69 kV 3PH fault at Pella SESS 69 kV on the Pella SESS-Pella East 69 kV line. Clear Pella SESS end of line at 4.33 cycles. Clear Pella East end of line at 7.33 cycles	C3	J329
D25_PO_3ph_PellaWest-PellaNorth	Prior Outage: Pella West-Pella SESS 69 kV 3PH fault at Pella West 69 kV on the Pella West-Pella North Plant 69 kV line. Clear Pella West end of line at 4.33 cycles. Clear Pella North Plant end of line at 7.33 cycles	C3	J329
D26_PO_3ph_PellaWest-PrairieCity	Prior Outage: Pella SESS-Beacon 69 kV 3PH fault at Pella West 69 kV on the Pella Wst-Prairie City 69 kV line. Clear Pella West end of line at 4.33 cycles. Clear Prairie City end of line at 47 cycles.	C3	J329
D27_3ph_PrairieCity-PellaWest	3PH fault at Prairie City 69 kV on the Prairie City-Pella West 69 kV line. Clear Prairie City end of line at 7 cycles. Clear Pella West end of line at 24.33 cycles.	B2	J329
D28_3ph_Beacon-PellaSESS	3PH fault at Beacon 69 kV on Pella SESS. Clear Beacon end of line at 4.33 cycles. Clear Pella SESS end of line at 24.33 cycles.	B2	J329
D29_PO_3ph_PrairieCity-PellaWest	Prior Outage: Pella SESS-Beacon 69 kV 3PH fault at Prairie City 69 kV on the Prairie City-Pella West 69 kV line. Clear Prairie City end of line at 7 cycles. Clear Pella West end of line at 24.33 cycles.	C3	J329

Disturbance Name	Description	NERC Cat.	Area
D30_SLG_PellaWest-PellaSESS_BNX616	SLG fault at Pella West 69 kV on Pella SESS line. Stuck breaker at Pella West breaker BNX616. Clear Pella SESS end of line at 7.33 cycle. Clear Pella West end of line at 16.37 cycle. Trip Pella West Diesel Gen	C8	J329
D31_SLG_PellaWest-PellaSESS_BNX615	SLG fault at Pella West 69 kV on Pella SESS line. Stuck breaker at Pella West breaker BNX615. Clear Pella SESS end of line at 7.33 cycle. Clear Pella West end of line at 16.37 cycle. Trip Pella West load.	C8	J329
D32_SLG_PellaWest-PellaNorth_BNX611	SLG fault at Pella West 69 kV on Pella North Plant line. Stuck breaker at Pella West breaker BNX611. Clear Pella North Plant end of line at 7.33 cycle. Clear Pella West end of line at 16.37 cycle. Trip Pella West Gen	C8	J329
D32-1_SLG_PellaWest-PellaNorth_BNX612	SLG fault at Pella West 69 kV on Pella North Plant line. Stuck breaker at Pella West breaker BNX612. Clear Pella North Plant end of line at 7.33 cycle. Clear Pella West end of line at 16.37 cycle. Trip Pella West-Prairie City	C8	J329
D33_SLG_PellaWest-PrairieCity_BNX612	SLG fault at Pella West 69 kV on the Pella West-Prairie City line. Stuck breaker at Pella West breaker BNX612. Clear Pella West end of line at 16.37 cycles. Trip Pella West-Pella North Plant. Clear Prairie City end of line at 50 cycles.	C8	J329
D34_3ph_PellaWest-PrairieCity_85	3PH fault on the Prairie City-Pella West 69 kV line at a distance 85% from Pella West. Clear Pella West end of line at 4.33 cycles. Clear Prairie City end of line at 7 cycles.	B2	J329
0878_w_xel__b2__highbridge-merriumpark	3ph fault at High Bridge on High Bridge-Merrium Park 115 kV line; trip High Bridge-Merrium Park 115 kV line	B2	J320
HighBridge_SLG_MerriumPark_115	SLG fault on High Bridge to Merrium Park 115 kV line; Delayed cleared at 18 cycles	C7	J320
HighBridge_3ph_RogersLake_115	3PH fault on High Bridge to Rogers Lake 115 kV line; Cleared at 6 cycles	B2	J320
0914_w_xel__c7__highbridge-5p475-stuck	SLG fault at High Bridge on High Bridge-Rogers Lake 115 kV; delayed clear High Bridge-Rogers Lake 115 kV	C7	J320
HighBridge_3ph_Shepard_115	3PH fault on High Bridge to Shepard 115 kV line; Cleared at 6 cycles	B2	J320
HighBridge_SLG_Shepard_115	SLG fault at High Bridge on High Bridge-Shepard 115 kV; delayed clear High Bridge-Shepard 115 kV	C7	J320
HighBridge_3ph_DaytonBluff_115	3PH fault on High Bridge to Dayton's Bluff 115 kV line; Cleared at 6 cycles	B2	J320
HighBridge_SLG_DaytonBluff_115	SLG fault at High Bridge on High Bridge-Dayton's Bluff 115 kV; delayed clear High Bridge-Dayton's Bluff 115 kV	C7	J320
Obrien_3ph_Lakefield_345	3PH fault on Obrien to Lakefield 345 kV line; Cleared at 4 cycles	B2	J285

Disturbance Name	Description	NERC Cat.	Area
Obrien_SLG_Lakefield_345	SLG fault at Obrien on Obrien-Lakefield 345 kV; delayed clear Obrien-Lakefield 345 kV	C7	J285
Obrien_3ph_KOS South_345	3PH fault on Obrien to Kossuth 345 kV line; Cleared at 4 cycles	B2	J285
Obrien_SLG_KOS South_345	SLG fault at Obrien on Obrien-Kossuth 345 kV; delayed clear Obrien-Kossuth 345 kV	C7	J285
Obrien_3ph_Highland_345	3PH fault on Obrien to Highland 345 kV line; Cleared at 4 cycles	B2	J285
Obrien_SLG_Highland_345	SLG fault at Obrien on Obrien-Highland 345 kV; delayed clear Obrien-Highland 345 kV	C7	J285
MCKSBRG_3ph_Creston_161	3PH fault on MCKSBRG to Creston 161 kV line; Cleared at 6 cycles	B2	J289
MCKSBRG_SLG_Creston_161	SLG fault at MCKSBRG on MCKSBRG-Creston 161 kV; delayed clear MCKSBRG-Creston 161 kV	C7	J289
MCKSBRG_3ph_Winterset_161	3PH fault on MCKSBRG to Winterset 161 kV line; Cleared at 6 cycles	B2	J289
MCKSBRG_SLG_Winterset_161	SLG fault at MCKSBRG on MCKSBRG-Winterset 161 kV; delayed clear MCKSBRG-Winterset 161 kV	C7	J289
Creston_3ph_Maryville_161	3PH fault on Creston to Maryville 161 kV line; Cleared at 6 cycles	B2	J343
Creston_SLG_Maryville_161	SLG fault at Creston on Creston-Maryville 161 kV; delayed clear Creston-Maryville 161 kV	C7	J343
Creston_3ph_Anita-Tap_161	3PH fault on Creston to Anita Tap 161 kV line; Cleared at 6 cycles	B2	J343
Creston_SLG_Anita-Tap_161	SLG fault at Creston on Creston-Anita Tap 161 kV; delayed clear Creston-Anita Tap 161 kV	C7	J343
Creston_3ph_MCKSBRG_161	3PH fault on Creston to MCKSBRG 161 kV line; Cleared at 6 cycles	B2	J343
Creston_SLG_MCKSBRG_161	SLG fault at Creston on Creston-MCKSBRG 161 kV; delayed clear Creston-MCKSBRG 161 kV	C7	J343
Creston_3ph_161-69-14_xfmr	3PH fault on Creston 161 kV side of 161-69-13.8 kV xfmr #1; Cleared at 6 cycles	B2	J343
Creston_SLG_161-69-14_xfmr	SLG fault on Creston 161 kV side of 161-69-13.8 kV xfmr #1; Delayed clear Creston 161-69-13.8 kV xfmr #1	C7	J343
J316_3ph_Tatanka-POI_230	3PH fault on J316 Sub to Tatanka POI 230 kV line; Cleared at 5 cycles	B2	J316
J316_SLG_Tatanka-POI_230	SLG fault at J316 Sub on J316 Sub-Tatanka POI 230 kV; delayed clear J316 Sub-Tatanka POI 230 kV	C7	J316
J316_3ph_Ellendale_230	3PH fault on J316 Sub to Ellendale 230 kV line; Cleared at 5 cycles	B2	J316

Disturbance Name	Description	NERC Cat.	Area
J316_SLG_Ellendale_230	SLG fault at J316 Sub on J316 Sub-Ellendale 230 kV; delayed clear J316 Sub-Ellendale 230 kV	C7	J316
J344_3ph_Poweshiek_161	3PH fault on J344 Sub to Poweshiek 161 kV line; Cleared at 6 cycles	B2	J344
J344_SLG_Poweshiek_161	SLG fault at J344 Sub on J344 Sub-Poweshiek 161 kV; delayed clear J344 Sub-Poweshiek 161 kV	C7	J344
J344_3ph_Beacon_161	3PH fault on J344 Sub to Beacon 161 kV line; Cleared at 6 cycles	B2	J344
J344_SLG_Beacon_161	SLG fault at J344 Sub on J344 Sub-Beacon 161 kV; delayed clear J344 Sub-Beacon 161 kV	C7	J344

Table 4-3: Generic Clearing Time Assumption

Voltage Level (kV)	Primary Clearing Time (cycle)	Backup Clearing Time (cycle)
345 kV	4	11
230 kV	5	13
161/138 kV	6	18
115 kV	6	20
69 kV	8	24

4.4 Performance Criteria

Stability simulation results are evaluated based on the following criteria:

- All on-line generating units are stable
- No unexpected generator tripping
- Post-fault transient voltage limits: 1.2 per unit maximum, 0.7 per unit minimum.
- Per local TOs's planning criteria, specific transient voltage limits are applied to specific buses, areas or companies that have different requirements.
- All machine rotor angle oscillations must be positively damped with a minimum damping ratio of 0.81633% for disturbances with a fault or 1.6766% for line trips without a fault.

4.5 Stability Results

The contingencies listed in Table 4-2 were simulated using the 2017 and 2024 study cases. If a transient stability criteria violation was identified, the same disturbance was repeated in the corresponding benchmark case.

Appendix G contains plots of generator rotor angles, generator power output, generator terminal voltages, bus voltages, and branch flows for each simulation. Simulations were

performed with a 2.0 seconds steady-state run followed by the appropriate disturbance. Simulations were run for a 10-second duration.

4.5.1 2017 Stability Analysis Results and Mitigations

Details of stability analysis results and mitigations for the 2017 scenario can be found in Appendix L.5.

4.5.2 2024 Stability Analysis Results

4.5.2.1 Tripping of Some Wind Farms by Frequency Protection

Several wind farms were tripped by their frequency protection during simulation of some 3PH disturbances (Table 4-4). These wind turbines used default protection settings shown in Table 4-5 (<56.5 Hz or >62.5 Hz with a 20 millisecond time delay).

During the simulation, frequency is calculated from the change in bus voltage angle. The spike in frequency during the simulation is due to the change in the bus voltage angle when the fault is applied. In reality, frequency will not change instantaneously during a fault. The simulation was repeated with the instantaneous frequency protection disabled. Aside from the frequency spike, frequency is around 60 Hz and the frequency protection will not operate. Also, no stability violations were identified with these disturbances.

Frequency protection operates due to frequency spikes that result from the method used to calculate instantaneous bus frequency in the simulation. In reality, frequency can not change instantaneously, so no mitigation plan is required by the West Area DPP projects for frequency protection operation.

Table 4-4: Tripping of Some Wind Farms by Frequency Protection

Disturbance Name	Description	2024 Results
0762_w_mec__c3__ia-ws4-1c3_at_cbec-fallow	3ph fault at Council Bluffs on Council Bluffs-Fallow 345 kV line; Prior outage of Rolling Hills-Madison Co 345 kV line	WTGs at bus 635102, 635104 and 635106 are tripped by frequency protection during the fault.
MCKSBRG_3ph_Creston_161	3PH fault on MCKSBRG to Creston 161 kV line; Cleared at 6 cycles	WTGs at bus 635648 (J289) is tripped by frequency protection during the fault.
MCKSBRG_3ph_Winterset_161	3PH fault on MCKSBRG to Winterset 161 kV line; Cleared at 6 cycles	WTGs at bus 635648 (J289) is tripped by frequency protection during the fault.

Table 4-5: Turbine Frequency Protection

Frequency	Time Limit
> 62.5 Hz	20 ms
< 56.5 Hz	20 ms

4.5.2.2 Instability of Big Stone Generator

Disturbance 'BigStone_BusDiff-Fault' is a 3PH fault at the Big Stone 230 kV bus with bus differential protection failure (fault was cleared after 96 cycles). Instability of the Big Stone generator was identified during the fault in both the study case and benchmark case (Table 4-6, Figure 4-1). If the out of step protection is modeled in the simulation, the Big Stone generator will be tripped by the out of step protection based on its actual relay settings. With tripping of the Big Stone generator, no other stability violations were identified with this disturbance.

No mitigation plan is required by the West Area DPP projects for instability of the Big Stone generator.

Table 4-6: Instability of Big Stone Generator

Disturbance Name	Description	NERC Cat.	2024 Results
BigStone_BusDiff-Fault	3PH fault at Big Stone 230 kV bus; Bus differential relay failure; Trip Big Stone-Browns Valley-Hankinson 230 kV, Big Stone-HWY12-Ortonville 230 kV at 26 cycles; Trip Big Stone-Blair 230 kV, Big Stone-Mariett-Burr 230 kV, Canby-Burr 230 kV, Big Stone xfmr, and clear the fault at 96 cycles	D4	Big Stone unit (620315) is unstable in both study and benchmark cases. No other stability violations are identified after Big Stone unit is tripped by out of step protection.

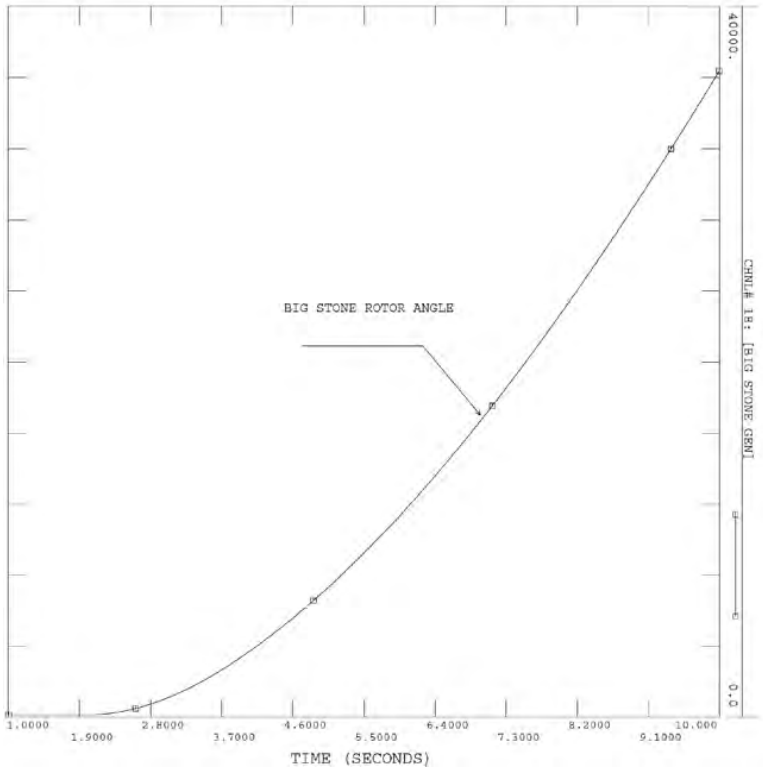


Figure 4-1: Instability of Big Stone Generator for Bus Differential Relay Failure Fault 'BigStone_BusDiff-Fault'

4.5.2.3 Tripping of J320 by Loss of Excitation Relay

Steam turbine generation unit (bus #: 600067) of combined cycle plant (J320 is 55 MW expansion) at High Bridge 115 kV substation was tripped by the Loss of Excitation (LOEX) relay during simulation of some 3PH disturbances (Table 4-7).

Table 4-7: Tripping of High Bridge Units by LOEX Relay

Disturbance Name	Description	2024 Results
0878_w_xel__b2__highbridge-merriumpark	3ph fault at High Bridge on High Bridge-Merrium Park 115 kV line; trip High Bridge-Merrium Park 115 kV line	Machine at bus 600067 (J320) is tripped by the loss of excitation Model. The LOEX model parameter may need to be reset. Also tripped in benchmark case.
HighBridge_3ph_Shepard_115	3PH fault on High Bridge to Shepard 115 kV line; Cleared at 6 cycles	Machine at bus 600067 (J320) is tripped by the loss of excitation Model. The LOEX model parameter may need to be reset. Also tripped in benchmark case.
HighBridge_3ph_DaytonBluff_115	3PH fault on High Bridge to Dayton's Bluff 115 kV line; Cleared at 6 cycles	Machine at bus 600067 (J320) is tripped by the loss of excitation Model. The LOEX model parameter may need to be reset. Also tripped in benchmark case.

Figure 4-2 shows the High Bridge steam turbine generator apparent impedance trajectory with the 3PH fault at High Bridge to Merrium Pak 115 kV line and post fault clearance ('0878_w_xel__b2__highbridge-merriumpark'). After the 3PH fault was cleared, the generator apparent impedance was still within the LOEX relay operational zone. This is the reason why the generator was tripped by the LOEX relay. Under the three 3PH faults listed in Table 4-7, the High Bridge steam turbine unit was also tripped in the benchmark case.

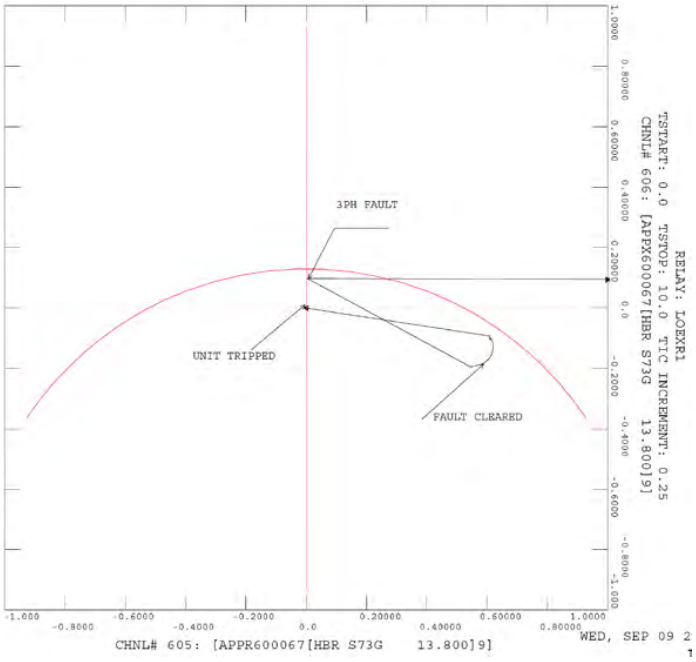


Figure 4-2: High Bridge Steam Turbine Unit (600067) Tripping by LOEX Relay for 3PH Fault '0878_w_xel__b2__highbridge-merriumpark'

Original parameters of the High Bridge steam turbine generator LOEX relay are listed in Table 4-8. A typical LOEX relay characteristic is shown in Figure 4-3[1]. Xcel Energy confirmed that the parameter D1 should be -1.27 (-(Xd'+R1)/2=-1.27) instead of -0.99.

With the High Bridge steam turbine generator LOEX relay set at the correct parameters, the disturbances in Table 4-7 were simulated again and no stability violations were identified.

Table 4-8: LOEX Relay Original Parameters for High Bridge Steam Turbine Generator

Parameter	Value	Note
T1, zone 1 operating time (cycles)	12.00	
R1, zone 1 reach (diameter in pu)	2.24	Generator Xd=2.24, Xd'=0.3
A1, zone 1 centerline angle (degrees)	90.00	
D1, zone 1 center distance (pu)	-0.99	

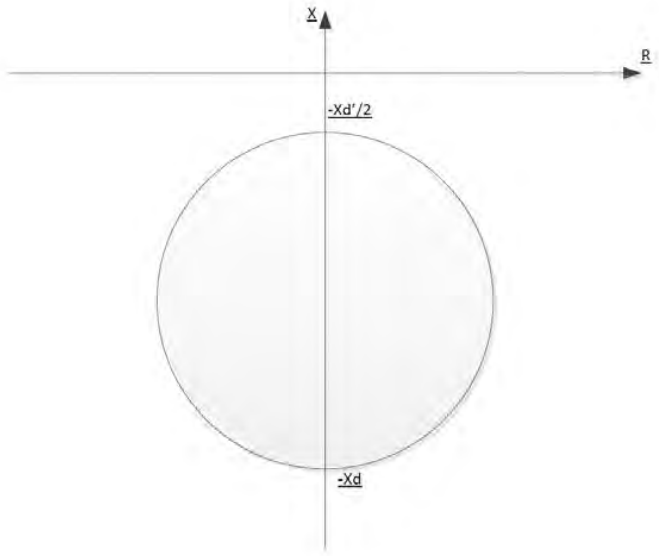


Figure 4-3: Typical LOEX Relay Characteristic

4.5.2.4 Tripping of J316 Wind Farm by Turbine High Voltage Protection

J316 wind farm was tripped by the turbine high voltage protection during post-fault period in simulation of some 3PH disturbances (Table 4-9). The J316 wind turbines are GE 1.7-100 Type 3 turbines with local (terminal) high voltage protection default settings shown in Table 4-10 (>1.15 pu with 0.1 second time delay).

[1] P.M. Anderson, “Power System Protection,” IEEE Press, 1999, pp. 736.

Table 4-9: Tripping of J316 Wind Farm by Turbine High Voltage Protection

Disturbance Name	Description	2024 Results
J316_3ph_Tatanka-POI_230	3PH fault on J316 Sub to Tatanka POI 230 kV line; Cleared at 5 cycles	J316 is tripped by the turbine high voltage protection (> 1.15 pu for over 0.1 second) after the fault is cleared.
J316_3ph_Ellendale_230	3PH fault on J316 Sub to Ellendale 230 kV line; Cleared at 5 cycles	J316 is tripped by the turbine high voltage protection (> 1.15 pu for over 0.1 second) after the fault is cleared.

Table 4-10: Turbine High Voltage Default Protection

Terminal Voltage	Time Limit (s)
>1.15 pu	0.1
1.1<V≤1.15 pu	1.0

Under the two 3PH fault disturbances listed in Table 4-9, the J316 terminal voltage is shown in Figure 4-4. The J316 terminal voltage is between 1.175 and 1.2 pu for more than 0.1 second but less than 0.12 second, so the turbine high voltage default protection (> 1.15 pu for over 0.1 second) trips the J316 wind farm.

It is verified[2] that the actual GE 1.7-100 type 3 turbine has the High Voltage Ride Through (HVRT) capability listed in Table 4-11. The actual turbine will not be tripped if the terminal voltage is between 1.175 and 1.2 pu for less than 0.2 second. The J316 terminal voltage is between 1.175 and 1.2 pu for less than 0.12 second under the disturbances in Table 4-9, therefore the J316 wind turbine will not be tripped under these two disturbances.

With the J316 turbine high voltage protection set at the correct value (Table 4-11), the disturbances in Table 4-9 were simulated again. J316 was not tripped, and no transient voltage violation or other stability violations were identified.

[2] "Technical Documentation Wind Turbine Generator Systems 1.x Series - 50 Hz and 60 Hz," GE Power & Water, 2014.

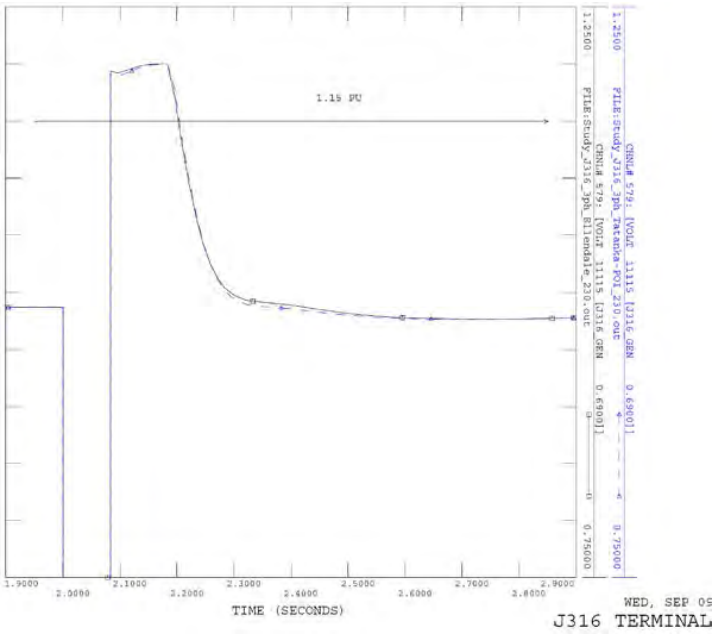


Figure 4-4: J316 Terminal Voltage under Two Disturbances in Table 4-9

Note 1: Voltage with black trace is J316 terminal voltage under the disturbance 'J316_3ph_Ellendale_230'.

Note 2: Voltage with blue trace is J316 terminal voltage under the disturbance 'J316_3ph_Tatanka-POI_230'.

Table 4-11: GE 1.7-100 Turbine High Voltage Ride Through (HVRT) Capability

	Time (s)
Dynamic Voltage Range (%)	**HVRT**
100 – 110	Continuous
110 – 115	1
115 – 117.5	0.5
117.5 – 120	0.2
120 - 130	0.1

4.6 Network Upgrades Identified in Stability Analysis for 2024 Scenario

No additional Network Upgrades are required in stability analysis for the 2024 scenario.

Section
5

MWEX Voltage Stability Study

ATC performed steady state voltage stability analysis. The results show that both the Pre-DPP and Post-DPP scenarios in the 2024 shoulder load cases are voltage stable. There are no violations of ATC criteria in either the Pre or Post DPP cases. No network upgrades will be assigned to the interconnection customers.

The MWEX voltage stability study details can be found in Appendix H.

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Section
6

Short Circuit Analysis

6.1 Introduction

MISO and several transmission owning companies performed short circuit analysis for the West Area DPP generation projects.

6.2 J285 Short Circuit Facilities Study Performed by MEC

The J285 short circuit facilities study was performed by MEC. Based on the Transmission Owner's short circuit criteria, interconnection of the J285 generation project does not cause any Transmission Owner short circuit constraints. The applicable short circuit bus results were shared with other potentially impacted transmission owners if the modeled change in fault current was greater than 100 Amps, and no short circuit constraints were identified.

Study details can be found in Appendix I.1.

6.3 J289 Short Circuit Facilities Study Performed by MEC

The J289 short circuit facilities study was performed by MEC. Based on the Transmission Owner's short circuit criteria, interconnection of the J289 generation project does not cause any Transmission Owner short circuit constraints. The applicable short circuit bus results were shared with other potentially impacted transmission owners if the modeled change in fault current was greater than 100 Amps, and no short circuit constraints were identified.

Study details can be found in Appendix I.2.

6.4 J316 Short Circuit Facilities Study

The J316 short circuit facilities study was performed by Siemens PTI. Based on the Transmission Owner's short circuit criteria, interconnection of the J316 generation project does not cause any Transmission Owner short circuit constraints. The applicable short circuit bus results were shared with other potentially impacted transmission owners if the modeled change in fault current was greater than 100 Amps, and no short circuit constraints were identified.

Study details can be found in Appendix I.3.

6.5 J320 Short Circuit Facilities Study

Generation project J320 is a 55 MW expansion of the existing combined cycle power plant at High Bridge substation in Xcel Energy. The short circuit facilities study is not required.

6.6 J329 Short Circuit Facilities Study Performed by MEC

The J329 short circuit facilities study was performed by MEC. Based on the Transmission Owner's short circuit criteria, interconnection of the J329 generation project does not cause any Transmission Owner short circuit constraints. The applicable short circuit bus results were shared with other potentially impacted transmission owners if the modeled change in fault current was greater than 100 Amps, and no short circuit constraints were identified.

Study details can be found in Appendix I.4.

6.7 J343 Short Circuit Facilities Study Performed by MEC

The J343 short circuit facilities study was performed by MEC. Based on the Transmission Owner's short circuit criteria, interconnection of the J343 generation project does not cause any Transmission Owner short circuit constraints. The applicable short circuit bus results were shared with other potentially impacted transmission owners if the modeled change in fault current was greater than 100 Amps, and no short circuit constraints were identified.

Study details can be found in Appendix I.5.

6.8 J344 Short Circuit Facilities Studies Performed by MEC & ITCM

The J344 short circuit facilities study was performed by MEC and ITCM.

Based on the MidAmerican's short circuit criteria, interconnection of the J344 generation project does not cause any MidAmerican's short circuit constraints. The applicable short circuit bus results were shared with ITC Midwest.

ITCM evaluated the impacts of expected fault current from the J344 generation project based on CAPE modeling of the 169 MW wind generation. No ITCM upgrades were required to accommodate the expected fault current from project J344. A summary of the impact and breakers' ratings at ITCM's Poweshiek County substation are provided below:

- Existing Fault Current: 3PH: 8821.9 A; SLG: 6686.3 A
- Expected Fault Current w/ J344: 3PH: 9564.4 A; SLG: 8339.4 A

Poweshiek Co Breaker #	IR (kA)
1060, 1072, 872, 972	40
176, 177	40
272	20
172, 372	19

Study details can be found in Appendix I.6.

Section
7

Deliverability Study

7.1 Project Description

Interconnection requests requesting Network Resource Interconnection Services (NRIS) were considered for deliverability analysis.

7.2 Introduction

Generator interconnection projects have to pass Generator Deliverability Study to be granted Network Resource Interconnection Services (NRIS).

If the generator is determined as not fully deliverable, the customer can choose either to change his project to an Energy Resource (ER) project or proceed with the system upgrades that will make the generator fully deliverable.

Generator Deliverability Study ensures that the Network Resources, on an aggregate basis, can meet the MISO aggregate load requirements during system peak condition without getting bottled up. The wind generators are tested at 100 % of their maximum output level which then can be used to meet Resource Adequacy obligations, under Module E, of the Midwest ISO Transmission and Energy Market Tariff (TEMT).

7.3 Study Methodology

MISO Generator Deliverability Study whitepaper describing the algorithm can be found at "https://www.misoenergy.org/Library/Repository/Study/Generator%20Interconnection/Generator%20Deliverability%20Study%20Methodology.pdf".

7.4 Determining the MW restriction

If one facility is overloaded based on the assessed "severe yet credible dispatch" scenario described in the study methodology, and the generator under study is in the "Top 30 DF List" (see white paper for detail), part or all of its output is not deliverable. The restricted MW is calculated as following:

(MW restricted) = (worst loading – MW rating) / (generator sensitivity factor)

If the result is larger than the maximum output of the generator, 100% of this generator's output is not deliverable.

The generator is also responsible for any NEW base case (pre-shift) overload or NEW "severe yet credible dispatch overload" where the generator is not in the "Top 30 DF List", if the generator's DF is greater than 5%. Please see white paper for detail. The formula above also applies to these situations.

7.5 Study Result

7.5.1 2017 Deliverability Study Results

Details of deliverability study results for the 2017 scenario can be found in Appendix L.

7.5.2 2024 Deliverability Study Results

7.5.2.1 J285

J285 Deliverable (NRIS) Amount in Outyear Case: (Conditional on ERIS upgrades and case assumptions)	**250 MW (100%)**

7.5.2.2 J289

J289 Deliverable (NRIS) Amount in Outyear Case: (Conditional on ERIS upgrades and case assumptions)	**20 MW (100%)**

7.5.2.3 J316

J316 Deliverable (NRIS) Amount in Outyear Case: (Conditional on ERIS upgrades and case assumptions)	**0 MW (0%)**						
Next Upgrade for Higher NRIS Level (cumulative) (i.e. All upgrades must be made for 100% NRIS)	**Level of Service Attainable**	**Distribution Factor**	**Constraint in ERIS Analysis?**	**Projects Associated With ERIS Constraint**	**Projects Associated With NRIS Constraint**	**Upgrade Cost Allocated to Project**	**Total Cost of Upgrade**
Mandan–Ward 230 kV	25.1 MW (16.7%)	11.15%	No		J316	$7,000,000	$7,000,000
J316 Sub-Ellendale 230 kV	43.1 MW (28.7%)	74.53%	Yes	J316	J316	$12,000,000	$12,000,000
Heskett–Mandan 115 kV	98.5 MW (65.7%)	13.99%	No		J316	$125,000	$125,000
Merricourt–Ellendale 230 kV	129.0 MW (86.0%)	65.60%	No		J316	$15,000,000	$15,000,000
Mandan–Ward 230 kV	150.0 MW (100.0%)	9.91%	No		J316	$7,000,000	$7,000,000

7.5.2.4 J329

J329 Deliverable (NRIS) Amount in Outyear Case: (Conditional on ERIS upgrades and case assumptions)	**55 MW (100%)**

7.5.2.5 J343

J343 Deliverable (NRIS) Amount in Outyear Case: (Conditional on ERIS upgrades and case assumptions)	**150 MW (100%)**

7.5.2.6 J344

J344 Deliverable (NRIS) Amount in Outyear Case: (Conditional on ERIS upgrades and case assumptions)	**169 MW (100%)**

7.5.2.7 J382

J382 Deliverable (NRIS) Amount in Outyear Case: (Conditional on ERIS upgrades and case assumptions)	**48.3 MW (100%)**

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Section
8

Shared Network Upgrades Analysis

MISO performed the Shared Network Upgrade (SNU) test for Network Upgrades driven by higher queued interconnection project.

Generation projects J289 and J344 are the only two projects to have the SNUs. These Network Upgrades were originally identified in the MISO 2013 August West Area DPP restudy which are listed below:

- J274 POI-Creston 161 kV ($175,000)
- Jasper-Newton 161 kV ($50,000)

The maximum MW impacts from the generation projects J289 and J344 are listed in Table 8-1. Shared Network Upgrade (SNU) cost allocations are listed in Table 8-2.

Table 8-1: Maximum MW Impact of J289 and J344 on the SNUs

Network Upgrades	PTDF	MW Impact	Reason for Sharing	Original Driver for the Project	DPP-2014-AUG-West Projects sharing
J274 POI-Creston 161 kV	0.47416	9.4832	PTDF >20%; MW Impact >5 MW and MW Impact >1% of the Facility Rating	J274	J289
Jasper-Newton 161 kV	0.1331	22.4939	PTDF <=20%; MW Impact >5 MW and MW Impact >5% of the Facility Rating	J233	J344

Table 8-2: SNU Cost Allocation

Network Upgrades	Original Driver for the Project	Total Network Upgrade Cost	J289 Cost Responsibility	J344 Cost Responsibility
J274 POI-Creston 161 kV	J274	$175,000	$32,953	$0
Jasper-Newton 161 kV	J233	$50,000	$0	$8,771

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Section
9

Cost Allocation

The cost allocation of Network Upgrades for the study group reflects responsibilities for mitigating system impacts based on Interconnection Customer-elected level of Network Resource Interconnection service as of the draft System Impact Study report date.

9.1 Cost Assumptions for Network Upgrades

The cost estimate for each thermal network upgrade was provided by the corresponding transmission owning company. The cost estimate for reactive support network upgrades (shunt capacitors) is based on assumptions used in previous MISO facility studies, and costs of previous similar projects. Table 9-1 summarizes all the cost assumptions used for shunt capacitors in the calculation of network upgrade costs.

Table 9-1: Shunt Capacitor Cost Assumptions

Shunt Capacitor	Fixed Cost ($)	Variable Cost ($)
69/115 kV Shunt Capacitor	$100K	$6.77K/Mvar
161/230 kV Shunt Capacitor	$400K	$6.77K/Mvar
345 kV Shunt Capacitor	$1,650K	$6.77K/Mvar

9.2 ERIS Network Upgrades Proposed for DPP West Area Projects

Network upgrades for Energy Resource Interconnection Service (ERIS) were identified in the MISO ERIS analysis and the affected system analysis. The network upgrades include reactive support network upgrades, thermal network upgrades identified in the MISO steady-state analysis, thermal network upgrades identified in the affected system analysis, reactive support network upgrades identified in the MISO voltage stability analysis, and stability network upgrades identified in the MISO transient stability analysis. The total costs of network upgrades for the 2017 scenario and the 2024 scenario are summarized in Table 9-2.

Table 9-2: Summary of ERIS Network Upgrades

Category of Network Upgrades	2017 Cost ($)	2024 Cost ($)
Network Upgrades Identified in MISO Steady-State Analysis	$8,185,000	$12,920,000
Network Upgrades Identified in Voltage Stability analysis	$0	$0
Network Upgrades Identified in Transient Stability Analysis	$0	$0
Additional Network Upgrades Identified in Affected System Analysis	$0[1]	$0

Category of Network Upgrades	2017 Cost ($)	2024 Cost ($)
Shared Network Upgrades	$41,724	$41,724
Total	**$8,226,724**	**$12,961,724**

Note 1: Assuming two projects J285 and J344 can wait until PJM baseline upgrades B2692.1 & B2692.2 are placed into service by summer 2019.

ERIS network upgrades for the 2017 scenario and the 2024 scenario are listed in the following sections.

9.2.1 ERIS Network Upgrades for 2017 Scenario

Details of ERIS network upgrades for the 2017 scenario can be found in Appendix L.7.1

9.2.2 ERIS Network Upgrades for 2024 Scenario

Table 9-3: Network Upgrades in MISO Steady-State Analysis for 2024 Scenario

Constraint	Mitigation	Owner	Cost ($)
J316 Sub-Ellendale 230 kV	Rebuild line with 795 ACSS conductor	MDU	$12,000,000
J344 Sub-Beacon 161 kV	MEC - Beacon terminal requires replacement of line drops to achieve an acceptable Ring Closed rating: $25k; ITCM - Planning level estimate of $300k for sag mitigation	MEC ITCM	$325,000
Maryville-Clarinda 161 kV	MidAmerican's section is clearance and terminal limited. Structure replacements and terminal equipment replacements with an estimated cost of $225k would provide a rating of 199 MVA for MidAmerican's section.	MEC GMO	$225,000
Wincor-Wincor Muncipal 69 kV	CIPCO - Approx. 1 mile of 3/0 ACSR will need to be rebuilt	CIPCO	$300,000
Clarinda-Brooks 161 kV	MidAmerican's rating is clearance limited. Structure replacements with an estimated cost of $70k would provide a rating of 167 MVA limited by terminal equipment.	MEC	$70,000

Table 9-4: Additional MAPP Network Upgrades for 2024 Scenario

Constraint	Mitigation	Owner	Cost ($)
Twin Church-Sioux City 230 kV	Constraint was identified in DPP 2012 Aug study. Build a second 25 miles line with sub expansion (NPPD owned, $30M). MAPP (WAPA) portion of the upgrade cost is $0	WAPA NPPD	$0

Table 9-5: PJM Network Upgrades for 2024 Scenario

Constraint	Mitigation	Owner	Cost ($)
No Constraints			$0

Table 9-6: SPP Network Upgrades for 2024 Scenario

Constraint	Mitigation	Owner	DPP Cost ($)
No Constraints			$0

Table 9-7: Network Upgrades in Voltage Stability Analysis for 2024 Scenario

Constraint	Owner	Mitigation	Cost ($)
No Constraints			$0

Table 9-8: Additional Network Upgrades in Transient Stability Analysis for 2024 Scenario

Constraint	Owner	Mitigation	Cost ($)
No Constraints			$0

Table 9-9: Shared Network Upgrades for 2024 Scenario

Network Upgrades	Original Driver for the Project	Total Network Upgrade Cost	J289 Cost Responsibility	J344 Cost Responsibility
J274 POI-Creston 161 kV	J274	$175,000	$32,953	$0
Jasper-Newton 161 kV	J233	$50,000	$0	$8,771

9.3 Cost Allocation Methodology

The costs of Network Upgrades (NU) for a set of generation projects (one or more sub-groups or entire group with identified NU) are allocated based on the MW impact from each project on the constrained facilities in the Post Case. For constraints identified in the shoulder peak scenario, the MW impact is calculated using the shoulder peak post-DPP case. The MW impact on constraints identified only in the summer peak scenario is calculated using the summer peak post-DPP case. With all Group Study generation projects dispatched in the Post Case, all thermal and voltage constraints will be identified and a distribution factor from each project on each constraint will be obtained.

Constraints which are mitigated by one or a subset of NU are identified. The MW contribution on these constraints from each generating facility is calculated in the Post Case without any network upgrades. Then the cost of each NU is allocated based on the pro rata share of the MW contribution from each generating facility on the constraints mitigated or partly mitigated by this NU. The methodology to determine the cost allocation of NU is:

$$\text{Project A cost portion of NU} = \text{Cost of NU} \times \left(\frac{Max(Proj.A \text{ MW } contribution \text{ on constraint})}{\sum_i Max(Proj.i \text{ MW } contribution \text{ on constraint})} \right)$$

9.4 Cost Allocation

The cost allocation of Network Upgrades for the study group reflects responsibilities for mitigating system impacts based on Interconnection Customer-elected level of Network Resource Interconnection service as of the draft System Impact Study report date.

The Distribution Factor (DF) from each generating facility is calculated on the constraints identified in the steady-state analysis in the Post Case without any network upgrades. For a reactive support network upgrade, DFs are calculated under the most critical contingency (King-Eau Claire-Arpin contingency in most cases) on all branches (proxy branches for reactive support network upgrade) connecting to the high voltage side of the transformer, where the reactive support network upgrade is located in the same substation.

For each constraint, the maximum MW contribution (increasing flow) from each generating facility is calculated. MW contribution from one generating facility is set as zero if the MW contribution is less than 1 MW, or the constraint is not categorized as MISO ERIS constraint or affected system constraint for that specific generating facility. For a reactive support network upgrade, the generators in same local area with positive MW impact will be responsible for mitigating the voltage violations.

The calculated DF results and the MW contribution on each constraint are in Appendix J.1 for the 2017 scenario and Appendix K.1 for the 2024 scenario.

Finally, the cost allocation for each NU is calculated based on the MW contribution of each generating facility, as detailed in Appendix J.2 for the 2017 scenario and Appendix K.2 for the 2024 scenario.

Assuming all generating facilities in the DPP 2014 August West Area group advance, a summary of the costs for total NUs (NUs for ERIS, NRIS, and Interconnection Facilities) allocated to each generating facility is listed in Table 9-10 for the 2024 scenario.

Table 9-10: Summary of Total NU Costs Allocated to Each Generation Project for 2024 Scenario

Project	Max Output (MW)	Total Cost of NU per Project ($)	$/MW	Share %
J285	250	$2,844,000	$11,376	5.08%
J289	20	$3,637,953	$181,898	6.50%
J316	150	$40,051,800	$267,012	71.53%
J320	55	$0	$0	0.00%

Project	Max Output (MW)	Total Cost of NU per Project ($)	$/MW	Share %
J329	55	$1,054,450	$19,172	1.88%
J343	150	$2,835,000	$18,900	5.06%
J344	169	$5,571,311	$32,966	9.95%
J382	48.3	$0	$0	0.00%
Total/Average	**897.3**	**$55,994,514**	**$66,415**	**100.00%**

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Appendix

A

Model Development for Steady-State and Stability Analysis

A.1 DPP 2014 August Generation Projects

Table A-1: DPP 2014 August West Area Projects

MISO Project Num	State	County	Transmission Owner	Point Of Interconnection	Max Output	Fuel Type	Service Type
J285	IA	O'Brien	MEC	O'Brien County 345 kV sub	250	Wind	NR
J289	IA	Madison	MEC	Winterset Junction-Creston 161 kV	20	Wind	NR
J316	ND	Dickey	MDU	Tatanka-Ellendale 230 kV	150	Wind	NR
J320	MN	Ramsey	Xcel	High Bridge 115 kV sub	0/55	CC	ER
J329	IA	Marion	MEC	Pella West Sub	55	Hydro	NR
J343	IA	Adams	MEC	Creston-Clarinda 161 kV	150	Wind	NR
J344	IA	Mahaska	ITCM	Poweshiek-Oskaloosa 161 kV	169	Wind	NR
J382	WI	Cambridge	ATC	Cambridge	48.3	Gas	NRIS Only

Table A-2: Dynamic Modeling for DPP West Area Projects

MISO Project #	Dynamic Modeling
J285	140 GE 1.79 MW turbines
J289	9 Siemens SWT4 DD 2M3-2.346-108 turbines
J316	89 GE 1.7 MW turbines
J320	GENROE, AC8B, GAST/IEEEG1, PSS2B
J329	GENSAL, ST6B, HYGOV, PSS2B
J343	64 Siemens SWT4 DD 2M3-2.346-108 turbines
J344	72 Siemens SWT4 DD 2M3-2.346-108 turbines

Table A-3: DPP 2014 August Central Area Projects

MISO Project Num	State	County	Transmission Owner	Point Of Interconnection	Max Output	Fuel Type	Service Type
J332	IN	Posey	Vectren	Point 138 kV sub	83	Gas	ER
J339	IL	Ford	AMIL	Gibson City South sub	68/96	Gas	NRIS Only
J371	IL	Ogle	ComEd	Byron sub	2300	Nuclear	External NRIS

MISO Project Num	State	County	Transmission Owner	Point Of Interconnection	Max Output	Fuel Type	Service Type
J372	IL	Rock Island	ComEd	Quad Cities sub	1364.3	Nuclear	External NRIS
J374	PA	Bucks	PECO	Fairless Hills plant	30	Landfill Gas	External NRIS

Table A-4: DPP 2014 August East Area Projects

MISO Project Num	State	County	Transmission Owner	Point Of Interconnection	Max Output	Fuel Type	Service Type
J325	MI	Huron	ITC	Minden sub	4	Wind	ER
J327	MI	Huron	ITC	Raphson 120 kV sub	150	Wind	NR
J340	MI	Huron	ITC	Cosmo-Bad Axe 120 kV	100	Wind	NR
J354	MI	Huron	ITC	Grassmere	52	Wind	NR

Table A-5: DPP 2014 August South Area Projects

MISO Project Num	State	County	Transmission Owner	Point Of Interconnection	Max Output	Fuel Type	Service Type
J348	AR	Arkansas	Entergy	Stuttgart Rcuskey-Almyra 115 kV line	81	PV	NR

A.2 DPP 2014 February Generation Projects

Table A-6: DPP 2014 February West Area Projects

MISO Project Num	State	County	Transmission Owner	Point Of Interconnection	Max Output	Fuel Type	Service Type
J292	Manitoba		MH	Limestone, Long Spruce and Kettle Generating Station	3576	Hydro	External NRIS
J303	MN	Murray	XEL	Hadley 69 kV sub	20	Solar	NR
J309	MN	Yellow Medicine	XEL	Wood Lake-Minn Valley 69 kV	20	Solar	NR

Table A-7: DPP Central and East Areas Projects

MISO Project Num	State	County	Transmission Owner	Point Of Interconnection	Max Output	Fuel Type	Service Type
J246	MI	Gratiot	METC	Slate 345 kV sub	7	Wind	NR
J276	IL	Iroquois	AMIL	Sheldon South	150	Wind	NRIS Only
J293	MI	Outagamie	ATC	Fox River 345 kV sub	475	CC	NR

A.3 DPP 2013 August Generation Projects

Table A-8: DPP 2013 August West Area Projects

MISO Project Num	State	County	Transmission Owner	Point Of Interconnection	Max Output	Fuel Type	Service Type
J233	IA	Marshall	ITCM	Marshalltown 161 kV sub	635 (Sum); 700 (Win)	Gas	NR
J274	IA	Madison	MEC	Winterset. - Creston 161 kV (50%)	100	Wind	NR
J278	MN	Mower	XEL	Pleasant Valley 161 kV sub	200	Wind	NR
J279	IA	Woodbury	MEC	Raun 345 kV sub	30	Coal	NR
J288	MN	Kandiyohi & Meeker	XEL	Atwater - Grove City 69kV (0.8 miles north of GRE Atwater Sub)	40	Wind	NR
J290	XEL	Rolette	XEL	Rugby – Glenboro 230 kV (50%)	150	Wind	NR

Table A-9: DPP Central and East Areas Projects

MISO Project Num	State	County	Transmission Owner	Point Of Interconnection	Max Output	Fuel Type	Service Type
G997	MI	Huron	ITCT	Wyatt - Harbor Beach 120kV	50	Wind	NR

A.4 DPP 2013 February Generation Projects

Table A-10: DPP 2013 February West Area Projects

MISO Project Num	State	County	Transmission Owner	Point Of Interconnection	Max Output	Fuel Type	Service Type
J262	ND	Stutsman	OTP	Jamestown 345/115 kV sub	100	Wind	NR
J263	ND	Stutsman	OTP	Jamestown 345/115 kV sub	100	Wind	NR
G858	MN	Stearns	XEL	Black Oak 69 kV sub	38	Wind	NR
H071	MN	Stearns	XEL	Black Oak 69 kV sub	40	Wind	NR

Table A-11: DPP Central and East Areas Projects

MISO Project Num	State	County	Transmission Owner	Point Of Interconnection	Max Output	Fuel Type	Service Type
J256	IN	Marshall	NIPS	NE corner of Marshall St & Michigan Rd, Argos	8	Gas	ER
J201	MI	Bay	METC	METC Manning 138 kV sub	20	Wind	NR

A.5 DPP 2012 August Generation Projects

Table A-12: DPP 2012 August West Area Projects

MISO Project Num	State	County	Transmission Owner	Point Of Interconnection	Max Output	Fuel Type	Service Type
G735	IA	Hancock	ITCM	Lime Creek Substation	200	Wind	ER
G798	IA	Story	ITCM	Fernald substation via a radial 9 mile 115 kV gen-tie line	150	Wind	NR
G826	MN	Jackson	XEL	Lakefield Generation SW - Lakefield JCT 345kV	200	Wind	NR
G830	ND	McHenry	GRE	McHenry substation	99	Wind	NR
G870	MN	Freeborn	ITCM	Hayward-Winnebago 161KV (11 miles west of Hayward and 38 miles east of Winnebago)	201	Wind	NR
G947	IA	Franklin	ITCM	Switchyard for G573,4,5 near Iowa Falls Ind Substn	99	Wind	NR
H008	IA	Fayette	ITCM	69 kV Richfield sub	36	Wind	NR
H009	IA	Tama	ITCM	161kV line between Traer and Marshalltown	150	Wind	ER
H021	IA	Grundy	ITCM	Wellsburg substation 115 kV bus	138.6	Wind	NR
H081	MN	Lyon	XEL	Brookings County - Lyon County 345kV	201	Wind	ER
H096	IA	Greene	ITCM	Newly built 161kV substation south of Grand Junction on Grand Jct. - Perry 161 kV	50	Wind	NR
J091	IA	Hancock	ITCM	161 kV Lime Creek substation	66	Wind	NR
J112	MN	Winona	ITCM	69 KV line southwest corner of section 11, Utica Township	4.95	Wind	ER
J171	MN	Swift	GRE	Benson 115 kV substation	7	Biomass	NR
J183[1]	MN	Rock	XEL	Split Rock Substation	200	Wind	ER
J191	IA	Cass	MEC	Rolling Hills 345 kV Substation	101.2	Wind	NR
J200	ND	Morton	MDU	RM Heskett Station 115 kV & 41.6 kV	75/99	Gas	NR
J249[2]	ND	Dickey	MDU	Tatanka 230 kV Substation	180	Existing Wind	NRIS Only
R42	IA	Webster	MEC	345 kV Lehigh Substation	250	Wind	NR

MISO Project Num	State	County	Transmission Owner	Point Of Interconnection	Max Output	Fuel Type	Service Type
R49	IA	Pomeroy	MEC	Pomeroy Generating station	12	Wind	NR
R65	IA	Cass	MEC	R34 Expansion	92	Wind	NR

Note 1: J183 request for Net Zero Interconnection Service (NZIS)

Note 2: J249 requests for NRIS for the existing MISO project G132

Table A-13: DPP Central Area Projects

MISO Project Num	State	County	Transmission Owner	Point Of Interconnection	Max Output	Fuel Type	Service Type
J232	IL	Randolph	AMRN	Baldwin Substation	35	Coal	NR
J238	IN	Morgan	IPL	Eagle Valley 138 kV Substation	725	CC	NR

Table A-14: DPP East Area Projects

MISO Project Num	State	County	Transmission Owner	Point Of Interconnection	Max Output	Fuel Type	Service Type
J075	MI	Huron	ITCT	Bauer-Rapson 345 kV	150	Wind	NR
J161	MI	Tuscola	ITCT	Bauer-Rapson 345 kV	155	Wind	NR
J202	MI	Tuscola	ITCT	Atlanta-Tuscola 115 kV	101	Wind	NR
J226	MI	Mason	METC	Ludington Substation	70	Hydro	NR
J227	MI	Mason	METC	Ludington Substation	70	Hydro	NR
J228	MI	Mason	METC	Ludington Substation	70	Hydro	NR
J229	MI	Mason	METC	Ludington Substation	70	Hydro	NR
J230	MI	Mason	METC	Ludington Substation	70	Hydro	NR
J231	MI	Mason	METC	Ludington Substation	70	Hydro	NR
J235	MI	Huron	ITCT	Bauer-Rapson 345 kV	110	Wind	NR
J241	WI	Florence	ATC	Twin Falls Substation	3.7	Hydro	NR

A.6 Network Upgrades Identified in DPP 2012 August West Area Restudy

Table A-15: NUs Identified in MISO Analysis

Constraint	Owner
Boone Jct-Fort Dodge 161 kV	MEC CIPCO
Dinsdale-Traer Tap 69 kV	ITCM
Hawkeye Tap-Richfield 69 kV	ITCM
Hawkeye Tap-Windsor 69 kV	ITCM
Hayward-Freeborn 161 kV	ITCM
Huntley-Freeborn 161 kV	ITCM
Jasper-Aurora 69 kV	ITCM
Traer-Traer Tap 69 kV	ITCM
Wellsburg 161-69 kV Transformer	ITCM
Voltage violations in area of Blackhawk	MEC

Table A-16: Additional NUs Identified in Affected System Analysis

Constraint	Owner
Lawrence-Sioux Falls 115 kV	XEL WAPA
Mt Vernon-Wyoming 161 kV	CIPCO
Liberty-Dundee 161 kV	CIPCO
Twin Church-Sioux City 230 kV	WAPA NPPD
Fargo 230-115-13.2 kV xfmr #2	WAPA

A.7 Network Upgrades Identified in DPP 2013 February West Area Restudy

Table A-17: NUs Identified in MISO Analysis

Constraint	Owner
Sheyenne-Mapleton 115 kV	XEL OTP
East Melrose-Melrose Muni 69 kV	XEL
East Melrose-Millwood Tap 69 kV	XEL
Black Oak-Melrose Muni 69 kV	XEL
Jamestown 345-115 kV #1	OTP
Jamestown 345-115 kV #2	OTP

Table A-18: Additional NUs Identified in Affected System Analysis

Constraint	Owner
Buffalo-Bison 345 kV	MPC
Jamestown-Buffalo 345 kV	MPC

A.8 Network Upgrades Identified in DPP 2013 August West Area Restudy

Table A-19: NUs Identified in MISO Analysis

Constraint	Owner
J274 POI-Creston 161 kV	MEC WAPA
Litchfield Tap–Litchfield 69 kV	GRE
Lake Lilian–Cosmo Tap 69 kV	XEL
Lake Lilian–Melville Tap 69 kV	XEL
Panther–Melville Tap 69 kV	XEL
Rugby OTP-Rugby Tap 115 kV	BEPC CPEC WAPA
Rugby 230-115-13.8 kV xfmr	OTP
Jasper 161-69 kV xfmr	ITCM
Newton 161-69 kV xfmr	ITCM
Newton-Colfax 69 kV	MEC ITCM
Aurora-Maytag 69 kV	ITCM
Patterson REC-Winterset 69 kV	CIPCO
Winterset 161-69 kV xfmr	CIPCO
Marshalltown-Blairstown 115 kV	ITCM
Jasper–Newton 161 kV	ITCM
Jasper-Laurel 161 kV	ITCM
Hazleton-Mitchell Co 345 kV	ITCM MEC
Raun-Tekamah 161 kV	MEC OPPD NPPD
Rugby-Rugby Tap 115 kV	BEPC CPEC WAPA
Voltage constraints in area of Blackhawk	MEC

Table A-20: Additional NUs Identified in Affected System Analysis

Constraint	Owner
N Summit Lake - S Summit Lake 69 kV	CIPCO
Ward-Mandan 230 kV	WAPA MDU
Richer-Roseau 230 kV series compensation[1]	MPC
G82R dc reduction scheme and OOS relay revision	MH
Letellier Station L20D Equipment	MH
Drayton Station L20D Equipment	MH
Quad Cities-MEC Cordova 345 kV	PJM

Note 1: Richer-Roseau 230 kV line is NRIS only constraint.

A.9 PJM Generation Projects and NUs Modeled

Table A-21: PJM Generation Projects Modeled

PJM Queue #	Project Name	County, State	Pmax (MW)	Fuel Type	MISO SH Output	MISO SPK Output
Q39	Kewanee 138kV	Henry, IL	105	wind	105	21
Q49	Dresden 345kV	Grundy, IL	957	nuclear	45	45
Q50	Dresden 345kV	Grundy, IL	957	nuclear	58	58
Q51	Quad City 345kV	Rock Island, IL	2028	nuclear	30	30
Q57	Steward-Waterman 138kV	Lee, IL	240	wind	22	4.4
R16	Lena 138kV	Stephenson, IL	126	wind	126	25.2
R30	Pontiac Mid-Point 345kV	Livingston, IL	500	wind	500	100
R33	Nelson 345kV	Unknown, IL	600	natural gas	0	600
S27	Blue Mound I	McLean, IL	198	wind	198	39.6
S28	Blue Mound II	McLean, IL	198	wind	198	39.6
S36	Kankakee 138kV	Kankakee, IL	175	wind	175	35
S37	Kankakee 138kV	Kankakee, IL	175	wind	175	35
S55	Zion 345kV	Lake, IL	780	natural gas	0	510
S57		IL	3500	HVDC	3500	1192
U1-054	Calumet	Cook, IL	327	natural gas	0	54
U3-031	Lincoln Generating Facility	Will, IL	616	natural gas	0	40
U4-033	University Park North	Will, IL	540	natural gas	0	36
05MLCS	Meadow Lake	IL	600	wind	600	120
Q01, Q03	Fowler Ridge		750	wind	750	150
T130	Convoy – East Lima 345kV	OH	300	wind	300	60
T131	Lincoln – Sterling 138kV	OH	150	wind	150	30
T142	Southwest Lima – Marysville 345kV	OH	300	wind	300	60
T143	Hennepin 138kV	IL	250	wind	250	50
T148	Caledonia Wind II 100 MW	IL	100	wind	100	20
T94	Cook – Palesades 345kV	MI	1035	natural gas	0	1035
T99	Caledonia Wind 100 MW	IL	100	wind	100	20
U2-028A_AT1	Ironville 138kV	OH	135	other	135	135
U2-072	East Lima – Marysville 345kV	OH	300	wind	300	60
U3-021	Silver Lake – Cherry Valley 345kV	IL	100	natural gas	0	100

PJM Queue #	Project Name	County, State	Pmax (MW)	Fuel Type	MISO SH Output	MISO SPK Output
U4-027	Normandy-Kewanee 138kV	IL	100	natural gas	0	100
V1-011	Haviland 138kV	OH	100	wind	100	20
V1-012	Haviland 138kV	OH	150	wind	150	30
V2-006	East Leipsic 138kV	OH	150	wind	150	30
V3-007	Desoto-Tanners Creek #1 345kV	IN	200	wind	200	40
V3-008	Desoto-Tanners Creek #1 345kV	IN	200	wind	200	40
V3-009	Desoto-Tanners Creek #1 345kV	IN	200	wind	200	40
V4-010	Tiffin Center 138kV	OH	200	wind	200	40
V4-015	Fostoria Central 138kV	OH	66.6	wind	66.6	13.32
V4-016	Valley 138kV	MI	200	wind	200	40
W1-072A_AT5	Lemoyne 345kV	OH	40	natural gas	0	40
W2-001	Fostoria Central 138kV	OH	66.6	wind	66.6	13.32
W3-059A_At6	Avery – Greenfield 138kV	OH	99	wind	99	19.8
W3-088	South West Lima 345kV	OH	200	wind	200	40
W3-128	Sporn – Waterford 345kV	OH	652	natural gas	0	652
W3-170	Buckskin 69kV	OH	12	solar	12	12
X1-027A_AT12	Davis Besse – Beaver 345kV	OH	500	wind	500	100
Y1-006	Jubal Early – Austinville 138kV	VA	72	wind	72	14.4
Y1-069	Bay Shore – Fostoria Central 345kV	OH	799	natural gas	0	799
V1-024	LaSalle 1	LaSalle, IL	1188	nuclear	20	20
V1-025	LaSalle 2	LaSalle, IL	1191	nuclear	20	20
V4-046	Byron 1	Ogle, IL	1249	nuclear	20	20
V4-047	Byron 2	Ogle, IL	1223	nuclear	20	20
V4-048	Braidwood 1	Will, IL	1247	nuclear	20	20
V4-049	Braidwood 2	Will, IL	1219	nuclear	20	20
W2-048	Pontiac MidPoint – Lanesville 345kV	Logan, IL	63	wind	62.5	12.5
W3-046	Powerton 345kV – Katydid 345kV	Mason, IL	208	wind	208	41.6
W4-005	Pontiac Midpoint – Latham	Macon	351	wind	351	70.2

PJM Queue #	Project Name	County, State	Pmax (MW)	Fuel Type	MISO SH Output	MISO SPK Output
	345kV					
X1-096	Loretto-Kings Creek 138kV	Somerset	150	wind	150	30
X2-022	Pontiac Midpoint-Lanesville II	Logan	189	wind	189	37.8
X2-031	Krayn 115kV	Cambria	50	wind	50	10
X2-052	Dumont-Olive 345kV	Adams	675	natural gas	0	675
X3-051	Flatlick 765kV	Unknown	1460	natural gas	0	610
X4-025	Millbrook Park 138kV	Greenup	80	coal	80	80
Y1-030	Forest 69kV	Wyandot	100	wind	100	20
Y1-065	Rock Spring 500kV	Cecil	852	natural gas	0	852
X1-087	Stillman Valley	IL	19	methane	0	19
X3-023	S. Greenwich-Willard 69kV	OH	60	wind	60	12
Y2-050	Tidd-Canton Central	OH	742	natural gas,CC	0	742
Y2-053	Lemoyne 138kV	OH	35	Gas	0	35
Y3-088	Kendall I	IL	20	natural gas,CC	0	20
Y3-089	Kendall II	IL	20	natural gas,CC	0	20
Y3-090	Kendall III	IL	20	natural gas,CC	0	20
Y3-091	Kendall IV	IL	20	natural gas,CC	0	20
Y3-103	Valley-Raccoon 138kV	PA	205	natural gas,CC	0	205

Table A-22: NUs Required by PJM Generation Projects

Idev File Name	Network Upgrade
Dumont CAP.idv	250 Mvar switched cap at Dumont 765 kV bus
Sorenson_ELima345kV.idv	Sorenson-East Lima 345 kV new line

A.10 Model Review Comments

Table A-23: Model Review Comments

Company	Python/ Idev File Name	2024 SH	2024 SPK	2024 Stability	2017 SH	2017 SPK	2017 Stability
ATC	2024SH_ATC_update_DPP-AUG14_20150312.idv	x					
ATC	2024PK_ATC_update_DPP-AUG14_20150312.idv		x				
ATC	2017SH_ATC_update_DPP-AUG14_20150312.idv				x		
ATC	2017PK_ATC_update_DPP-AUG14_20150312.idv					x	
MRES	J329_GSU_Data_Update_Rev_32_20150310.idv	x	x	x	x	x	x
MRES	J329_RRHP_LineParameter_Update_20150311.idv	x	x	x	x	x	x
MP	RMV_Oliver Co-3.py	x	x	x	x	x	x
DPC	DPC_Chngs.idv	x	x	x	x	x	x
XCEL	Briggs_Cap_Correct.py	x	x	x	x	x	x
NIPS	NIPS_2017Updates.py				x	x	x
NIPS	NIPS_2024Updates.py	x	x	x			
AMRN	SPK_AMRN_Updates_V32.idv		x			x	
AMRN	All-Models_AMRN_Updates_V32.idv	x	x	x	x	x	x
Vectren	Vectren_SIGE_StudyCase-DPP-AUG14_2024SH_v32_150205.idv	x		x			
Vectren	Vectren_SIGE_StudyCase-DPP-AUG14_2024SPK_v32_150205.idv		x				
Vectren	Vectren_SIGE_StudyCase-DPP-AUG14_2017SH_v32_150205.idv				x		x
Vectren	Vectren_SIGE_StudyCase-DPP-AUG14_2017SPK_v32_150205.idv					x	
ITCT	DTE_DCG.idv	x	x	x	x	x	x
ITCT	HarvestWindFix.idv	x	x	x	x	x	x
ITCT	ITCT_G867.idv	x	x	x	x	x	x
ITCT	DTE_G867.idv	x	x	x	x	x	x
ITCT	J075.idv	x	x	x	x	x	x
ITCT	J122 and G997 Reactive Fix.idv	x	x	x	x	x	x
ITCT	J161 Reactive Fix.idv	x	x	x	x	x	x

Company	Python/ Idev File Name	2024 SH	2024 SPK	2024 Stability	2017 SH	2017 SPK	2017 Stability
ITCT	J340 Corrections.idv	x	x	x	x	x	x
ITCT	J340 Connection.idv	x	x	x	x	x	x
ITCT	Meade.idv	x	x		x	x	
ITCT	Meade_Stability.idv			x			x
ITCT	MichiganWindFix.idv	x	x	x	x	x	x
ITCT	PJM-Y1-069-ITC.idv	x	x	x	x	x	x
ITCT	T94 Covert -- Phase I & II.idv	x	x	x	x	x	x
ITCT	Correct_Fermi 3.py	x	x	x	x	x	x
MISO	3205-3-ITCM_3205_MVP_Lakefield-Huntley.idv				x	x	x
MISO	3205-2-ITCM_3205_MVP_Huntley-Ledyard.idv				x	x	x
MISO	RMV_3205-1-ITCM_3205_MVP_Ledyard-Kossuth.idv				x	x	x
MISO	RMV_3213-1-ITCM_3213_MVP_Ledyard-Colby.idv				x	x	x
MISO	RMV_ATC_(3510)_Z5_SB_AM_671K61_MUK-EDW_Rebuild.idv				x	x	x
MISO	RMV_DEM-MISO-2154-CarmelRohrerRd69kvDistSubR1.idv				x	x	x
MISO	RMV_IPL-3273-SW-StoutCT_Upgrade.idv				x	x	x
MISO	RMV_ITCM_4099_ALeaWst-SBrdway_69kV.idv				x	x	x
MISO	RMV_ITCM_4108_Ellndale-W_Owtna_69kV.idv				x	x	x
MISO	RMV_ITCM_4467_Fairbank-Oelwein_69_Rbld.idv				x	x	x
MISO	RMV_ITCT-4500-Carrigan.idv				x	x	x
MISO	RMV_METC-3590-SVC_at_Tippy.idv				x	x	x
MISO	RMV_SIGE-MISO-Prj1788-StWendalltoMohrRd.idv				x	x	x
MISO	RMV_Duplicate_WNBAGO-Freeborn_2024.idv	x	x	x			
MEC	2024Sh.py	x		x			
MEC	2024SPK.py		x				
MEC	2017Sh.py				x		x

Company	Python/ Idev File Name	2024 SH	2024 SPK	2024 Stability	2017 SH	2017 SPK	2017 Stability
MEC	2017SPK.py					x	
GRE	GRE-xfmr-ratings-150502_wr.py	x	x	x	x	x	x
MPW	MPW Gen_SPK.idv		x			x	
MPW	RMV_J097.idv	x	x	x	x	x	x
MPW	RMV_J097 NU.idv	x	x	x	x	x	x
ATC	ATC_Rating_Correction.idv	x	x	x	x	x	x
ITCM/DPC	STM_TurkeyRV_rating.idv	x	x	x	x	x	x
ITCM	Hickory Creek-2.idv	x	x	x	x	x	x
ComEd	RMV_FakeGen_CE.idv	x	x	x			
DPC	i-summer.idv	x	x	x	x	x	x
DPC	TurnOff_Alma.idv	x	x	x	x	x	x
MDU	Missing Western ND Capacitors.idv	x	x	x	x	x	x
OTP	PelicanTurkeyTapFix.idv	x	x	x	x	x	x
OTP	PerhamSEFix.idv	x	x	x	x	x	x
OTP	ClearbrookAreaFix.idv	x	x	x	x	x	x
OTP	Bruce Imped.idv	x	x	x	x	x	x
OTP	Rugby230kVTransformerRatings.idv	x	x	x	x	x	x
OTP	BranchRatingCorrections.idv	x	x	x	x	x	x
OTP	BuffaloXfmrFix.idv	x	x	x	x	x	x
OTP	Correct_Peaking Units_SPK.idv		x			x	
OTP	3rd Lake Complete_2018.idv	x	x	x			
OTP	2024SHLoadAdjustment.idv	x		x			
OTP	2024SPKLoadAdjustment.idv		x				
OTP	2017SHLoadAdjustment.idv				x		x
OTP	2017SPKLoadAdjustment.idv					x	
MPC	MPC-fixrtngs-DPP-AUG14_all_cases.idv	x	x	x	x	x	x
J289	J289_pf-95.idv	x		x	x		x
J289	J289_pf-95_SPK.idv		x			x	
J320	J320_TrueUp_SPK.idv		x	x		x	x
J320	J320_TrueUp_SH.idv	x			x		
J329	Dispatch_Pella Mun_SPK.idv		x			x	
J329	J329_RRHP_Unit_Data_Update_Rev_32_20150526.idv	x	x	x	x	x	x

Company	Python/ Idev File Name	2024 SH	2024 SPK	2024 Stability	2017 SH	2017 SPK	2017 Stability
J329	J329_GSU_Rating_Update_Rev_32_20150526.idv	x	x	x	x	x	x
J329	J329_Capacitor_Bank_Move_Rev_32_20150526.idv	x	x	x	x	x	x
SPP	SPP_2024SH.idv	x		x			
SPP	New-2024SH_Ties.idv	x		x			
SPP	SPP_2017SH.idv				x		x
SPP	New-2017SH_Ties.idv				x		x
MISO	RMV_J026.idv	x	x	x	x	x	x
MPW	2024SH_DPP-MPW.idv	x		x			
MPW	2024SPK_DPP-MPW.idv		x				
MPW	2017SH_DPP-MPW.idv				x		x
MPW	2017SPK_DPP-MPW.idv					x	
MP	Dorsey 500kV Tie Line Updates	x	x	x			
MP	RMV_G117_Stinson.idv	x	x	x	x	x	x
MISO	Remove_NU-G520-J097-J026_150701.py	x	x	x	x	x	x
MISO	RMV_J281-J282.idv	x	x	x	x	x	x
MISO	Huntley-Freeborn_Rebuild.idv	x	x	x	x	x	x
PJM	RMV_Duplicate-R033.idv	x	x	x	x	x	x
MISO	Disp_J371-J372-J374.idv	x	x	x	x	x	x
MISO	Add_Gordon-Cap.idv	x	x	x	x	x	x
MISO	correct_Hickory Area.idv	x	x	x	x	x	x
MISO	2017SH_SPP-NebraskaCity-Sibley_345.idv				x		x
MPW	StudyCase-DPP-AUG14_2017SH_v32_150804_TAP_MPW.idv				x	x	x

A.11 MISO Market as the Study Sink

Table A-24: MISO Market as the Study Sink

Area #	Area Name	Area #	Area Name
207	HE	361	SIPC
208	DEI	502	CLEC
210	SIGE	503	LAFA
216	IPL	504	LEPA
217	NIPS	600	Xcel
218	METC	608	MP
219	ITC	613	SMMPA
295	WEC	615	GRE
296	MIUP	620	OTP
314	BREC	627	ALTW
327	EES-EAI	633	MPW
332	LAGN	635	MEC
333	CWLD	661	MDU
349	SMEPA	680	DPC
351	EES	694	ALTE
356	AMMO	696	WPS
357	AMIL	697	MGE
360	CWLP	698	UPPC

A.12 PJM Market as PJM Projects Sink

Table A-25: PJM Market as PJM Projects Sink

Area #	Area Name	Area #	Area Name
201	AP	229	PPL
202	ATSI	230	PECO
205	AEP	231	PSE&G
209	DAY	232	BGE
212	DEO&K	233	PEPCO
215	DLCO	234	AE
222	CE	235	DP&L
225	PJM	236	UGI
226	PENELEC	237	RECO
227	METED	320	EKPC
228	JCP&L	345	DVP

A.13 SPP Market as SPP Projects Sink

Table A-26: SPP Market as SPP Projects Sink

Area #	Area Name	Area #	Area Name
515	SWPA	540	GMO
520	AEPW	541	KCPL
523	GRDA	542	KACY
524	OKGE	544	EMDE
525	WFEC	545	INDN
526	SPS	546	SPRM
527	OMPA	640	NPPD
531	MIDW	645	OPPD
534	SUNC	650	LES
536	WERE		

A.14 Contingency Files used in Steady-State Analysis

Table A-27: List of Contingencies used in Steady-State Analysis

Contingency File Name	Description	2024	2017
Category B Contingencies			
Automatic single element contingencies	Single element outages at buses 60 kV and above in the study region	x	x
ATC_P1P2_2017_DPP.con	Specified category P1, P2 contingencies in ATC		x
ATC_P1P2_2024_DPP.con	Specified category P1, P2 contingencies in ATC	x	
MNTACT_category-B-MTEP.con	Specified category B contingencies in Minnesota	x	x
XEL_MTEP13_B_non-MNTACT.con	Specified category B contingencies in XEL	x	x
DPC_MTEP14_B.con	Specified category B contingencies in DPC	x	x
MTEP14_2019_ITCM_Cat_B.con	Specified category B contingencies in ITCM		x
MTEP14_2024_ITCM_Cat_B.CON	Specified category B contingencies in ITCM	x	
MDU-CON-CAT-B_2019sh.con	Specified category B contingencies in MDU		x
MDU-CON-CAT-B_2024sh.con	Specified category B contingencies in MDU	x	
Selected_MDU_CONS_B.con	Specified category B contingencies in MDU	x	x
MEC DPP2014 Aug West 2017 Cat P1.con	Specified category P1 contingencies in MEC		x
MEC DPP2014 Aug West 2024 Cat P1.con	Specified category P1 contingencies in MEC	x	
MEC DPP2014 Aug West 2017 Cat P2.con	Specified category P2 contingencies in MEC		x
MEC DPP2014 Aug West 2024 Cat P2.con	Specified category P2 contingencies in MEC	x	
MPW_NERC_Cat_B_2014.con	Specified category B contingencies in MPW	x	x
MPW_other_Cat_B_2014.con	Specified category B contingencies in MPW	x	x
HVDC_Red_2017SH.con	Specified category B contingencies with HVDC reduction in 2017 shoulder		x
HVDC_Red_2024SH.con	Specified category B contingencies with HVDC reduction in 2024 shoulder	x	
HVDC_Red_2017SPK.con	Specified category B contingencies with HVDC reduction in 2017 peak		x
HVDC_Red_2024SPK.con	Specified category B contingencies with HVDC reduction in 2024 peak	x	
Without_SPS_MN_2023.con	Specified category B contingencies without LGS and Mankato Energy Center SPS	x	x
AMRN_B_2019S.con	Specified category B contingencies in Ameren		x
AMRN_B_2024S.con	Specified category B contingencies in	x	

Contingency File Name	Description	2024	2017
	Ameren		
ComEd_RTEP_Cat_B_2017.con	Specified category B contingencies in ComEd		x
ComEd_RTEP_Cat_B_2024.con	Specified category B contingencies in ComEd	x	
Category C Contingencies			
ATC_P5_2017_DPP.con	Specified category P5 contingencies in ATC		x
ATC_P5_2024_DPP.con	Specified category P5 contingencies in ATC	x	
ATC_P7_2017_DPP.con	Specified category P7 contingencies in ATC		x
ATC_P7_2024_DPP.con	Specified category P7 contingencies in ATC	x	
MNTACT_category-C-MTEP.con	Specified category C contingencies in Minnesota	x	x
CIPC Additional Contingencies_09192013_C_fixed.con	Specified category C contingencies in CIPCO	x	x
DPC_MTEP14_C.con	Specified category C contingencies in DPC	x	x
MTEP14_2019_ITCM_Cat_C.con	Specified category C contingencies in ITCM		x
MTEP14_2024_ITCM_Cat_C.CON	Specified category C contingencies in ITCM	x	
MDU_CONS_C1.con	Specified category C contingencies in MDU	x	x
MDU-CON-CAT-C_2019sh.con	Specified category C contingencies in MDU		x
MDU-CON-CAT-C_2024sh.con	Specified category C contingencies in MDU	x	
MEC DPP2014 Aug West 2017 Cat P7.con	Specified category P7 contingencies in MEC		x
MEC DPP2014 Aug West 2024 Cat P7.con	Specified category P7 contingencies in MEC	x	
MPW_NERC_Cat_C1_C2_C5_2014.con	Specified category C contingencies in MPW	x	x
MPW_other_Cat_C1_C2_C3_C5_2014.con	Specified category C contingencies in MPW	x	x
Selected_WAPA_CONS_C.con	Specified category C contingencies in WAPA	x	x
XEL_MTEP13_C_non-MNTACT.con	Specified category C contingencies in XEL	x	x
AMRN_C1_2019.con	Specified category C contingencies in AMRN		x
AMRN_C1_2024.con	Specified category C contingencies in AMRN	x	
AMRN_C2_2019.con	Specified category C contingencies in AMRN		x
AMRN_C2_2024.con	Specified category C contingencies in AMRN	x	
AMRN_C5_2019.con	Specified category C contingencies in AMRN		x

Contingency File Name	Description	2024	2017
AMRN_C5_2024.con	Specified category C contingencies in AMRN	x	
C1_Explicit_CWLD_2017_MISO.con	Specified category C contingencies in CWLD	x	x
C2_Explicit_CWLD_2017_MISO_2018-Revision.con	Specified category C contingencies in CWLD	x	x
C5_Explicit_CWLD_2017_MISO.con	Specified category C contingencies in CWLD	x	x
ComEd_RTEP_Cat_C_fixed.con	Specified category C contingencies in ComEd	x	x

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Appendix
B

Model Data

B.1 Power Flow Model Data

J285

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DATA FOR BUS  11118 [J285_GEN1   0.6900] RESIDING IN AREA  635, ZONE  679, OWNER  635:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  2     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 0.99332  91.73

                                                X--------- REMOTE BUS ----------X
 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED  PCT Q   BUS# X-- NAME --X BASKV VOLTAGE
     125.0   -14.2    41.2   -41.2 1.02000 100.00  11120 J285_SUB    345.00 1.02000

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4 WMOD   WPF
 1  1  125.0  -14.2   41.2  -41.2  131.9 0.0000 0.8000 0.0000 0.0000 1.0000  125.0  125.0  635 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
  12000 J285_1      34.500  1               1 T T 1 1  0.00582  0.04360  100.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
  12000 J285_1      34.500  1  1 1.00000 0.0000    0.0 1.00000 0.0000  131.9  131.9    0.0    1 1.000

 X------- TO BUS --------X     W C                                        X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
  12000 J285_1      34.500  1  T 1   0 1.10000 0.90000 1.10000 0.90000   33                              0.000


 DATA FOR BUS  11119 [J285_GEN2   0.6900] RESIDING IN AREA  635, ZONE  679, OWNER  635:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  2     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 0.99332  91.73

                                                X--------- REMOTE BUS ----------X
 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED  PCT Q   BUS# X-- NAME --X BASKV VOLTAGE
     125.0   -14.2    41.2   -41.2 1.02000 100.00  11120 J285_SUB    345.00 1.02000

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4 WMOD   WPF
 1  1  125.0  -14.2   41.2  -41.2  131.9 0.0000 0.8000 0.0000 0.0000 1.0000  125.0  125.0  635 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
  12001 J285_1      34.500  1               1 T T 1 1  0.00582  0.04360  100.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
  12001 J285_1      34.500  1  1 1.00000 0.0000    0.0 1.00000 0.0000  131.9  131.9    0.0    1 1.000

 X------- TO BUS --------X     W C                                        X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
  12001 J285_1      34.500  1  T 1   0 1.10000 0.90000 1.10000 0.90000   33                              0.000


 DATA FOR BUS  12000 [J285_1      34.500] RESIDING IN AREA  635, ZONE  679, OWNER  635:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 0.99380  88.52
```

```
 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
  11118 J285_GEN1   0.6900  1              1 F F 1 1  0.00582  0.04360  100.0  0.00000  0.00000  0
  11120 J285_SUB    345.00  1  J285 GSU_1   1 F F 2 1  0.00447  0.08944   81.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
  11118 J285_GEN1   0.6900  1  1 1.00000 0.0000    0.0 1.00000 0.0000  131.9  131.9    0.0    1 1.000
  11120 J285_SUB    345.00  1  1 1.00000 0.0000    0.0 1.00000 0.0000  135.0  135.0    0.0  635 1.000

 X------- TO BUS --------X     W C                                        X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
  11118 J285_GEN1   0.6900  1  F 1  0 1.10000 0.90000 1.10000 0.90000   33                               0.000
  11120 J285_SUB    345.00  1  F 1  0 1.05000 0.95000 1.05000 0.95000    5                               0.000


 DATA FOR BUS  12001 [J285_1      34.500] RESIDING IN AREA  635, ZONE  679, OWNER  635:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 0.99380  88.52

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
  11119 J285_GEN2   0.6900  1              1 F F 1 1  0.00582  0.04360  100.0  0.00000  0.00000  0
  11120 J285_SUB    345.00  1  J285 GSU_2   1 F F 2 1  0.00447  0.08944   81.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
  11119 J285_GEN2   0.6900  1  1 1.00000 0.0000    0.0 1.00000 0.0000  131.9  131.9    0.0    1 1.000
  11120 J285_SUB    345.00  1  1 1.00000 0.0000    0.0 1.00000 0.0000  135.0  135.0    0.0  635 1.000

 X------- TO BUS --------X     W C                                        X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
  11119 J285_GEN2   0.6900  1  F 1  0 1.10000 0.90000 1.10000 0.90000   33                               0.000
  11120 J285_SUB    345.00  1  F 1  0 1.05000 0.95000 1.05000 0.95000    5                               0.000


 DATA FOR BUS  11120 [J285_SUB    345.00] RESIDING IN AREA  635, ZONE  679, OWNER  635:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.02000  80.68

 X------- TO BUS --------X
   BUS# X-- NAME --X BASKV CKT   LINE R   LINE X CHARGING ST MET RATE-A RATE-B RATE-C LENGTH ZI OWN1 FRAC1
OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 635368 OBRIEN 3    345.00  1   0.00008  0.00125  0.01393  1  F   999.0  999.0  999.0    2.0     635 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
  12000 J285_1      34.500  1  J285 GSU_1   1 T T 2 1  0.00447  0.08944   81.0  0.00000  0.00000  0
  12001 J285_1      34.500  1  J285 GSU_2   1 T T 2 1  0.00447  0.08944   81.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
  12000 J285_1      34.500  1  1 1.00000 0.0000    0.0 1.00000 0.0000  135.0  135.0    0.0  635 1.000
  12001 J285_1      34.500  1  1 1.00000 0.0000    0.0 1.00000 0.0000  135.0  135.0    0.0  635 1.000

 X------- TO BUS --------X     W C                                        X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
  12000 J285_1      34.500  1  T 1  0 1.05000 0.95000 1.05000 0.95000    5                               0.000
  12001 J285_1      34.500  1  T 1  0 1.05000 0.95000 1.05000 0.95000    5                               0.000


 DATA FOR BUS 635368 [OBRIEN 3    345.00] RESIDING IN AREA  635, ZONE  679, OWNER  635:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.02075  80.51

     S ADJ                                                                    X----- REMOTE BUS ------X
X--FACTS/--X
 MOD T METH VHI     VLO      SHUNT  X-------X X-------X X-------X X-------X  PCT Q   BUS# X-- NAME --X BASKV
X-VSC NAME-X
  1  1  0 1.04000 1.00000   -50.00  1: -50.00                                 100.00
```

X------- TO BUS --------X BUS#	X-- NAME	--X BASKV	CKT	LINE R	LINE X	CHARGING	ST	MET	RATE-A	RATE-B	RATE-C	LENGTH	ZI	OWN1	FRAC1	OWN2	FRAC2	OWN3	FRAC3	OWN4	FRAC4
11120	J285_SUB	345.00	1	0.00008	0.00125	0.01393	1	T	999.0	999.0	999.0	2.0		635	1.000						
631138	LAKEFLD3	345.00	1	0.00256	0.02530	0.40373	1	T	864.0	864.0	864.0	49.5		1	1.000						
635369	KOSSUTH 3	345.00	1	0.00333	0.03915	0.74321	1	F	1739.0	1739.0	1739.0	81.8		635	1.000						
635400	HIGHLND 3	345.00	1	0.00021	0.00210	0.03346	1	F	864.0	864.0	864.0	4.1		1	1.000						

J289

```
DATA FOR BUS 635648 [DEY415 W    0.6000] RESIDING IN AREA  635, ZONE  678, OWNER  635:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  2     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.08234  67.00

                                                  X--------- REMOTE BUS ----------X
 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED  PCT Q   BUS# X-- NAME --X BASKV VOLTAGE
     119.6    12.3    39.3   -39.3 1.01863 100.00 635645 MCKSBRG 3   161.00 1.01863

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4 WMOD   WPF
 W  1  119.6   12.3   39.3  -39.3  119.6 0.0000 0.6415 0.0000 0.0000 1.0000  119.6  119.6  635 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
 635647 DEY415C 9   34.500  1  DEYGSU       1 T T 1 1  0.00737  0.04423  130.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
 635647 DEY415C 9   34.500  1  1 1.00000 0.0000    0.0 1.00000 0.0000  130.0  130.0  130.0  635 1.000

 X------- TO BUS --------X     W C                                          X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
 635647 DEY415C 9   34.500  1  T 1  0 1.10000 0.90000 1.05000 0.95000    9                               0.000


 DATA FOR BUS 635647 [DEY415C 9   34.500] RESIDING IN AREA  635, ZONE  678, OWNER  635:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.07024  64.43

 X------- TO BUS --------X
   BUS# X-- NAME --X BASKV CKT   LINE R   LINE X CHARGING ST MET RATE-A RATE-B RATE-C LENGTH ZI OWN1 FRAC1
OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 635646 DEY415 9    34.500  1   0.04000  0.02000  0.05000  1  T   150.0  150.0  150.0    0.0     635 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
 635648 DEY415 W    0.6000  1  DEYGSU       1 F F 1 1  0.00737  0.04423  130.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
 635648 DEY415 W    0.6000  1  1 1.00000 0.0000    0.0 1.00000 0.0000  130.0  130.0  130.0  635 1.000

 X------- TO BUS --------X     W C                                          X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
 635648 DEY415 W    0.6000  1  F 1  0 1.10000 0.90000 1.05000 0.95000    9                               0.000


 DATA FOR BUS 635646 [DEY415 9    34.500] RESIDING IN AREA  635, ZONE  678, OWNER  635:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.02423  63.39

 X------- TO BUS --------X
   BUS# X-- NAME --X BASKV CKT   LINE R   LINE X CHARGING ST MET RATE-A RATE-B RATE-C LENGTH ZI OWN1 FRAC1
OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 635647 DEY415C 9   34.500  1   0.04000  0.02000  0.05000  1  F   150.0  150.0  150.0    0.0     635 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
 635645 MCKSBRG 3   161.00  1  DEY8T1       1 F F 1 1  0.00366  0.14100  100.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
 635645 MCKSBRG 3   161.00  1  1 1.00000 0.0000    0.0 1.00000 0.0000  126.0  126.0  126.0  635 1.000

 X------- TO BUS --------X     W C                                          X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
 635645 MCKSBRG 3   161.00  1  F 1  0 1.10000 0.90000 1.05000 0.95000    9                               0.000
```

```
 DATA FOR BUS 635645 [MCKSBRG 3   161.00] RESIDING IN AREA  635, ZONE  678, OWNER  635:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.01863  54.57

 X------- TO BUS --------X
   BUS# X-- NAME --X BASKV CKT   LINE R   LINE X CHARGING ST MET RATE-A RATE-B RATE-C LENGTH ZI OWN1 FRAC1
OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 631078 WNTRST 5    161.00  1   0.01222  0.03836  0.01718  1  F   154.0  154.0  154.0   12.4     627 1.000
 652560 CRESTON5    161.00  1   0.01118  0.03510  0.01572  1  T   154.0  154.0  154.0   11.4     627 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y         TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
 635646 DEY415 9    34.500  1  DEY8T1       1 T T 1 1  0.00366  0.14100  100.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
 635646 DEY415 9    34.500  1  1 1.00000 0.0000    0.0 1.00000 0.0000  126.0  126.0  126.0  635 1.000

 X------- TO BUS --------X     W C                                          X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
 635646 DEY415 9    34.500  1  T 1  0 1.10000 0.90000 1.05000 0.95000    9                              0.000
```

J316

```
DATA FOR BUS  11115 [J316_GEN    0.6900] RESIDING IN AREA  661, ZONE 1636, OWNER  661:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  2     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 0.99395 118.33

                                                X--------- REMOTE BUS ----------X
 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED  PCT Q   BUS# X-- NAME --X BASKV VOLTAGE
     150.0    -5.3    49.2   -49.2 1.01000 100.00  11117 J316_SUB    230.00 1.01000

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4 WMOD   WPF
 1  1  150.0   -5.3   49.2  -49.2  159.3 0.0000 0.8000 0.0000 0.0000 1.0000  150.0  150.0  661 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
  11116 J316_COLHI  34.500  1  J316 GSU     1 F F 1 1  0.00482  0.03610  100.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
  11116 J316_COLHI  34.500  1  1 1.00000 0.0000    0.0 1.00000 0.0000  159.3  159.3    0.0  661 1.000

 X------- TO BUS --------X     W C                                          X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
  11116 J316_COLHI  34.500  1  F 1  0 1.05000 0.95000 1.05000 0.95000    5                               0.000


 DATA FOR BUS  11116 [J316_COLHI  34.500] RESIDING IN AREA  661, ZONE 1636, OWNER  661:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 0.99011 115.16

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
  11115 J316_GEN    0.6900  1  J316 GSU     1 T T 1 1  0.00482  0.03610  100.0  0.00000  0.00000  0
  11117 J316_SUB    230.00  1  J316_MAINTR  1 F F 2 1  0.00237  0.09500   99.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
  11115 J316_GEN    0.6900  1  1 1.00000 0.0000    0.0 1.00000 0.0000  159.3  159.3    0.0  661 1.000
  11117 J316_SUB    230.00  1  1 1.00000 0.0000    0.0 1.00000 0.0000  165.0  165.0    0.0  661 1.000

 X------- TO BUS --------X     W C                                          X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
  11115 J316_GEN    0.6900  1  T 1  0 1.05000 0.95000 1.05000 0.95000    5                               0.000
  11117 J316_SUB    230.00  1  F 1  0 1.05000 0.95000 1.05000 0.95000    5                               0.000


 DATA FOR BUS  11117 [J316_SUB    230.00] RESIDING IN AREA  661, ZONE 1636, OWNER  661:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.01000 106.92

 X------- TO BUS --------X
   BUS# X-- NAME --X BASKV CKT   LINE R   LINE X CHARGING ST MET RATE-A RATE-B RATE-C LENGTH ZI OWN1 FRAC1
OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 661096 TTNKPOI4    230.00  1   0.00228  0.01561  0.02931  1  T   319.0  343.0    0.0    0.0     661 1.000
 661098 ELLENDLMVP4 230.00  1   0.00228  0.01561  0.02931  1  F   319.0  343.0    0.0    0.0     661 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
  11116 J316_COLHI  34.500  1  J316_MAINTR  1 T T 2 1  0.00237  0.09500   99.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
  11116 J316_COLHI  34.500  1  1 1.00000 0.0000    0.0 1.00000 0.0000  165.0  165.0    0.0  661 1.000

 X------- TO BUS --------X     W C                                          X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
  11116 J316_COLHI  34.500  1  T 1  0 1.05000 0.95000 1.05000 0.95000    5                               0.000
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J320

```
DATA FOR BUS 600065 [HBR C71G    18.000] RESIDING IN AREA  600, ZONE  601, OWNER  600:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  2     2.0     2.0     0.0     0.0     0.0     0.0     0.0     0.0 1.01670 -54.02

 ID ST     PSI   P Q - L O A D     I - L O A D     Y - L O A D  AREA  ZONE OWNER SCALE
 X4  1   1.000     2.0     2.0     0.0     0.0     0.0     0.0   600   601   600   NO

                                                X--------- REMOTE BUS ----------X
 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED  PCT Q   BUS# X-- NAME --X BASKV VOLTAGE
     197.0    18.2   116.0   -50.0 1.01670  30.00

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4 WMOD   WPF
 7  1  197.0   18.2  116.0  -50.0  231.8 0.0007 0.1470 0.0000 0.0000 0.0000  197.0  197.0  600 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
 603079 HIBRDGE7    115.00  7               1 T T 1 1  0.00100  0.06300  100.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
 603079 HIBRDGE7    115.00  7  1 1.02520 0.0000    0.0 1.00000 0.0000  227.0  227.0  227.0  600 1.000

 X------- TO BUS --------X     W C                                          X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
 603079 HIBRDGE7    115.00  7  T 1  0 1.50000 0.51000 1.50000 0.51000  159                               0.000


 DATA FOR BUS 600066 [HBR C72G    18.000] RESIDING IN AREA  600, ZONE  601, OWNER  600:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  2     2.0     2.0     0.0     0.0     0.0     0.0     0.0     0.0 1.01670 -54.02

 ID ST     PSI   P Q - L O A D     I - L O A D     Y - L O A D  AREA  ZONE OWNER SCALE
 X4  1   1.000     2.0     2.0     0.0     0.0     0.0     0.0   600   601   600   NO

                                                X--------- REMOTE BUS ----------X
 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED  PCT Q   BUS# X-- NAME --X BASKV VOLTAGE
     197.0    18.2   116.0   -50.0 1.01670  30.00

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4 WMOD   WPF
 8  1  197.0   18.2  116.0  -50.0  231.8 0.0007 0.1470 0.0000 0.0000 0.0000  197.0  197.0  600 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
 603079 HIBRDGE7    115.00  8               1 T T 1 1  0.00100  0.06300  100.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
 603079 HIBRDGE7    115.00  8  1 1.02520 0.0000    0.0 1.00000 0.0000  227.0  227.0  227.0  600 1.000

 X------- TO BUS --------X     W C                                          X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
 603079 HIBRDGE7    115.00  8  T 1  0 1.50000 0.51000 1.50000 0.51000  159                               0.000


 DATA FOR BUS 600067 [HBR S73G    13.800] RESIDING IN AREA  600, ZONE  601, OWNER  600:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  2     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.01450 -56.41

 ID ST     PSI   P Q - L O A D     I - L O A D     Y - L O A D  AREA  ZONE OWNER SCALE
 X4  1   1.000     0.0     0.0     0.0     0.0     0.0     0.0   600   601   600   NO

                                                X--------- REMOTE BUS ----------X
 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED  PCT Q   BUS# X-- NAME --X BASKV VOLTAGE
     240.0     9.8   158.0   -80.0 1.01450  40.00

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4 WMOD   WPF
 9  1  240.0    9.8  158.0  -80.0  294.1 0.0000 0.2500 0.0000 0.0000 0.0000  240.0  240.0  600 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
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```
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
 603079 HIBRDGE7    115.00  9              1 T T 1 1  0.00100  0.03333  100.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
 603079 HIBRDGE7    115.00  9  1 1.02520 0.0000    0.0 1.00000 0.0000  320.0  320.0  320.0  600 1.000

 X------- TO BUS --------X     W C                                        X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR       CX
 603079 HIBRDGE7    115.00  9  T 1  0 1.50000 0.51000 1.50000 0.51000  159                              0.000


 DATA FOR BUS 603079 [HIBRDGE7    115.00] RESIDING IN AREA  600, ZONE  601, OWNER  600:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1   138.2    19.7     0.0     0.0     0.0     0.0     0.0     0.0 1.03747 -60.87

 ID ST     PSI   P Q - L O A D     I - L O A D     Y - L O A D  AREA  ZONE OWNER SCALE
 X0  1   1.000   138.2    19.7     0.0     0.0     0.0     0.0   600   601   600  YES

 X------- TO BUS --------X
   BUS# X-- NAME --X BASKV CKT   LINE R   LINE X CHARGING ST MET RATE-A RATE-B RATE-C LENGTH ZI OWN1 FRAC1
OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 603072 DYTNBLF7    115.00  1   0.00258  0.01522  0.00209  1  T   239.0  239.0    0.0    2.7     600 1.000
 603090 MERIMPK7    115.00  1   0.00344  0.01917  0.00275  1  F   195.6  215.2    0.0    3.5     600 1.000
 603098 ROGRSLK7    115.00  1   0.00152  0.01000  0.00134  1  F   398.4  398.4    0.0    4.1     600 1.000
 603104 SHEPARD7    115.00  1   0.00372  0.02026  0.00348  1  F   239.0  298.2    0.0    4.1     600 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
 600040 STP CO1G    13.800  4              1 T T 3 2    98650  0.11600   28.0    17780  0.00120  0
 600065 HBR C71G    18.000  7              1 F F 1 1  0.00100  0.06300  100.0  0.00000  0.00000  0
 600066 HBR C72G    18.000  8              1 F F 1 1  0.00100  0.06300  100.0  0.00000  0.00000  0
 600067 HBR S73G    13.800  9              1 F F 1 1  0.00100  0.03333  100.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
 600040 STP CO1G    13.800  4  1 1.00000 0.0000    0.0 1.02610 0.0000   46.7   47.8    0.0  600 1.000
 600065 HBR C71G    18.000  7  1 1.02520 0.0000    0.0 1.00000 0.0000  227.0  227.0  227.0  600 1.000
 600066 HBR C72G    18.000  8  1 1.02520 0.0000    0.0 1.00000 0.0000  227.0  227.0  227.0  600 1.000
 600067 HBR S73G    13.800  9  1 1.02520 0.0000    0.0 1.00000 0.0000  320.0  320.0  320.0  600 1.000

 X------- TO BUS --------X     W C                                        X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR       CX
 600040 STP CO1G    13.800  4  T 1  0 1.14540 0.94000 1.50000 0.51000   33                              0.000
 600065 HBR C71G    18.000  7  F 1  0 1.50000 0.51000 1.50000 0.51000  159                              0.000
 600066 HBR C72G    18.000  8  F 1  0 1.50000 0.51000 1.50000 0.51000  159                              0.000
 600067 HBR S73G    13.800  9  F 1  0 1.50000 0.51000 1.50000 0.51000  159                              0.000
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J329

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DATA FOR BUS 638067 [RRHP_1_9    13.800] RESIDING IN AREA  635, ZONE  680, OWNER  639:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  2     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.02000  56.94

                                                 X--------- REMOTE BUS ----------X
 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED  PCT Q   BUS# X-- NAME --X BASKV VOLTAGE
      27.5    -5.1     9.2    -9.2 1.02000 100.00

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4 WMOD   WPF
 1  1   27.5   -5.1    9.2   -9.2   29.0 0.0062 0.2500 0.0000 0.0000 1.0000   27.5   27.5  639 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
 638066 RRHP8       69.000  1              1 T T 3 2    54900  0.05400   20.0    14090  0.00560  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
 638066 RRHP8       69.000  1  2  69.000 69.000    0.0  13.800 13.800   33.3   33.3   33.3  639 1.000

 X------- TO BUS --------X     W C                                          X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
 638066 RRHP8       69.000  1  T 2  0 1.10000 0.90000 1.10000 1.00000   33                               0.000


 DATA FOR BUS 638068 [RRHP_2_9    13.800] RESIDING IN AREA  635, ZONE  680, OWNER  639:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  2     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.02000  56.94

                                                 X--------- REMOTE BUS ----------X
 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED  PCT Q   BUS# X-- NAME --X BASKV VOLTAGE
      27.5    -5.1     9.2    -9.2 1.02000 100.00

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4 WMOD   WPF
 2  1   27.5   -5.1    9.2   -9.2   29.0 0.0062 0.2500 0.0000 0.0000 1.0000   27.5   27.5  639 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
 638066 RRHP8       69.000  2              1 T T 3 2    54900  0.05400   20.0    14090  0.00560  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
 638066 RRHP8       69.000  2  2  69.000 69.000    0.0  13.800 13.800   33.3   33.3   33.3  639 1.000

 X------- TO BUS --------X     W C                                          X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
 638066 RRHP8       69.000  2  T 2  0 1.10000 0.90000 1.10000 1.00000   33                               0.000


 DATA FOR BUS 638066 [RRHP8       69.000] RESIDING IN AREA  635, ZONE  680, OWNER  639:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.03246  52.87

 X------- TO BUS --------X
   BUS# X-- NAME --X BASKV CKT   LINE R   LINE X CHARGING ST MET RATE-A RATE-B RATE-C LENGTH ZI OWN1 FRAC1
OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 638061 PELLA W8    69.000  1   0.02037  0.06442  0.00948  1  T    69.9   69.9   69.9    4.5     639 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
 638067 RRHP_1_9    13.800  1              1 F F 3 2    54900  0.05400   20.0    14090  0.00560  0
 638068 RRHP_2_9    13.800  2              1 F F 3 2    54900  0.05400   20.0    14090  0.00560  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
 638067 RRHP_1_9    13.800  1  2  69.000 69.000    0.0  13.800 13.800   33.3   33.3   33.3  639 1.000
 638068 RRHP_2_9    13.800  2  2  69.000 69.000    0.0  13.800 13.800   33.3   33.3   33.3  639 1.000

 X------- TO BUS --------X     W C                                          X---- CONTROLLED BUS ----X CONECXN
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```
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
 638067 RRHP_1_9    13.800  1  F 2  0 1.10000 0.90000 1.10000 1.00000   33                                0.000
 638068 RRHP_2_9    13.800  2  F 2  0 1.10000 0.90000 1.10000 1.00000   33                                0.000


 DATA FOR BUS 638061 [PELLA W8    69.000] RESIDING IN AREA  635, ZONE  680, OWNER  639:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
 -2     6.3     1.3     0.0     0.0     0.0     0.0     0.0     0.0 1.03108  50.81

 ID ST     PSI   P Q - L O A D     I - L O A D     Y - L O A D  AREA  ZONE OWNER SCALE
 40  1   1.000     6.3     1.3     0.0     0.0     0.0     0.0   635   682   639  YES

                                                X--------- REMOTE BUS ----------X
 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED  PCT Q   BUS# X-- NAME --X BASKV VOLTAGE
       0.0     0.0     0.0     0.0 1.02000 100.00

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4 WMOD   WPF
 1  0    0.0    0.0    2.8   -2.8   31.9 0.0000 0.2070 0.0000 0.0000 1.0000   28.0    0.0  635 1.000

 X------- TO BUS --------X
   BUS# X-- NAME --X BASKV CKT   LINE R   LINE X CHARGING ST MET RATE-A RATE-B RATE-C LENGTH ZI OWN1 FRAC1
OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 630825 PELLARC8    69.000  1   0.00096  0.00141  0.00002  1  T    50.7   50.7   50.7    0.1     635 1.000
 638060 PELLA PLNT8 69.000  1   0.00714  0.02727  0.00060  1  F    71.7   71.7   71.7    2.0     635 1.000
 638063 PELLA SESS8 69.000  1   0.01073  0.05025  0.00116  1  T    71.7   71.7   71.7    3.7     635 1.000
 638066 RRHP8       69.000  1   0.02037  0.06442  0.00948  1  F    69.9   69.9   69.9    4.5     639 1.000
```

J343

```
DATA FOR BUS  11133 [J343_GEN    0.6900] RESIDING IN AREA  635, ZONE  679, OWNER  635:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  2     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 0.98056  69.61

                                              X--------- REMOTE BUS ----------X
 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED  PCT Q   BUS# X-- NAME --X BASKV VOLTAGE
     150.0    15.4    49.3   -49.3 1.00000 100.00  11136 J343_SUB    161.00 1.00000

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4 WMOD   WPF
 1  1  150.0   15.4   49.3  -49.3  147.2 0.0000 0.5700 0.0000 0.0000 1.0000  150.0  150.0  635 1.000
1  1.0000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
  11134 J343_COLLO  34.500  1  J343 GSU     1 F F 2 1  0.00840  0.06000  166.4  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
  11134 J343_COLLO  34.500  1  1 1.00000 0.0000    0.0 1.00000 0.0000  166.4  166.4    0.0  635 1.000

 X------- TO BUS --------X     W C                                        X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
  11134 J343_COLLO  34.500  1  F 1  0 1.05000 0.95000 1.05000 0.95000    5                                0.000

 DATA FOR BUS  11134 [J343_COLLO  34.500] RESIDING IN AREA  635, ZONE  679, OWNER  635:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 0.99780  64.85

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
  11133 J343_GEN    0.6900  1  J343 GSU     1 T T 2 1  0.00840  0.06000  166.4  0.00000  0.00000  0
  11135 J343_COLHI  161.00  1  J343_MAINTR  1 T F 2 1  0.00220  0.13440  108.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
  11133 J343_GEN    0.6900  1  1 1.00000 0.0000    0.0 1.00000 0.0000  166.4  166.4    0.0  635 1.000
  11135 J343_COLHI  161.00  1  1 1.02500 161.00    0.0 1.00000 34.500  180.0  180.0  180.0  635 1.000

 X------- TO BUS --------X     W C                                        X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
  11133 J343_GEN    0.6900  1  T 1  0 1.05000 0.95000 1.05000 0.95000    5                                0.000
  11135 J343_COLHI  161.00  1  T 1  0 1.05000 0.95000 1.05000 0.95000    5                                0.000


 DATA FOR BUS  11135 [J343_COLHI  161.00] RESIDING IN AREA  635, ZONE  679, OWNER  635:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.01044  54.02

 X------- TO BUS --------X
   BUS# X-- NAME --X BASKV CKT   LINE R   LINE X CHARGING ST MET RATE-A RATE-B RATE-C LENGTH ZI OWN1 FRAC1
OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
  11136 J343_SUB    161.00  1   0.00044  0.00290  0.00146  1  F   999.0  999.0  999.0    0.1     635 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
  11134 J343_COLLO  34.500  1  J343_MAINTR  1 F T 2 1  0.00220  0.13440  108.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
  11134 J343_COLLO  34.500  1  1 1.02500 161.00    0.0 1.00000 34.500  180.0  180.0  180.0  635 1.000

 X------- TO BUS --------X     W C                                        X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
  11134 J343_COLLO  34.500  1  F 1  0 1.05000 0.95000 1.05000 0.95000    5                                0.000


 DATA FOR BUS  11136 [J343_SUB    161.00] RESIDING IN AREA  635, ZONE  679, OWNER  635:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
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```
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.01000  53.78

 X------- TO BUS --------X
    BUS# X-- NAME --X BASKV CKT   LINE R   LINE X CHARGING ST MET RATE-A RATE-B RATE-C LENGTH ZI OWN1 FRAC1
OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
   11135 J343_COLHI  161.00  1   0.00044  0.00290  0.00146  1  T   999.0  999.0  999.0    0.1     635 1.000
  635037 BROOKS 5    161.00  1   0.00360  0.02800  0.01580  1  F   410.0  410.0  410.0   10.0     635 1.000
  652560 CRESTON5    161.00  1   0.02080  0.06530  0.02920  1  T   154.0  154.0  154.0   21.1     635 1.000
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J344

```
DATA FOR BUS  11125 [J344_GEN    0.6900] RESIDING IN AREA  635, ZONE  680, OWNER  635:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  2     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.02375  63.58

                                                 X--------- REMOTE BUS ----------X
 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED  PCT Q   BUS# X-- NAME --X BASKV VOLTAGE
     169.0     7.5    55.5   -55.5 1.02000 100.00  11127 J344_COLHI  161.00 1.02000

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4 WMOD   WPF
 1  1  169.0    7.5   55.5  -55.5  165.6 0.0000 0.5700 0.0000 0.0000 1.0000  169.0  169.0  635 1.000
1  1.0000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
  11126 J344_COLLO  34.500  1  J344 GSU     1 F F 2 1  0.00840  0.06000  187.2  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
  11126 J344_COLLO  34.500  1  1 1.00000 0.0000    0.0 1.00000 0.0000  198.0  198.0    0.0  635 1.000

 X------- TO BUS --------X     W C                                        X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
  11126 J344_COLLO  34.500  1  F 1  0 1.05000 0.95000 1.05000 0.95000    5                                0.000

 DATA FOR BUS  11126 [J344_COLLO  34.500] RESIDING IN AREA  635, ZONE  680, OWNER  635:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 0.95063  61.04

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
  11125 J344_GEN    0.6900  1  J344 GSU     1 T T 2 1  0.00840  0.06000  187.2  0.00000  0.00000  0
  11127 J344_COLHI  161.00  1  J344_MAINTR  1 F F 2 1  0.00360  0.08990  110.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
  11125 J344_GEN    0.6900  1  1 1.00000 0.0000    0.0 1.00000 0.0000  198.0  198.0    0.0  635 1.000
  11127 J344_COLHI  161.00  1  1 1.00000 0.0000    0.0 1.00000 0.0000  182.0  182.0    0.0  635 1.000

 X------- TO BUS --------X     W C                                        X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
  11125 J344_GEN    0.6900  1  T 1  0 1.05000 0.95000 1.05000 0.95000    5                                0.000
  11127 J344_COLHI  161.00  1  F 1  0 1.05000 0.95000 1.05000 0.95000    5                                0.000


 DATA FOR BUS  11127 [J344_COLHI  161.00] RESIDING IN AREA  635, ZONE  680, OWNER  635:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.00000  52.66

 X------- TO BUS --------X
   BUS# X-- NAME --X BASKV CKT   LINE R   LINE X CHARGING ST MET RATE-A RATE-B RATE-C LENGTH ZI OWN1 FRAC1
OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
  11128 J344_SUB    161.00  1   0.00050  0.00293  0.00144  1  F   999.0  999.0  999.0    0.1     635 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2
X 1-2
  11126 J344_COLLO  34.500  1  J344_MAINTR  1 T T 2 1  0.00360  0.08990  110.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4
  11126 J344_COLLO  34.500  1  1 1.00000 0.0000    0.0 1.00000 0.0000  182.0  182.0    0.0  635 1.000

 X------- TO BUS --------X     W C                                        X---- CONTROLLED BUS ----X CONECXN
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV   ANGLE
CR      CX
  11126 J344_COLLO  34.500  1  T 1  0 1.05000 0.95000 1.05000 0.95000    5                                0.000


 DATA FOR BUS  11128 [J344_SUB    161.00] RESIDING IN AREA  635, ZONE  680, OWNER  635:

 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
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```
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.00151  52.36

 X------- TO BUS --------X
   BUS# X-- NAME --X BASKV CKT   LINE R   LINE X CHARGING ST MET RATE-A RATE-B RATE-C LENGTH ZI OWN1 FRAC1
OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
  11127 J344_COLHI  161.00  1   0.00050  0.00293  0.00144  1  T   999.0  999.0  999.0    0.1     635 1.000
 631113 POWESHK5    161.00  1   0.00442  0.03053  0.01527  1  F   261.0  261.0  261.0    0.0     627 1.000
 635870 BEACON 5    161.00  1   0.00442  0.03053  0.01527  1  T   261.0  261.0  261.0    0.0     627 1.000
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B.2 Dynamic Model Data

J285

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PLANT MODELS

 REPORT FOR ALL MODELS                    BUS 11118 [J285_GEN1   0.6900] MODELS


 ** GEWTG2 **  BUS X-- NAME --X   BASEKV MC  C O N S     S T A T E S        VAR         ICON
            11118    J285_GEN1 0.6900 1  383444-383461 132607-132609  79861-79865   50342-50345

   PRATE        XEQ    VLVPL1    VLVPL2    GLVPL2   VHVRCR2
   1.7900       0.8    0.5000    0.9000    1.2200    1.2000

   CURHVRCR2 VLVACR1   VLVACR2   RIp_LVPL   T_LVPL     LVPL1V
   2.0000    0.4000    0.8000   10.0000    0.0200    0.0000


   LVPL1P   LVPL2V    LVPL2P    LVPL3V     LVPL3P     XLVPL
   0.0000    0.5000    0.1670    0.9000    0.9250    0.0000


 NUMBER OF AGGREGATED ORIGINAL WT UNITS:   70
 WT UNITS USE DFIGs


 ** GEWTE2 OF GEWTG **  BUS X-- NAME --X BASEKV MC       C O N S       S T A T E S     VAR          ICON
                        11118 J285_GEN1    0.6900 1  384602-384668 132993-133010  80399-80407   50641-50652

   TFV      KPV        KIV       RC        XC        TFP       KPP
   0.1500    2.0000    1.0000    0.0000    0.0000    0.0500    3.0000

   KIP       PMX       PMN       QMX       QMN       IPMAX     TRV
   0.6000    1.1200    0.0400    0.4360   -0.4360    1.1000    0.0200

   RPMX      RPMN      T_POWER   KQi       VMINCL    VMAXCL    KVi
   0.4500   -0.4500   60.0000    0.1000    0.9000    1.1000   40.0000

   XIQmin    XIQmax    Tv        Tp        Fn        TPav
   0.5000    1.4500    0.0500    0.0500    1.0000    0.1500

   FRa       FRb       FRc       FRd
   0.9600    0.9960    1.0040    1.0400

   PFRa      PFRb      PFRc      PFRd
   1.0000    1.0000    1.0000    0.4000

   PFRmax    PFRmin    TW        T_LVPL    V_LVPL
   1.0000    0.2000    1.0000    0.2500   -1.0000

   SPDW1     SPDWMX    SPDWMN    SPD_LOW   WTTHRES
  14.0000   25.0000    3.0000   -0.9000    8.0000

   EBST      KDBR      Pdbr_MAX
   0.2000   10.0000    1.0000

   ImaxTD    Iphl      Iqhl      TIpqd      Kqd       Xqd       Kwi
   1.7000    1.2200    1.2500    5.0000    0.0000    0.0000    0.0000

   dbwi      Tipwi     Twowi     urIwi     drIwi     Pmxwi     Pmnwi
   0.0025    1.0000    5.5000    0.1000   -1.0000    0.1000    0.0000

   Vermx     Vermn     Vfrz      QmxZP     QmnZP
   0.1000   -0.1000    0.7000    0.1200   -0.1200


 Remote controlled Bus #     11118
                VARFLG =  1 PFAFLG =  0
                APCFLG =  0 FRFLG =  0
                PQFLAG =  0 WindFREE Enabling Bit = 0
 Q Droop Branch FROM Bus=       0  TO Bus =       0  ID =  1


 **  GEWTT1 **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      ICON
            11118    J285_GEN1 0.6900 1  385277-385281 133221-133224  80717-80719   50831

     H           DAMP          Htfrac       Freq1       DSHAFT
    4.1341       0.0000       0.0000       1.8800       1.5000


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PLANT MODELS

 REPORT FOR ALL MODELS                    BUS 11119 [J285_GEN2   0.6900] MODELS


 ** GEWTG2 **  BUS X-- NAME --X   BASEKV MC  C O N S     S T A T E S        VAR         ICON
             11119    J285_GEN2 0.6900 1  383462-383479 132610-132612  79866-79870   50346-50349

   PRATE        XEQ    VLVPL1    VLVPL2    GLVPL2   VHVRCR2
   1.7900       0.8    0.5000    0.9000    1.2200    1.2000

   CURHVRCR2 VLVACR1   VLVACR2   RIp_LVPL   T_LVPL     LVPL1V
   2.0000    0.4000    0.8000   10.0000    0.0200    0.0000


   LVPL1P   LVPL2V    LVPL2P    LVPL3V     LVPL3P     XLVPL
   0.0000    0.5000    0.1670    0.9000    0.9250    0.0000


 NUMBER OF AGGREGATED ORIGINAL WT UNITS:   70
 WT UNITS USE DFIGs


 ** GEWTE2 OF GEWTG **  BUS X-- NAME --X BASEKV MC       C O N S       S T A T E S     VAR          ICON
                        11119 J285_GEN2    0.6900 1  384669-384735 133011-133028  80408-80416   50653-50664

   TFV      KPV        KIV       RC        XC        TFP       KPP
   0.1500    2.0000    1.0000    0.0000    0.0000    0.0500    3.0000

   KIP       PMX       PMN       QMX      QMN        IPMAX     TRV
   0.6000    1.1200    0.0400    0.4360   -0.4360    1.1000    0.0200

   RPMX      RPMN      T_POWER   KQi      VMINCL     VMAXCL    KVi
   0.4500   -0.4500   60.0000    0.1000    0.9000    1.1000   40.0000

   XIQmin    XIQmax    Tv        Tp       Fn         TPav
   0.5000    1.4500    0.0500    0.0500    1.0000    0.1500

   FRa       FRb       FRc       FRd
   0.9600    0.9960    1.0040    1.0400

   PFRa      PFRb      PFRc      PFRd
   1.0000    1.0000    1.0000    0.4000

   PFRmax    PFRmin    TW        T_LVPL   V_LVPL
   1.0000    0.2000    1.0000    0.2500   -1.0000

   SPDW1     SPDWMX    SPDWMN    SPD_LOW  WTTHRES
  14.0000   25.0000    3.0000   -0.9000    8.0000

   EBST      KDBR      Pdbr_MAX
   0.2000   10.0000    1.0000

   ImaxTD    Iphl      Iqhl      TIpqd      Kqd      Xqd      Kwi
   1.7000    1.2200    1.2500    5.0000    0.0000    0.0000    0.0000

   dbwi      Tipwi     Twowi     urIwi    drIwi    Pmxwi      Pmnwi
   0.0025    1.0000    5.5000    0.1000   -1.0000    0.1000    0.0000

   Vermx     Vermn     Vfrz      QmxZP    QmnZP
   0.1000   -0.1000    0.7000    0.1200   -0.1200


 Remote controlled Bus #     11119
                VARFLG =  1 PFAFLG =  0
                APCFLG =  0 FRFLG =  0
                PQFLAG =  0 WindFREE Enabling Bit = 0
 Q Droop Branch FROM Bus=       0  TO Bus =       0  ID =  1


 **  GEWTT1 **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      ICON
             11119    J285_GEN2 0.6900 1  385282-385286 133225-133228  80720-80722   50832

     H           DAMP          Htfrac       Freq1       DSHAFT
    4.1341       0.0000       0.0000       1.8800       1.5000


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CONEC MODELS

 REPORT FOR ALL MODELS                    BUS 11118 [J285_GEN1   0.6900] MODELS


  ** WGUSTD ** BUS X-- NAME --X     BASEKV MC    C O N S       V A R S        ICONS
```

```
           11118     J285_GEN1    0.6900 1  389826-389831  82559-82562   51560-51562

 T1G          TG       MAXG       T1R      T2R       MAXR
 9999.000     5.000    30.000  9999.000  9999.000    30.000
              Wind generator Bus #  11118
              Wind Generator ID        1


 ** GEWTA1 for GEWTG **      BUS X-- NAME --X BASEKV MC    C O N S        STATE         VAR         ICON
                        11118 J285_GEN1    0.6900 1  389832-389840  134916-134916  82563-82566   51563-51565

     Lambda_Max      Lambda_Min   PITCH_MAX    PITCH_MIN      Ta         RHO
      20.0000       0.0000      27.0000      -4.0000       0.0000       1.2250

       Radius      GB_RATIO        SYNCHR
      50.0000      89.2200        1200.0000


              Wind Generator Bus #  11118
              Wind Generator ID        1


 ** GEWTP1 for GEWTG **  BUS X-- NAME --X BASEKV MC    C O N S         STATE         VAR         ICON
                        11118 J285_GEN1    0.6900 1  389841-389850  134917-134919  82567-82569   51566-51568

       Tp             Kpp        Kip            Kpc           Kic
      0.3000     150.0000      25.0000       3.0000      30.0000
        TetaMin   TetaMax   RTetaMin   RTetaMax    PMX
        -4.0000   27.0000  -10.0000   10.0000    1.0000


              Wind Generator Bus #  11118
              Wind Generator ID        1


  ** GEWPLT ** BUS X-- NAME --X    BASEKV MC       V A R S        ICONS
            11118    J285_GEN1    0.69001       82570-82586   51569-51570


              Wind generator Bus #  11118
              Wind Generator ID        1

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CONEC MODELS

 REPORT FOR ALL MODELS                    BUS 11119 [J285_GEN2   0.6900] MODELS


  ** WGUSTD ** BUS X-- NAME --X     BASEKV MC    C O N S       V A R S        ICONS
            11119     J285_GEN2    0.6900 1  389851-389856  82587-82590   51571-51573

 T1G          TG       MAXG       T1R      T2R       MAXR
 9999.000     5.000    30.000  9999.000  9999.000    30.000
              Wind generator Bus #  11119
              Wind Generator ID        1


 ** GEWTA1 for GEWTG **      BUS X-- NAME --X BASEKV MC    C O N S        STATE         VAR         ICON
                        11119 J285_GEN2    0.6900 1  389857-389865  134920-134920  82591-82594   51574-51576

     Lambda_Max      Lambda_Min   PITCH_MAX    PITCH_MIN      Ta         RHO
      20.0000       0.0000      27.0000      -4.0000       0.0000       1.2250

       Radius      GB_RATIO        SYNCHR
      50.0000      89.2200        1200.0000


              Wind Generator Bus #  11119
              Wind Generator ID        1


 ** GEWTP1 for GEWTG **  BUS X-- NAME --X BASEKV MC    C O N S         STATE         VAR         ICON
                        11119 J285_GEN2    0.6900 1  389866-389875  134921-134923  82595-82597   51577-51579

       Tp             Kpp        Kip            Kpc           Kic
      0.3000     150.0000      25.0000       3.0000      30.0000
        TetaMin   TetaMax   RTetaMin   RTetaMax    PMX
        -4.0000   27.0000  -10.0000   10.0000    1.0000


              Wind Generator Bus #  11119
              Wind Generator ID        1


  ** GEWPLT ** BUS X-- NAME --X    BASEKV MC       V A R S        ICONS
            11119    J285_GEN2    0.69001       82598-82614   51580-51581
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              Wind generator Bus #  11119
              Wind Generator ID       1

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CONET MODELS

 REPORT FOR ALL MODELS                    BUS 11118 [J285_GEN1   0.6900] MODELS


              *** CALL VTGTPA( 51912,390678,     0, 83133) ***

               BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
             11118 J285_GEN.690           11118 J285_GEN.690    1

                 I C O N S      C O N S       S T A T E   V A R
                51912-51917  390678-390681         0     83133

                   VLO       VUP      PICKUP     TB
                   0.200     5.000     1.000     0.080


              *** CALL VTGTPA( 51918,390682,     0, 83134) ***

               BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
             11118 J285_GEN.690           11118 J285_GEN.690    1

                 I C O N S      C O N S       S T A T E   V A R
                51918-51923  390682-390685         0     83134

                   VLO       VUP      PICKUP     TB
                   0.400     5.000     1.700     0.080


              *** CALL VTGTPA( 51924,390686,     0, 83135) ***

               BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
             11118 J285_GEN.690           11118 J285_GEN.690    1

                 I C O N S      C O N S       S T A T E   V A R
                51924-51929  390686-390689         0     83135

                   VLO       VUP      PICKUP     TB
                   0.600     5.000     2.200     0.080


              *** CALL VTGTPA( 51930,390690,     0, 83136) ***

               BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
             11118 J285_GEN.690           11118 J285_GEN.690    1

                 I C O N S      C O N S       S T A T E   V A R
                51930-51935  390690-390693         0     83136

                   VLO       VUP      PICKUP     TB
                   0.750     5.000     3.000     0.080


              *** CALL VTGTPA( 51936,390694,     0, 83137) ***

               BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
             11118 J285_GEN.690           11118 J285_GEN.690    1

                 I C O N S      C O N S       S T A T E   V A R
                51936-51941  390694-390697         0     83137

                   VLO       VUP      PICKUP     TB
                   0.850     5.000    10.000     0.080


              *** CALL VTGTPA( 51942,390698,     0, 83138) ***

               BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
             11118 J285_GEN.690           11118 J285_GEN.690    1

                 I C O N S      C O N S       S T A T E   V A R
                51942-51947  390698-390701         0     83138

                   VLO       VUP      PICKUP     TB
                   0.900     5.000   600.000     0.080


              *** CALL VTGTPA( 51948,390702,     0, 83139) ***

               BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
```

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11118 J285_GEN.690          11118 J285_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    51948-51953  390702-390705         0     83139

       VLO       VUP      PICKUP     TB
       0.000     1.101     1.000     0.080


 *** CALL VTGTPA( 51954,390706,     0, 83140) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11118 J285_GEN.690          11118 J285_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    51954-51959  390706-390709         0     83140

       VLO       VUP      PICKUP     TB
       0.000     1.150     0.500     0.080


 *** CALL VTGTPA( 51960,390710,     0, 83141) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11118 J285_GEN.690          11118 J285_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    51960-51965  390710-390713         0     83141

       VLO       VUP      PICKUP     TB
       0.000     1.175     0.200     0.080


 *** CALL VTGTPA( 51966,390714,     0, 83142) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11118 J285_GEN.690          11118 J285_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    51966-51971  390714-390717         0     83142

       VLO       VUP      PICKUP     TB
       0.000     1.200     0.100     0.080


 *** CALL VTGTPA( 51972,390718,     0, 83143) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11118 J285_GEN.690          11118 J285_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    51972-51977  390718-390721         0     83143

       VLO       VUP      PICKUP     TB
       0.000     1.300     0.010     0.080

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CONET MODELS

 REPORT FOR ALL MODELS                    BUS 11119 [J285_GEN2   0.6900] MODELS


 *** CALL VTGTPA( 51978,390722,     0, 83144) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11119 J285_GEN.690          11119 J285_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    51978-51983  390722-390725         0     83144

       VLO       VUP      PICKUP     TB
       0.200     5.000     1.000     0.080


 *** CALL VTGTPA( 51984,390726,     0, 83145) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11119 J285_GEN.690          11119 J285_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    51984-51989  390726-390729         0     83145

       VLO       VUP      PICKUP     TB
       0.400     5.000     1.700     0.080
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 *** CALL VTGTPA( 51990,390730,     0, 83146) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11119 J285_GEN.690           11119 J285_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    51990-51995  390730-390733         0     83146

       VLO       VUP      PICKUP     TB
       0.600     5.000     2.200     0.080


 *** CALL VTGTPA( 51996,390734,     0, 83147) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11119 J285_GEN.690           11119 J285_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    51996-52001  390734-390737         0     83147

       VLO       VUP      PICKUP     TB
       0.750     5.000     3.000     0.080


 *** CALL VTGTPA( 52002,390738,     0, 83148) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11119 J285_GEN.690           11119 J285_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52002-52007  390738-390741         0     83148

       VLO       VUP      PICKUP     TB
       0.850     5.000    10.000     0.080


 *** CALL VTGTPA( 52008,390742,     0, 83149) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11119 J285_GEN.690           11119 J285_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52008-52013  390742-390745         0     83149

       VLO       VUP      PICKUP     TB
       0.900     5.000   600.000     0.080


 *** CALL VTGTPA( 52014,390746,     0, 83150) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11119 J285_GEN.690           11119 J285_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52014-52019  390746-390749         0     83150

       VLO       VUP      PICKUP     TB
       0.000     1.101     1.000     0.080


 *** CALL VTGTPA( 52020,390750,     0, 83151) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11119 J285_GEN.690           11119 J285_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52020-52025  390750-390753         0     83151

       VLO       VUP      PICKUP     TB
       0.000     1.150     0.500     0.080


 *** CALL VTGTPA( 52026,390754,     0, 83152) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11119 J285_GEN.690           11119 J285_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52026-52031  390754-390757         0     83152

       VLO       VUP      PICKUP     TB
       0.000     1.175     0.200     0.080


 *** CALL VTGTPA( 52032,390758,     0, 83153) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
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11119 J285_GEN.690           11119 J285_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52032-52037  390758-390761         0     83153

       VLO       VUP      PICKUP     TB
       0.000     1.200     0.100     0.080


 *** CALL VTGTPA( 52038,390762,     0, 83154) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11119 J285_GEN.690           11119 J285_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52038-52043  390762-390765         0     83154

       VLO       VUP      PICKUP     TB
       0.000     1.300     0.010     0.080
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J289

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WIND MODELS

 REPORT FOR ALL MODELS                    BUS 635648 [DEY415 W    0.6000] MODELS


 ** W4G2U **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S
            635648 DEY415 W     0.6000 W  349502-349510 124392-124394  61430-61434

     TIqCmd     TIpCmd     VLVPL1      VLVPL2    GLVPL
     0.0100     0.0200     0.4000     -0.1000    1.1100

     VHVRCR    CURHVRCR    RIp_LVPL    T_LVPL
     1.2500     2.0000     2.0000      0.0200


 ** W4E2U **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      I C O N S
            635648 DEY415 W     0.6000 W  357575-357608 127078-127088  63053-63056   32315-32318

     TFV       KPV       KIV       KPP
   0.0000   15.0000    2.0000    0.0800

     KIP       Kf        Tf        QMX        QMN      IPMAX     TRV
   0.0100    0.0000    0.0800    1.0000     -1.2000   1.1000    0.0000

     dPMX      dPMN     T_POWER    KQi      VMINCL     VMAXCL      Kvi
    0.5000   -0.5000    0.0500    0.0100    0.8750     1.1250    55.0000

     Tv        Tp    ImaxTD       Iph1      Iqh1
   0.0500    0.0500    1.1150    1.2500    1.0850


     Tiqf  FRT_Thres FRT_Hys   FRT_Droop  FRT_Iq_Gain
   0.0200    0.8750    0.0500    0.0000    2.0000

     Max_FRT_Iq  IQMax_Fact1  IQMax_Fact2
         1.0000       1.0000       1.0000

     DC_Link_Droop       VinvMax0     NBR_X
            1.0000       1.1000       0.1415


     ICON(M) -  Remote controlled Bus :  635645
   ICON(M+1) -  PFAFLG =  0 (1 if PF fast control is enabled; else 0)
   ICON(M+2) -  VARFLG =  1 (1 if Qcmd is provided by WindVar; else 0)
   ICON(M+3) -  PQFLAG =  0 (1 for P priority, =0 for Q priority)

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CONET MODELS

 REPORT FOR ALL MODELS                    BUS 635645 [MCKSBRG 3   161.00] MODELS


               *** CALL VTGDCA( 47318,378929,     0, 77140) ***

                  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
               635645 MCKSBRG  161          635648 DEY415 W.600    W

                    I C O N S      C O N S       S T A T E   V A R
                   47318-47323  378929-378932        0     77140

                      VLO       VUP      PICKUP     TB
                      0.150     5.000     0.020     0.080


               *** CALL VTGDCA( 47324,378933,     0, 77141) ***

                  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
               635645 MCKSBRG  161          635648 DEY415 W.600    W

                    I C O N S      C O N S       S T A T E   V A R
                   47324-47329  378933-378936        0     77141

                      VLO       VUP      PICKUP     TB
                      0.700     5.000     0.620     0.080


               *** CALL VTGDCA( 47330,378937,     0, 77142) ***

                  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
               635645 MCKSBRG  161          635648 DEY415 W.600    W

                    I C O N S      C O N S       S T A T E   V A R
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     47330-47335  378937-378940         0     77142

        VLO       VUP      PICKUP     TB
        0.750     5.000     1.000     0.080


   *** CALL VTGDCA( 47336,378941,     0, 77143) ***

    BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
635645 MCKSBRG  161          635648 DEY415 W.600    W

      I C O N S      C O N S        S T A T E   V A R
     47336-47341  378941-378944         0     77143

        VLO       VUP      PICKUP     TB
        0.850     5.000    10.000     0.080


   *** CALL VTGDCA( 47342,378945,     0, 77144) ***

    BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
635645 MCKSBRG  161          635648 DEY415 W.600    W

      I C O N S      C O N S        S T A T E   V A R
     47342-47347  378945-378948         0     77144

        VLO       VUP      PICKUP     TB
        0.000     1.100     1.000     0.080


   *** CALL VTGDCA( 47348,378949,     0, 77145) ***

    BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
635645 MCKSBRG  161          635648 DEY415 W.600    W

      I C O N S      C O N S        S T A T E   V A R
     47348-47353  378949-378952         0     77145

        VLO       VUP      PICKUP     TB
        0.000     1.150     0.100     0.080


   *** CALL VTGDCA( 47354,378953,     0, 77146) ***

    BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
635645 MCKSBRG  161          635648 DEY415 W.600    W

      I C O N S      C O N S        S T A T E   V A R
     47354-47359  378953-378956         0     77146

        VLO       VUP      PICKUP     TB
        0.000     1.300     0.020     0.080

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CONET MODELS

 REPORT FOR ALL MODELS                    BUS 635648 [DEY415 W    0.6000] MODELS


   *** CALL FRQDCA( 47360,378957,     0, 77147) ***

    BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
635648  DEY415 W  .600       635648  DEY415 W  .600    W

      I C O N S      C O N S        S T A T E   V A R
     47360-47365  378957-378960         0     77147

        FLO       FUP      PICKUP     TB
       56.500    66.000     0.020     0.080


   *** CALL FRQDCA( 47366,378961,     0, 77148) ***

    BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
635648  DEY415 W  .600       635648  DEY415 W  .600    W

      I C O N S      C O N S        S T A T E   V A R
     47366-47371  378961-378964         0     77148

        FLO       FUP      PICKUP     TB
       57.500    66.000    10.000     0.080


   *** CALL FRQDCA( 47372,378965,     0, 77149) ***

    BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
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```
635648  DEY415 W  .600      635648  DEY415 W  .600    W

      I C O N S      C O N S       S T A T E   V A R
     47372-47377  378965-378968         0     77149

        FLO       FUP      PICKUP     TB
       54.000    61.500    30.000     0.080


  *** CALL FRQDCA( 47378,378969,     0, 77150) ***

   BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
635648  DEY415 W  .600      635648  DEY415 W  .600    W

      I C O N S      C O N S       S T A T E   V A R
     47378-47383  378969-378972         0     77150

        FLO       FUP      PICKUP     TB
       54.000    62.500     0.020     0.080
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J316

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PLANT MODELS

 REPORT FOR ALL MODELS                    BUS 11115 [J316_GEN    0.6900] MODELS


 ** GEWTG1 **  BUS X-- NAME --X   BASEKV MC  C O N S     S T A T E S        VAR         ICON
            11115    J316_GEN  0.6900 1  383480-383490 132613-132615  79871-79875   50350-50351

   PRATE        XEQ    VLVPL1    VLVPL2    GLVPL2
   1.7000       0.8    0.5000    0.9000    1.2200

   VHVRCR2   CURHVRCR2 VLVACR1   VLVACR2   RIp_LVPL   T_LVPL
   1.2000    2.0000    0.4000    0.8000   10.0000    0.0200


 NUMBER OF AGGREGATED ORIGINAL WT UNITS:   89


 ** GEWTE1 OF GEWTG **  BUS X-- NAME --X BASEKV MC       C O N S       S T A T E S     VAR          ICON
                        11115 J316_GEN     0.6900 1  384736-384797 133029-133046  80417-80423   50665-50674

   TFV      KPV        KIV       RC        XC        TFP       KPP
   0.1500   18.0000    5.0000    0.0000    0.0000    0.0500    3.0000

   KIP       PMX       PMN       QMX       QMN       IPMAX     TRV
   0.6000    1.1200    0.0400    0.4360   -0.4360    1.1000    0.0200

   RPMX      RPMN      T_POWER   KQi       VMINCL    VMAXCL    KVi
   0.4500   -0.4500   60.0000    0.1000    0.9000    1.1000   40.0000

   XIQmin    XIQmax    Tv        Tp        Fn        TPav
   0.5000    1.4500    0.0500    0.0500    1.0000    0.1500

   FRa       FRb       FRc       FRd
   0.9600    0.9960    1.0040    1.0400

   PFRa      PFRb      PFRc      PFRd
   1.0000    1.0000    1.0000    0.4000

   PFRmax    PFRmin    TW        T_LVPL    V_LVPL
   1.0000    0.2000    1.0000    0.2500   -1.0000

   SPDW1     SPDWMX    SPDWMN    SPD_LOW   WTTHRES
  14.0000   25.0000    3.0000   -0.9000    8.0000

   EBST      KDBR      Pdbr_MAX
   0.2000   10.0000    1.0000

   ImaxTD    Iphl      Iqhl      TIpqd      Kqd       Xqd       Kwi
   1.7000    1.2200    1.2500    5.0000    0.0000    0.0000   10.0000

   dbwi      Tipwi     Twowi     urIwi     drIwi     Pmxwi     Pmnwi
   0.0025    1.0000    5.5000    0.1000   -1.0000    0.1000    0.0000


 Remote controlled Bus #     11115
                VARFLG =  1 PFAFLG =  0
                APCFLG =  0 FRFLG =  0
                PQFLAG =  0
 Q Droop Branch FROM Bus=       0  TO Bus =       0  ID =  0


 **  GEWTT **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      ICON
            11115    J316_GEN  0.6900 1  385287-385291 133229-133232  80723-80725   50833

     H           DAMP          Htfrac       Freq1       DSHAFT
    4.3600       0.0000       0.0000       1.8800       2.3000


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CONEC MODELS

 REPORT FOR ALL MODELS                    BUS 11115 [J316_GEN    0.6900] MODELS


  ** WGUSTC ** BUS X-- NAME --X     BASEKV MC    C O N S       V A R S        ICONS
            11115     J316_GEN     0.6900 1  389876-389881  82615-82618   51582-51584

  T1G          TG       MAXG       T1R      T2R       MAXR
  9999.000     5.000    30.000  9999.000  9999.000    30.000
               Wind generator Bus #  11115
               Wind Generator ID        1
```

```
** GEWTA for GEWTG **      BUS X-- NAME --X BASEKV MC    C O N S        STATE         VAR         ICON
                        11115 J316_GEN     0.6900 1  389882-389890  134924-134924  82619-82622   51585-51587

    Lambda_Max      Lambda_Min   PITCH_MAX    PITCH_MIN      Ta         RHO
     20.0000       0.0000      27.0000      -4.0000       0.0000       1.2250

      Radius      GB_RATIO        SYNCHR
     48.7000      89.2200        1200.0000


             Wind Generator Bus #  11115
             Wind Generator ID        1


** GEWTP for GEWTG **  BUS X-- NAME --X BASEKV MC    C O N S         STATE         VAR         ICON
                        11115 J316_GEN     0.6900 1  389891-389900  134925-134927  82623-82625   51588-51590

       Tp             Kpp        Kip           Kpc           Kic
      0.3000     150.0000      25.0000       3.0000      30.0000
        TetaMin   TetaMax   RTetaMin   RTetaMax    PMX
        -4.0000   27.0000  -10.0000   10.0000    1.0000


             Wind Generator Bus #  11115
             Wind Generator ID        1


 ** GEWTPT ** BUS X-- NAME --X    BASEKV MC       V A R S        ICONS
           11115    J316_GEN     0.69001       82626-82642   51591-51592


             Wind generator Bus #  11115
             Wind Generator ID        1

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CONET MODELS

 REPORT FOR ALL MODELS                    BUS 11115 [J316_GEN    0.6900] MODELS


              *** CALL VTGDCA( 52044,390766,     0, 83155) ***

                BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
              11115 J316_GEN.690           11115 J316_GEN.690    1

                  I C O N S      C O N S        S T A T E   V A R
                 52044-52049  390766-390769         0     83155

                    VLO       VUP      PICKUP     TB
                    0.150     5.000     0.200     0.080


              *** CALL VTGDCA( 52050,390770,     0, 83156) ***

                BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
              11115 J316_GEN.690           11115 J316_GEN.690    1

                  I C O N S      C O N S        S T A T E   V A R
                 52050-52055  390770-390773         0     83156

                    VLO       VUP      PICKUP     TB
                    0.300     5.000     0.700     0.080


              *** CALL VTGDCA( 52056,390774,     0, 83157) ***

                BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
              11115 J316_GEN.690           11115 J316_GEN.690    1

                  I C O N S      C O N S        S T A T E   V A R
                 52056-52061  390774-390777         0     83157

                    VLO       VUP      PICKUP     TB
                    0.500     5.000     1.200     0.080


              *** CALL VTGDCA( 52062,390778,     0, 83158) ***

                BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
              11115 J316_GEN.690           11115 J316_GEN.690    1

                  I C O N S      C O N S        S T A T E   V A R
                 52062-52067  390778-390781         0     83158
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      VLO       VUP      PICKUP     TB
      0.750     5.000     1.900     0.080


 *** CALL VTGDCA( 52068,390782,     0, 83159) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11115 J316_GEN.690           11115 J316_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52068-52073  390782-390785         0     83159

      VLO       VUP      PICKUP     TB
      0.000     1.100     1.000     0.080


 *** CALL VTGDCA( 52074,390786,     0, 83160) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11115 J316_GEN.690           11115 J316_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52074-52079  390786-390789         0     83160

      VLO       VUP      PICKUP     TB
      0.000     1.150     0.100     0.080
```

J320

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PLANT MODELS

 REPORT FOR ALL MODELS                    BUS 600065 [HBR C71G    18.000] MODELS


 ** GENROE **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
            600065 HBR C71G     18.000 7   96027-96040   37805-37810

             MBASE     Z S O R C E         X T R A N       GENTAP
             231.8  0.00070+J 0.14700  0.00000+J 0.00000  0.00000

  T'D0 T''D0  T'Q0 T''Q0     H   DAMP   XD     XQ     X'D    X'Q   X''D    XL
 11.80 0.012  0.33 0.086   5.50  0.00 1.9400 1.8900 0.1970 0.3500 0.1470 0.1080

                              S(1.0)  S(1.2)
                              0.1640  0.6970


 ** PSS2B  **   BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      I C O N S
            600065 HBR C71G     18.000 7  132899-132921  62660-62676   23947-23950   11009-11014

                    IC1 REMBUS1     IC2 REMBUS2       M       N
                      1       0       3       0       5       1

       TW1      TW2      T6       TW3      TW4      T7       KS2      KS3
      8.000    8.000    0.000    8.000    0.000    8.000    0.727    1.000

       T8       T9      KS1       T1       T2       T3       T4       T10      T11
      0.500    0.100    3.000    0.100    0.020    0.100    0.020    0.100    0.020

       VS1MAX   VS1MIN   VS2MAX   VS2MIN    VSTMAX   VSTMIN
      2.000    -2.000    2.000    -2.000    0.050   -0.050


 **   AC8B **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S
            600065 HBR C71G     18.000 7  235005-235025  92029-92033   28836-28838

        TR           KPR           KIR          KDR          TDR        VPIDMAX       VPIDMIN
       0.0000     250.0000      10.0000      50.0000       0.0500      21.3000     -21.3000

        KA           TA           VRMAX        VRMIN         KC           KD
       2.5000       0.0050      21.3000     -21.3000       0.1000       2.0000

        KE           TE           VFEMAX       VEMIN
       1.0000       0.9000      99.0000     -99.0000

       E1           S(E1)         E2           S(E2)
       3.8250       0.1000        5.1000       0.2500


 ** GAST **    BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     VAR
            600065 HBR C71G     18.000 7  320840-320848 118718-118720  50981

       R      T1     T2      T3   LOAD LIM   KT     VMAX    VMIN     DT
     0.040  0.400  0.100   5.000   0.851   2.000   1.200   0.000   0.000


 **  LCFB1 **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      I C O N S
            600065 HBR C71G     18.000 7  332013-332019 122545-122546  54205-54207   16971-16972

     FB   TPELEC    DB     EMAX     KP     KI      LRMAX
   0.010  20.000   0.005   0.025   0.500   0.050   0.050

              ICON(M)=       1 (FREQUENCY BIAS FLAG)
              ICON(M+1)=     1 (POWER CONTROLLER FLAG)

------------------------------------------------------------------------------

PLANT MODELS

 REPORT FOR ALL MODELS                    BUS 600066 [HBR C72G    18.000] MODELS


 ** GENROE **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
            600066 HBR C72G     18.000 8   96041-96054   37811-37816

             MBASE     Z S O R C E         X T R A N       GENTAP
             231.8  0.00070+J 0.14700  0.00000+J 0.00000  0.00000

  T'D0 T''D0  T'Q0 T''Q0     H   DAMP   XD     XQ     X'D    X'Q   X''D    XL
 11.80 0.012  0.33 0.086   5.50  0.00 1.9400 1.8900 0.1970 0.3500 0.1470 0.1080

                              S(1.0)  S(1.2)
                              0.1640  0.6970
```

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 ** PSS2B  **   BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      I C O N S
            600066 HBR C72G     18.000 8  132922-132944  62677-62693   23951-23954   11015-11020

                     IC1 REMBUS1     IC2 REMBUS2       M       N
                       1       0       3       0       5       1

       TW1      TW2      T6       TW3      TW4      T7       KS2      KS3
      8.000    8.000    0.000    8.000    0.000    8.000    0.727    1.000

       T8       T9      KS1       T1       T2       T3       T4       T10      T11
      0.500    0.100    3.000    0.100    0.020    0.100    0.020    0.100    0.020

       VS1MAX   VS1MIN   VS2MAX   VS2MIN    VSTMAX   VSTMIN
      2.000    -2.000    2.000    -2.000    0.050   -0.050


 **   AC8B **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S
            600066 HBR C72G     18.000 8  235026-235046  92034-92038   28839-28841

        TR           KPR           KIR          KDR          TDR        VPIDMAX       VPIDMIN
       0.0000     250.0000      10.0000      50.0000       0.0500      21.3000     -21.3000

        KA           TA           VRMAX        VRMIN         KC           KD
       2.5000       0.0050      21.3000     -21.3000       0.1000       2.0000

        KE           TE           VFEMAX       VEMIN
       1.0000       0.9000      99.0000     -99.0000

       E1           S(E1)         E2           S(E2)
       3.8250       0.1000        5.1000       0.2500


 ** GAST **    BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     VAR
            600066 HBR C72G     18.000 8  320849-320857 118721-118723  50982

       R      T1     T2      T3   LOAD LIM   KT     VMAX    VMIN     DT
     0.040  0.400  0.100   5.000   0.851   2.000   1.200   0.000   0.000


 **  LCFB1 **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      I C O N S
            600066 HBR C72G     18.000 8  332020-332026 122547-122548  54208-54210   16973-16974

     FB   TPELEC    DB     EMAX     KP     KI      LRMAX
   0.010  20.000   0.005   0.025   0.500   0.050   0.050

              ICON(M)=       1 (FREQUENCY BIAS FLAG)
              ICON(M+1)=     1 (POWER CONTROLLER FLAG)

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PLANT MODELS

 REPORT FOR ALL MODELS                    BUS 600067 [HBR S73G    13.800] MODELS


 ** GENROE **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
            600067 HBR S73G     13.800 9   96055-96068   37817-37822

             MBASE     Z S O R C E         X T R A N       GENTAP
             294.1  0.00000+J 0.25000  0.00000+J 0.00000  0.00000

  T'D0 T''D0  T'Q0 T''Q0     H    DAMP   XD     XQ     X'D    X'Q   X''D    XL
  7.90 0.043  0.88 0.070   4.41  0.00 2.2400 2.1800 0.3000 0.4900 0.2500 0.1800

                               S(1.0)  S(1.2)
                               0.1063  0.4844


 ** PSS2B  **   BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      I C O N S
            600067 HBR S73G     13.800 9  132945-132967  62694-62710   23955-23958   11021-11026

                     IC1 REMBUS1     IC2 REMBUS2       M       N
                       1       0       3       0       5       1

       TW1      TW2      T6       TW3      TW4      T7       KS2      KS3
     12.000   12.000    0.000   12.000    0.000   12.000    1.361    1.000

       T8       T9      KS1       T1       T2       T3       T4       T10      T11
      0.500    0.100    3.000    0.170    0.045    0.170    0.045    0.170    0.045

       VS1MAX   VS1MIN   VS2MAX   VS2MIN    VSTMAX   VSTMIN
      2.000    -2.000    2.000    -2.000    0.050   -0.050


 **   AC8B **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S
            600067 HBR S73G     13.800 9  235047-235067  92039-92043   28842-28844
```

```
       TR          KPR          KIR          KDR          TDR        VPIDMAX       VPIDMIN
      0.0000     250.0000      10.0000      50.0000       0.0500      16.2000     -16.2000

       KA          TA          VRMAX        VRMIN        KC           KD
      2.3330       0.0050      16.2000     -16.2000       0.1000       0.6000

       KE          TE          VFEMAX       VEMIN
      1.0000       1.0000      99.0000     -99.0000

      E1          S(E1)        E2          S(E2)
      3.0000       0.1500       4.0000       0.5500


 ** IEEEG1 **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S
           600067 HBR S73G     13.800 9  320858-320877 118724-118729  50983-50984

     K      T1      T2      T3     UO      UC    PMAX   PMIN     T4      K1
   20.00   0.000   0.000   0.500  0.100  -0.100 0.8160 0.0000   0.300   0.400

    K2      T5      K3      K4      T6      K5      K6      T7      K7      K8
  0.000   7.000   0.300   0.000   0.000   0.300   0.000   0.000   0.000   0.000

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CONET MODELS

 REPORT FOR ALL MODELS                    BUS 600065 [HBR C71G    18.000] MODELS


                    *** CALL LOEXR1(371121, 74669, 36378) ***

 ** LOEXR1 **  BUS X-- NAME --X BASEKV  MACH    C O N S       V A R S      I C O N S
           600065 HBR C71G     18.000  '7 ' 371121-371134  74669-74674   36378-36388

      CY1   REACH1   ANGLE1    DIST1      CY2   REACH2   ANGLE2    DIST2
   12.000    1.940   90.000   -0.890    0.000    0.000    0.000    0.000

         CY3   REACH3   ANGLE3    DIST3           VOLPIC  SELF TB
       0.000    0.000    0.000    0.000           10.000    2.000

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CONET MODELS

 REPORT FOR ALL MODELS                    BUS 600066 [HBR C72G    18.000] MODELS


                    *** CALL LOEXR1(371135, 74675, 36389) ***

 ** LOEXR1 **  BUS X-- NAME --X BASEKV  MACH    C O N S       V A R S      I C O N S
           600066 HBR C72G     18.000  '8 ' 371135-371148  74675-74680   36389-36399

      CY1   REACH1   ANGLE1    DIST1      CY2   REACH2   ANGLE2    DIST2
   12.000    1.940   90.000   -0.890    0.000    0.000    0.000    0.000

         CY3   REACH3   ANGLE3    DIST3           VOLPIC  SELF TB
       0.000    0.000    0.000    0.000           10.000    2.000

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CONET MODELS

 REPORT FOR ALL MODELS                    BUS 600067 [HBR S73G    13.800] MODELS


                    *** CALL LOEXR1(371149, 74681, 36400) ***

 ** LOEXR1 **  BUS X-- NAME --X BASEKV  MACH    C O N S       V A R S      I C O N S
           600067 HBR S73G     13.800  '9 ' 371149-371162  74681-74686   36400-36410

      CY1   REACH1   ANGLE1    DIST1      CY2   REACH2   ANGLE2    DIST2
   12.000    2.240   90.000   -0.990    0.000    0.000    0.000    0.000

         CY3   REACH3   ANGLE3    DIST3           VOLPIC  SELF TB
       0.000    0.000    0.000    0.000           10.000    2.000
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J329

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PLANT MODELS

 REPORT FOR ALL MODELS                    BUS 638067 [RRHP_1_9    13.800] MODELS


 ** GENSAL **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
           638067 RRHP_1_9     13.800 1  383491-383502 132616-132620

            MBASE     Z S O R C E         X T R A N       GENTAP
             29.0  0.00618+J 0.25000  0.00000+J 0.00000  1.00000

   T'D0   T''D0   T''Q0     H    DAMP    XD      XQ      X'D    X''D     XL
  3.030   0.040   0.090   3.08   0.00  0.8800  0.6100  0.3500  0.2500  0.1660

                             S(1.0)  S(1.2)
                             0.0300  0.2200


 ** PSS2B  **   BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      I C O N S
           638067 RRHP_1_9     13.800 1  383690-383712 132729-132745  79917-79920   50388-50393

                   IC1 REMBUS1     IC2 REMBUS2       M       N
                     1       0       3       0       4       1

       TW1      TW2      T6       TW3      TW4      T7       KS2      KS3
     3.000    3.000    0.000    3.000    3.000    3.000    0.490    1.000

       T8       T9      KS1       T1       T2       T3       T4       T10      T11
     0.400    0.100   15.000    0.140    0.010    0.140    0.010    1.000    1.000

      VS1MAX   VS1MIN   VS2MAX   VS2MIN    VSTMAX   VSTMIN
    99.000   -99.000   99.000   -99.000    0.050   -0.050


 **   ST6B **  BUS X-- NAME --X BASEKV MC    C O N S     I C O N     S T A T E S     V A R S
           638067 RRHP_1_9     13.800 1  384798-384813    50675   133047-133050  80424-80426

   OEL OPTION
         1

        TR           KPA           KIA           KDA        TDA          VAMAX         VAMIN
      0.0200       36.7500       10.5000        0.0000       0.0000        2.4231       -2.1304

       KFF           KM            KCI          KLR          ILR          VRMAX         VRMIN
      0.0000        1.0000        1.0000       12.3000        2.2900        2.4231       -2.1304

       KG            TG
      0.0000        0.1000


 ** HYGOV **   BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S
           638067 RRHP_1_9     13.800 1  385292-385303 133233-133236  80726-80727

  R-PERM R-TEMP   TR    TF    TG    VELM  GMAX  GMIN   TW    AT   DTURB   QNL
   0.050  0.670  3.00 0.100 0.200  0.100  1.00  0.00  5.70  1.29   0.00   0.250

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PLANT MODELS

 REPORT FOR ALL MODELS                    BUS 638068 [RRHP_2_9    13.800] MODELS


 ** GENSAL **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S
           638068 RRHP_2_9     13.800 2  383503-383514 132621-132625

            MBASE     Z S O R C E         X T R A N       GENTAP
             29.0  0.00618+J 0.25000  0.00000+J 0.00000  1.00000

   T'D0   T''D0   T''Q0     H    DAMP    XD      XQ      X'D    X''D     XL
  3.030   0.040   0.090   3.08   0.00  0.8800  0.6100  0.3500  0.2500  0.1660

                             S(1.0)  S(1.2)
                             0.0300  0.2200


 ** PSS2B  **   BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      I C O N S
           638068 RRHP_2_9     13.800 2  383713-383735 132746-132762  79921-79924   50394-50399

                   IC1 REMBUS1     IC2 REMBUS2       M       N
                     1       0       3       0       4       1

       TW1      TW2      T6       TW3      TW4      T7       KS2      KS3
     3.000    3.000    0.000    3.000    3.000    3.000    0.490    1.000
```

```
      T8       T9      KS1       T1       T2       T3       T4      T10      T11
   0.400    0.100   15.000    0.140    0.010    0.140    0.010    1.000    1.000

     VS1MAX   VS1MIN   VS2MAX   VS2MIN    VSTMAX   VSTMIN
   99.000   -99.000   99.000   -99.000    0.050   -0.050


**   ST6B **  BUS X-- NAME --X BASEKV MC    C O N S     I C O N     S T A T E S     V A R S
          638068 RRHP_2_9     13.800 2  384814-384829    50676   133051-133054  80427-80429

  OEL OPTION
        1

       TR           KPA           KIA           KDA        TDA          VAMAX         VAMIN
   0.0200       36.7500       10.5000        0.0000     0.0000         2.4231       -2.1304

      KFF           KM            KCI          KLR        ILR          VRMAX         VRMIN
   0.0000        1.0000        1.0000       12.3000     2.2900         2.4231       -2.1304

      KG            TG
   0.0000        0.1000


** HYGOV **   BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S
          638068 RRHP_2_9     13.800 2  385304-385315 133237-133240  80728-80729

 R-PERM R-TEMP   TR    TF    TG    VELM  GMAX  GMIN   TW    AT   DTURB   QNL
  0.050  0.670  3.00 0.100 0.200  0.100  1.00  0.00  5.70  1.29   0.00   0.250
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J343

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WIND MODELS

 REPORT FOR ALL MODELS                    BUS 11133 [J343_GEN    0.6900] MODELS


 ** SWTGU1 **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      I C O N S
            11133 J343_GEN     0.6900 1  402349-402353 139084-139085  84756-84763       0-

     TIpCmd     TIqCmd     RIp_LVPL   IPHmax      Tnc
     0.0100     0.0100     2.0000     1.2000      0.1100


 ** SWTEU1 **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      I C O N S
            11133 J343_GEN     0.6900 1  402359-402403 139088-139094  84772-84791   53741-53746

           TRV                       KPV                       KIV
           0.0000                    0.0370                    9.9800

           Tp                        T_Power                   PdMX
           0.0500                    1.0000                    1.0000

           PdMN                      PBoost                 VolBoostOut_Low
           0.0000                    0.0500                    0.9500

           BoostInHys_Low      VolBoostOut_High           BoostInHys_High
           0.0300                    1.0800                    0.0300

           PBoost_OutTime         PBoost_InTime             dPow_PosRate
          15.0000                   15.0000                   0.2174

           dPow_NegRate              Iphl                      ImaxTD
          -0.2174                    1.2500                    1.1871

           IPmax                     Iqhl                    IQMax_Fact1
           1.2000                    1.0733                    0.9880

           IQMax_Fact2            DC_Link_Droop               VinvMax0
           1.0290                    1.0000                    1.1021

           NBR_X                     Tiqf                     FRT_Thres
           0.1415                    0.0200                    0.8750

           FRT_Hys                  Itot_FRT                 Max_FRT_Iq
           0.0500                    1.1111                    1.0000

           dIQMAX_PosRate        dIQMAX_NegRate              FRT_Droop
          20.0000                   -20.0000                   0.0000

           FRT_Iq_Gain               Ip_LF_dip                DTPowStep
           2.0000                    0.9000                    -5.0000

           DTPowStepDelay      DTPowStepActivation         DTPowStepTime
           0.1900                    0.9750                    7.5000

           A_SecOrd                  B_SecOrd                  C_SecOrd
           0.0000                    0.0000                  134.5600

           D_SecOrd                  E_SecOrd                  F_SecOrd
           1.0000                    0.5800                  134.5600


   ICON(M)   -  Boost Control =  2 (=0 if Normal;  =1 if Power Boost; =2 if Power+ Type Turbine)
   ICON(M+1) -  PFAFLG =  0 (=0 if ReactivPower Control; =1 if PowerFactor Control) Not Tested & Available for
Siemens Wind Turbines
   ICON(M+2) -  VARFLG =  1 (Always VARFLG = 1) Use Always Local Voltage Control for Siemens Wind Turbines
   ICON(M+3) -  FRT_Mode =  1 (=1 if Normal FRT Mode; =2 if UK FRT Mode)
   ICON(M+4) -  Voltage Ref Flag =  0 (=0 if Local WT Control; =1 if HPPP Control)
   ICON(M+5) -  WGO Control =  0 (=0 if Disabled; =1 if Enabled)


--------------------------------------------------------------------------------

CONET MODELS

 REPORT FOR ALL MODELS                    BUS 11133 [J343_GEN    0.6900] MODELS


              *** CALL VTGTPA( 52080,390790,     0, 83161) ***

               BUS    NAME  BSKV        GENR BUS    NAME  BSKV   ID
             11133 J343_GEN.690           11133 J343_GEN.690    1

                  I C O N S      C O N S       S T A T E   V A R
```

```
    52080-52085  390790-390793         0     83161

       VLO       VUP      PICKUP     TB
       0.900     5.000   200.000     0.050


 *** CALL VTGTPA( 52086,390794,     0, 83162) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11133 J343_GEN.690           11133 J343_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52086-52091  390794-390797         0     83162

       VLO       VUP      PICKUP     TB
       0.850     5.000     3.000     0.050


 *** CALL VTGTPA( 52092,390798,     0, 83163) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11133 J343_GEN.690           11133 J343_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52092-52097  390798-390801         0     83163

       VLO       VUP      PICKUP     TB
       0.700     5.000     2.600     0.050


 *** CALL VTGTPA( 52098,390802,     0, 83164) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11133 J343_GEN.690           11133 J343_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52098-52103  390802-390805         0     83164

       VLO       VUP      PICKUP     TB
       0.400     5.000     1.600     0.050


 *** CALL VTGTPA( 52104,390806,     0, 83165) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11133 J343_GEN.690           11133 J343_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52104-52109  390806-390809         0     83165

       VLO       VUP      PICKUP     TB
       0.150     5.000     0.850     0.050


 *** CALL VTGTPA( 52110,390810,     0, 83166) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11133 J343_GEN.690           11133 J343_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52110-52115  390810-390813         0     83166

       VLO       VUP      PICKUP     TB
       0.000     1.100     1.000     0.050


 *** CALL VTGTPA( 52116,390814,     0, 83167) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11133 J343_GEN.690           11133 J343_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52116-52121  390814-390817         0     83167

       VLO       VUP      PICKUP     TB
       0.000     1.200     0.150     0.050


 *** CALL FRQTPA( 52122,390818,     0, 83168) ***

  BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
11133  J343_GEN  .690       11133  J343_GEN  .690    1

     I C O N S      C O N S        S T A T E   V A R
    52122-52127  390818-390821         0     83168

       FLO       FUP      PICKUP     TB
```

```
      57.000   100.000     0.200     0.000


 *** CALL FRQTPA( 52128,390822,     0, 83169) ***

  BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
11133  J343_GEN  .690       11133  J343_GEN  .690    1

     I C O N S      C O N S        S T A T E   V A R
    52128-52133  390822-390825         0     83169

       FLO       FUP      PICKUP     TB
       0.000    62.000     0.200     0.000
```

J344

```
WIND MODELS

 REPORT FOR ALL MODELS                    BUS 11125 [J344_GEN    0.6900] MODELS


 ** SWTGU1 **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      I C O N S
             11125 J344_GEN     0.6900 1  402354-402358 139086-139087  84764-84771       0-

     TIpCmd     TIqCmd     RIp_LVPL   IPHmax      Tnc
     0.0100     0.0100     2.0000     1.2000      0.1100


 ** SWTEU1 **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      I C O N S
             11125 J344_GEN     0.6900 1  402404-402448 139095-139101  84792-84811   53747-53752

           TRV                       KPV                       KIV
           0.0000                    0.0370                    9.9800

           Tp                        T_Power                   PdMX
           0.0500                    1.0000                    1.0000

           PdMN                      PBoost                 VolBoostOut_Low
           0.0000                    0.0500                    0.9500

           BoostInHys_Low      VolBoostOut_High           BoostInHys_High
           0.0300                    1.0800                    0.0300

           PBoost_OutTime         PBoost_InTime             dPow_PosRate
          15.0000                   15.0000                    0.2174

           dPow_NegRate              Iphl                      ImaxTD
          -0.2174                    1.2500                    1.1871

           IPmax                     Iqhl                    IQMax_Fact1
           1.2000                    1.0733                    0.9880

           IQMax_Fact2            DC_Link_Droop               VinvMax0
           1.0290                    1.0000                    1.1021

           NBR_X                     Tiqf                     FRT_Thres
           0.1415                    0.0200                    0.8750

           FRT_Hys                  Itot_FRT                 Max_FRT_Iq
           0.0500                    1.1111                    1.0000

           dIQMAX_PosRate        dIQMAX_NegRate             FRT_Droop
          20.0000                   -20.0000                   0.0000

           FRT_Iq_Gain               Ip_LF_dip                DTPowStep
           2.0000                    0.9000                    -5.0000

           DTPowStepDelay      DTPowStepActivation         DTPowStepTime
           0.1900                    0.9750                    7.5000

           A_SecOrd                  B_SecOrd                  C_SecOrd
           0.0000                    0.0000                  134.5600

           D_SecOrd                  E_SecOrd                  F_SecOrd
           1.0000                    0.5800                  134.5600


   ICON(M)   -  Boost Control =  2 (=0 if Normal;  =1 if Power Boost; =2 if Power+ Type Turbine)
   ICON(M+1) -  PFAFLG =  0 (=0 if ReactivPower Control; =1 if PowerFactor Control) Not Tested & Available for
Siemens Wind Turbines
   ICON(M+2) -  VARFLG =  1 (Always VARFLG = 1) Use Always Local Voltage Control for Siemens Wind Turbines
   ICON(M+3) -  FRT_Mode =  1 (=1 if Normal FRT Mode; =2 if UK FRT Mode)
   ICON(M+4) -  Voltage Ref Flag =  0 (=0 if Local WT Control; =1 if HPPP Control)
   ICON(M+5) -  WGO Control =  0 (=0 if Disabled; =1 if Enabled)


------------------------------------------------------------------------------

CONET MODELS

 REPORT FOR ALL MODELS                    BUS 11125 [J344_GEN    0.6900] MODELS


              *** CALL VTGTPA( 52134,390826,     0, 83170) ***

               BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
             11125 J344_GEN.690           11125 J344_GEN.690    1

                 I C O N S     C O N S       S T A T E   V A R
```

```
    52134-52139  390826-390829         0     83170

       VLO       VUP      PICKUP     TB
       0.900     5.000   200.000     0.050


 *** CALL VTGTPA( 52140,390830,     0, 83171) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11125 J344_GEN.690           11125 J344_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52140-52145  390830-390833         0     83171

       VLO       VUP      PICKUP     TB
       0.850     5.000     3.000     0.050


 *** CALL VTGTPA( 52146,390834,     0, 83172) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11125 J344_GEN.690           11125 J344_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52146-52151  390834-390837         0     83172

       VLO       VUP      PICKUP     TB
       0.700     5.000     2.600     0.050


 *** CALL VTGTPA( 52152,390838,     0, 83173) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11125 J344_GEN.690           11125 J344_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52152-52157  390838-390841         0     83173

       VLO       VUP      PICKUP     TB
       0.400     5.000     1.600     0.050


 *** CALL VTGTPA( 52158,390842,     0, 83174) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11125 J344_GEN.690           11125 J344_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52158-52163  390842-390845         0     83174

       VLO       VUP      PICKUP     TB
       0.150     5.000     0.850     0.050


 *** CALL VTGTPA( 52164,390846,     0, 83175) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11125 J344_GEN.690           11125 J344_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52164-52169  390846-390849         0     83175

       VLO       VUP      PICKUP     TB
       0.000     1.100     1.000     0.050


 *** CALL VTGTPA( 52170,390850,     0, 83176) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
11125 J344_GEN.690           11125 J344_GEN.690    1

     I C O N S      C O N S        S T A T E   V A R
    52170-52175  390850-390853         0     83176

       VLO       VUP      PICKUP     TB
       0.000     1.200     0.150     0.050


 *** CALL FRQTPA( 52176,390854,     0, 83177) ***

  BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
11125  J344_GEN  .690       11125  J344_GEN  .690    1

     I C O N S      C O N S        S T A T E   V A R
    52176-52181  390854-390857         0     83177

       FLO       FUP      PICKUP     TB
```

```
     57.000   100.000     0.200     0.000


 *** CALL FRQTPA( 52182,390858,     0, 83178) ***

  BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
11125  J344_GEN  .690       11125  J344_GEN  .690    1

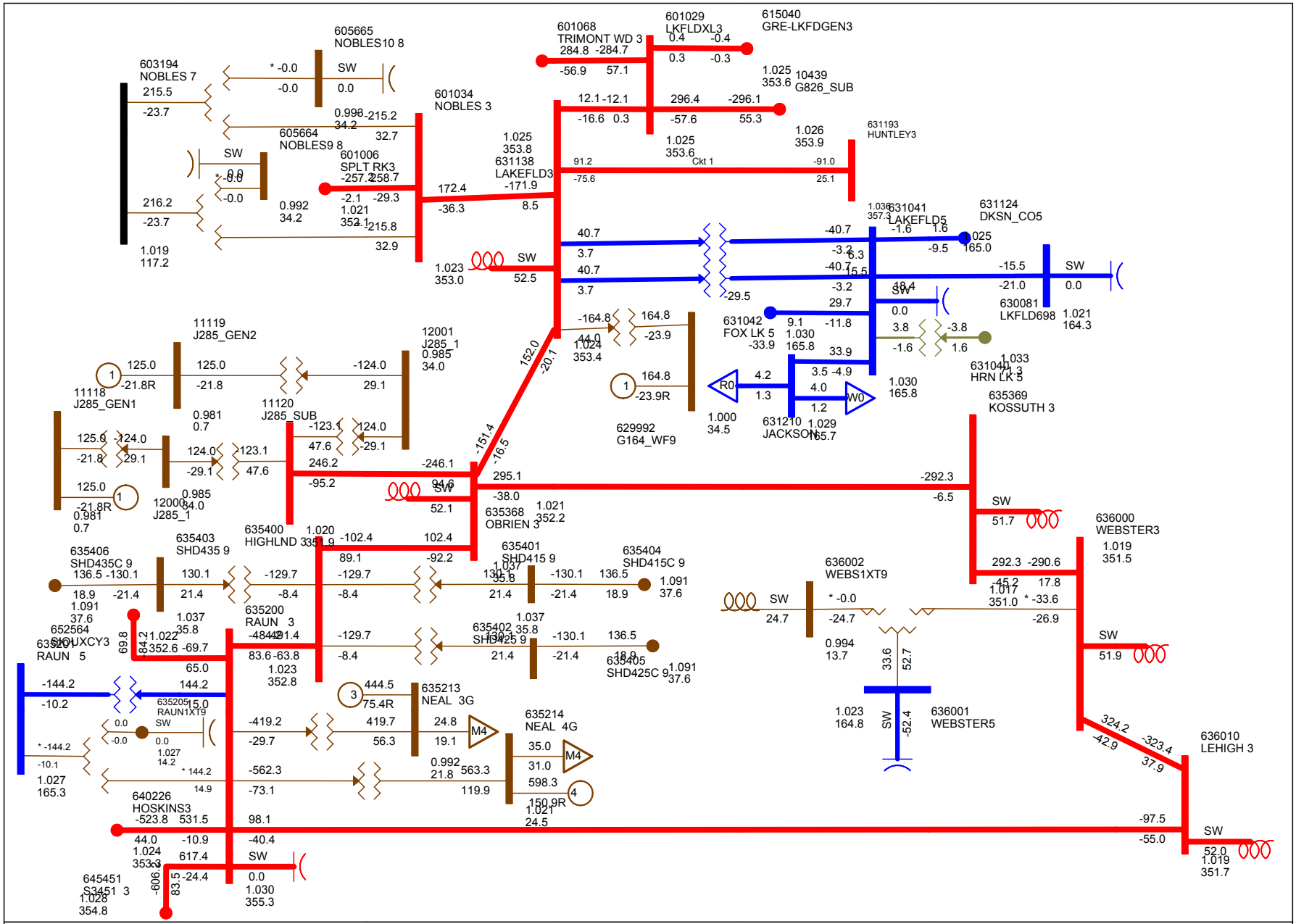
     I C O N S      C O N S        S T A T E   V A R
    52182-52187  390858-390861         0     83178

       FLO       FUP      PICKUP     TB
       0.000    62.000     0.200     0.000
```

B.3 Slider Diagrams

B.3.1 2017 Slider Diagrams

PUBLIC DOCUMENT
NOT PUBLIC (OR PRIVILEGED) DATA HAS BEEN EXCISED

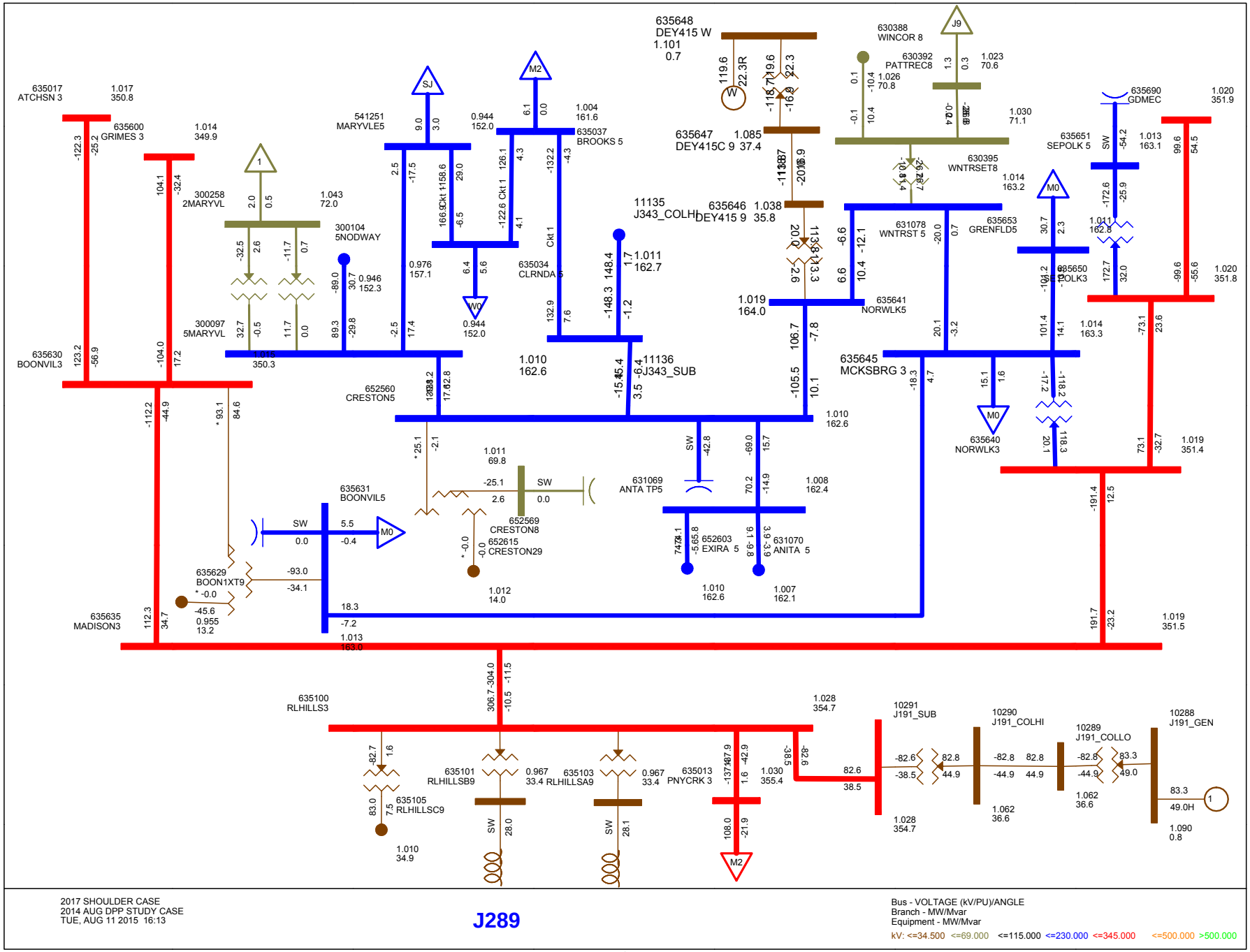


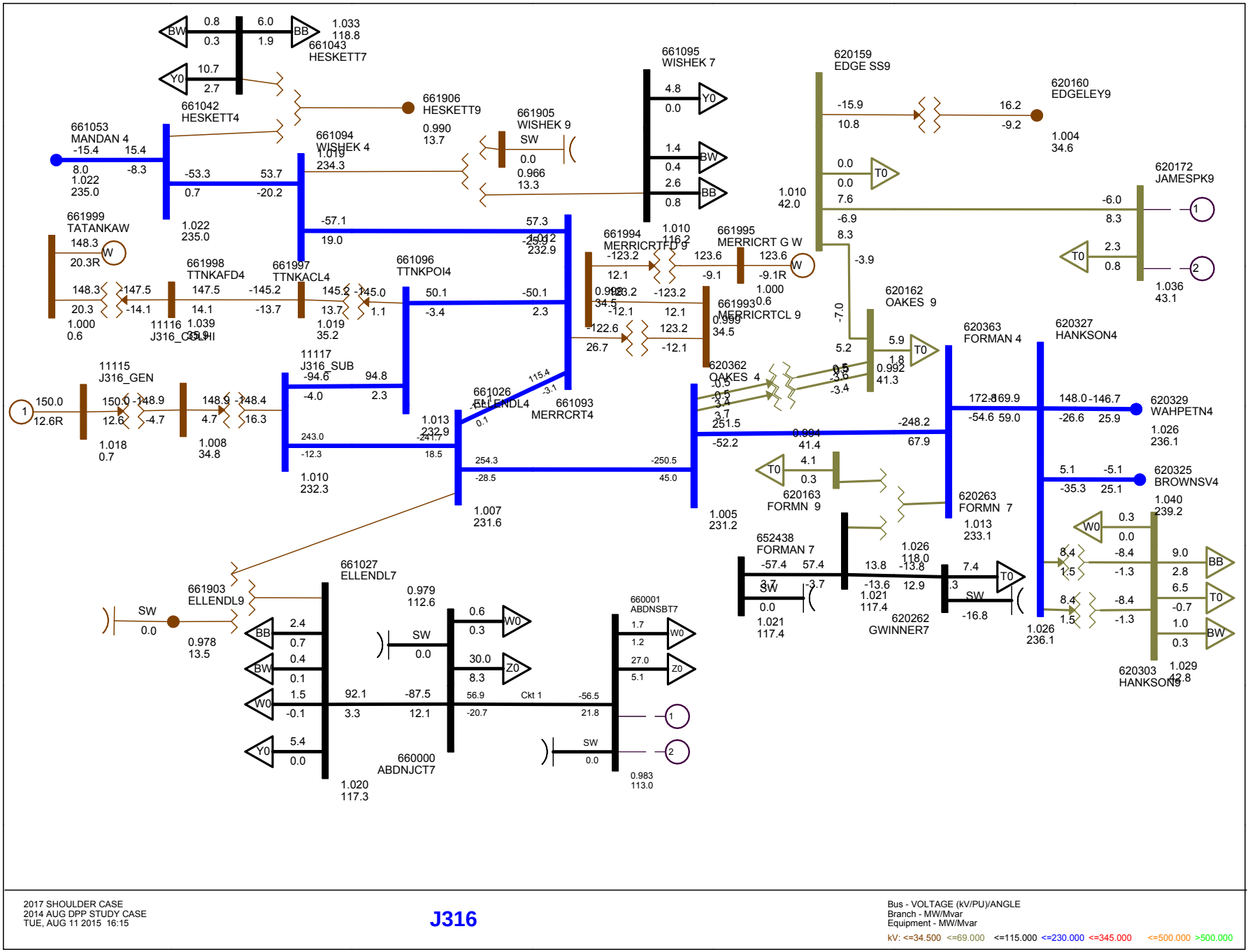
2017 SHOULDER CASE
2014 AUG DPP STUDY CASE
TUE, AUG 11 2015 16:09

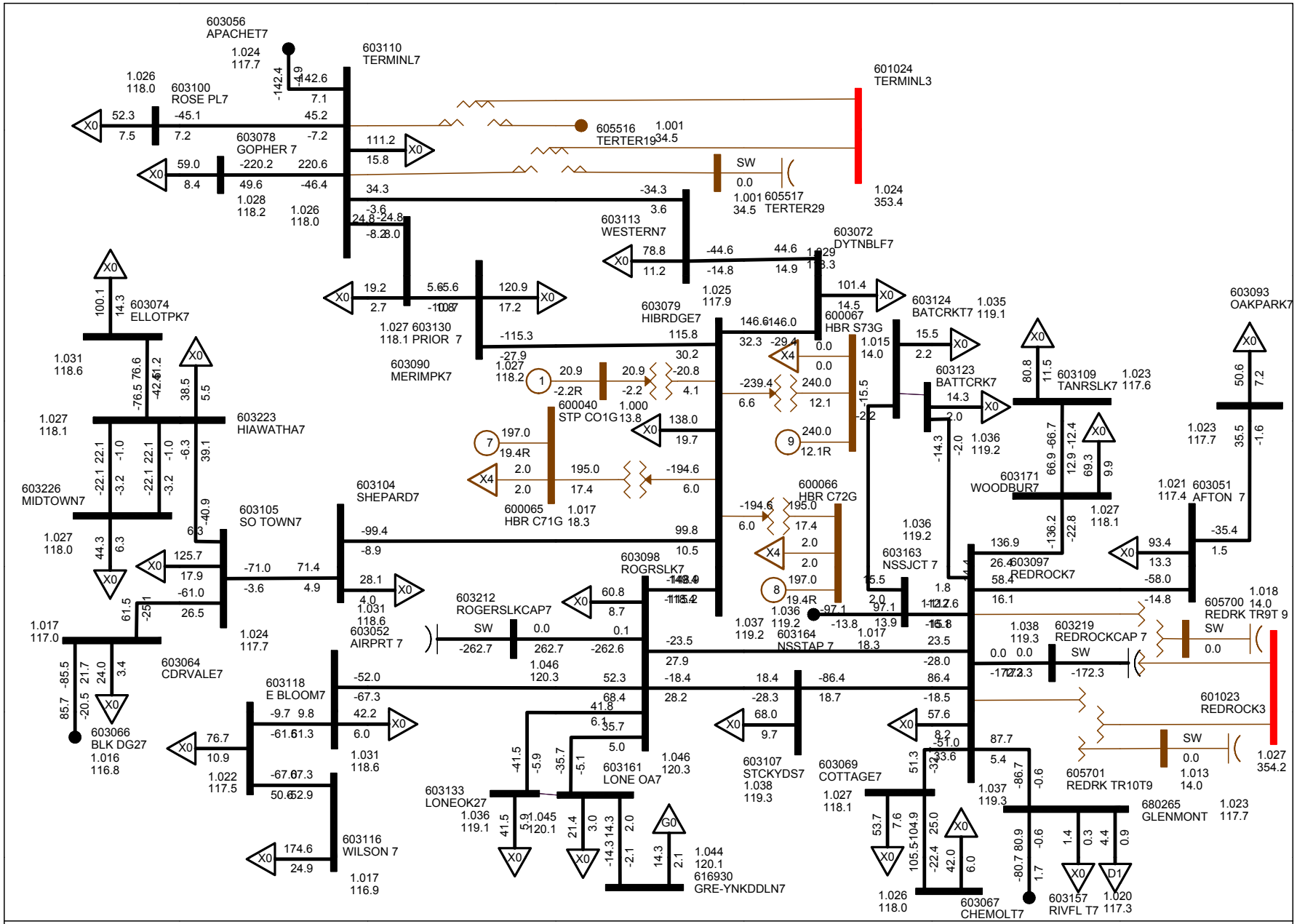
J285

Bus - VOLTAGE (kV/PU)
Branch - MW/Mvar
Equipment - MW/Mvar
kV: <=34.500 <=69.000 <=115.000 <=230.000 <=345.000 <=500.000 >500.000

PUBLIC DOCUMENT
NOT PUBLIC (OR PRIVILEGED) DATA HAS BEEN EXCISED



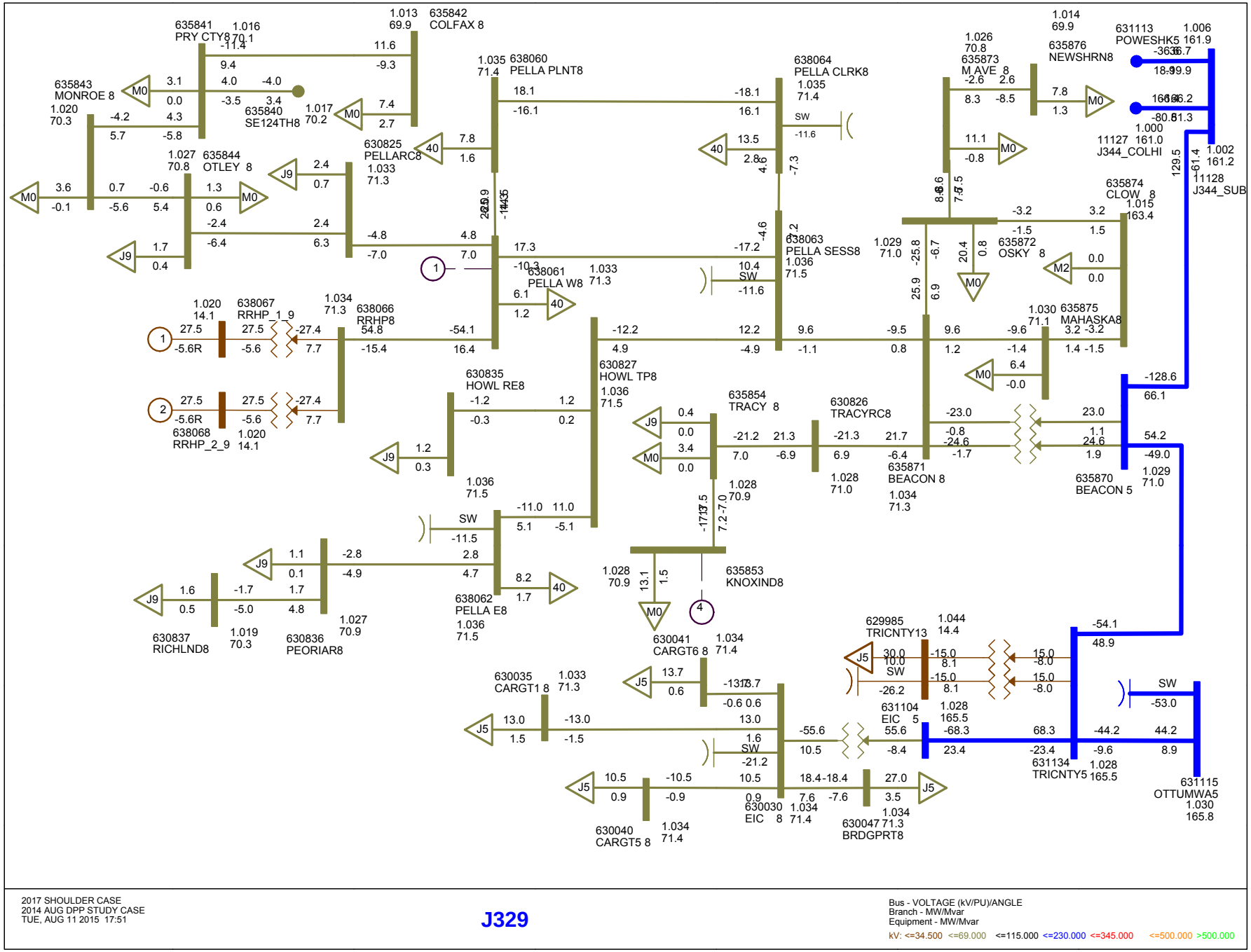

661043
HESKETT7
661042
HESKETT4
661906
HESKETT9
661053
MANDAN 4
661094
WISHEK 4
661905
WISHEK 9
661095
WISHEK 7
620159
EDGE SS9
620160
EDGELEY9
620172
JAMESPK9
661999
TATANKAW
661998
TTNKAFD4
661997
TTNKACL4
661096
TTNKPOI4
661994
MERRICRTFD 9
661995
MERRICRT G W
661993
MERRICRTCL 9
620162
OAKES 9
620362
OAKES 4
620363
FORMAN 4
620327
HANKSON4
620329
WAHPETN4
620325
BROWNSV4
620303
HANKSON9
11115
J316_GEN
11117
J316_SUB
661026
ELLENDL4
661093
MERRCRT4
620163
FORMN 9
620263
FORMN 7
652438
FORMAN 7
620262
GWINNER7
661903
ELLENDL9
661027
ELLENDL7
660000
ABDNJCT7
660001
ABDNSBT7
2017 SHOULDER CASE
2014 AUG DPP STUDY CASE
TUE, AUG 11 2015 16:15
J316
Bus - VOLTAGE (kV/PU)/ANGLE
Branch - MW/Mvar
Equipment - MW/Mvar
kV: <=34.500 <=69.000 <=115.000 <=230.000 <=345.000 <=500.000 >500.000



2017 PEAK CASE
2014 AUG DPP STUDY CASE
TUE, AUG 11 2015 16:00

J320

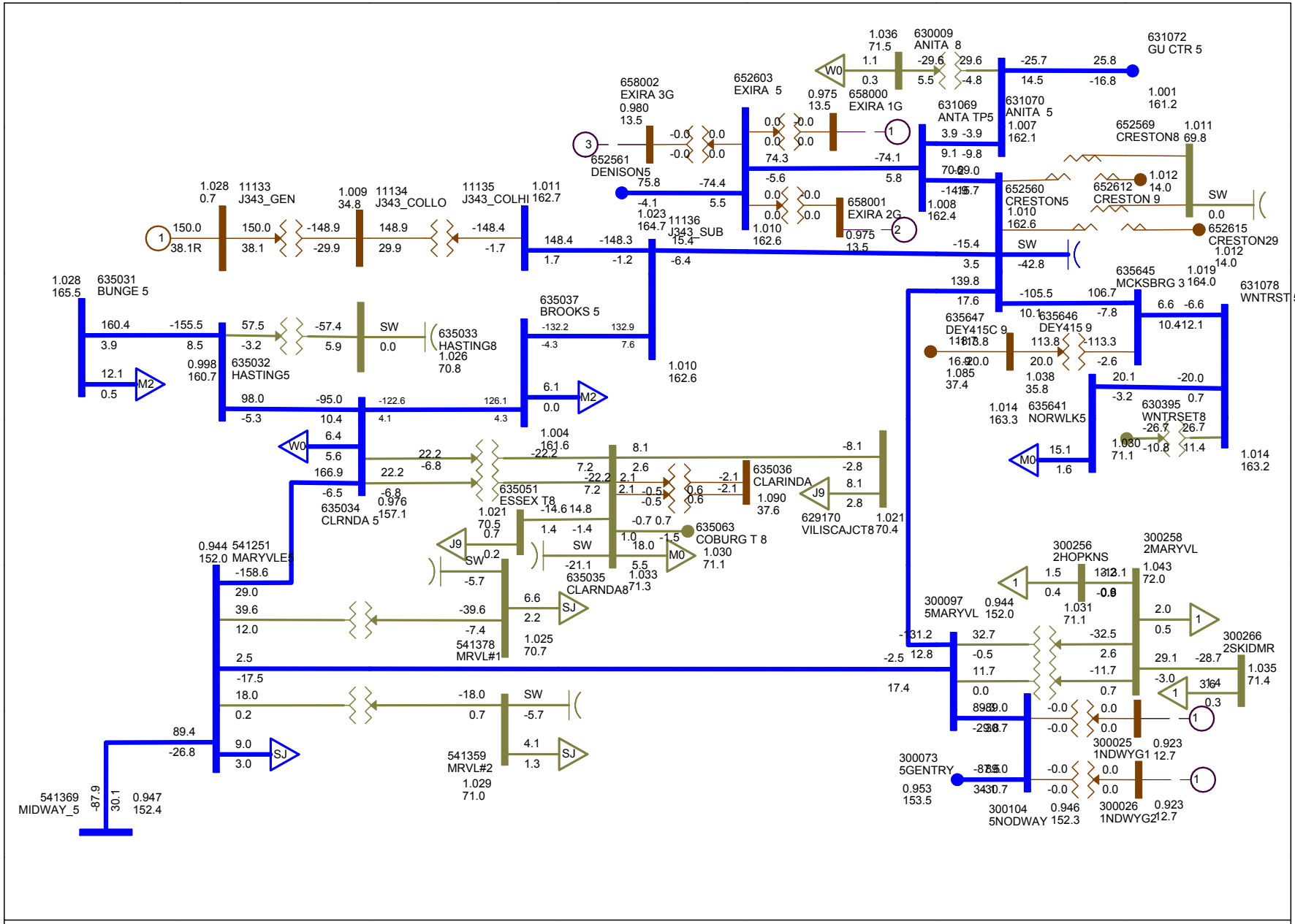
Bus - VOLTAGE (kV/PU)/ANGLE
Branch - MW/Mvar
Equipment - MW/Mvar
kV: <=34.500 <=69.000 <=115.000 <=230.000 <=345.000 <=500.000 >500.000



2017 SHOULDER CASE
2014 AUG DPP STUDY CASE
TUE, AUG 11 2015 17:51

J329

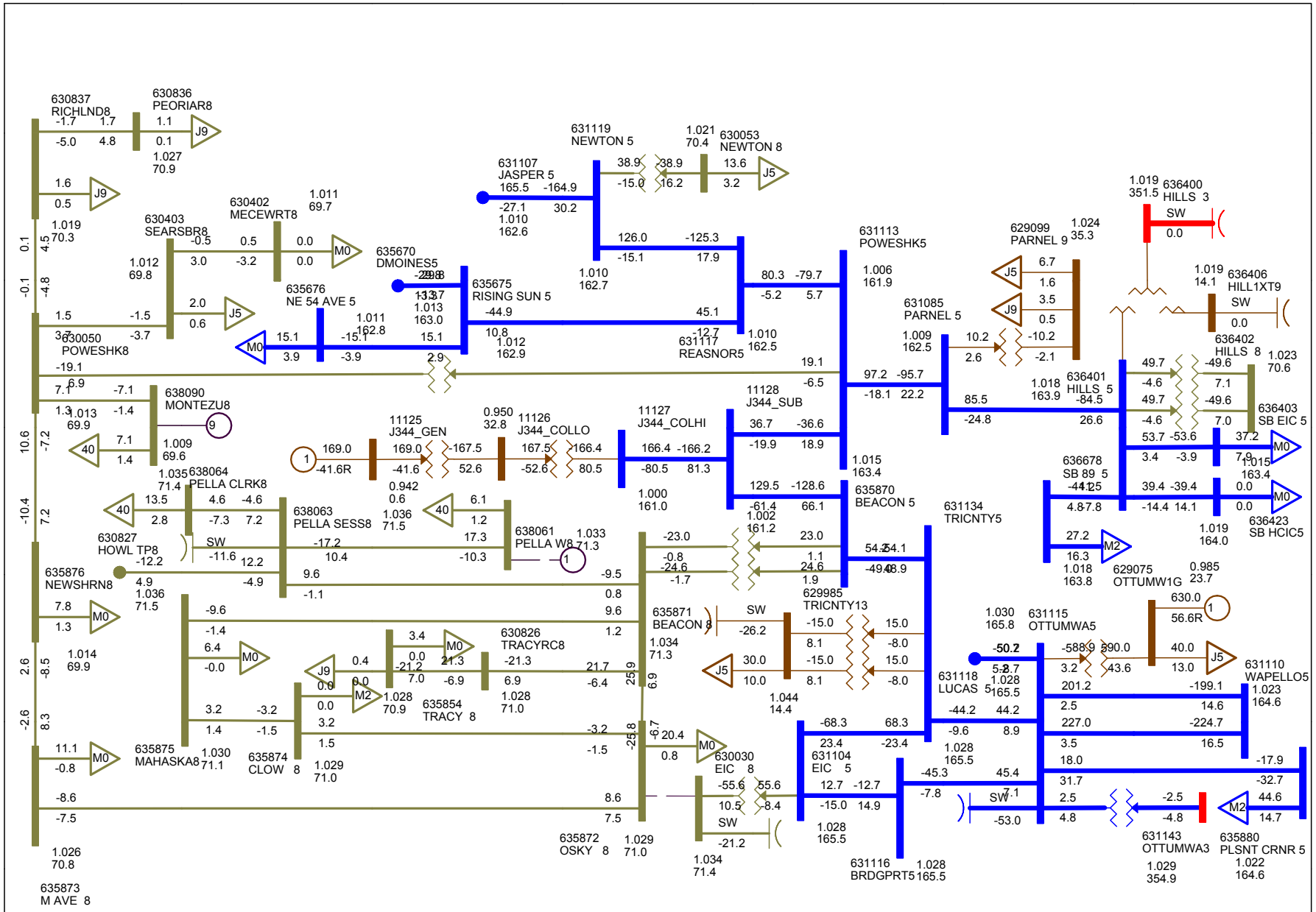
Bus - VOLTAGE (kV/PU)/ANGLE
Branch - MW/Mvar
Equipment - MW/Mvar
kV: <=34.500 <=69.000 <=115.000 <=230.000 <=345.000 <=500.000 >500.000



2017 SHOULDER CASE
2014 AUG DPP STUDY CASE
TUE, AUG 11 2015 17:52

J343

Bus - VOLTAGE (kV/PU)/ANGLE
Branch - MW/Mvar
Equipment - MW/Mvar
kV: <=34.500 <=69.000 <=115.000 <=230.000 <=345.000 <=500.000 >500.000



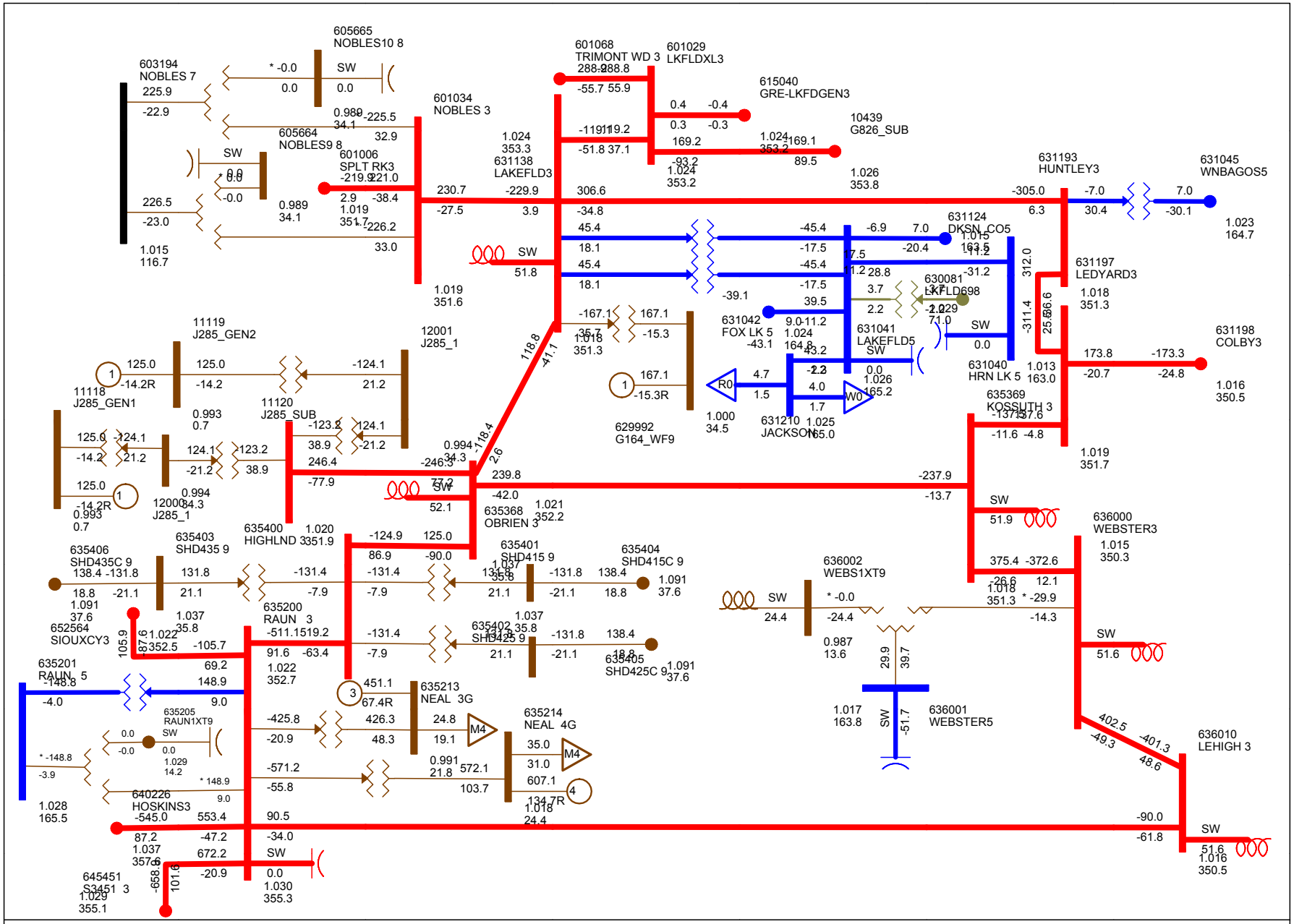
2017 SHOULDER CASE
2014 AUG DPP STUDY CASE
TUE, AUG 11 2015 17:54

J344

Bus - VOLTAGE (kV/PU)/ANGLE
Branch - MW/Mvar
Equipment - MW/Mvar

kV: <=34.500 <=69.000 <=115.000 <=230.000 <=345.000 <=500.000 >500.000

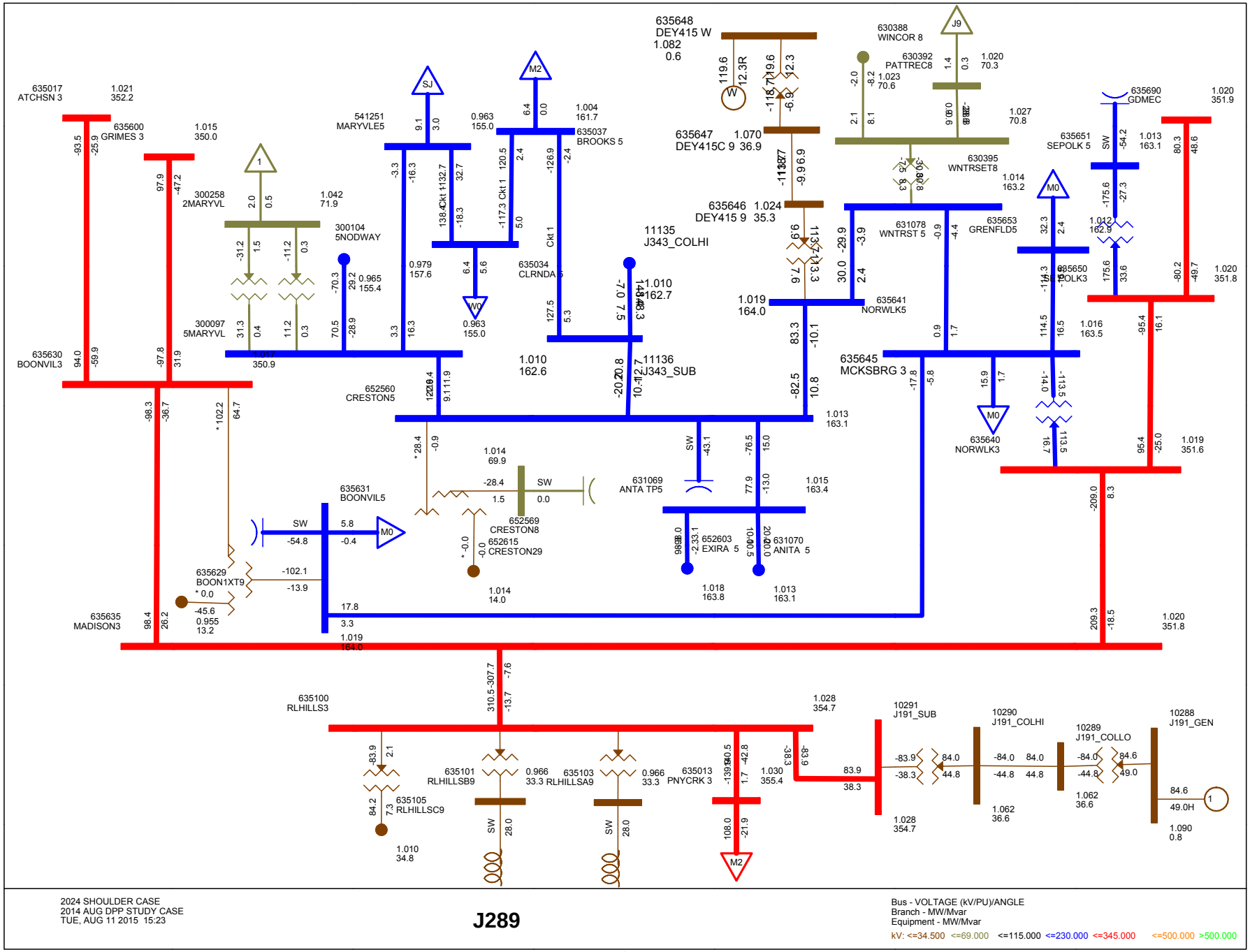
B.3.2 2024 Slider Diagrams

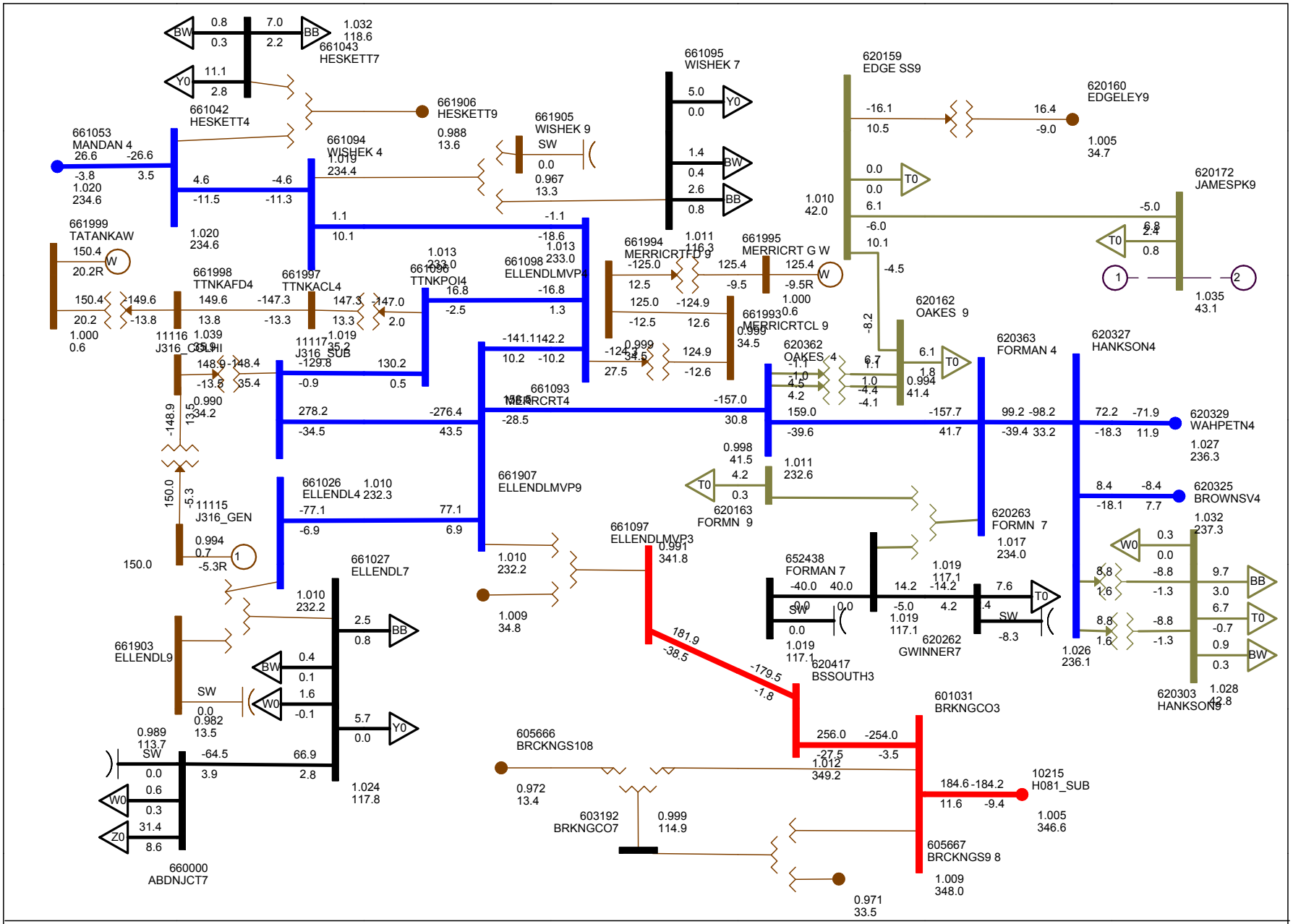


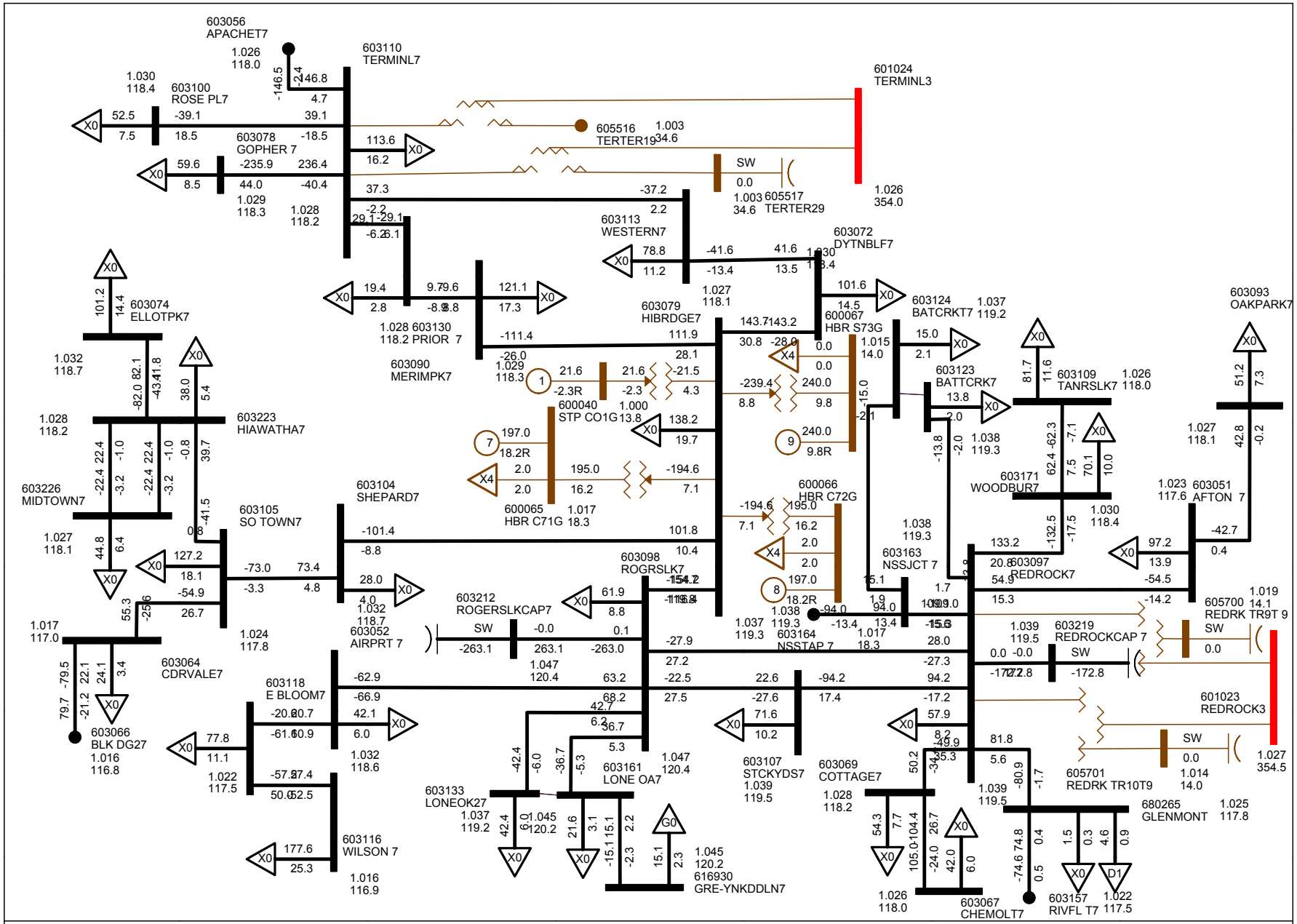
2024 SHOULDER CASE
2014 AUG DPP STUDY CASE
TUE, AUG 11 2015 15:09

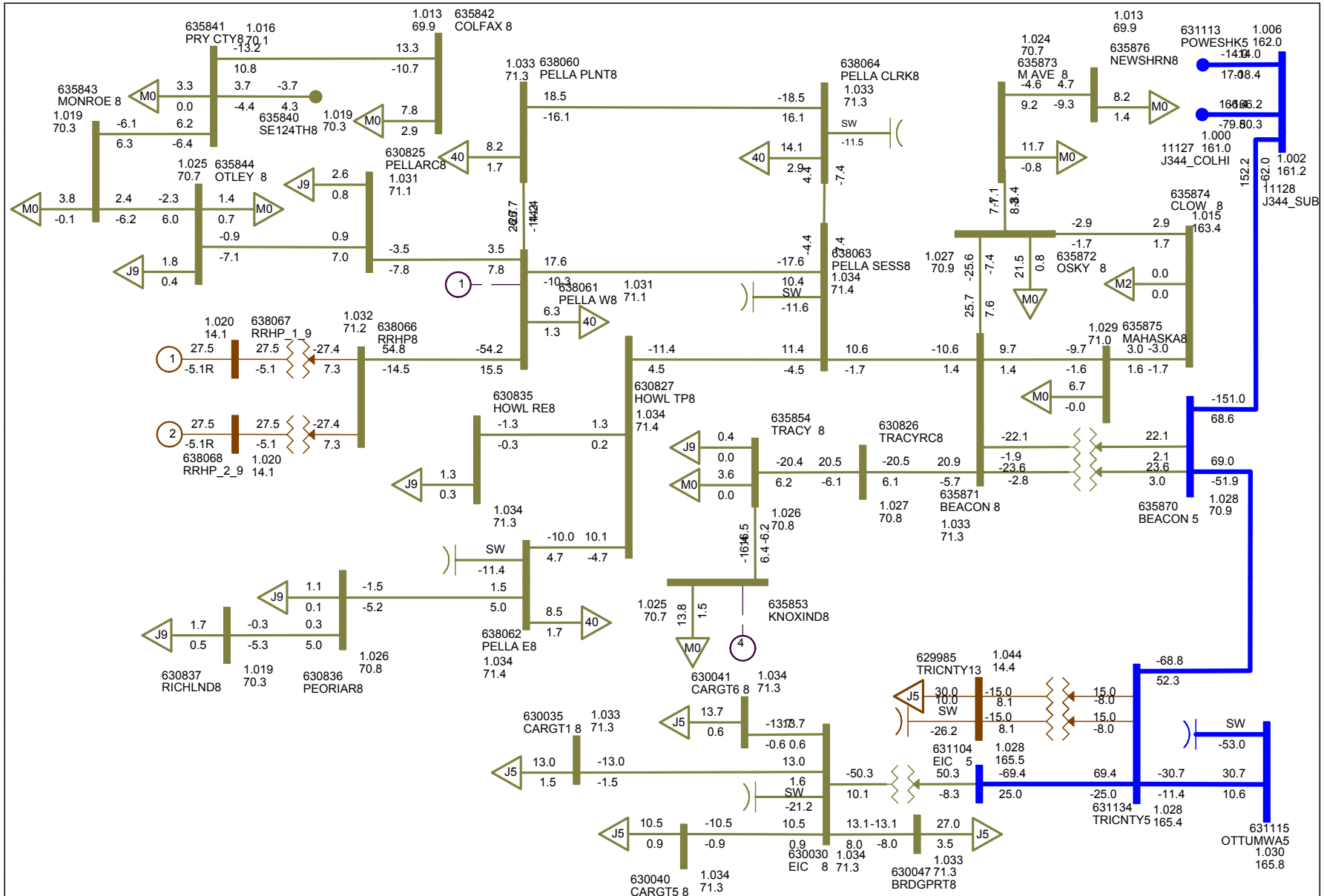
J285

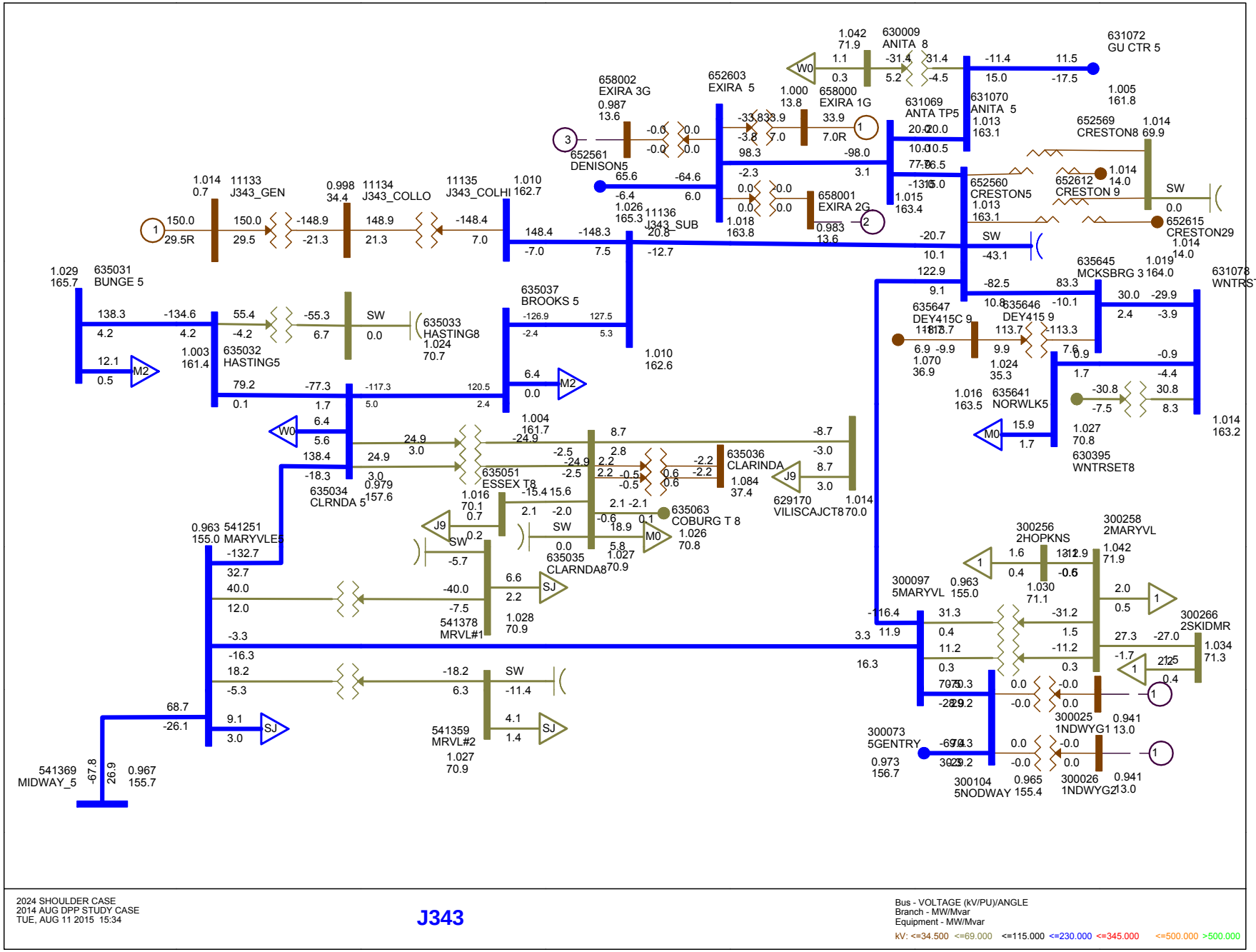
Bus - VOLTAGE (kV/PU)
Branch - MW/Mvar
Equipment - MW/Mvar
kV: <=34.500 <=69.000 <=115.000 <=230.000 <=345.000 <=500.000 >500.000


635017
ATCHSN 3
1.021
352.2
635600
GRIMES 3
1.015
350.0
635630
BOONVIL3
635631
BOONVIL5
635635
MADISON3
635629
BOON1XT9
* 0.0
-45.6
0.955
13.2
300258
2MARYVL
1.042
71.9
300104
5NODWAY
0.965
155.4
300097
5MARYVL
1.017
350.9
541251
MARYVLE5
0.979
157.6
652560
CRESTON5
635034
CLRNDA 5
635037
BROOKS 5
0.963
155.0
635648
DEY415 W
1.082
0.6
635647
DEY415C 9
1.070
36.9
635646
DEY415 9
1.024
35.3
11135
J343_COLHI
1.010
162.7
11136
J343_SUB
1.010
162.6
1.019
164.0
635641
NORWLK5
635645
MCKSBRG 3
635640
NORWLK3
1.013
163.1
631069
ANTA TP5
1.015
163.4
652603
EXIRA 5
1.018
163.8
631070
ANITA 5
1.013
163.1
652569
CRESTON8
652615
CRESTON29
1.014
69.9
1.014
14.0
630388
WINCOR 8
630392
PATTREC8
1.023
70.6
1.020
70.3
1.027
70.8
630395
WNTRSET8
1.014
163.2
631078
WNTRST 5
635653
GRENFLD5
635650
HOLK3
1.016
163.5
635690
GDMEC
1.020
351.9
635651
SEPOLK 5
1.013
163.1
1.012
162.9
1.020
351.8
1.019
351.6
635100
RLHILLS3
1.028
354.7
635101
RLHILLSB9
635103
RLHILLSA9
635013
PNYCRK 3
1.030
355.4
635105
RLHILLSC9
1.010
34.8
10291
J191_SUB
10290
J191_COLHI
10289
J191_COLLO
10288
J191_GEN
1.062
36.6
1.090
0.8
1.028
354.7
2024 SHOULDER CASE
2014 AUG DPP STUDY CASE
TUE, AUG 11 2015 15:23
J289
Bus - VOLTAGE (kV/PU)/ANGLE
Branch - MW/Mvar
Equipment - MW/Mvar
kV: <=34.500 <=69.000 <=115.000 <=230.000 <=345.000 <=500.000 >500.000


661043 HESKETT7
661042 HESKETT4
661906 HESKETT9
661053 MANDAN 4
661094 WISHEK 4
661905 WISHEK 9
661095 WISHEK 7
620159 EDGE SS9
620160 EDGELEY9
620172 JAMESPK9
661999 TATANKAW
661998 TTNKAFD4
661997 TTNKACL4
661996 TTNKPOI4
661098 ELLENDLMVP4
661994 MERRICRTFD 9
661995 MERRICRT G W
661993 MERRICRTCL 9
620162 OAKES 9
620362 OAKES 4
620363 FORMAN 4
620327 HANKSON4
620329 WAHPETN4
620325 BROWNSV4
620303 HANKSON9
11116 J316_CCSHI
11117 J316_SUB
661093 MERRCRT4
661907 ELLENDLMVP9
661026 ELLENDL4
661027 ELLENDL7
661903 ELLENDL9
11115 J316_GEN
620163 FORMN 9
620263 FORMN 7
652438 FORMAN 7
620262 GWINNER7
661097 ELLENDLMVP3
620417 BSSOUTH3
601031 BRKNGCO3
605666 BRCKNGS108
603192 BRKNGCO7
605667 BRCKNGS9 8
10215 H081_SUB
660000 ABDNJCT7
2024 SHOULDER CASE
2014 AUG DPP STUDY CASE
TUE, AUG 11 2015 15:28
J316
Bus - VOLTAGE (kV/PU)/ANGLE
Branch - MW/Mvar
Equipment - MW/Mvar
kV: <=34.500 <=69.000 <=115.000 <=230.000 <=345.000 <=500.000 >500.000


603056
APACHET7
1.026
118.0
603110
TERMINL7
1.030
118.4
603100
ROSE PL7
603078
GOPHER 7
1.029
118.3
1.028
118.2
601024
TERMINL3
605516
TERTER19
1.003
34.6
SW
0.0
1.003
34.6
605517
TERTER29
1.026
354.0
603113
WESTERN7
603072
DYTNBLF7
1.027
118.1
603074
ELLOTPK7
1.032
118.7
603223
HIAWATHA7
1.028
118.2
603226
MIDTOWN7
1.027
118.1
603105
SO TOWN7
603104
SHEPARD7
603079
HIBRDGE7
603090
MERIMPK7
1.028 603130
118.2 PRIOR 7
600040
STP CO1G
600065
HBR C71G
1.017
18.3
600067
HBR S73G
600066
HBR C72G
603124
BATCRKT7
1.037
119.2
603123
BATTCRK7
603109
TANRSLK7
1.026
118.0
603171
WOODBUR7
1.038
119.3
603093
OAKPARK7
1.027
118.1
603051
AFTON 7
1.023
117.6
603163
NSSJCT 7
603097
REDROCK7
603098
ROGRSLK7
603212
ROGERSLKCAP7
603052
AIRPRT 7
1.024
117.8
603164
NSSTAP 7
1.017
18.3
603219
REDROCKCAP 7
605700
REDRK TR9T 9
1.019
14.1
601023
REDROCK3
1.017
117.0
603064
CDRVALE7
603066
BLK DG27
1.016
116.8
603118
E BLOOM7
1.032
118.6
1.022
117.5
603116
WILSON 7
1.016
116.9
603133
LONEOK27
1.037
119.2
603161
LONE OA7
1.047
120.4
1.045
120.2
616930
GRE-YNKDDLN7
603107
STCKYDS7
1.039
119.5
603069
COTTAGE7
1.028
118.2
1.026
118.0
603067
CHEMOLT7
603157
RIVFL T7
1.022
117.5
605701
REDRK TR10T9
1.014
14.0
680265
GLENMONT
1.025
117.8
2024 PEAK CASE
2014 AUG DPP STUDY CASE
TUE, AUG 11 2015 15:52
J320
Bus - VOLTAGE (kV/PU)/ANGLE
Branch - MW/Mvar
Equipment - MW/Mvar
kV: <=34.500 <=69.000 <=115.000 <=230.000 <=345.000 <=500.000 >500.000

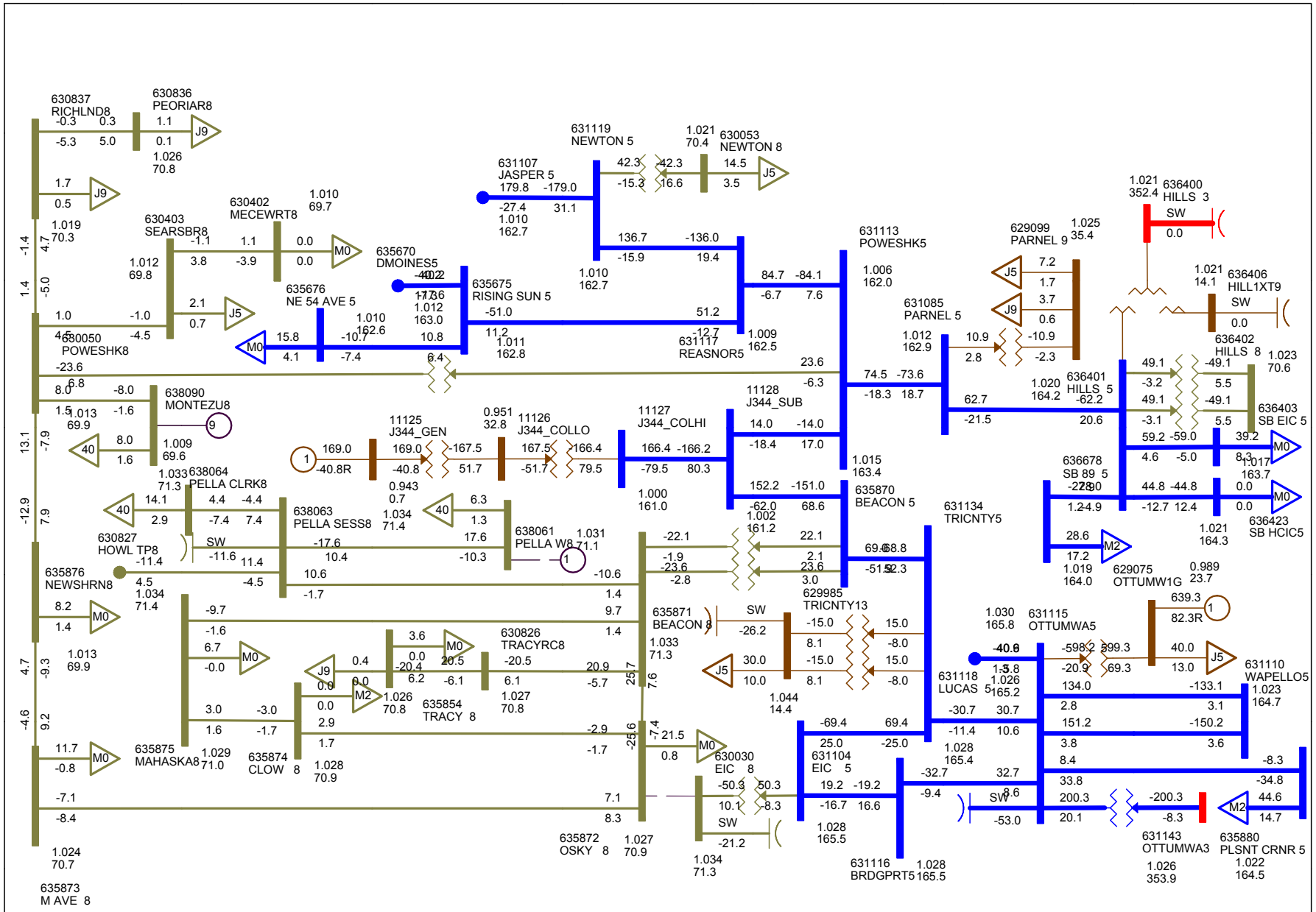

635841 PRY CTY8 1.016 70.1
635842 COLFAX 8 1.013 69.9
635843 MONROE 8 1.019 70.3
635840 SE124TH8 1.019 70.3
630825 PELLARC8 1.031 71.1
638060 PELLA PLNT8 1.033 71.3
638064 PELLA CLRK8 1.033 71.3
635844 OTLEY 8 1.025 70.7
638061 PELLA W8 1.031 71.1
638063 PELLA SESS8 1.034 71.4
635873 M AVE 8 1.024 70.7
635876 NEWSHRN8 1.013 69.9
631113 POWESHK5 1.006 162.0
11127 J344_COLHI 161.0 1.000
11128 J344_SUB 161.2 1.002
635874 CLOW 8 1.015 163.4
635872 OSKY 8 1.027 70.9
635875 MAHASKA8 1.029 71.0
638067 RRHP_1_9 1.020 14.1
638066 RRHP8 1.032 71.2
638068 RRHP_2_9 1.020 14.1
630827 HOWL TP8 1.034 71.4
630835 HOWL RE8 1.034 71.3
635854 TRACY 8 1.026 70.8
630826 TRACYRC8 1.027 70.8
635871 BEACON 8 1.033 71.3
635870 BEACON 5 1.028 70.9
635853 KNOXIND8 1.025 70.7
630041 CARGT6 8 1.034 71.3
638062 PELLA E8 1.034 71.4
630837 RICHLND8 1.019 70.3
630836 PEORIAR8 1.026 70.8
629985 TRICNTY13 1.044 14.4
631104 EIC 5 1.028 165.5
631134 TRICNTY5 1.028 165.4
631115 OTTUMWA5 1.030 165.8
630035 CARGT1 8 1.033 71.3
630040 CARGT5 8 1.034 71.3
630030 EIC 8 1.034 71.3
630047 BRDGPRT8 1.033 71.3
2024 SHOULDER CASE
2014 AUG DPP STUDY CASE
TUE, AUG 11 2015 15:30
J329
Bus - VOLTAGE (kV/PU)/ANGLE
Branch - MW/Mvar
Equipment - MW/Mvar
kV: <=34.500 <=69.000 <=115.000 <=230.000 <=345.000 <=500.000 >500.000



2024 SHOULDER CASE
2014 AUG DPP STUDY CASE
TUE, AUG 11 2015 15:34

Bus - VOLTAGE (kV/PU)/ANGLE
Branch - MW/Mvar
Equipment - MW/Mvar

kV: <=34.500 <=69.000 <=115.000 <=230.000 <=345.000 <=500.000 >500.000



2024 SHOULDER CASE
2014 AUG DPP STUDY CASE
TUE, AUG 11 2015 15:51

J344

Bus - VOLTAGE (kV/PU)/ANGLE
Branch - MW/Mvar
Equipment - MW/Mvar

kV: <=34.500 <=69.000 <=115.000 <=230.000 <=345.000 <=500.000 >500.000

Appendix

C

Reactive Power Requirement Analysis Results

C.1 Reactive Power Requirement Results for 2017 Summer Shoulder

2017 Shoulder Case - J285 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
11118	J285_GEN1 0.6900	635 MEC	0.95	1.05	1.0239	System Intact	voltage is within range
11119	J285_GEN2 0.6900	635 MEC	0.95	1.05	1.0239	System Intact	voltage is within range
11120	J285_SUB 345.00	635 MEC	0.96	1.05	1.0274	System Intact	voltage is within range
12000	J285_1 34.500	635 MEC	0.95	1.05	1.0182	System Intact	voltage is within range
12001	J285_1 34.500	635 MEC	0.95	1.05	1.0182	System Intact	voltage is within range
601029	LKFLDXL3 345.00	600 XEL	0.95	1.05	1.0250	System Intact	voltage is within range
601034	NOBLES 3 345.00	600 XEL	0.95	1.05	1.0240	System Intact	voltage is within range
629992	G164_WF9 34.500	627 ALTW	0.95	1.05	1.0000	System Intact	voltage is within range
631041	LAKEFLD5 161.00	627 ALTW	0.95	1.05	1.0310	System Intact	voltage is within range
631138	LAKEFLD3 345.00	627 ALTW	0.95	1.05	1.0257	System Intact	voltage is within range
631193	HUNTLEY3 345.00	627 ALTW	0.95	1.05	1.0366	System Intact	voltage is within range
635200	RAUN 3 345.00	635 MEC	1.00	1.05	1.0300	System Intact	voltage is within range
635368	OBRIEN 3 345.00	635 MEC	0.96	1.05	1.0277	System Intact	voltage is within range
635369	KOSSUTH 3 345.00	635 MEC	0.96	1.05	1.0210	System Intact	voltage is within range
635400	HIGHLND 3 345.00	635 MEC	0.96	1.05	1.0290	System Intact	voltage is within range
635401	SHD415 9 34.500	635 MEC	0.95	1.05	1.0436	System Intact	voltage is within range
635402	SHD425 9 34.500	635 MEC	0.95	1.05	1.0436	System Intact	voltage is within range
635403	SHD435 9 34.500	635 MEC	0.95	1.05	1.0436	System Intact	voltage is within range
636000	WEBSTER3 345.00	635 MEC	0.96	1.05	1.0206	System Intact	voltage is within range
11118	J285_GEN1 0.6900	635 MEC	0.95	1.05	1.0239	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
11119	J285_GEN2 0.6900	635 MEC	0.95	1.05	1.0239	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
11120	J285_SUB 345.00	635 MEC	0.96	1.05	1.0274	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
12000	J285_1 34.500	635 MEC	0.95	1.05	1.0182	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
12001	J285_1 34.500	635 MEC	0.95	1.05	1.0182	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
601029	LKFLDXL3 345.00	600 XEL	0.92	1.05	1.0250	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
601034	NOBLES 3 345.00	600 XEL	0.92	1.05	1.0219	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
629992	G164_WF9 34.500	627 ALTW	0.93	1.05	1.0000	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range

2017 Shoulder Case - J285 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
631041	LAKEFLD5 161.00	627 ALTW	0.93	1.05	1.0296	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
631138	LAKEFLD3 345.00	627 ALTW	0.93	1.05	1.0236	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
631193	HUNTLEY3 345.00	627 ALTW	0.93	1.05	1.0348	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
635200	RAUN 3 345.00	635 MEC	1.00	1.05	1.0300	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
635368	OBRIEN 3 345.00	635 MEC	0.96	1.05	1.0278	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
635369	KOSSUTH 3 345.00	635 MEC	0.96	1.05	1.0231	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
635400	HIGHLND 3 345.00	635 MEC	0.96	1.05	1.0290	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
635401	SHD415 9 34.500	635 MEC	0.95	1.05	1.0398	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
635402	SHD425 9 34.500	635 MEC	0.95	1.05	1.0398	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
635403	SHD435 9 34.500	635 MEC	0.95	1.05	1.0398	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
636000	WEBSTER3 345.00	635 MEC	0.96	1.05	1.0220	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
11118	J285_GEN1 0.6900	635 MEC	0.95	1.05	1.0194	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
11119	J285_GEN2 0.6900	635 MEC	0.95	1.05	1.0194	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
11120	J285_SUB 345.00	635 MEC	0.96	1.05	1.0231	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range

2017 Shoulder Case - J285 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
12000	J285_1 34.500	635 MEC	0.95	1.05	1.0137	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
12001	J285_1 34.500	635 MEC	0.95	1.05	1.0137	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
601029	LKFLDXL3 345.00	600 XEL	0.92	1.05	1.0250	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
601034	NOBLES 3 345.00	600 XEL	0.92	1.05	1.0231	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
629992	G164_WF9 34.500	627 ALTW	0.93	1.05	1.0000	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
631041	LAKEFLD5 161.00	627 ALTW	0.93	1.05	1.0306	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
631138	LAKEFLD3 345.00	627 ALTW	0.93	1.05	1.0248	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
631193	HUNTLEY3 345.00	627 ALTW	0.93	1.05	1.0358	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
635200	RAUN 3 345.00	635 MEC	1.00	1.05	1.0300	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
635368	OBRIEN 3 345.00	635 MEC	0.96	1.05	1.0235	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
635369	KOSSUTH 3 345.00	635 MEC	0.96	1.05	1.0102	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
635400	HIGHLND 3 345.00	635 MEC	0.96	1.05	1.0244	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
635401	SHD415 9 34.500	635 MEC	0.95	1.05	1.0390	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
635402	SHD425 9 34.500	635 MEC	0.95	1.05	1.0390	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range

2017 Shoulder Case - J285 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
635403	SHD435 9 34.500	635 MEC	0.95	1.05	1.0390	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
636000	WEBSTER3 345.00	635 MEC	0.96	1.05	1.0168	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
11118	J285_GEN1 0.6900	635 MEC	0.95	1.05	1.0066	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
11119	J285_GEN2 0.6900	635 MEC	0.95	1.05	1.0066	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
11120	J285_SUB 345.00	635 MEC	0.96	1.05	1.0108	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
12000	J285_1 34.500	635 MEC	0.95	1.05	1.0009	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
12001	J285_1 34.500	635 MEC	0.95	1.05	1.0009	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
601029	LKFLDXL3 345.00	600 XEL	0.92	1.05	1.0250	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
601034	NOBLES 3 345.00	600 XEL	0.92	1.05	1.0215	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
629992	G164_WF9 34.500	627 ALTW	0.93	1.05	1.0000	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
631041	LAKEFLD5 161.00	627 ALTW	0.93	1.05	1.0282	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
631138	LAKEFLD3 345.00	627 ALTW	0.93	1.05	1.0223	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
631193	HUNTLEY3 345.00	627 ALTW	0.93	1.05	1.0338	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
635200	RAUN 3 345.00	635 MEC	1.00	1.05	1.0300	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range

2017 Shoulder Case - J285 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
635368	OBRIEN 3 345.00	635 MEC	0.96	1.05	1.0112	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
635369	KOSSUTH 3 345.00	635 MEC	0.96	1.05	1.0101	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
635400	HIGHLND 3 345.00	635 MEC	0.96	1.05	1.0290	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
635401	SHD415 9 34.500	635 MEC	0.95	1.05	1.0249	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
635402	SHD425 9 34.500	635 MEC	0.95	1.05	1.0249	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
635403	SHD435 9 34.500	635 MEC	0.95	1.05	1.0249	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
636000	WEBSTER3 345.00	635 MEC	0.96	1.05	1.0152	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range

2017 Shoulder Case - J289 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
11136	J343_SUB 161.00	635 MEC	0.95	1.05	1.0100	System Intact	voltage is within range
300097	5MARYVL 161.00	330 AECI	0.95	1.05	0.9622	System Intact	voltage is within range
630395	WNTRSET8 69.000	627 ALTW	0.95	1.05	1.0237	System Intact	voltage is within range
631069	ANTA TP5 161.00	652 WAPA	0.95	1.05	1.0135	System Intact	voltage is within range
631078	WNTRST 5 161.00	627 ALTW	0.95	1.05	1.0103	System Intact	voltage is within range
635641	NORWLK5 161.00	635 MEC	0.95	1.05	1.0149	System Intact	voltage is within range
635645	MCKSBRG 3 161.00	635 MEC	0.95	1.05	1.0129	System Intact	voltage is within range
635646	DEY415 9 34.500	635 MEC	0.95	1.05	0.9999	System Intact	voltage is within range
635647	DEY415C 9 34.500	635 MEC	0.95	1.05	1.0445	System Intact	voltage is within range
652560	CRESTON5 161.00	652 WAPA	0.95	1.05	1.0100	System Intact	voltage is within range
652569	CRESTON8 69.000	652 WAPA	0.95	1.05	1.0105	System Intact	voltage is within range
652612	CRESTON 9 13.800	652 WAPA	0.95	1.05	1.0111	System Intact	voltage is within range
652615	CRESTON29 13.800	652 WAPA	0.95	1.05	1.0110	System Intact	voltage is within range
11136	J343_SUB 161.00	635 MEC	0.95	1.05	1.0100	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
300097	5MARYVL 161.00	330 AECI	0.90	1.10	0.9654	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
630395	WNTRSET8 69.000	627 ALTW	0.93	1.05	1.0209	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
631069	ANTA TP5 161.00	652 WAPA	0.90	1.10	1.0104	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
631078	WNTRST 5 161.00	627 ALTW	0.93	1.05	1.0038	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
635641	NORWLK5 161.00	635 MEC	0.95	1.05	1.0130	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
635645	MCKSBRG 3 161.00	635 MEC	0.95	1.05	1.0086	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
635646	DEY415 9 34.500	635 MEC	0.95	1.05	0.9953	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
635647	DEY415C 9 34.500	635 MEC	0.95	1.05	1.0401	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range

2017 Shoulder Case - J289 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
635648	DEY415 W 0.6000	635 MEC	0.95	1.05	1.0473	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
652560	CRESTON5 161.00	652 WAPA	0.90	1.10	1.0100	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
652569	CRESTON8 69.000	652 WAPA	0.90	1.10	1.0101	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
652612	CRESTON 9 13.800	652 WAPA	0.90	1.10	1.0104	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
652615	CRESTON29 13.800	652 WAPA	0.90	1.10	1.0104	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
11136	J343_SUB 161.00	635 MEC	0.95	1.05	1.0100	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
300097	5MARYVL 161.00	330 AECI	0.90	1.10	0.9608	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
630395	WNTRSET8 69.000	627 ALTW	0.93	1.05	1.0214	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
631069	ANTA TP5 161.00	652 WAPA	0.90	1.10	1.0143	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
631078	WNTRST 5 161.00	627 ALTW	0.93	1.05	1.0086	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
635641	NORWLK5 161.00	635 MEC	0.95	1.05	1.0148	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
635645	MCKSBRG 3 161.00	635 MEC	0.95	1.05	1.0146	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
635646	DEY415 9 34.500	635 MEC	0.95	1.05	1.0018	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range

2017 Shoulder Case - J289 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
635647	DEY415C 9 34.500	635 MEC	0.95	1.05	1.0464	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
652560	CRESTON5 161.00	652 WAPA	0.90	1.10	1.0101	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
652569	CRESTON8 69.000	652 WAPA	0.90	1.10	1.0108	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
652612	CRESTON 9 13.800	652 WAPA	0.90	1.10	1.0114	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
652615	CRESTON29 13.800	652 WAPA	0.90	1.10	1.0113	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range

2017 Shoulder Case - J316 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
11115	J316_GEN 0.6900	661 MDU	0.95	1.05	0.9947	System Intact	voltage is within range
11116	J316_COLHI 34.500	661 MDU	0.95	1.05	0.9889	System Intact	voltage is within range
11117	J316_SUB 230.00	661 MDU	0.95	1.05	1.0038	System Intact	voltage is within range
620362	OAKES 4 230.00	620 OTP	0.97	1.05	1.0011	System Intact	voltage is within range
661026	ELLENDL4 230.00	661 MDU	0.95	1.05	1.0015	System Intact	voltage is within range
661027	ELLENDL7 115.00	661 MDU	0.95	1.05	1.0151	System Intact	voltage is within range
661093	MERRCRT4 230.00	661 MDU	0.95	1.05	1.0078	System Intact	voltage is within range
661096	TTNKPOI4 230.00	661 MDU	0.95	1.05	1.0078	System Intact	voltage is within range
661903	ELLENDL9 13.800	661 MDU	0.95	1.05	0.9731	System Intact	voltage is within range
661997	TTNKACL4 34.500	661 MDU	0.95	1.05	1.0168	System Intact	voltage is within range
11115	J316_GEN 0.6900	661 MDU	0.90	1.10	0.9827	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range
11116	J316_COLHI 34.500	661 MDU	0.90	1.10	0.9769	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range
11117	J316_SUB 230.00	661 MDU	0.90	1.10	0.9923	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range
620362	OAKES 4 230.00	620 OTP	0.92	1.10	0.996	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range
661026	ELLENDL4 230.00	661 MDU	0.90	1.10	0.9939	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range
661027	ELLENDL7 115.00	661 MDU	0.90	1.10	1.0085	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range
661093	MERRCRT4 230.00	661 MDU	0.90	1.10	1.0069	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range
661096	TTNKPOI4 230.00	661 MDU	0.90	1.10	1.0084	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range
661903	ELLENDL9 13.800	661 MDU	0.90	1.10	0.9669	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range
661997	TTNKACL4 34.500	661 MDU	0.90	1.10	1.0171	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range

2017 Shoulder Case - J316 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
11115	J316_GEN 0.6900	661 MDU	0.90	1.10	0.9851	J316-OUTLET2-1 11117 [J316_SUB 230.00] TO 661026 [ELLENDL4 230.00] 1	voltage is within range
11116	J316_COLHI 34.500	661 MDU	0.90	1.10	0.9793	J316-OUTLET2-1 11117 [J316_SUB 230.00] TO 661026 [ELLENDL4 230.00] 1	voltage is within range
11117	J316_SUB 230.00	661 MDU	0.90	1.10	0.9946	J316-OUTLET2-1 11117 [J316_SUB 230.00] TO 661026 [ELLENDL4 230.00] 1	voltage is within range
620362	OAKES 4 230.00	620 OTP	0.92	1.10	0.9913	J316-OUTLET2-1 11117 [J316_SUB 230.00] TO 661026 [ELLENDL4 230.00] 1	voltage is within range
661026	ELLENDL4 230.00	661 MDU	0.90	1.10	0.986	J316-OUTLET2-1 11117 [J316_SUB 230.00] TO 661026 [ELLENDL4 230.00] 1	voltage is within range
661027	ELLENDL7 115.00	661 MDU	0.90	1.10	1.0018	J316-OUTLET2-1 11117 [J316_SUB 230.00] TO 661026 [ELLENDL4 230.00] 1	voltage is within range
661093	MERRCRT4 230.00	661 MDU	0.90	1.10	0.9947	J316-OUTLET2-1 11117 [J316_SUB 230.00] TO 661026 [ELLENDL4 230.00] 1	voltage is within range
661096	TTNKPOI4 230.00	661 MDU	0.90	1.10	0.9961	J316-OUTLET2-1 11117 [J316_SUB 230.00] TO 661026 [ELLENDL4 230.00] 1	voltage is within range
661903	ELLENDL9 13.800	661 MDU	0.90	1.10	0.9607	J316-OUTLET2-1 11117 [J316_SUB 230.00] TO 661026 [ELLENDL4 230.00] 1	voltage is within range
661997	TTNKACL4 34.500	661 MDU	0.90	1.10	1.0113	J316-OUTLET2-1 11117 [J316_SUB 230.00] TO 661026 [ELLENDL4 230.00] 1	voltage is within range

2017 Shoulder Case - J343 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
11133	J343_GEN 0.6900	635 MEC	0.95	1.05	0.9360	System Intact	Low Voltage Violation
11134	J343_COLLO 34.500	635 MEC	0.95	1.05	0.9297	System Intact	Low Voltage Violation
11135	J343_COLHI 161.00	635 MEC	0.95	1.05	0.9838	System Intact	voltage is within range
11136	J343_SUB 161.00	635 MEC	0.95	1.05	0.9843	System Intact	voltage is within range
300097	5MARYVL 161.00	330 AECI	0.95	1.05	0.9384	System Intact	Low Voltage Violation
631069	ANTA TP5 161.00	652 WAPA	0.95	1.05	1.0057	System Intact	voltage is within range
635034	CLRNDA 5 161.00	635 MEC	0.95	1.05	0.9639	System Intact	voltage is within range
635037	BROOKS 5 161.00	635 MEC	0.95	1.05	0.9816	System Intact	voltage is within range
635645	MCKSBRG 3 161.00	635 MEC	0.95	1.05	1.0185	System Intact	voltage is within range
652560	CRESTON5 161.00	652 WAPA	0.95	1.05	1.0041	System Intact	voltage is within range
652569	CRESTON8 69.000	652 WAPA	0.95	1.05	1.0099	System Intact	voltage is within range
652612	CRESTON 9 13.800	652 WAPA	0.95	1.05	1.0111	System Intact	voltage is within range
652615	CRESTON29 13.800	652 WAPA	0.95	1.05	1.0108	System Intact	voltage is within range
11133	J343_GEN 0.6900	635 MEC	0.95	1.05	0.9569	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
11134	J343_COLLO 34.500	635 MEC	0.95	1.05	0.9507	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
11135	J343_COLHI 161.00	635 MEC	0.95	1.05	1.0031	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
11136	J343_SUB 161.00	635 MEC	0.95	1.05	1.0036	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
300097	5MARYVL 161.00	330 AECI	0.90	1.10	0.9331	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
631069	ANTA TP5 161.00	652 WAPA	0.90	1.10	1.0080	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
635034	CLRNDA 5 161.00	635 MEC	0.95	1.05	0.9466	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	Low Voltage Violation
635037	BROOKS 5 161.00	635 MEC	0.95	1.05	0.9463	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	Low Voltage Violation
635645	MCKSBRG 3 161.00	635 MEC	0.95	1.05	1.0170	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range

2017 Shoulder Case - J343 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
652560	CRESTON5 161.00	652 WAPA	0.90	1.10	1.0034	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
652569	CRESTON8 69.000	652 WAPA	0.90	1.10	1.0099	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
652612	CRESTON 9 13.800	652 WAPA	0.90	1.10	1.0113	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
652615	CRESTON29 13.800	652 WAPA	0.90	1.10	1.0109	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
11133	J343_GEN 0.6900	635 MEC	0.95	1.05	0.8443	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	Low Voltage Violation
11134	J343_COLLO 34.500	635 MEC	0.95	1.05	0.8378	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	Low Voltage Violation
11135	J343_COLHI 161.00	635 MEC	0.95	1.05	0.9012	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	Low Voltage Violation
11136	J343_SUB 161.00	635 MEC	0.95	1.05	0.9022	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	Low Voltage Violation
300097	5MARYVL 161.00	330 AECI	0.90	1.10	0.9290	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	voltage is within range
631069	ANTA TP5 161.00	652 WAPA	0.90	1.10	1.0073	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	voltage is within range
635034	CLRNDA 5 161.00	635 MEC	0.95	1.05	0.9337	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	Low Voltage Violation
635037	BROOKS 5 161.00	635 MEC	0.95	1.05	0.9133	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	Low Voltage Violation
635645	MCKSBRG 3 161.00	635 MEC	0.95	1.05	1.0186	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	voltage is within range
652560	CRESTON5 161.00	652 WAPA	0.90	1.10	1.0084	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	voltage is within range

2017 Shoulder Case - J343 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
652569	CRESTON8 69.000	652 WAPA	0.90	1.10	1.0100	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	voltage is within range
652612	CRESTON 9 13.800	652 WAPA	0.90	1.10	1.0107	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	voltage is within range
652615	CRESTON29 13.800	652 WAPA	0.90	1.10	1.0105	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	voltage is within range

2017 Shoulder Case - J344 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
11125	J344_GEN 0.6900	635 MEC	0.95	1.05	1.0113	System Intact	voltage is within range
11126	J344_COLLO 34.500	635 MEC	0.95	1.05	1.0052	System Intact	voltage is within range
11127	J344_COLHI 161.00	635 MEC	0.95	1.05	1.0162	System Intact	voltage is within range
11128	J344_SUB 161.00	635 MEC	0.95	1.05	1.0163	System Intact	voltage is within range
630050	POWESHK8 69.000	627 ALTW	0.95	1.05	1.0150	System Intact	voltage is within range
631085	PARNEL 5 161.00	627 ALTW	0.95	1.05	1.0138	System Intact	voltage is within range
631113	POWESHK5 161.00	627 ALTW	0.95	1.05	1.0145	System Intact	voltage is within range
631117	REASNOR5 161.00	627 ALTW	0.95	1.05	1.0127	System Intact	voltage is within range
631134	TRICNTY5 161.00	627 ALTW	0.95	1.05	1.0291	System Intact	voltage is within range
635870	BEACON 5 161.00	635 MEC	0.95	1.05	1.0210	System Intact	voltage is within range
635871	BEACON 8 69.000	635 MEC	0.95	1.05	1.0317	System Intact	voltage is within range
635880	PLSNT CRNR 5161.00	635 MEC	0.95	1.05	1.0241	System Intact	voltage is within range
11125	J344_GEN 0.6900	635 MEC	0.95	1.05	1.0128	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
11126	J344_COLLO 34.500	635 MEC	0.95	1.05	1.0067	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
11127	J344_COLHI 161.00	635 MEC	0.95	1.05	1.0177	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
11128	J344_SUB 161.00	635 MEC	0.95	1.05	1.0178	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
630050	POWESHK8 69.000	627 ALTW	0.93	1.05	1.0100	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
631085	PARNEL 5 161.00	627 ALTW	0.93	1.05	1.0126	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
631113	POWESHK5 161.00	627 ALTW	0.93	1.05	1.0105	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
631117	REASNOR5 161.00	627 ALTW	0.93	1.05	1.0106	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
631134	TRICNTY5 161.00	627 ALTW	0.93	1.05	1.0291	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range

2017 Shoulder Case - J344 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
635870	BEACON 5 161.00	635 MEC	0.95	1.05	1.0213	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
635871	BEACON 8 69.000	635 MEC	0.95	1.05	1.0324	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
635880	PLSNT CRNR 5161.00	635 MEC	0.95	1.05	1.0242	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
11125	J344_GEN 0.6900	635 MEC	0.95	1.05	0.9908	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
11126	J344_COLLO 34.500	635 MEC	0.95	1.05	0.9847	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
11127	J344_COLHI 161.00	635 MEC	0.95	1.05	0.9967	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
11128	J344_SUB 161.00	635 MEC	0.95	1.05	0.9968	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
630050	POWESHK8 69.000	627 ALTW	0.93	1.05	1.0132	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
631085	PARNEL 5 161.00	627 ALTW	0.93	1.05	1.0030	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
631113	POWESHK5 161.00	627 ALTW	0.93	1.05	1.0009	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
631117	REASNOR5 161.00	627 ALTW	0.93	1.05	1.0082	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
631134	TRICNTY5 161.00	627 ALTW	0.93	1.05	1.0297	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
635870	BEACON 5 161.00	635 MEC	0.95	1.05	1.0235	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range

2017 Shoulder Case - J344 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
635871	BEACON 8 69.000	635 MEC	0.95	1.05	1.0307	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
635880	PLSNT CRNR 5161.00	635 MEC	0.95	1.05	1.0250	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range

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C.2 Reactive Power Requirement Results for 2024 Summer Shoulder

2024 Shoulder Case - J285 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
11118	J285_GEN1 0.6900	635 MEC	0.9500	1.0500	1.0211	System Intact	voltage is within range
11119	J285_GEN2 0.6900	635 MEC	0.9500	1.0500	1.0211	System Intact	voltage is within range
11120	J285_SUB 345.00	635 MEC	0.9600	1.0500	1.0247	System Intact	voltage is within range
12000	J285_1 34.500	635 MEC	0.9500	1.0500	1.0153	System Intact	voltage is within range
12001	J285_1 34.500	635 MEC	0.9500	1.0500	1.0153	System Intact	voltage is within range
601029	LKFLDXL3 345.00	600 XEL	0.9500	1.0500	1.0242	System Intact	voltage is within range
601034	NOBLES 3 345.00	600 XEL	0.9500	1.0500	1.0199	System Intact	voltage is within range
629992	G164_WF9 34.500	627 ALTW	0.9500	1.0500	1.0000	System Intact	voltage is within range
631041	LAKEFLD5 161.00	627 ALTW	0.9500	1.0500	1.0273	System Intact	voltage is within range
631138	LAKEFLD3 345.00	627 ALTW	0.9500	1.0500	1.0195	System Intact	voltage is within range
631193	HUNTLEY3 345.00	627 ALTW	0.9500	1.0500	1.0195	System Intact	voltage is within range
631197	LEDYARD3 345.00	627 ALTW	0.9500	1.0500	1.0207	System Intact	voltage is within range
635200	RAUN 3 345.00	635 MEC	1.0000	1.0500	1.0300	System Intact	voltage is within range
635368	OBRIEN 3 345.00	635 MEC	0.9600	1.0500	1.0250	System Intact	voltage is within range
635369	KOSSUTH 3 345.00	635 MEC	0.9600	1.0500	1.0199	System Intact	voltage is within range
635400	HIGHLND 3 345.00	635 MEC	0.9600	1.0500	1.0263	System Intact	voltage is within range
635401	SHD415 9 34.500	635 MEC	0.9500	1.0500	1.0407	System Intact	voltage is within range
635402	SHD425 9 34.500	635 MEC	0.9500	1.0500	1.0407	System Intact	voltage is within range
635403	SHD435 9 34.500	635 MEC	0.9500	1.0500	1.0407	System Intact	voltage is within range
636000	WEBSTER3 345.00	635 MEC	0.9600	1.0500	1.0161	System Intact	voltage is within range
11118	J285_GEN1 0.6900	635 MEC	0.9500	1.0500	1.0239	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
11119	J285_GEN2 0.6900	635 MEC	0.9500	1.0500	1.0239	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
11120	J285_SUB 345.00	635 MEC	0.9600	1.0500	1.0274	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
12000	J285_1 34.500	635 MEC	0.9500	1.0500	1.0182	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
12001	J285_1 34.500	635 MEC	0.9500	1.0500	1.0182	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
601029	LKFLDXL3 345.00	600 XEL	0.9200	1.0500	1.0225	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
601034	NOBLES 3 345.00	600 XEL	0.9200	1.0500	1.0173	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range

2024 Shoulder Case - J285 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
629992	G164_WF9 34.500	627 ALTW	0.9300	1.0500	1.0000	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
631041	LAKEFLD5 161.00	627 ALTW	0.9300	1.0500	1.0244	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
631138	LAKEFLD3 345.00	627 ALTW	0.9300	1.0500	1.0157	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
631193	HUNTLEY3 345.00	627 ALTW	0.9300	1.0500	1.0174	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
631197	LEDYARD3 345.00	627 ALTW	0.9300	1.0500	1.0198	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
635200	RAUN 3 345.00	635 MEC	1.0000	1.0500	1.0300	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
635368	OBRIEN 3 345.00	635 MEC	0.9600	1.0500	1.0277	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
635369	KOSSUTH 3 345.00	635 MEC	0.9600	1.0500	1.0201	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
635400	HIGHLND 3 345.00	635 MEC	0.9600	1.0500	1.0290	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
635401	SHD415 9 34.500	635 MEC	0.9500	1.0500	1.0425	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
635402	SHD425 9 34.500	635 MEC	0.9500	1.0500	1.0425	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
635403	SHD435 9 34.500	635 MEC	0.9500	1.0500	1.0425	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range
636000	WEBSTER3 345.00	635 MEC	0.9600	1.0500	1.0162	J285-OUTLET1 635368 [OBRIEN 3 345.00] TO 631138 [LAKEFLD3 345.00] 1	voltage is within range

2024 Shoulder Case - J285 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
11118	J285_GEN1 0.6900	635 MEC	0.9500	1.0500	1.0152	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
11119	J285_GEN2 0.6900	635 MEC	0.9500	1.0500	1.0152	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
11120	J285_SUB 345.00	635 MEC	0.9600	1.0500	1.0191	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
12000	J285_1 34.500	635 MEC	0.9500	1.0500	1.0095	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
12001	J285_1 34.500	635 MEC	0.9500	1.0500	1.0095	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
601029	LKFLDXL3 345.00	600 XEL	0.9200	1.0500	1.0229	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
601034	NOBLES 3 345.00	600 XEL	0.9200	1.0500	1.0183	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
629992	G164_WF9 34.500	627 ALTW	0.9300	1.0500	1.0000	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
631041	LAKEFLD5 161.00	627 ALTW	0.9300	1.0500	1.0249	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
631138	LAKEFLD3 345.00	627 ALTW	0.9300	1.0500	1.0165	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
631193	HUNTLEY3 345.00	627 ALTW	0.9300	1.0500	1.0138	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
631197	LEDYARD3 345.00	627 ALTW	0.9300	1.0500	1.0147	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
635200	RAUN 3 345.00	635 MEC	1.0000	1.0500	1.0300	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range

2024 Shoulder Case - J285 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
635368	OBRIEN 3 345.00	635 MEC	0.9600	1.0500	1.0195	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
635369	KOSSUTH 3 345.00	635 MEC	0.9600	1.0500	1.0128	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
635400	HIGHLND 3 345.00	635 MEC	0.9600	1.0500	1.0207	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
635401	SHD415 9 34.500	635 MEC	0.9500	1.0500	1.0350	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
635402	SHD425 9 34.500	635 MEC	0.9500	1.0500	1.0350	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
635403	SHD435 9 34.500	635 MEC	0.9500	1.0500	1.0350	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
636000	WEBSTER3 345.00	635 MEC	0.9600	1.0500	1.0139	J285-OUTLET2 635368 [OBRIEN 3 345.00] TO 635369 [KOSSUTH 3 345.00] 1	voltage is within range
11118	J285_GEN1 0.6900	635 MEC	0.9500	1.0500	1.0035	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
11119	J285_GEN2 0.6900	635 MEC	0.9500	1.0500	1.0035	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
11120	J285_SUB 345.00	635 MEC	0.9600	1.0500	1.0078	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
12000	J285_1 34.500	635 MEC	0.9500	1.0500	0.9977	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
12001	J285_1 34.500	635 MEC	0.9500	1.0500	0.9977	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
601029	LKFLDXL3 345.00	600 XEL	0.9200	1.0500	1.0220	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range

2024 Shoulder Case - J285 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
601034	NOBLES 3 345.00	600 XEL	0.9200	1.0500	1.0165	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
629992	G164_WF9 34.500	627 ALTW	0.9300	1.0500	1.0000	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
631041	LAKEFLD5 161.00	627 ALTW	0.9300	1.0500	1.0233	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
631138	LAKEFLD3 345.00	627 ALTW	0.9300	1.0500	1.0146	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
631193	HUNTLEY3 345.00	627 ALTW	0.9300	1.0500	1.0142	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
631197	LEDYARD3 345.00	627 ALTW	0.9300	1.0500	1.0146	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
635200	RAUN 3 345.00	635 MEC	1.0000	1.0500	1.0300	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
635368	OBRIEN 3 345.00	635 MEC	0.9600	1.0500	1.0082	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
635369	KOSSUTH 3 345.00	635 MEC	0.9600	1.0500	1.0122	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
635400	HIGHLND 3 345.00	635 MEC	0.9600	1.0500	1.0290	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
635401	SHD415 9 34.500	635 MEC	0.9500	1.0500	1.0251	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
635402	SHD425 9 34.500	635 MEC	0.9500	1.0500	1.0251	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range
635403	SHD435 9 34.500	635 MEC	0.9500	1.0500	1.0251	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range

2024 Shoulder Case - J285 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
636000	WEBSTER3 345.00	635 MEC	0.9600	1.0500	1.0120	J285-OUTLET3 635368 [OBRIEN 3 345.00] TO 635400 [HIGHLND 3 345.00] 1	voltage is within range

2024 Shoulder Case - J289 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
11136	J343_SUB 161.00	635 MEC	0.9500	1.0500	1.0100	System Intact	voltage is within range
300097	5MARYVL 161.00	330 AECI	0.9500	1.0500	0.9622	System Intact	voltage is within range
630395	WNTRSET8 69.000	627 ALTW	0.9500	1.0500	1.0237	System Intact	voltage is within range
631069	ANTA TP5 161.00	652 WAPA	0.9500	1.0500	1.0135	System Intact	voltage is within range
631078	WNTRST 5 161.00	627 ALTW	0.9500	1.0500	1.0103	System Intact	voltage is within range
635641	NORWLK5 161.00	635 MEC	0.9500	1.0500	1.0149	System Intact	voltage is within range
635645	MCKSBRG 3 161.00	635 MEC	0.9500	1.0500	1.0129	System Intact	voltage is within range
635646	DEY415 9 34.500	635 MEC	0.9500	1.0500	0.9999	System Intact	voltage is within range
635647	DEY415C 9 34.500	635 MEC	0.9500	1.0500	1.0445	System Intact	voltage is within range
652560	CRESTON5 161.00	652 WAPA	0.9500	1.0500	1.0100	System Intact	voltage is within range
652569	CRESTON8 69.000	652 WAPA	0.9500	1.0500	1.0105	System Intact	voltage is within range
652612	CRESTON 9 13.800	652 WAPA	0.9500	1.0500	1.0111	System Intact	voltage is within range
652615	CRESTON29 13.800	652 WAPA	0.9500	1.0500	1.0110	System Intact	voltage is within range
11136	J343_SUB 161.00	635 MEC	0.9500	1.0500	1.0100	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
300097	5MARYVL 161.00	330 AECI	0.9000	1.1000	0.9654	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
630395	WNTRSET8 69.000	627 ALTW	0.9300	1.0500	1.0209	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
631069	ANTA TP5 161.00	652 WAPA	0.9000	1.1000	1.0104	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
631078	WNTRST 5 161.00	627 ALTW	0.9300	1.0500	1.0038	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
635641	NORWLK5 161.00	635 MEC	0.9500	1.0500	1.0130	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
635645	MCKSBRG 3 161.00	635 MEC	0.9500	1.0500	1.0086	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
635646	DEY415 9 34.500	635 MEC	0.9500	1.0500	0.9953	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
635647	DEY415C 9 34.500	635 MEC	0.9500	1.0500	1.0401	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range

2024 Shoulder Case - J289 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
635648	DEY415 W 0.6000	635 MEC	0.9500	1.0500	1.0473	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
652560	CRESTON5 161.00	652 WAPA	0.9000	1.1000	1.0100	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
652569	CRESTON8 69.000	652 WAPA	0.9000	1.1000	1.0101	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
652612	CRESTON 9 13.800	652 WAPA	0.9000	1.1000	1.0104	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
652615	CRESTON29 13.800	652 WAPA	0.9000	1.1000	1.0104	J289-OUTLET1 652560 [CRESTON5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
11136	J343_SUB 161.00	635 MEC	0.9500	1.0500	1.0100	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
300097	5MARYVL 161.00	330 AECI	0.9000	1.1000	0.9608	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
630395	WNTRSET8 69.000	627 ALTW	0.9300	1.0500	1.0214	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
631069	ANTA TP5 161.00	652 WAPA	0.9000	1.1000	1.0143	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
631078	WNTRST 5 161.00	627 ALTW	0.9300	1.0500	1.0086	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
635641	NORWLK5 161.00	635 MEC	0.9500	1.0500	1.0148	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
635645	MCKSBRG 3 161.00	635 MEC	0.9500	1.0500	1.0146	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
635646	DEY415 9 34.500	635 MEC	0.9500	1.0500	1.0018	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
635647	DEY415C 9 34.500	635 MEC	0.9500	1.0500	1.0464	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range

2024 Shoulder Case - J289 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
652560	CRESTON5 161.00	652 WAPA	0.9000	1.1000	1.0101	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
652569	CRESTON8 69.000	652 WAPA	0.9000	1.1000	1.0108	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
652612	CRESTON 9 13.800	652 WAPA	0.9000	1.1000	1.0114	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range
652615	CRESTON29 13.800	652 WAPA	0.9000	1.1000	1.0113	J289-OUTLET2 631078 [WNTRST 5 161.00] TO 635645 [MCKSBRG 3 161.00] 1	voltage is within range

2024 Shoulder Case - J316 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
11115	J316_GEN 0.6900	661 MDU	0.9500	1.0500	1.0034	System Intact	voltage is within range
11116	J316_COLHI 34.500	661 MDU	0.9500	1.0500	0.9977	System Intact	voltage is within range
11117	J316_SUB 230.00	661 MDU	0.9500	1.0500	1.0121	System Intact	voltage is within range
620362	OAKES 4 230.00	620 OTP	0.9700	1.0500	1.0125	System Intact	voltage is within range
661026	ELLENDL4 230.00	661 MDU	0.9500	1.0500	1.0114	System Intact	voltage is within range
661093	MERRCRT4 230.00	661 MDU	0.9500	1.0500	1.0145	System Intact	voltage is within range
661096	TTNKPOI4 230.00	661 MDU	0.9500	1.0500	1.0146	System Intact	voltage is within range
661097	ELLENDLMVP3 345.00	661 MDU	0.9500	1.0500	0.9920	System Intact	voltage is within range
661098	ELLENDLMVP4 230.00	661 MDU	0.9500	1.0500	1.0114	System Intact	voltage is within range
661907	ELLENDLMVP9 34.500	661 MDU	0.9500	1.0500	1.0110	System Intact	voltage is within range
661997	TTNKACL4 34.500	661 MDU	0.9500	1.0500	1.0197	System Intact	voltage is within range
11115	J316_GEN 0.6900	661 MDU	0.9000	1.1000	0.9973	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range
11116	J316_COLHI 34.500	661 MDU	0.9000	1.1000	0.9915	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range
11117	J316_SUB 230.00	661 MDU	0.9000	1.1000	1.0062	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range
620362	OAKES 4 230.00	620 OTP	0.9200	1.1000	1.0099	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range
661026	ELLENDL4 230.00	661 MDU	0.9000	1.1000	1.0076	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range
661093	MERRCRT4 230.00	661 MDU	0.9000	1.1000	1.0129	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range
661096	TTNKPOI4 230.00	661 MDU	0.9000	1.1000	1.0142	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range
661097	ELLENDLMVP3 345.00	661 MDU	0.9000	1.1000	0.9891	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range
661098	ELLENDLMVP4 230.00	661 MDU	0.9000	1.1000	1.0076	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range
661907	ELLENDLMVP9 34.500	661 MDU	0.9000	1.1000	1.0071	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range

2024 Shoulder Case - J316 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
661997	TTNKACL4 34.500	661 MDU	0.9000	1.1000	1.0195	J316-OUTLET1 11117 [J316_SUB 230.00] TO 661096 [TTNKPOI4 230.00] 1	voltage is within range
11115	J316_GEN 0.6900	661 MDU	0.9000	1.1000	0.9916	J316-OUTLET2 11117 [J316_SUB 230.00] TO 661098 [ELLENDLMVP4 230.00] 1	voltage is within range
11116	J316_COLHI 34.500	661 MDU	0.9000	1.1000	0.9858	J316-OUTLET2 11117 [J316_SUB 230.00] TO 661098 [ELLENDLMVP4 230.00] 1	voltage is within range
11117	J316_SUB 230.00	661 MDU	0.9000	1.1000	1.0008	J316-OUTLET2 11117 [J316_SUB 230.00] TO 661098 [ELLENDLMVP4 230.00] 1	voltage is within range
620362	OAKES 4 230.00	620 OTP	0.9200	1.1000	1.0048	J316-OUTLET2 11117 [J316_SUB 230.00] TO 661098 [ELLENDLMVP4 230.00] 1	voltage is within range
661026	ELLENDL4 230.00	661 MDU	0.9000	1.1000	1.0004	J316-OUTLET2 11117 [J316_SUB 230.00] TO 661098 [ELLENDLMVP4 230.00] 1	voltage is within range
661093	MERRCRT4 230.00	661 MDU	0.9000	1.1000	1.0010	J316-OUTLET2 11117 [J316_SUB 230.00] TO 661098 [ELLENDLMVP4 230.00] 1	voltage is within range
661096	TTNKPOI4 230.00	661 MDU	0.9000	1.1000	1.0022	J316-OUTLET2 11117 [J316_SUB 230.00] TO 661098 [ELLENDLMVP4 230.00] 1	voltage is within range
661097	ELLENDLMVP3 345.00	661 MDU	0.9000	1.1000	0.9835	J316-OUTLET2 11117 [J316_SUB 230.00] TO 661098 [ELLENDLMVP4 230.00] 1	voltage is within range
661098	ELLENDLMVP4 230.00	661 MDU	0.9000	1.1000	1.0004	J316-OUTLET2 11117 [J316_SUB 230.00] TO 661098 [ELLENDLMVP4 230.00] 1	voltage is within range
661907	ELLENDLMVP9 34.500	661 MDU	0.9000	1.1000	0.9997	J316-OUTLET2 11117 [J316_SUB 230.00] TO 661098 [ELLENDLMVP4 230.00] 1	voltage is within range
661997	TTNKACL4 34.500	661 MDU	0.9000	1.1000	1.0138	J316-OUTLET2 11117 [J316_SUB 230.00] TO 661098 [ELLENDLMVP4 230.00] 1	voltage is within range

2024 Shoulder Case - J343 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
11133	J343_GEN 0.6900	635 MEC	0.9500	1.0500	0.9413	System Intact	Low Voltage Violation
11134	J343_COLLO 34.500	635 MEC	0.9500	1.0500	0.9351	System Intact	Low Voltage Violation
11135	J343_COLHI 161.00	635 MEC	0.9500	1.0500	0.9887	System Intact	voltage is within range
11136	J343_SUB 161.00	635 MEC	0.9500	1.0500	0.9892	System Intact	voltage is within range
300097	5MARYVL 161.00	330 AECI	0.9500	1.0500	0.9581	System Intact	voltage is within range
631069	ANTA TP5 161.00	652 WAPA	0.9500	1.0500	1.0125	System Intact	voltage is within range
635034	CLRNDA 5 161.00	635 MEC	0.9500	1.0500	0.9694	System Intact	voltage is within range
635037	BROOKS 5 161.00	635 MEC	0.9500	1.0500	0.9866	System Intact	voltage is within range
635645	MCKSBRG 3 161.00	635 MEC	0.9500	1.0500	1.0186	System Intact	voltage is within range
652560	CRESTON5 161.00	652 WAPA	0.9500	1.0500	1.0076	System Intact	voltage is within range
652569	CRESTON8 69.000	652 WAPA	0.9500	1.0500	1.0100	System Intact	voltage is within range
652612	CRESTON 9 13.800	652 WAPA	0.9500	1.0500	1.0108	System Intact	voltage is within range
652615	CRESTON29 13.800	652 WAPA	0.9500	1.0500	1.0106	System Intact	voltage is within range
11133	J343_GEN 0.6900	635 MEC	0.9500	1.0500	0.9619	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
11134	J343_COLLO 34.500	635 MEC	0.9500	1.0500	0.9557	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
11135	J343_COLHI 161.00	635 MEC	0.9500	1.0500	1.0078	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
11136	J343_SUB 161.00	635 MEC	0.9500	1.0500	1.0083	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
300097	5MARYVL 161.00	330 AECI	0.9000	1.1000	0.9532	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
631069	ANTA TP5 161.00	652 WAPA	0.9000	1.1000	1.0145	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
635034	CLRNDA 5 161.00	635 MEC	0.9500	1.0500	0.9526	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
635037	BROOKS 5 161.00	635 MEC	0.9500	1.0500	0.9522	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
635645	MCKSBRG 3 161.00	635 MEC	0.9500	1.0500	1.0186	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range

2024 Shoulder Case - J343 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
652560	CRESTON5 161.00	652 WAPA	0.9000	1.1000	1.0077	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
652569	CRESTON8 69.000	652 WAPA	0.9000	1.1000	1.0100	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
652612	CRESTON 9 13.800	652 WAPA	0.9000	1.1000	1.0109	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
652615	CRESTON29 13.800	652 WAPA	0.9000	1.1000	1.0107	J343-OUTLET1 11136 [J343_SUB 161.00] TO 635037 [BROOKS 5 161.00] 1	voltage is within range
11133	J343_GEN 0.6900	635 MEC	0.9500	1.0500	0.8546	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	Low Voltage Violation
11134	J343_COLLO 34.500	635 MEC	0.9500	1.0500	0.8481	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	Low Voltage Violation
11135	J343_COLHI 161.00	635 MEC	0.9500	1.0500	0.9102	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	Low Voltage Violation
11136	J343_SUB 161.00	635 MEC	0.9500	1.0500	0.9111	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	Low Voltage Violation
300097	5MARYVL 161.00	330 AECI	0.9000	1.1000	0.9474	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	voltage is within range
631069	ANTA TP5 161.00	652 WAPA	0.9000	1.1000	1.0142	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	voltage is within range
635034	CLRNDA 5 161.00	635 MEC	0.9500	1.0500	0.9406	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	Low Voltage Violation
635037	BROOKS 5 161.00	635 MEC	0.9500	1.0500	0.9217	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	Low Voltage Violation
635645	MCKSBRG 3 161.00	635 MEC	0.9500	1.0500	1.0186	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	voltage is within range

2024 Shoulder Case - J343 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
652560	CRESTON5 161.00	652 WAPA	0.9000	1.1000	1.0126	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	voltage is within range
652569	CRESTON8 69.000	652 WAPA	0.9000	1.1000	1.0129	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	voltage is within range
652612	CRESTON 9 13.800	652 WAPA	0.9000	1.1000	1.0134	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	voltage is within range
652615	CRESTON29 13.800	652 WAPA	0.9000	1.1000	1.0133	J343-OUTLET2 11136 [J343_SUB 161.00] TO 652560 [CRESTON5 161.00] 1	voltage is within range

2024 Shoulder Case - J344 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
11125	J344_GEN 0.6900	635 MEC	0.9500	1.0500	1.0128	System Intact	voltage is within range
11126	J344_COLLO 34.500	635 MEC	0.9500	1.0500	1.0068	System Intact	voltage is within range
11127	J344_COLHI 161.00	635 MEC	0.9500	1.0500	1.0178	System Intact	voltage is within range
11128	J344_SUB 161.00	635 MEC	0.9500	1.0500	1.0179	System Intact	voltage is within range
630050	POWESHK8 69.000	627 ALTW	0.9500	1.0500	1.0197	System Intact	voltage is within range
631085	PARNEL 5 161.00	627 ALTW	0.9500	1.0500	1.0171	System Intact	voltage is within range
631113	POWESHK5 161.00	627 ALTW	0.9500	1.0500	1.0166	System Intact	voltage is within range
631117	REASNOR5 161.00	627 ALTW	0.9500	1.0500	1.0132	System Intact	voltage is within range
631134	TRICNTY5 161.00	627 ALTW	0.9500	1.0500	1.0294	System Intact	voltage is within range
635870	BEACON 5 161.00	635 MEC	0.9500	1.0500	1.0222	System Intact	voltage is within range
635871	BEACON 8 69.000	635 MEC	0.9500	1.0500	1.0342	System Intact	voltage is within range
635880	PLSNT CRNR 5161.00	635 MEC	0.9500	1.0500	1.0245	System Intact	voltage is within range
11125	J344_GEN 0.6900	635 MEC	0.9500	1.0500	1.0141	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
11126	J344_COLLO 34.500	635 MEC	0.9500	1.0500	1.0081	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
11127	J344_COLHI 161.00	635 MEC	0.9500	1.0500	1.0190	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
11128	J344_SUB 161.00	635 MEC	0.9500	1.0500	1.0191	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
630050	POWESHK8 69.000	627 ALTW	0.9300	1.0500	1.0172	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
631085	PARNEL 5 161.00	627 ALTW	0.9300	1.0500	1.0160	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
631113	POWESHK5 161.00	627 ALTW	0.9300	1.0500	1.0139	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
631117	REASNOR5 161.00	627 ALTW	0.9300	1.0500	1.0121	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
631134	TRICNTY5 161.00	627 ALTW	0.9300	1.0500	1.0295	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range

2024 Shoulder Case - J344 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
635870	BEACON 5 161.00	635 MEC	0.9500	1.0500	1.0226	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
635871	BEACON 8 69.000	635 MEC	0.9500	1.0500	1.0346	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
635880	PLSNT CRNR 5161.00	635 MEC	0.9500	1.0500	1.0246	J344-OUTLET1 11128 [J344_SUB 161.00] TO 631113 [POWESHK5 161.00] 1	voltage is within range
11125	J344_GEN 0.6900	635 MEC	0.9500	1.0500	0.9945	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
11126	J344_COLLO 34.500	635 MEC	0.9500	1.0500	0.9883	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
11127	J344_COLHI 161.00	635 MEC	0.9500	1.0500	1.0002	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
11128	J344_SUB 161.00	635 MEC	0.9500	1.0500	1.0003	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
630050	POWESHK8 69.000	627 ALTW	0.9300	1.0500	1.0194	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
631085	PARNEL 5 161.00	627 ALTW	0.9300	1.0500	1.0071	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
631113	POWESHK5 161.00	627 ALTW	0.9300	1.0500	1.0043	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
631117	REASNOR5 161.00	627 ALTW	0.9300	1.0500	1.0095	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
631134	TRICNTY5 161.00	627 ALTW	0.9300	1.0500	1.0300	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
635870	BEACON 5 161.00	635 MEC	0.9500	1.0500	1.0246	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range

2024 Shoulder Case - J344 Reactive Power Requirement Analysis Results

Bus#	Bus Name	Area	Voltage Low Limit	Voltage High Limit	Voltage in studycase (with Qlimits set at 0 MVAR)	Contingency	Comments
635871	BEACON 8 69.000	635 MEC	0.9500	1.0500	1.0325	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range
635880	PLSNT CRNR 5161.00	635 MEC	0.9500	1.0500	1.0253	J344-OUTLET2 11128 [J344_SUB 161.00] TO 635870 [BEACON 5 161.00] 1	voltage is within range

Appendix
D

2017 Contingency Analysis Results

D.1 2017 Summer Shoulder (SH) Constraints

Table D-1: 2017 SH System Intact Thermal Constraints

Table D-2: 2017 SH System Intact Voltage Constraints

Table D-3: 2017 SH Category B Thermal Constraints

Table D-4: 2017 SH Category B Voltage Constraints

Table D-5: 2017 SH Category C Thermal Constraints

Table D-6: 2017 SH Category C Voltage Constraints

Table D-7: 2017 SH Non-Converged Category C Contingencies

Table D-8: 2017 SH Non-Converged Category C Contingencies DCCC Results

Table D-1: 2017 SH System Intact Thermal Constraints

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>5%	MW>20%*Rating	Outlet Con.	Outlet Mon.	Summary
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				27.5	20	250	150	55	150	169	GIP With Impact-1	GIP With Impact-2	GIP With Impact-3	GIP With Impact-4	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR					
No constraints																					

Table D-2: 2017 SH System Intact Voltage Constraints

Bus	Area	Vlow	Vhi	Benchmark Case Vcont	Study Case Vcont	Delta (> 0.01 p.u.)	Contingency Details	Cont Type
No constraints								

Table D-3: 2017 SH Category B Thermal Constraints

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>20%	MW>20%*Rating	Outlet Con.	Outlet Mon.	Summary
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				27.5	20	250	150	55	150	169					
										ER	NR	NR	NR	NR	NR	NR					
																	GIP With Impact-1	GIP With Impact-2	GIP With Impact-3	GIP With Impact-4	GIP With Impact
541251 MARYVLE5 161 635034 CLRNDA 5 161 1	168.0	MEC GMO	150.9	89.8	197.3	117.4	300097 5MARYVL 16	CRESTON5 161 - 5MARYVL 161 1	B	0.01060	0.09990	0.01665	0.01146	0.01749	0.22050	0.01536	J343,				J343,
620263 FORMN 7 115 620363 FORMAN 4 230 620163 FORMN 9 41.6 1	140.0	OTP	108.0	77.1	143.9	102.8	620327 HANKSON4 23	HANKSON4 230 - FORMAN 4 230 1	B	-0.00221	-0.00148	-0.00215	0.25307	-0.00162	-0.00142	-0.00163	J316,	J316,			J316, J316,
620362 OAKES 4 230 620363 FORMAN 4 230 1	305.0	OTP	231.3	75.8	313.7	102.8	B3.ELN-XF	ELLENDL4 230 - ELLENDL7 115 - ELLENDL9 13.8 1	B	-0.00737	-0.00278	-0.00421	0.55480	-0.00353	-0.00259	-0.00362	J316,	J316,			J316, J316,
620362 OAKES 4 230 620363 FORMAN 4 230 1	305.0	OTP	225.8	74.0	308.1	101.0	660000 ABDNJCT7 11	ABDNJCT7 115 - ELLENDL7 115 1	B	-0.00737	-0.00278	-0.00421	0.55480	-0.00353	-0.00259	-0.00362	J316,	J316,			J316, J316,
631110 WAPELLO5 161 631112 APANOSE5 161 1	171.0	ITCM	160.1	93.6	185.3	108.3	J344-Outlet1	J344_SUB 161 - POWESHK5 161 1	B	0.00831	0.01153	0.00956	0.00767	0.06046	0.00656	0.09641			J344-Outlet1		J344-Outlet1
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	91.9	59.7	167.9	109.0	300097 5MARYVL 16	CRESTON5 161 - 5MARYVL 161 1	B	0.00510	0.18567	0.00627	0.00402	0.01922	0.44824	0.01724	J343,	J343,			J343, J343,
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	104.7	68.0	166.1	107.9	635001 CBLUFFS5 16	CBLUFFS5 161 - RIVRBND5 161 1	B	0.00435	0.11617	0.00588	0.00389	0.01308	0.36057	0.01168	J343,	J343,			J343, J343,
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	102.3	66.4	163.8	106.4	635030 RIVRBND5 16	RIVRBND5 161 - BUNGE 5 161 1	B	0.00435	0.11617	0.00588	0.00389	0.01308	0.36057	0.01168	J343,	J343,			J343, J343,
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	102.4	66.5	163.8	106.4	P12:161:MEC:CBEC-River	CBLUFFS5 161 - RIVRBND5 161 1 RIVRBND5 161 - BUNGE 5 161 1	B	0.00435	0.11617	0.00588	0.00389	0.01308	0.36057	0.01168	J343,	J343,			J343, J343,
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	98.8	64.2	160.2	104.0	635031 BUNGE 5 16	BUNGE 5 161 - HASTING5 161 1	B	0.00435	0.11617	0.00588	0.00389	0.01308	0.36057	0.01168	J343,	J343,			J343, J343,
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	99.5	64.6	159.5	103.5	P13:069:MEC:Hastings 8	HASTING5 161 - HASTING8 69.0 1 HASTING5 161 - CLRNDA 5 161 1 BUNGE 5 161 - HASTING5 161 1	B	0.00456	0.11204	0.00630	0.00418	0.01295	0.35005	0.01155	J343,	J343,			J343, J343,
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	128.0	NWPS	98.9	77.3	140.1	109.5	B2.HK4-EL4	FORMAN 4 230 - FORMN 7 115 - FORMN 9 41.6 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 EDGE SS9 41.6 - OAKES 9 41.6 1	B	-0.00018	-0.00342	-0.00423	0.30805	-0.00293	-0.00344	-0.00284	J316,	J316,			J316, J316,
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	128.0	NWPS	98.5	77.0	139.8	109.2	620362 OAKES 4 23	OAKES 4 230 - ELLENDL4 230 1	B	-0.00023	-0.00340	-0.00421	0.30825	-0.00292	-0.00342	-0.00283	J316,	J316,			J316, J316,
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	128.0	NWPS	98.0	76.6	138.2	108.0	B2F.HK4-OA4	FORMAN 4 230 - FORMN 7 115 - FORMN 9 41.6 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1	B	-0.00007	-0.00349	-0.00430	0.29987	-0.00297	-0.00351	-0.00287	J316,	J316,			J316, J316,
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	128.0	NWPS	97.9	76.5	138.1	107.9	620362 OAKES 4 23	OAKES 4 230 - FORMAN 4 230 1	B	-0.00013	-0.00347	-0.00428	0.30009	-0.00296	-0.00349	-0.00287	J316,	J316,			J316, J316,
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	128.0	NWPS MDU	127.2	99.4	171.5	134.0	B2.HK4-EL4	FORMAN 4 230 - FORMN 7 115 - FORMN 9 41.6 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 EDGE SS9 41.6 - OAKES 9 41.6 1	B	-0.00018	-0.00342	-0.00423	0.30805	-0.00293	-0.00344	-0.00284	J316,	J316,			J316, J316,
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	128.0	NWPS MDU	126.9	99.1	171.2	133.8	620362 OAKES 4 23	OAKES 4 230 - ELLENDL4 230 1	B	-0.00023	-0.00340	-0.00421	0.30825	-0.00292	-0.00342	-0.00283	J316,	J316,			J316, J316,
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	128.0	NWPS MDU	126.4	98.8	169.6	132.5	B2F.HK4-OA4	FORMAN 4 230 - FORMN 7 115 - FORMN 9 41.6 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1	B	-0.00007	-0.00349	-0.00430	0.29987	-0.00297	-0.00351	-0.00287	J316,	J316,			J316, J316,
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	128.0	NWPS MDU	126.3	98.7	169.5	132.4	620362 OAKES 4 23	OAKES 4 230 - FORMAN 4 230 1	B	-0.00013	-0.00347	-0.00428	0.30009	-0.00296	-0.00349	-0.00287	J316,	J316,			J316, J316,

Table D-4: 2017 SH Category B Voltage Constraints

Bus	Area	Vlow	Vhi	Benchmark Case Vcont	Study Case Vcont	Delta (> 0.01 p.u.)	Contingency Details	Cont Type
No constraints								

Table D-5: 2017 SH Category C Thermal Constraints

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>20%	MW>20%*Rating	Outlet Con.	Outlet Mon.	Summary
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				27.5	20	250	150	55	150	169	GIP With Impact-1	GIP With Impact-2	GIP With Impact-3	GIP With Impact-4	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR					
11128 J344_SUB 161 635870 BEACON 5 161 1	261.0	MEC ITCM	289.5	110.9	***355.7***	***136.3***	ITCM-C501-TR	OTTUMWA5 161 - OTTUMWA3 345 1 REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0	C	0.01197	0.00534	0.01462	0.01189	-0.13903	0.00213	0.43342	J344,	J344,		J344-Outlet-2	J344, J344, J344-Outlet-2
541251 MARYVLE5 161 635034 CLRNDA 5 161 1	168.0	MEC GMO	134.7	80.2	***188.5***	***112.2***	ITCM-C304-SW	CRESTON5 161 - 5MARYVL 161 1 MCKSBRG 3 161 - CRESTON5 161 1 CRESTON5 161 - CRESTON8 69.0 - CRESTON29 13.8 1	C	0.01069	0.01901	0.01693	0.01197	0.01432	0.28023	0.01284	J343,	J343,			J343, J343,
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	98.8	64.2	***160.2***	***104.1***	P23:161:MEC:Bunge 86	RIVRBND5 161 - BUNGE 5 161 1 CBLUFFS5 161 - RIVRBND5 161 1 BUNGE 5 161 - HASTING5 161 1	C	0.00435	0.11617	0.00588	0.00389	0.01308	0.36057	0.01168	J343,	J343,			J343, J343,
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	98.8	64.2	***160.2***	***104.0***	P23:161:MEC:Bunge 86	BUNGE 5 161 - HASTING5 161 1 RIVRBND5 161 - BUNGE 5 161 1	C	0.00435	0.11617	0.00588	0.00389	0.01308	0.36057	0.01168	J343,	J343,			J343, J343,

Table D-6: 2017 SH Category C Voltage Constraints

Bus	Area	Vlow	Vhi	Benchmark Case Vcont	Study Case Vcont	Delta (> 0.01 p.u.)	Contingency Details	Cont Type
No constraints								

Table D-7: 2017 SH Non-Converged Category C Contingencies

Contingency	Benchmark Case	Study Case	Contingency Details
ITCM-C925-LN	BlowUp	BlowUp	GRE-BREWSTR5 161 - HRN LK 5 161 1 SPLT RK5 161 - ROCK CO5 161 1 ROCK CO5 161 - ROCKCOFDR1_134.5 1
ITCM-C938-LN	BlowUp	BlowUp	EIC 5 161 - TRICNTY5 161 1 OTTUMWA5 161 - BRDGPRT5 161 1
CIPC-56	BlowUp	BlowUp	ANTA TP5 161 - ANITA 5 161 1 SCRANTN5 161 - GU CTR 5 161 1
CIPC-57	BlowUp	BlowUp	ANTA TP5 161 - ANITA 5 161 1 SCRANTN5 161 - GR JCT 5 161 1

Table D-8: 2017 SH Non-Converged Category C Contingencies DCCC Results

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>20%	MW>20%*Rating	Outlet Con.	Outlet Mon.	Summary
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				27.5	20	250	150	55	150	169	GIP With Impact-1	GIP With Impact-2	GIP With Impact-3	GIP With Impact-4	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR					
No constraints																					

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D.2 2017 Summer Peak (SPK) Constraints

Table D-9: 2017 SPK System Intact Thermal Constraints

Table D-10: 2017 SPK System Intact Voltage Constraints

Table D-11: 2017 SPK Category B Thermal Constraints

Table D-12: 2017 SPK Category B Voltage Constraints

Table D-13: 2017 SPK Category C Thermal Constraints

Table D-14: 2017 SPK Category C Voltage Constraints

Table D-15: 2017 SPK Non-Converged Category C Contingencies

Table D-16: 2017 SPK Non-Converged Category C Contingencies DCCC Results

Table D-9: 2017 SPK System Intact Thermal Constraints

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>5%	MW>20%*Rating	Outlet Con.	Outlet Mon.	Summary
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				55	4	50	30	55	30	33.8	GIP With Impact-1	GIP With Impact-2	GIP With Impact-3	GIP With Impact-4	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR					
No constraints																					

Table D-10: 2017 SPK System Intact Voltage Constraints

Bus	Area	Vlow	Vhi	Benchmark Case Vcont	Study Case Vcont	Delta (> 0.01 p.u.)	Contingency Details	Cont Type
No constraints								

Table D-11: 2017 SPK Category B Thermal Constraints

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>20%	MW>20%*Rating	Outlet Con.	Outlet Mon.	Summary
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				55	4	50	30	55	30	33.8	GIP With Impact-1	GIP With Impact-2	GIP With Impact-3	GIP With Impact-4	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR					
No constraints																					

Table D-12: 2017 SPK Category B Voltage Constraints

Bus	Area	Vlow	Vhi	Benchmark Case Vcont	Study Case Vcont	Delta (> 0.01 p.u.)	Contingency Details	Cont Type
No constraints								

Table D-13: 2017 SPK Category C Thermal Constraints

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>20%	MW>20%*Rating	Outlet Con.	Outlet Mon.	Summary
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				55	4	50	30	55	30	33.8	GIP With Impact-1	GIP With Impact-2	GIP With Impact-3	GIP With Impact-4	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR					
No constraints																					

Table D-14: 2017 SPK Category C Voltage Constraints

Bus	Area	Vlow	Vhi	Benchmark Case	Study Case	Delta (> 0.01 p.u.)	Contingency Details	Cont Type
				Vcont	Vcont			
No constraints								

Table D-15: 2017 SPK Non-Converged Category C Contingencies

Contingency	Benchmark Case	Study Case	Contingency Details
ITCM-C925-LN	BlowUp	BlowUp	GRE-BREWSTR5 161 - HRN LK 5 161 1 SPLT RK5 161 - ROCK CO5 161 1 ROCK CO5 161 - ROCKCOFDR1_134.5 1
ITCM-C927-LN	BlowUp	BlowUp	ANTA TP5 161 - ANITA 5 161 1 SCRANTN5 161 - GU CTR 5 161 1 SCRANTN9 34.5 - SCRANTN5 161 1 SCRANTN5 161 - GR JCT 5 161 1
ITCM-C938-LN	BlowUp	BlowUp	EIC 5 161 - TRICNTY5 161 1 OTTUMWA5 161 - BRDGPRT5 161 1
CIPC-56	BlowUp	BlowUp	ANTA TP5 161 - ANITA 5 161 1 SCRANTN5 161 - GU CTR 5 161 1
CIPC-57	BlowUp	BlowUp	ANTA TP5 161 - ANITA 5 161 1 SCRANTN5 161 - GR JCT 5 161 1

Table D-16: 2017 SPK Non-Converged Category C Contingencies DCCC Results

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>20%	MW>20%*Rating	Outlet Con.	Outlet Mon.	Summary
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				55	4	50	30	55	30	33.8	GIP With Impact-1	GIP With Impact-2	GIP With Impact-3	GIP With Impact-4	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR					
No constraints																					

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Appendix
E

2024 Contingency Analysis Results

E.1 2024 Summer Shoulder (SH) Constraints

Table E-1: 2024 SH System Intact Thermal Constraints

Table E-2: 2024 SH System Intact Voltage Constraints

Table E-3: 2024 SH Category B Thermal Constraints

Table E-4: 2024 SH Category B Voltage Constraints

Table E-5: 2024 SH Category C Thermal Constraints

Table E-6: 2024 SH Category C Voltage Constraints

Table E-7: 2024 SH Non-Converged Category C Contingencies

Table E-8: 2024 SH Non-Converged Category C Contingencies DCCC Results

Table E-1: 2024 SH System Intact Thermal Constraints

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>5%	MW>20%*Rating	Outlet Con.	Outlet Mon.	Summary
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				27.5	20	250	150	55	150	169	GIP With Impact-1	GIP With Impact-2	GIP With Impact-3	GIP With Impact-4	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR					
No constraints																					

Table E-2: 2024 SH System Intact Voltage Constraints

Bus	Area	Vlow	Vhi	Benchmark Case	Study Case	Delta (> 0.01 p.u.)	Contingency Details	Cont Type
				Vcont	Vcont			
No constraints								

Table E-3: 2024 SH Category B Thermal Constraints

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>20%	MW>20%*Rating	Outlet Con.	Outlet Mon.	Summary
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				27.5	20	250	150	55	150	169	GIP With Impact-1	GIP With Impact-2	GIP With Impact-3	GIP With Impact-4	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR					
11117 J316_SUB 230 661098 ELLENDLMVP4 230 1	343.0	MDU	291.6	85.0	***399.4***	***116.4***	B2.ELM-MRC4	MERRCRT4 230 - ELLENDLMVP4 230 1	B	-0.00623	-0.00552	-0.00826	0.74119	-0.00575	-0.00531	-0.00574	J316,	J316,		J316-Outlet-2	J316, J316, J316-Outlet-2
11128 J344_SUB 161 635870 BEACON 5 161 1	261.0	MEC ITCM	173.4	66.4	***266.3***	***102.0***	OTTUMW1G	REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0	B	0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	J344,	J344,		J344-Outlet-2	J344, J344, J344-Outlet-2
541251 MARYVLE5 161 635034 CLRNDA 5 161 1	168.0	MEC GMO	146.4	87.1	***190.4***	***113.4***	300097 5MARYVL 16	CRESTON5 161 - 5MARYVL 161 1	B	0.01012	0.09798	0.01479	0.01124	0.01459	0.21895	0.01233	J343,				J343,
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	104.3	67.7	***163.7***	***106.3***	635001 CBLUFFS5 16	CBLUFFS5 161 - RIVRBND5 161 1	B	0.00422	0.11504	0.00512	0.00383	0.01085	0.35967	0.00928	J343,	J343,			J343, J343,
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	88.9	57.7	***163.3***	***106.0***	300097 5MARYVL 16	CRESTON5 161 - 5MARYVL 161 1	B	0.00500	0.18395	0.00539	0.00397	0.01589	0.44686	0.01364	J343,	J343,			J343, J343,
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	102.1	66.3	***161.2***	***104.7***	635030 RIVRBND5 16	RIVRBND5 161 - BUNGE 5 161 1	B	0.00422	0.11504	0.00512	0.00383	0.01085	0.35967	0.00928	J343,	J343,			J343, J343,
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	102.0	66.2	***161.2***	***104.7***	P12:161:MEC:CBEC-River	CBLUFFS5 161 - RIVRBND5 161 1 RIVRBND5 161 - BUNGE 5 161 1	B	0.00422	0.11504	0.00512	0.00383	0.01085	0.35967	0.00928	J343,	J343,			J343, J343,
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	98.7	64.1	***157.5***	***102.3***	635031 BUNGE 5 16	BUNGE 5 161 - HASTING5 161 1	B	0.00422	0.11504	0.00512	0.00383	0.01085	0.35967	0.00928	J343,	J343,			J343, J343,
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	98.4	63.9	***156.7***	***101.8***	P13:069:MEC:Hastings 8	HASTING5 161 - HASTING8 69.0 1 HASTING5 161 - CLRNDA 5 161 1 BUNGE 5 161 - HASTING5 161 1	B	0.00442	0.11091	0.00550	0.00412	0.01074	0.34915	0.00918	J343,	J343,			J343, J343,

Table E-4: 2024 SH Category B Voltage Constraints

Bus	Area	Vlow	Vhi	Benchmark Case Vcont	Study Case Vcont	Delta (> 0.01 p.u.)	Contingency Details	Cont Type
No constraints								

Table E-5: 2024 SH Category C Thermal Constraints

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>20%	MW>20%*Rating	Outlet Con.	Outlet Mon.	Summary
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				27.5	20	250	150	55	150	169	GIP With Impact-1	GIP With Impact-2	GIP With Impact-3	GIP With Impact-4	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR					
11128 J344_SUB 161 635870 BEACON 5 161 1	261.0	MEC ITCM	254.6	97.5	324.2	124.2	ITCM-C501-TR	OTTUMWA5 161 - OTTUMWA3 345 1 REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0	C	0.01053	0.00356	0.01272	0.01076	-0.13630	0.00127	0.43733	J344,	J344,		J344-Outlet-2	J344, J344, J344-Outlet-2
11128 J344_SUB 161 635870 BEACON 5 161 1	261.0	MEC ITCM	181.3	69.5	273.6	104.8	GENS: OTTUMW1G + BUR	REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0 REMOVE UNIT 1 FROM BUS BURLIN1G 20.0	C	0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	J344,	J344,		J344-Outlet-2	J344, J344, J344-Outlet-2
11128 J344_SUB 161 635870 BEACON 5 161 1	261.0	MEC ITCM	180.3	69.1	268.1	102.7	ITCM-C703-GE	MNTZUMA3 345 - HILLS 3 345 1 REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0	C	0.01003	0.00160	0.00953	0.00881	-0.06567	-0.00032	0.52282	J344,	J344,		J344-Outlet-2	J344, J344, J344-Outlet-2
11128 J344_SUB 161 635870 BEACON 5 161 1	261.0	MEC ITCM	172.1	65.9	265.1	101.6	GENS: OTTUMW1G + BVR	REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0 REMOVE UNIT 2 FROM BUS BVRCH52G 20.0	C	0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	J344,	J344,		J344-Outlet-2	J344, J344, J344-Outlet-2
11128 J344_SUB 161 635870 BEACON 5 161 1	261.0	MEC ITCM	171.7	65.8	264.7	101.4	GENS: OTTUMW1G + EMB	REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0 REMOVE UNIT 1 FROM BUS EMERYST1 18.0	C	0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	J344,	J344,		J344-Outlet-2	J344, J344, J344-Outlet-2
11128 J344_SUB 161 635870 BEACON 5 161 1	261.0	MEC ITCM	171.4	65.7	264.4	101.3	GENS: OTTUMW1G + G17	REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0 REMOVE UNIT 1 FROM BUS G172_G1 34.5	C	0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	J344,	J344,		J344-Outlet-2	J344, J344, J344-Outlet-2
11128 J344_SUB 161 635870 BEACON 5 161 1	261.0	MEC ITCM	171.1	65.6	264.2	101.2	GENS: OTTUMW1G + G73	REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0 REMOVE UNIT 1 FROM BUS G735_WF5 34.5	C	0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	J344,	J344,		J344-Outlet-2	J344, J344, J344-Outlet-2
11128 J344_SUB 161 635870 BEACON 5 161 1	261.0	MEC ITCM	170.7	65.4	263.8	101.1	GENS: OTTUMW1G + LAN	REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0 REMOVE UNIT 4 FROM BUS LANS5 4G 22.0	C	0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	J344,	J344,		J344-Outlet-2	J344, J344, J344-Outlet-2
11128 J344_SUB 161 635870 BEACON 5 161 1	261.0	MEC ITCM	170.7	65.4	263.8	101.1	GENS: OTTUMW1G + ECL	REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0 REMOVE UNIT W FROM BUS ECLIPSEW 0.69	C	0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	J344,	J344,		J344-Outlet-2	J344, J344, J344-Outlet-2
11128 J344_SUB 161 635870 BEACON 5 161 1	261.0	MEC ITCM	170.7	65.4	263.8	101.1	ITCM-C602-GE	REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0 REMOVE UNIT 4 FROM BUS LANS5 4G 22.0	C	0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	J344,	J344,		J344-Outlet-2	J344, J344, J344-Outlet-2
11128 J344_SUB 161 635870 BEACON 5 161 1	261.0	MEC ITCM	169.5	64.9	262.6	100.6	GENS: LOUIS31G + OTT	REMOVE UNIT 1 FROM BUS LOUIS31G 24.0 REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0	C	0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	J344,	J344,		J344-Outlet-2	J344, J344, J344-Outlet-2
541251 MARYVLE5 161 635034 CLRNDA 5 161 1	168.0	MEC GMO	132.4	78.8	184.3	109.7	ITCM-C304-SW	CRESTON5 161 - 5MARYVL 161 1 MCKSBRG 3 161 - CRESTON5 161 1 CRESTON5 161 - CRESTON8 69.0 - CRESTON29 13.8 1	C	0.01022	0.01708	0.01518	0.01183	0.01185	0.27906	0.01027	J343,	J343,			J343, J343,
630388 WINCOR 8 69.0 630389 WINMUNI8 69.0 1	40.0	CIPCO	33.0	82.5	43.6	108.9	CIPC-102	MCKSBRG 3 161 - CRESTON5 161 1 WNTRST 5 161 - NORWLK5 161 1	C	-0.00036	0.55872	-0.00126	-0.00086	0.00681	0.00237	0.00432	J289,	J289,			J289, J289,
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	98.7	64.1	157.5	102.3	P23:161:MEC:Bunge 86	BUNGE 5 161 - HASTING5 161 1 RIVRBND5 161 - BUNGE 5 161 1	C	0.00422	0.11504	0.00512	0.00383	0.01085	0.35967	0.00928	J343,	J343,			J343, J343,
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	98.7	64.1	157.6	102.3	P23:161:MEC:Bunge 86	RIVRBND5 161 - BUNGE 5 161 1 CBLUFFS5 161 - RIVRBND5 161 1 BUNGE 5 161 - HASTING5 161 1	C	0.00422	0.11504	0.00512	0.00383	0.01085	0.35967	0.00928	J343,	J343,			J343, J343,

Table E-6: 2024 SH Category C Voltage Constraints

Bus	Area	Vlow	Vhi	Benchmark Case	Study Case	Delta (> 0.01 p.u.)	Contingency Details	Cont Type
				Vcont	Vcont			
No constraints								

Table E-7: 2024 SH Non-Converged Category C Contingencies

Contingency	Benchmark Case	Study Case	Contingency Details
ITCM-C925-LN	BlowUp	BlowUp	GRE-BREWSTR5 161 - HRN LK 5 161 1 SPLT RK5 161 - ROCK CO5 161 1 ROCK CO5 161 - ROCKCOFDR1_134.5 1
ITCM-C927-LN	BlowUp	BlowUp	ANTA TP5 161 - ANITA 5 161 1 SCRANTN5 161 - GU CTR 5 161 1 SCRANTN9 34.5 - SCRANTN5 161 1 SCRANTN5 161 - GR JCT 5 161 1
ITCM-C938-LN	BlowUp	BlowUp	EIC 5 161 - TRICNTY5 161 1 OTTUMWA5 161 - BRDGPRT5 161 1
CIPC-56	BlowUp	BlowUp	ANTA TP5 161 - ANITA 5 161 1 SCRANTN5 161 - GU CTR 5 161 1
CIPC-57	BlowUp	BlowUp	ANTA TP5 161 - ANITA 5 161 1 SCRANTN5 161 - GR JCT 5 161 1

Table E-8: 2024 SH Non-Converged Category C Contingencies DCCC Results

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>20%	MW>20%*Rating	Outlet Con.	Outlet Mon.	Summary
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				27.5	20	250	150	55	150	169	GIP With Impact-1	GIP With Impact-2	GIP With Impact-3	GIP With Impact-4	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR					
No constraints																					

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E.2 2024 Summer Peak (SPK) Constraints

Table E-9: 2024 SPK System Intact Thermal Constraints

Table E-10: 2024 SPK System Intact Voltage Constraints

Table E-11: 2024 SPK Category B Thermal Constraints

Table E-12: 2024 SPK Category B Voltage Constraints

Table E-13: 2024 SPK Category C Thermal Constraints

Table E-14: 2024 SPK Category C Voltage Constraints

Table E-15: 2024 SPK Non-Converged Category C Contingencies

Table E-16: 2024 SPK Non-Converged Category C Contingencies DCCC Results

Table E-9: 2024 SPK System Intact Thermal Constraints

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>5%	MW>20%*Rating	Outlet Con.	Outlet Mon.	Summary
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				55	4	50	30	55	30	33.8	GIP With Impact-1	GIP With Impact-2	GIP With Impact-3	GIP With Impact-4	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR					
No constraints																					

Table E-10: 2024 SPK System Intact Voltage Constraints

Bus	Area	Vlow	Vhi	Benchmark Case	Study Case	Delta (> 0.01 p.u.)	Contingency Details	Cont Type
				Vcont	Vcont			
No constraints								

Table E-11: 2024 SPK Category B Thermal Constraints

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>20%	MW>20%*Rating	Outlet Con.	Outlet Mon.	Summary
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				55	4	50	30	55	30	33.8	GIP With Impact-1	GIP With Impact-2	GIP With Impact-3	GIP With Impact-4	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR					
No constraints																					

Table E-12: 2024 SPK Category B Voltage Constraints

Bus	Area	Vlow	Vhi	Benchmark Case	Study Case	Delta (> 0.01 p.u.)	Contingency Details	Cont Type
				Vcont	Vcont			
No constraints								

Table E-13: 2024 SPK Category C Thermal Constraints

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>20%	MW>20%*Rating	Outlet Con.	Outlet Mon.	Summary
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				55	4	50	30	55	30	33.8	GIP With Impact-1	GIP With Impact-2	GIP With Impact-3	GIP With Impact-4	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR					
No constraints																					

Table E-14: 2024 SPK Category C Voltage Constraints

Bus	Area	Vlow	Vhi	Benchmark Case	Study Case	Delta (> 0.01 p.u.)	Contingency Details	Cont Type
				Vcont	Vcont			
No constraints								

Table E-15: 2024 SPK Non-Converged Category C Contingencies

Contingency	Benchmark Case	Study Case	Contingency Details
ITCM-C925-LN	BlowUp	BlowUp	GRE-BREWSTR5 161 - HRN LK 5 161 1 SPLT RK5 161 - ROCK CO5 161 1 ROCK CO5 161 - ROCKCOFDR1_134.5 1
ITCM-C927-LN	BlowUp	BlowUp	ANTA TP5 161 - ANITA 5 161 1 SCRANTN5 161 - GU CTR 5 161 1 SCRANTN9 34.5 - SCRANTN5 161 1 SCRANTN5 161 - GR JCT 5 161 1
ITCM-C938-LN	BlowUp	BlowUp	EIC 5 161 - TRICNTY5 161 1 OTTUMWA5 161 - BRDGPRT5 161 1
CIPC-56	BlowUp	BlowUp	ANTA TP5 161 - ANITA 5 161 1 SCRANTN5 161 - GU CTR 5 161 1
CIPC-57	BlowUp	BlowUp	ANTA TP5 161 - ANITA 5 161 1 SCRANTN5 161 - GR JCT 5 161 1

Table E-16: 2024 SPK Non-Converged Category C Contingencies DCCC Results

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>20%	MW>20%*Rating	Outlet Con.	Outlet Mon.	Summary
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				55	4	50	30	55	30	33.8	GIP With Impact-1	GIP With Impact-2	GIP With Impact-3	GIP With Impact-4	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR					
No constraints																					

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Appendix

F

Affected System Contingency Analysis Results

F.1 MAPP Companies SAF Results

Table F-1: 2017 SH MAPP SAF Results

Table F-2: 2017 SPK MAPP SAF Results

Table F-3: 2024 SH MAPP SAF Results

Table F-4: 2024 SPK MAPP SAF Results

Table F-1: 2017 SH MAPP SAF Results

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>3%
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				27.5	20	250	150	55	150	169	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR	
640386 TWIN CH4 230 652565 SIOUXCY4 230 1	320.0	WAPA NPPD	***451.4***	141.1	***469.8***	***146.8***	P23:345:MEC:RAUN 0270	RAUN 3 345 - S3451 3 345 1 RAUN 3 345 - HOSKINS3 345 1	B	0.02406	-0.00307	0.05118	0.02210	0.00005	-0.00999	0.00024	J285,
640386 TWIN CH4 230 652565 SIOUXCY4 230 1	320.0	WAPA NPPD	***363.6***	113.6	***375.7***	***117.4***	635200 RAUN 3 345	RAUN 3 345 - HOSKINS3 345 1	B	0.01633	0.00162	0.03243	0.01389	0.00175	-0.00279	0.00169	J285,
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	128.0	NWPS	***98.2***	76.7	***139.5***	***109.0***	C2.HA4-2525F	WAHPETN4 230 - WAHPET2Y 230 1 HANKSON4 230 - WAHPETN4 230 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 EDGE SS9 41.6 - OAKES 9 41.6 1	C	-0.00002	-0.00352	-0.00438	0.30826	-0.00299	-0.00354	-0.00289	J316, J316,
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	128.0	NWPS	***97.8***	76.4	***139.1***	***108.6***	C2.HA4-2515F	BROWNSV4 230 - HANKSON4 230 1 BROWNSV9 41.6 - BROWNSV4 230 1 BIGSTON4 230 - BROWNSV4 230 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 EDGE SS9 41.6 - OAKES 9 41.6 1	C	-0.00002	-0.00352	-0.00438	0.30826	-0.00299	-0.00354	-0.00289	J316, J316,
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	128.0	NWPS	***96.1***	75.1	***138.5***	***108.2***	C2.ELN4-5135	ELLENDL4 230 - MERRCRT4 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 FORMAN 4 230 - FORMN 7 115 - FORMN 9 41.6 1 HANKSON4 230 - FORMAN 4 230 1	C	-0.00018	-0.00335	-0.00413	0.31522	-0.00286	-0.00336	-0.00277	J316, J316,
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	128.0	NWPS	***97.4***	76.1	***137.6***	***107.5***	C2F.HA4-2525F	WAHPETN9 41.6 - WAHPET2Y 230 1 WAHPETN7 115 - WAHPET2Y 230 1 WAHPETN4 230 - WAHPET2Y 230 1 HANKSON4 230 - WAHPETN4 230 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1	C	0.00010	-0.00359	-0.00445	0.30011	-0.00303	-0.00362	-0.00293	J316, J316,
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	128.0	NWPS	***96.9***	75.7	***137.1***	***107.1***	C2F.HA4-2515F	BROWNSV4 230 - HANKSON4 230 1 BROWNSV9 41.6 - BROWNSV4 230 1 BIGSTON4 230 - BROWNSV4 230 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1	C	0.00010	-0.00359	-0.00445	0.30011	-0.00303	-0.00362	-0.00293	J316, J316,
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	128.0	NWPS	***93.5***	73.0	***130.7***	***102.1***	C2.ELN4-5150	ELLENDL4 230 - J316_SUB 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 FORMAN 4 230 - FORMN 7 115 - FORMN 9 41.6 1 HANKSON4 230 - FORMAN 4 230 1	C	-0.00016	-0.00330	-0.00407	0.28025	-0.00282	-0.00331	-0.00273	J316, J316,
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	128.0	NWPS MDU	***126.6***	98.9	***170.9***	***133.5***	C2.HA4-2525F	WAHPETN4 230 - WAHPET2Y 230 1 HANKSON4 230 - WAHPETN4 230 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 EDGE SS9 41.6 - OAKES 9 41.6 1	C	-0.00002	-0.00352	-0.00438	0.30826	-0.00299	-0.00354	-0.00289	J316, J316,

Table F-1: 2017 SH MAPP SAF Results

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>3%
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				27.5	20	250	150	55	150	169	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR	
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	128.0	NWPS MDU	***126.2***	98.6	***170.5***	***133.2***	C2.HA4-2515F	BROWNSV4 230 - HANKSON4 230 1 BROWNSV9 41.6 - BROWNSV4 230 1 BIGSTON4 230 - BROWNSV4 230 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 EDGE SS9 41.6 - OAKES 9 41.6 1	C	-0.00002	-0.00352	-0.00438	0.30826	-0.00299	-0.00354	-0.00289	J316, J316,
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	128.0	NWPS MDU	***124.2***	97.0	***169.9***	***132.7***	C2.ELN4-5135	ELLENDL4 230 - MERRCRT4 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 FORMAN 4 230 - FORMN 7 115 - FORMN 9 41.6 1 HANKSON4 230 - FORMAN 4 230 1	C	-0.00018	-0.00335	-0.00413	0.31522	-0.00286	-0.00336	-0.00277	J316, J316,
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	128.0	NWPS MDU	***125.8***	98.3	***169.0***	***132.0***	C2F.HA4-2525F	WAHPETN9 41.6 - WAHPET2Y 230 1 WAHPETN7 115 - WAHPET2Y 230 1 WAHPETN4 230 - WAHPET2Y 230 1 HANKSON4 230 - WAHPETN4 230 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1	C	0.00010	-0.00359	-0.00445	0.30011	-0.00303	-0.00362	-0.00293	J316, J316,
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	128.0	NWPS MDU	***125.4***	98.0	***168.5***	***131.7***	C2F.HA4-2515F	BROWNSV4 230 - HANKSON4 230 1 BROWNSV9 41.6 - BROWNSV4 230 1 BIGSTON4 230 - BROWNSV4 230 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1	C	0.00010	-0.00359	-0.00445	0.30011	-0.00303	-0.00362	-0.00293	J316, J316,
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	128.0	NWPS MDU	***121.6***	95.0	***161.9***	***126.5***	C2.ELN4-5150	ELLENDL4 230 - J316_SUB 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 FORMAN 4 230 - FORMN 7 115 - FORMN 9 41.6 1 HANKSON4 230 - FORMAN 4 230 1	C	-0.00016	-0.00330	-0.00407	0.28025	-0.00282	-0.00331	-0.00273	J316, J316,

Table F-2: 2017 SPK MAPP SAF Results

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>3%
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				55	4	50	30	55	30	33.8	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR	
No constraints																	

Table F-3: 2024 SH MAPP SAF Results

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>3%
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				27.5	20	250	150	55	150	169	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR	
640386 TWIN CH4 230 652565 SIOUXCY4 230 1	320.0	WAPA NPPD	368.9	115.3	***381.1***	***119.1***	635200 RAUN 3 345	RAUN 3 345 - HOSKINS3 345 1	B	0.01577	0.00169	0.03064	0.01592	0.00172	-0.00260	0.00163	J285,
640386 TWIN CH4 230 652565 SIOUXCY4 230 1	320.0	WAPA NPPD	460.5	143.9	***478.0***	***149.4***	P23:345:MEC:RAUN 0270	RAUN 3 345 - S3451 3 345 1 RAUN 3 345 - HOSKINS3 345 1	C	0.02334	-0.00280	0.04798	0.02474	0.00030	-0.00952	0.00046	J285,

Table F-4: 2024 SPK MAPP SAF Results

Monitored Element	Rating	Owner	Benchmark Case		Study Case		Contingency label	Contingency	Cont Type	J320	J289	J285	J316	J329	J343	J344	DF>3%
			Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)				55	4	50	30	55	30	33.8	GIP With Impact
										ER	NR	NR	NR	NR	NR	NR	
No constraints																	

F.2 PJM Affected System Study Results

Below is the PJM affected system study report provided by PJM.

Impact of MISO DPP-2014-August Generators on PJM Facilities

1. MISO generators studied:

Table 1 – MISO DPP-2014-AUG

Project Number	POI	Area	Max Output	Fuel Type
J285	Proposed O'Brien County 345kV substation	635 MEC	250	Wind
J289	161 kV substation on Winterset Junction to Creston 161 kV Line	627 ALTW	20	Wind
J316	MDU 230 kV Tatanka-Ellendale line	661 MDU	150	Wind
J320	Xcel's existing High Bridge 115 kV substation	600 XEL	55	Gas
J325	ITC Minden Station	219 ITC	4	Wind
J327	Raphson 120kV substation	219 ITC	150	Wind
J329	Pella West Substation	635 MEC	55	Hydro
J332	Point Substation	210 SIGE	83	Gas
J339	Gibson City South Substation	357 AMIL	68	Gas
J340	ITC Grassmere 345kV Substation	219 ITC	100	Wind
J343	161 kV substation on Creston-Clarinda line	635 MEC	150	Wind
J344	161 kV substation on Poweshiek-Oskaloosa line	627 ALTW	169	Wind
J348	Entergy Stuttgart Rcuskey-Almyra115 kV line	351 EES	81	Solar
J354	ITC Grassmere	219 ITC	52	Wind

2. Results Summary

a. The steady state analysis performed identified thermal impacts on PJM system for J285 and J344 projects from Table 1.

b. There were no thermal impacts on PJM system identified for the rest of the projects from Table 1.

3. Summer Peak analysis

- Model used – PJM Z1 2017SP with the above MISO generators and previous MISO DPP generators added
- Contingencies used – All PJM category B and C contingencies
- Monitored areas – All PJM areas
- Analysis type – Generation Deliverability
- All generators were scaled to their respective capacity portions for base case and category B events
- All generators were scaled to their respective total capabilities for category C events
- Results – **No overloads were identified**

4. Light Load analysis

- Model used – PJM Z1 2016LL with the above MISO generators and higher queued MISO DPP generators (wind, coal, and nuclear) added to the model
- Contingencies used – All PJM category B and C contingencies
- Monitored areas – All PJM areas
- Analysis type – Generation Deliverability
    - All wind generators were scaled to 80% of their respective total capabilities for base case, category B, and category C events
    - The coal generator was scaled to 45% of its respective total capabilities for base case, category B, and category C events
- Results :

Table 2 – Light load results (MW impacts of MISO projects are highlighted in yellow)

Name	Name	CKT	KVs	Areas	Rating	FN AC Flow	FN AC %	Cont Label	Cont Type	J285	J344
CORDO; B	NELSO; B	1	345	ComEd	1528	1593.79	**104.31**	'345-L0404___-R'	single	23.5	25.15
QUAD3-11	H471 ;	1	345	ComEd	1528	1599.7	**104.69**	'345-L15503_B-R'	single	23.51	25.11
H471 ;	NELSO; B	1	345	ComEd	1528	1598.8	**104.63**	'345-L15503_B-R'	single	23.51	25.11

- MVP option:
    - MISO Fargo-Sandburg-Oak Grove MVP was tested and proved to alleviate all identified overloads.

5. Required System Upgrades & Cost Estimates/Allocations:

1. To relieve the Cordova - Nelson 345 kV line overloads:

   Existing PJM baseline upgrades B2692.1 & B2692.2 are planned to be put into service by summer 2019. B2692.1 & B2692.2 will upgrade the Cordova - Nelson 345 kV line. The new line ratings will be 1679/2058/2280 MVA (SN/SE/SLD).

   The following MISO 2014 AUG DPP projects contribute loading to this overload: J285, J344. These projects can wait until B2692.1 & B2692.2 are placed into service or the projects can pay an advancement cost to place B2692.1 & B2692.2 into service earlier, if feasible per ComEd.

2. To relieve the Quad Cities – ESS H471 345 kV line overload:

   Existing PJM baseline upgrades B2692.1 & B2692.2 are planned to be put into service by summer 2019. B2692.1 & B2692.2 will upgrade the Quad Cities – ESS H471 345 kV line. The new line ratings will be 1679/2011/2280 MVA (SN/SE/SLD).

   The following MISO 2014 AUG DPP projects contribute loading to this overload: J285, J344. These projects can wait until B2692.1 & B2692.2 are placed into service or the projects can pay an advancement cost to place B2692.1 & B2692.2 into service earlier, if feasible per ComEd.

3. To relieve the ESS H471 - Nelson 345 kV line overload:

   Existing PJM baseline upgrades B2692.1 & B2692.2 are planned to be put into service by summer 2019. B2692.1 & B2692.2 will upgrade the ESS H471 - Nelson 345 kV line. The new line ratings will be 1679/2011/2280 MVA (SN/SE/SLD).

   The following MISO 2014 AUG DPP projects contribute loading to this overload: J285, J344. These projects can wait until B2692.1 & B2692.2 are placed into service or the projects can pay an advancement cost to place B2692.1 & B2692.2 into service earlier, if feasible per ComEd.

F.3 SPP Affected System Study Results

Below is the SPP affected system study report provided by SPP.

Impacts of MISO August 2014 West Area DPP Study Generator Interconnection Requests on SPP Facilities

October 2015

Generator Interconnection

SPP Southwest Power Pool

Revision History

Date	Author	Change Description
9/14/2015	SPP	Initial Draft Report Issued
10/9/2015	SPP	Report with Appendices Issued

Executive Summary

Southwest Power Pool (SPP) has conducted this Affected System Interconnection System Impact Study to evaluate potential impacts to the SPP Transmission System related to the interconnection of generators on the Mid-Continent Independent System Operator (MISO) Transmission System. The generators requesting interconnection to the MISO system will be referred to as the MISO Customers (MISO Customers). The MISO Customers' requests have been clustered together for the following Affected System Impact Study in the MISO Definitive Planning Process August 2014 Study (DPP-Aug2014). The MISO Customer's requests included in this System Impact Cluster Study are listed in Table 1 by their queue number, amount, requested interconnection service, area, requested interconnection point, proposed interconnection point, and the requested in-service date.

Power flow analysis has indicated that for the power flow cases studied, the SPP Transmission System is impacted from the interconnection of the MISO Customer generation. Most constraints can be mitigated by the curtailment of generation, the addition of the Nebraska City – Sibley 345kV line, and certain MISO Multi Value Project (MVP) transmission projects[1]. Additional transmission reinforcements for ERIS constraints are not required. For Network Resource Interconnection Service (NRIS), a number of additional constraints were identified. While many of the NRIS constraints are mitigated by the addition of the Nebraska City – Sibley 345kV line and the MISO MVP projects that are scheduled to be placed in service in 2017 and 2018 respectively, some constraints must be mitigated by other means. For constraints that are mitigated by the addition of the Nebraska City – Sibley 345kV line and MISO MVP projects, NRIS should be delayed until 2017 and 2018. The Nebraska City – Sibley 345kV line is currently scheduled to be placed into service on December 31, 2016.

In no way does this study guarantee operation for all periods of time. This interconnection study identifies impacts for Energy Resource (ER) interconnection injection constraints (defined as a 20% distribution factor impact for observed constraints) and Network Resource (NR) constraints (defined as 3% distribution factor impact) on the MISO Transmission System. This affected system study does identify impacts for all potential situations. It should be noted that although this study analyzed many of the most probable contingencies, it is not an all-inclusive list and cannot account for every operational situation. Because of this, it is likely that the MISO Customer(s) may be required to reduce their generation output to 0 MW, also known as curtailment, under certain system conditions to allow system operators to maintain the reliability of the transmission network.

[1] MISO MVPs included are the MVP 3: Lakefield Junction – Winnebago – Winco – Burt area & Sheldon – Burt area – Webster and MVP 4: Winco – Lime Creek – Emery – Black Hawk – Hazelton 345kV projects all located within Iowa.

Network constraints listed in Appendix B are identified on the SPP Transmission System when this generation is injected into the MISO footprint for Energy Resource Interconnection Service (ERIS) requests. Some MISO Customer generation was also studied for Network Resource Interconnection Service (NRIS). Those constraints are listed in Appendix C. Additional network constraints will have to be verified with a Transmission Service Request (TSR) and associated studies. With a defined source and sink in a TSR, this list of Network Constraints will be refined and expanded to account for all Network Upgrade requirements.

Contents

Revision History 1
Executive Summary ii
Introduction 1
Analysis 1
1. Interconnection Requests Included in the Study 1
2. Previously Queued Interconnection Requests 1
3. Models 4
4. Contingencies 5
5. Monitored Elements 5
6. Methodology 5
7. Results 7
8. Determination 8
Conclusion 9
Appendix 10
A: SPP Generator Interconnection Requests Included in Study 1
B: Power Flow Study Results 1
C: MISO Sink Studied 1

Introduction

Southwest Power Pool (SPP) has conducted this Affected System Interconnection System Impact Study to evaluate potential impacts to the SPP Transmission System related to the interconnection of generators on the Mid-Continent Independent System Operator (MISO) Transmission System. The generator requesting interconnection to the MISO system will be referred to as the MISO Customers (MISO Customers). The MISO Customers' requests have been clustered together for the following Affected System Impact Study in the MISO Definitive Planning Process August 2014 Study (DPP-Aug2014). The MISO Customer's requests included in this System Impact Cluster Study are listed in Table 1 by their queue number, amount, requested interconnection service, area, requested interconnection point, proposed interconnection point, and the requested in-service date.

Analysis

1. Interconnection Requests Included in the Study

SPP included all MISO Customer requests as provided by MISO in this study. The MISO Customers represent the DPP-Aug2014 MISO Impact Study. These are listed in Table 1.

Table 1 - MISO Study Generators

MISO Project	Point of Interconnection	Max MW Output	Service	Fuel Type
J285	Proposed O'Brien 345 kV Sub	250	NRIS	Wind
J289	161 kV substation on Winterset Junction to Creston 161 kV line	20	NRIS	Wind
J316	MDU Tatanka – Ellendale line	150	NRIS	Wind
J320	High Bridge 115 kV Sub	55	ERIS	Gas
J329	Pella West 69 kV Substation	55	NRIS	Hydro
J343	161 kV substation on Creston – Clarinda 161 kV line	150	NRIS	Wind
J344	161 kV substation on Poweshiek – Oskaloosa 161 kV line	169	NRIS	Wind
J382	Christiana Switching Station	48.3	NRIS Only	Gas

2. Previously Queued Interconnection Requests

2.1. Previously Queued MISO Generators

The previous queued requests included in this study are listed in Table 2. These requests were taken from the MISO Interconnection Queue.

Table 2 - MISO Prior Queued Generators

MISO Project	Point of Interconnection	Max MW Output	NRIS	Fuel Type
G132	Ellendale Sub 230 kV	180	20%[a]	Wind
G255	Yankee Substation	100	20%	Wind
G263	Lakefield Generating Substation	105	20%	Wind
G287	Nobles County Substation	200	20%	Wind
G349	Brookings County Substation	200	n/a	Wind
G362	Pleasant Valley Substation	200	20%	Wind
G370	Anson 4	205	n/a	Gas
G380	Rugby 115kV Substation	150	n/a	Wind
G386	Lakefield Substation 345kV	100	20%	Wind
G389	Elk River 230 kV substation	200	100%	Gas
G514	Lakefield Station via Trimont G263 Interconnect	150	20%	Wind
G540	Adams - Lime Creek 161 kV	80	100%	Wind
G548	Barton 161kV Substation	80	100%	Wind
G549	Next to Williams Substation (69kV)	20	100%	Wind
G551	Rice 161 kV	99	20%	Wind
G573	Franklin 161 kV Substation	80	100%	Wind
G574	Franklin 161 kV Substation	80	100%	Wind
G575	Franklin 161 kV Substation	40	100%	Wind
G586	Xcel New Yankee Sub 34.5 kV	30	100%	Wind
G587	69 kV to Winthrop Sub	20	100%	Wind
G595	Lime Creek 161 kV Substation	150	n/a	Wind
G602	Nobles County 115 kV Substation	32	20%	Wind
G604	Owatonna - County Line 69 kV	44	n/a	Wind
G612	ITC Midwest Fernald 115 kV Substation	150	n/a	Wind
G619	GRE Tamarac 41 kV Substation	50	100%	Wind
G620	Kenyon - Dodge 69 kV	19	n/a	Wind
G621	Rock Tap – South Ridge 69kV	20	100%	Wind
G667	Round Lake Tap 69kV	13	n/a	Wind
G685	Lake Lillian-Atwater 69kV	20	n/a	Wind
G735	Lime Creek Substation	200	100%	Wind
G741	Alliant 69kV	8	100%	Waste Heat
G752	Bison-Hettinger 230kV	150	100%	Wind
G788	Ladish 115kV	49	100%	Wind
G798	Fernald 115kV Substation	150	100%	Wind
G826	Lakefield Generation SW – Lakefield Junction 345kV	200	n/a	Wind
G830	McHenry 115kV Substation	99	100%	Wind
G858	Black Oak 69 kV Substation		100%	Wind
G870	Hayward – Winnebago 161kV	201	100%	Wind
G929	Monticello	60	100%	Nuclear
G930	Sherco	60	100%	Coal
G947	Whispering Willows 161kV Substation	99	87%	Wind
G971	Cosmos Township 69kV	20	n/a	Wind
G997	Minden Substation	50	100%	Wind
H007	Edgewood 69kV	41	n/a	Wind
H008	Richfield 69kV Substation	36	100%	Wind
H009	Traer – Marshalltown 161kV	150	n/a	Wind
H021	Wellsburg 115kV Substation	138.6	86%	Wind
H071	Black Oak 69 kV Substation	40	100%	Wind
H078	New Sub in Laurel,IA	121	n/a	Wind
H092	Boswell	60	100%	Coal
H081	Brookings County – Lyon County 345kV	201	n/a	Wind
H096	Grand Junction – Perry 161kV	50	100%	Wind
J020		20	100%	Diesel
J021		40	100%	Diesel
J075	Bauer - Rapson 345 kV	150	100%	Wind
J091	Lime Creek 161kV substation	66	100%	Wind

MISO Project	Point of Interconnection	Max MW Output	NRIS	Fuel Type
J110	Glen Ullin	7.5	100%	Biomass
J112	DPC Utica – Lewiston 69kV	4.95	n/a	Wind
J161	Bauer - Rapson 345 kV	155	100%	Wind
J171	Benson 115kV Substation	12	100%	Biomass
J183	Split Rock Substation	200	n/a	Wind
J191	Rolling Hills 345kV Substation	101.2	100%	Wind
J200	RM Heskett Station 115kV & 41.6kV	75	80%	Gas
J201	Manning 138kV Substation	20	100%	Wind
J202	Atlanta - Tuscola 115 kV	101	100%	Wind
J226	Ludington Substation	70	100%	Hydro
J231	Ludington Substation	70	100%	Hydro
J233	Marshalltown 161kV	635	100%	CC
J235	Bauer - Rapson 345 kV	110	100%	Wind
J238	Eagle Valley 138kV Substation	725	100%	Gas
J241	Twin Falls Substation	3.7	100%	Hydro
J249	MDU Tatanka Substation	180	100%[a]	Wind
J256	NIPSCO Plymouth 69kV	8	100%	Gas
J262	Jamestown 345/115 kV substation	100	100%	Wind
J263	Jamestown 345/115 kV substation	100	100%	Wind
J274	Tap Winterset – Creston 161kV	100	100%	Wind
J278	Pleasant Valley 161kV	200	100%	Wind
J279	Raun 345kV	(Uprate) 30	100%	Coal
J281	Cosmo-Harvest Wind 120 kV circuit near Cosmo substation	50	100%	Wind
J282	Cosmo-Harvest Wind 120 kV circuit near Cosmo substation	50	100%	Wind
J288	Tap Atwater – Grove City 69kV	40	100%	Wind
J290	Tap Rugby – Glenboro 230kV	150	100%	Wind
R15	Pomeroy 161 kV substation	80	20%	Wind
R23	Monona - Carroll 161 kV	100	20%	Wind
R26	MEC Cooper - Booneville 345 kV	146	20%	Wind
R34	Council Bluffs - Madison County 345 kV	250	20%	Wind
R38	MEC Council Bluffs - Grimes 345 kV	200	20%	Wind
R39	Raun - Lakefield Junction	500	20%	Wind
R41	MEC Council Bluffs - Grimes 345 kV	100	20%	Wind
R42	Lehigh 345kV Substation	250	100%	Wind
R49	Pomeroy Generating Station	12	n/a	Wind
R65	R34 Expansion	92	100%	Wind

Notes:
a: NRIS shared between G132 and J249 to total no more than 180 MW at any time.
n/a: NRIS is not available for this request

2.2. Other MISO Generators

Also included in this study were Iowa generators in the models that were ramped up to their Pmax. These generators were consistent with generators dispatched at their Pmax value in models provided by MISO.

Table 3 – Other MISO generators dispatched to Pmax

Bus Number	Bus Name	Pmax	NRIS
629147	G426/538_WF534.500	100.0000	n/a
629147	G426/538_WF534.500	50.0000	20%
629983	G358_WF9 34.500	35.0000	n/a
629984	G298_WF9 34.500	100.0000	n/a
629992	G164_WF9 34.500	200.0000	n/a
630385	SLAKES 8 69.000	40.0000	20%
630385	SLAKES 8 69.000	39.0000	20%
631157	G172_G1 34.500	200.0000	n/a
631158	G172_G2 34.500	100.0000	n/a
633408	MPW GEN8 69.000	22.0000	100%
633408	MPW GEN8 69.000	18.8000	100%
635044	WALNUT0 0.5750	75.0000	20%
635045	WALNUT1 0.5750	75.0000	20%
635312	VICTRYG1 0.5750	99.0000	20%
635316	CARROLG2 0.5750	75.0000	20%
635317	CARROLG1 0.5750	75.0000	20%
635352	CLIPR G1 0.5700	70.5000	20%
635352	CLIPR G1 0.5700	15.0000	20%
635354	CLIPR G2 0.5700	90.0000	20%
635637	ADAIRWG1 0.6900	87.5000	20%
635638	ADAIRWG2 0.6900	87.5000	20%
636027	POCHNTG1 0.5750	94.5000	20%
636033	POCHNTG2 0.5750	103.5000	20%
636035	POCHNTG3 0.5750	51.0000	20%
636035	POCHNTG3 0.5750	29.9000	n/a
636238	ENXCO G1 0.5700	70.5000	20%
636238	ENXCO G1 0.5700	35.0000	n/a
636239	ENXCO G2 0.5700	94.5000	n/a
636309	CCITYSG1 0.5750	75.0000	n/a

Notes:
n/a: NRIS is not available for this request

2.3. Previously Queued SPP Generators

Also included in this study were SPP Generator Interconnection Requests as listed in Appendix A. These Interconnection Requests include Group 9 Requests through DISIS-2014-002.

3. Models

The 2014 series Integrated Transmission Planning models (used in the 2015ITPNT) including the 2015 (spring and summer peak seasons), the 2020 (summer peak seasons) and the 2025 (summer peak season) scenario 0 cases were used for this study. After the cases were developed, each of the control areas' resources were then re-dispatched to account for the new generation requests using current dispatch orders. The Nebraska City – Mullins Creek – Sibley 345kV line and the MISO MVP projects were included in cases prior to their in-service dates.

For Energy Resource Interconnection Service (ERIS), the MISO wind generating plants were modeled at 100% nameplate of maximum generation in the spring and High VER cases. Coal and gas units were dispatched at 100% in the summer peak cases. These projects were dispatched as Energy Resources and sunk to load across the MISO footprint. All generators that requested Network Resource Interconnection Service (NRIS) were dispatched in an additional analysis in accordance with the values listed in Tables 2 and 3. The models used for this study include the following:

- 2015 Spring (15G) – ERIS
- 2015 Spring (15G) - NRIS
- 2015 Summer (15SP)- ERIS
- 2015 Summer High VER (15SP) – ERIS
- 2015 Summer (15SP) - NRIS
- 2020 Summer High VER (20SP) - ERIS
- 2020 Summer (20SP) – ERIS
- 2020 Summer (20SP) - NRIS
- 2025 Summer High VER (25SP) – ERIS
- 2025 Summer (25SP) ERIS
- 2025 Summer (25SP) - NRIS

4. Contingencies

- All branches and ties within the following areas:
  - 502 – 546, 640, 645, 650, 652, 998, 999
  - 326, 327, 328, 329, 330, 332, 334, 335, 336, 337, 338, 339, 351, 356, 635
- NERC, SPP, and Tier 1 Permanent Contingent Flowgates
- SPP T.O. Specific and Tier 1 Specific Contingencies
- SPP T.O. Specific Op Guide Implementation

5. Monitored Elements

- NERC, SPP, and Tier 1 Permanent Monitor Flowgates
- All branches and ties within the following areas:
  - 330,502 – 546,640,645,650,652,998,999 for voltages 65 kV – 999 kV
  - 326, 327, 328, 329, 332, 334, 335, 336, 337, 338, 339, 351, 356, 635 for voltages 100 kV – 999 kV

6. Sink for Studied Generation

The MISO footprint was used as a sink for the studied generation. The list of buses can be found in Appendix C.

7. Methodology

This Affected System Study for the MISO August 2014 West Area DPP Restudy used both DC screening and ACCC analysis. To perform DC analysis, the FCITC function within PSS/MUST is used to determine

the limiting constraints and determine the associated distribution factors (DFs). AC Analysis uses the ACCC function of PSS/E to determine the constraints and PSS/MUST to determine the associated DFs.

Per the following SPP Constraint identification criteria, a facility requires review if loadings are higher than 95%. If loadings are higher than 100% mitigation may be required depending on the type of service requested and the distribution factors associated with the affecting requests and the type of contingency. Other factors may also be considered when determining the effects of requests on overloaded facilities.

7.1. ERIS Constraint Criteria

If a facility is overloaded under no contingency (CAT A) or under contingency (CAT B, CAT C, and CAT D and Extreme Events) by a request with a distribution factor of greater than or equal to 19.5%, that request will be labeled as affecting and mitigation may be required. If the overloaded facilities make up a flowgate (OTDF) and a request has a distribution factor of greater than or equal to 19.5%, that request will be labeled as affecting and mitigation may be required. Non-converged contingencies shall also be considered for mitigation.

7.2. NRIS Constraint Criteria

If a facility is overloaded under no contingency (CAT A) or under contingency (CAT B, CAT C, and CAT D and Extreme Events) by a request with a distribution factor of greater than or equal to 3%, that request will be labeled as affecting and mitigation may be required. If the overloaded facilities make up a flowgate (PTDF or OTDF) and a request has a distribution factor of greater than or equal to 3%, that request will be labeled as affecting and mitigation may be required. Non-converged contingencies shall also be considered for mitigation.

7.3. Additional Constraint Consideration

Notwithstanding, should any facility be identified by MISO using MISO Constraint Identification Criteria as being affected by a study request, such as “Outlet” constraints or other specific criteria, review and mitigation of those constraints may also be required.

As a note the SPP Permanent List of Flowgates are included within SPP Planning studies and can be reviewed on the SPP OASIS website. The direct link to the current Permanent Flowgate list is as follows: https://www.oasis.oati.com/SWPP/SWPPdocs/Permanent_flowgates.xls

8. Results

The following facilities were found to be impacted by the MISO generators. More detail can be found in Appendix B.

Table 4 – Potential Constraints

ERIS Constraint	Area	Contingency	Affecting Requests	Season
Cooper – St Joseph 345kV	NPPD GMO	Cooper – Fairport 345kV	J329, J285, J344, J320, J343, J316, J289	2015SP (ERIS)
Nashua 345/161kV xfmr	KCPL	Hawthorn – Nashua 345kV	J285, J343, J289, J285 J343, J289	2015G (ERIS) 2015SP (ERIS) 2020SP (ERIS)
Clarinda – Maryville	GMO MEC	Creston - Maryville 161Kv	J289, J343	2015SP (ERIS)
Council Bluffs – Sub 3456	MEC OPPD	Multiple	J289, J329, J343, J344	2015SP (ERIS) 2020SP (ERIS) 2025SP (ERIS)

8.1. ERIS Impacts

Some overloads in Table 4 are observed in the near term models but are no longer observed in the longer term models.

The following constraint was found to need further evaluation.

ERIS Constraint	Area	Contingency	Loading	Affecting Requests	Season	DF
Clarinda – Maryville	GMO MEC	Creston - Maryville 161kV	100%	J343	2015SP (ERIS)	22.4%

The loading for this element is 100% of Rate B in the 15SP model. This loading includes the Nebraska City – Sibley 345kV line and the MISO MVP lines. The loading in the 2020SP model falls to below 100%. The light load model (15G) also shows a loading below 100% of Rate B. No further mitigation is required.

A sensitivity was run to determine impacts on the SPP Transmission System for ERIS constraints prior to the in-service date of the Nebraska City – Sibley 345kV line. The results are shown below. It was found that Cooper-St Joseph will not overload for system intact conditions prior to the in-service date of the Nebraska City – Sibley 345kv line.

Constraint	Area	Contingency	Loading	Season
Cooper – St Joseph 345kV	NPPD GMO	None	95%	2015SP (ERIS)

8.2. NRIS Impacts

No NRIS overloads were observed on SPP facilities with the addition of the Nebraska City – Sibley and MISO MVP projects included. However, NRIS cannot be provided until the in-service date of this line.

9. Determination

The SPP Transmission System is impacted by the interconnection of the MISO Customer generation. Most ERIS impacts can be mitigated through generator curtailment and do not require additional transmission reinforcement.

Potential mitigations are listed in Table 8.

Table 8 – SPP Suggested Mitigations within DPP August 2014 Study

Mitigation	Area	Purpose	ERIS and/or NRIS Affecting Requests	Estimated Cost
Delay NRIS until in service date of the Nebraska City – Sibley 345kV line **Nebraska City – Sibley 345kV line is scheduled for 12/31/2016 in-service**		Needed to mitigate NRIS overloads identified in 15G and 15SP models that were alleviated by the Nebraska City – Sibley 345kV line		

Conclusion

Southwest Power Pool (SPP) has conducted this Affected System Interconnection System Impact Study to evaluate potential impacts to the SPP Transmission System related to the interconnection of generators on the Mid-Continent Independent System Operator (MISO) Transmission System.

Power flow analysis has indicated that for the power flow cases studied, the SPP Transmission System is impacted from the interconnection of the MISO Customer generation. Most Energy Resource Interconnection Service (ERIS) constraints can be mitigated by the curtailment of generation and transmission reinforcements are not required. NRIS constraints must be mitigated by the delay of NRIS until such time that the Nebraska City – Sibley 345kV can be place in service in 2017.

If additional analysis is required it will be performed under an executed Affected System Facility Study. The purpose of the Affected System Facility Study is to perform additional analysis required to refine the scope, cost estimates, and expected time of construction of system facilities identified as Network Upgrades that would be placed under the SPP Open Access Transmission Tariff.

Appendix

A: SPP Generator Interconnection Requests Included in Study

A1: Prior Queued Interconnection Requests (Nebraska-Missouri)

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2002-023N	0.80	NPPD	Harmony 115kV	On-Line
GEN-2003-021N	75.00	NPPD	Ainsworth Wind Tap 115kV	On-Line
GEN-2004-023N	75.00	NPPD	Columbus Co 115kV	On-Line
GEN-2006-020N	42.00	NPPD	Bloomfield 115kV	On-Line
GEN-2006-031	75.00	MIDW	Knoll 115kV	On-Line
GEN-2006-037N1	75.00	NPPD	Broken Bow 115kV	On-Line
GEN-2006-038N005	80.00	NPPD	Broken Bow 115kV	On-Line
GEN-2006-038N019	80.00	NPPD	Petersburg North 115kV	On-Line
GEN-2006-044N	40.50	NPPD	North Petersburg 115kV	On-Line
GEN-2007-011N08	81.00	NPPD	Bloomfield 115kV	On-Line
GEN-2008-086N02	201.00	NPPD	Meadow Grove 230kV	On-Line
GEN-2008-119O	60.00	OPPD	S1399 161kV	On-Line
GEN-2008-123N	89.70	NPPD	Tap Pauline - Hildreth (Rosemont) 115kV	On Schedule for 2015
GEN-2009-040	73.80	WERE	Marshall 115kV	On Schedule for 2016
GEN-2010-036	4.60	WERE	6th Street 115kV	On-Line
GEN-2010-041	10.50	OPPD	S1399 161kV	On Schedule for 2015
GEN-2010-051	200.00	NPPD	Tap Twin Church - Hoskins 230kV	On Suspension
GEN-2011-018	73.60	NPPD	Steele City 115kV	On-Line
GEN-2011-027	120.00	NPPD	Tap Hoskins - Twin Church 230kV	On Suspension
GEN-2011-056	3.60	NPPD	Jeffrey 115kV	On-Line
GEN-2011-056A	3.60	NPPD	John 1 115kV	On-Line
GEN-2011-056B	4.50	NPPD	John 2 115kV	On-Line
GEN-2012-021	4.80	LES	Terry Bundy Generating Station 115kV	On-Line
GEN-2013-002	50.60	LES	Tap Sheldon - Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV CKT 2	On Schedule for 2016
GEN-2013-008	1.20	NPPD	Steele City 115kV	On-Line
GEN-2013-014	25.50	NPPD	Tap Guide Rock - Pauline (Rosemont) 115kV	On Suspension
GEN-2013-019	73.60	LES	Tap Sheldon - Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV CKT 2	On Schedule for 2016
GEN-2013-032	204.00	NPPD	Antelope 115kV	On Schedule for 2017
GEN-2014-004	4.00	NPPD	Steele City 115kV (GEN-2011-018 POI)	Facility Study Stage
GEN-2014-013	73.50	NPPD	Meadow Grove (GEN-2008-086N2 Sub) 230kV	On Schedule for 2015
GEN-2014-021	300.00	GMO	Tap Nebraska City - Mullin Creek 345kV	Facility Study
GEN-2014-031	35.80	NPPD	Meadow Grove 230kV	Facility Study
GEN-2014-032	10.20	NPPD	Meadow Grove 230kV	Facility Study
GEN-2014-039	73.40	NPPD	Friend 115kV	Facility Study
NPPD Distributed (Broken Bow)	8.30	NPPD	Broken Bow 115kV	On-Line
NPPD Distributed (Buffalo County Solar)	10.00	NPPD	Kearney Northeast	On-Line
NPPD Distributed (Burt County Wind)	12.00	NPPD	Tekamah & Oakland 115kV	On-Line
NPPD Distributed (Burwell)	3.00	NPPD	Ord 115kV	On-Line
NPPD Distributed (Columbus Hydro)	45.00	NPPD	Columbus 115kV	On-Line
NPPD Distributed (North Platte - Lexington)	54.00	NPPD	Multiple: Jeffrey 115kV, John_1 115kV, John_2 115kV	On-Line

A2: Prior Queued Interconnection Requests (SPP Remote Groups – Reduced Wind Output)

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
ASGI-2010-006	150.00	AECI	Tap Fairfax (AECI) - Shilder (AEPW) 138kV	AECI queue Affected Study
ASGI-2010-010	42.20	SPS	Lovington 115kV	Lea County Affected Study
ASGI-2010-020	30.00	SPS	Tap LE-Tatum - LE-Crossroads 69kV	Lea County Affected Study
ASGI-2010-021	15.00	SPS	Tap LE-Saunders Tap - LE-Anderson 69kV	Lea County Affected Study
ASGI-2011-001	27.30	SPS	Lovington 115kV	On-Line
ASGI-2011-002	20.00	SPS	Herring 115kV	On-Line
ASGI-2011-003	10.00	SPS	Hendricks 115kV	On-Line
ASGI-2011-004	20.00	SPS	Pleasant Hill 69kV	Under Study (DISIS-2011-002)
ASGI-2012-002	18.15	SPS	FE-Clovis Interchange 115kV	Under Study (DISIS-2012-002)
ASGI-2012-006	22.50	SUNCMKEC	Tap Hugoton - Rolla 69kV	Under Study (DISIS-2012-001)
ASGI-2013-001	11.50	SPS	PanTex South 115kV	Under Study (DISIS-2013-001)
ASGI-2013-002	18.40	SPS	FE Tucumcari 115kV	Under Study (DISIS-2013-001)
ASGI-2013-003	18.40	SPS	FE Clovis 115kV	Under Study (DISIS-2013-001)
ASGI-2013-004	36.60	SUNCMKEC	Morris 115kV	Under Study (DISIS-2013-002)
ASGI-2013-005	1.65	SPS	FE Clovis 115kV	Under Study (DISIS-2013-002)
ASGI-2013-006	2.00	SPS	SP-Erskine 115kV	
ASGI-2014-001	2.50	SPS	SP-Erskine 115kV	Under Study (DISIS-2014-001)
ASGI-2014-002	49.60	SPS	Tap Tucumcari - Santa Rosa 115kV	Under Study (DISIS-2014-001)
ASGI-2014-005	10.00	SPS	Strata 69kV	Under Study (DISIS-2014-002)
ASGI-2014-008	10.00	SPS	South Loving 69kV	Under Study (DISIS-2014-002)
ASGI-2014-009	10.00	SPS	Wood Draw 115kV	Under Study (DISIS-2014-002)
ASGI-2014-010	10.00	SPS	Ochoa 115kV	Under Study (DISIS-2014-002)
ASGI-2014-012	10.00	SPS	Cooper Ranch 115kV	Under Study (DISIS-2014-002)
ASGI-2014-014	56.40	GRDA	Ferguson 69kV	Under Study (DISIS-2014-002)
GEN-2001-014	96.00	WFEC	Ft Supply 138kV	On-Line
GEN-2001-026	74.30	WFEC	Washita 138kV	On-Line
GEN-2001-033	180.00	SPS	San Juan Tap 230kV	On-Line at 120MW
GEN-2001-036	80.00	SPS	Norton 115kV	On-Line
GEN-2001-037	100.00	OKGE	FPL Moreland Tap 138kV	On-Line
GEN-2001-039A	105.00	SUNCMKEC	Shooting Star Tap 115kV	On-Line
GEN-2001-039M	100.00	SUNCMKEC	Central Plains Tap 115kV	On-Line
GEN-2002-004	200.00	WERE	Latham 345kV	On-Line at 150MW
GEN-2002-005	120.00	WFEC	Red Hills Tap 138kV	On-Line
GEN-2002-008	240.00	SPS	Hitchland 345kV	On-Line at 120MW
GEN-2002-009	80.00	SPS	Hansford 115kV	On-Line
GEN-2002-022	240.00	SPS	Bushland 230kV	On-Line
GEN-2002-025A	150.00	SUNCMKEC	Spearville 230kV	On-Line
GEN-2003-004	100.00	WFEC	Washita 138kV	On-Line
GEN-2003-005	100.00	WFEC	Anadarko - Paradise (Blue Canyon) 138kV	On-Line
GEN-2003-006A	200.00	SUNCMKEC	Elm Creek 230kV	On-Line
GEN-2003-019	250.00	MIDW	Smoky Hills Tap 230kV	On-Line
GEN-2003-020	160.00	SPS	Martin 115kV	On-Line
GEN-2003-022	120.00	AEPW	Washita 138kV	On-Line
GEN-2004-014	154.50	SUNCMKEC	Spearville 230kV	On-Line at 100MW
GEN-2004-020	27.00	AEPW	Washita 138kV	On-Line
GEN-2004-023	20.60	WFEC	Washita 138kV	On-Line

Southwest Power Pool, Inc. Appendix A2: Prior Queued Generation Interconnection

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2005-003	30.60	WFEC	Washita 138kV	On-Line
GEN-2005-008	120.00	OKGE	Woodward 138kV	On-Line
GEN-2005-012	250.00	SUNCMKEC	Ironwood 345kV	On-Line at 160MW
GEN-2005-013	201.00	WERE	Caney River 345kV	On-Line
GEN-2006-002	101.00	AEPW	Sweetwater 230kV	On-Line
GEN-2006-006	205.50	SUNCMKEC	Spearville 345kV	On Suspension
GEN-2006-018	170.00	SPS	TUCO Interchange 230kV	On-Line
GEN-2006-020S	18.90	SPS	DWS Frisco 115kV	On-Line
GEN-2006-021	101.00	SUNCMKEC	Flat Ridge Tap 138kV	On-Line
GEN-2006-024S	19.80	WFEC	Buffalo Bear Tap 69kV	On-Line
GEN-2006-026	502.00	SPS	Hobbs 230kV & Hobbs 115kV	On-Line
GEN-2006-031	75.00	MIDW	Knoll 115kV	On-Line
GEN-2006-035	225.00	AEPW	Sweetwater 230kV	On-Line at 132MW
GEN-2006-043	99.00	AEPW	Sweetwater 230kV	On-Line
GEN-2006-044	370.00	SPS	Hitchland 345kV	On-Line at 120MW
GEN-2006-046	131.00	OKGE	Dewey 138kV	On-Line
GEN-2007-021	201.00	OKGE	Tatonga 345kV	On-Line
GEN-2007-025	300.00	WERE	Viola 345kV	On-Line
GEN-2007-032	150.00	WFEC	Tap Clinton Junction - Clinton 138kV	On Suspension
GEN-2007-040	200.00	SUNCMKEC	Buckner 345kV	On-Line at 132MW
GEN-2007-043	200.00	OKGE	Minco 345kV	On-Line
GEN-2007-044	300.00	OKGE	Tatonga 345kV	On-Line at 199MW
GEN-2007-046	200.00	SPS	Hitchland 115kV	On Schedule for 2015
GEN-2007-050	170.00	OKGE	Woodward EHV 138kV	On-Line at 150MW
GEN-2007-052	150.00	WFEC	Anadarko 138kV	On-Line
GEN-2007-062	765.00	OKGE	Woodward EHV 345kV	On Schedule for 2016 and 2017
GEN-2008-003	101.00	OKGE	Woodward EHV 138kV	On-Line
GEN-2008-013	300.00	OKGE	Hunter 345kV	On-Line at 235MW
GEN-2008-018	250.00	SPS	Finney 345kV	On-Line
GEN-2008-021	42.00	WERE	Wolf Creek 345kV	On-Line
GEN-2008-022	300.00	SPS	Tap Tolk - Eddy County (Crossroads) 345kV	On Schedule for 2015
GEN-2008-023	150.00	AEPW	Hobart Junction 138kV	On-Line
GEN-2008-037	101.00	WFEC	Tap Washita - Blue Canyon Wind 138kV	On-Line
GEN-2008-044	197.80	OKGE	Tatonga 345kV	On-Line
GEN-2008-047	300.00	OKGE	Beaver County 345kV	On-Line
GEN-2008-051	322.00	SPS	Potter County 345kV	On-Line at 161MW
GEN-2008-079	99.20	SUNCMKEC	Crooked Creek 115kV	On-Line
GEN-2008-092	201.00	MIDW	Post Rock 230kV	On Schedule for 2015
GEN-2008-098	100.80	WERE	Waverly 345kV	On Schedule for 2015
GEN-2008-124	200.10	SUNCMKEC	Ironwood 345kV	On Schedule for 2016
GEN-2009-008	199.50	MIDW	South Hays 230kV	On Schedule for 2015
GEN-2009-020	48.30	MIDW	Tap Nekoma - Bazine (Walnut Creek) 69kV	On Schedule for 2015
GEN-2009-025	59.80	OKGE	Nardins 69kV	On-Line
GEN-2010-001	300.00	OKGE	Beaver County 345kV	On-Line at 204 MW, On Schedule for 2015 (96 MW)
GEN-2010-003	100.80	WERE	Waverly 345kV	On Schedule for 2015
GEN-2010-005	299.20	WERE	Viola 345kV	On-Line at 170MW
GEN-2010-006	205.00	SPS	Jones 230kV	On-Line
GEN-2010-009	165.60	SUNCMKEC	Buckner 345kV	On-Line
GEN-2010-011	29.70	OKGE	Tatonga 345kV	On-Line
GEN-2010-014	358.80	SPS	Hitchland 345kV	On Suspension

Southwest Power Pool, Inc. Appendix A2: Prior Queued Generation Interconnection

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2010-040	300.00	OKGE	Cimarron 345kV	On-Line
GEN-2010-045	197.80	SUNCMKEC	Buckner 345kV	On Schedule for 2017
GEN-2010-046	56.00	SPS	TUCO Interchange 230kV	On Schedule for 2016
GEN-2010-055	4.50	AEPW	Wekiwa 138kV	On-Line
GEN-2010-057	201.00	MIDW	Rice County 230kV	On-Line
GEN-2011-008	600.00	SUNCMKEC	Clark County 345kV	On Schedule for 2016
GEN-2011-010	100.80	OKGE	Minco 345kV	On-Line
GEN-2011-014	201.00	OKGE	Tap Hitchland - Woodward Dbl Ckt (GEN-2011-014 Tap) 345kV	On Schedule for 2016
GEN-2011-016	200.10	SUNCMKEC	Spearville 345kV	Facility Study Stage
GEN-2011-017	299.00	SUNCMKEC	Tap Spearville - Post Rock (GEN-2011-017T) 345kV	On Schedule for 2018
GEN-2011-019	299.00	OKGE	Woodward 345kV	On Suspension
GEN-2011-020	299.00	OKGE	Woodward 345kV	On Suspension
GEN-2011-022	299.00	SPS	Hitchland 345kV	On Suspension
GEN-2011-025	80.00	SPS	Tap Floyd County - Crosby County 115kV	On Schedule for 2016
GEN-2011-037	7.00	WFEC	Blue Canyon 5 138kV	On-Line
GEN-2011-040	111.00	OKGE	Carter County 138kV	On-Line
GEN-2011-045	205.00	SPS	Jones 230kV	On-Line
GEN-2011-046	27.00	SPS	Lopez 115kV	On-Line
GEN-2011-048	175.00	SPS	Mustang 230kV	On-Line
GEN-2011-049	250.70	OKGE	Border 345kV	On Schedule for 2016
GEN-2011-050	109.80	AEPW	Santa Fe Tap 138kV	On Schedule for 2016
GEN-2011-051	104.40	OKGE	Tap Woodward - Tatonga 345kV (GEN-2011-051 Tap)	On Suspension
GEN-2011-054	300.00	OKGE	Cimarron 345kV	On Schedule for 2015
GEN-2011-057	150.40	WERE	Creswell 138kV	On Schedule for 2015
GEN-2012-001	61.20	SPS	Cirrus Tap 230kV	On-Line
GEN-2012-004	41.40	OKGE	Carter County 138kV	On-Line
GEN-2012-007	120.00	SUNCMKEC	Rubart 115kV	On-Line
GEN-2012-009	15.00	SPS	Mustang 230kV	On-Line
GEN-2012-010	15.00	SPS	Mustang 230kV	On-Line
GEN-2012-020	478.00	SPS	TUCO 230kV	On Schedule for 2016
GEN-2012-024	180.00	SUNCMKEC	Clark County 345kV	On Schedule for 2016
GEN-2012-027	136.00	AEPW	Shidler 138kV	On Suspension
GEN-2012-028	74.80	WFEC	Gotebo 69kV	On Schedule for 2015
GEN-2012-032	300.00	OKGE	Open Sky 345kV	On Schedule for 2015
GEN-2012-033	98.80	OKGE	Tap and Tie South 4th - Bunch Creek & Enid Tap - Fairmont (GEN-2012-033T) 138kV	On Schedule for 2015
GEN-2012-034	7.00	SPS	Mustang 230kV	On-Line
GEN-2012-035	7.00	SPS	Mustang 230kV	On-Line
GEN-2012-036	7.00	SPS	Mustang 230kV	On-Line
GEN-2012-037	203.00	SPS	TUCO 345kV	On-Line
GEN-2012-040	76.50	WFEC	Chilocco 138kV	On Suspension
GEN-2012-041	121.50	OKGE	Ranch Road 345kV	On-Line
GEN-2013-007	100.30	OKGE	Tap Prices Falls - Carter 138kV	On Schedule for 2015
GEN-2013-010	99.00	SUNCMKEC	Tap Spearville - Post Rock (North of GEN-2011-017 Tap) 345kV	Facility Study
GEN-2013-011	30.00	AEPW	Turk 138kV	On-Line
GEN-2013-012	147.00	OKGE	Redbud 345kV	On-Line
GEN-2013-016	203.00	SPS	TUCO 345kV	IA Pending
GEN-2013-022	25.00	SPS	Norton 115kV	On Schedule for 2016
GEN-2013-027	150.00	SPS	Tap Tolk - Yoakum 230kV	Facility Study

Southwest Power Pool, Inc. Appendix A2: Prior Queued Generation Interconnection

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2013-028	559.50	GRDA	Tap N Tulsa - GRDA 1 345kV	On Schedule for 2017
GEN-2013-029	300.00	OKGE	Renfrow 345kV	On Schedule for 2016 (150MW) and 2016 (150MW)
GEN-2013-030	300.00	OKGE	Beaver County 345kV	On Schedule for 2016 (200MW) and 2017 (100MW)
GEN-2013-033	28.00	MIDW	Goodman Energy Center 115kV	On Schedule for 2016
GEN-2014-001	200.60	WERE	Tap Wichita - Emporia Energy Center 345kV	IA Pending
GEN-2014-002	10.50	OKGE	Tatonga 345kV (GEN-2007-021 POI)	Facility Study Stage
GEN-2014-003	15.84	OKGE	Tatonga 345kV (GEN-2007-044 POI)	Facility Study Stage
GEN-2014-005	5.70	OKGE	Minco 345kV (GEN-2011-010 POI)	On-Line
GEN-2014-012	225.00	SPS	Tap Hobbs Interchange - Andrews 230kV	IA Pending
GEN-2014-020	100.00	AEPW	Tuttle 138kV	Facility Study
GEN-2014-025	2.40	MIDW	Tap Nekoma - Bazine (Walnut Creek) 69kV	Facility Study
GEN-2014-026	150.00	OKGE	Beaver County 345kV	Facility Study
GEN-2014-028	35.00	EMDE	Riverton 161kV	Facility Study
GEN-2014-033	70.00	SPS	Chaves County 115kV	Facility Study
GEN-2014-034	70.00	SPS	Chaves County 115kV	Facility Study
GEN-2014-035	30.00	SPS	Chaves County 115kV	Facility Study
GEN-2014-040	320.00	SPS	Castro 115kV	IA Pending
GEN-2014-041	123.17	SUNCMKEC	Arnold 115kV	Facility Study
GEN-2014-047	40.00	SPS	Tap Tolk - Eddy County (Crossroads) 345kV	Facility Study
GEN-2014-049	200.00	SUNCMKEC	Thistle 345kV	Facility Study
GEN-2014-053	80.00	SPS	Carlisle 230kV	Facility Study
GEN-2014-054	120.00	SPS	Carlisle 230kV	Facility Study
GEN-2014-056	250.00	OKGE	Minco 345kV	Facility Study
GEN-2014-057	250.00	AEPW	Tap Lawton - Sunnyside 345kV	IA Pending
GEN-2014-064	248.40	OKGE	Otter 138kV	IA Pending
GEN-2014-066	30.00	SPS	Norton 115kV	Facility Study
Gray County Wind (Montezuma)	110.00	SUNCMKEC	Gray County Tap 115kV	On-Line
Llano Estacado (White Deer)	80.00	SPS	Llano Wind 115kV	On-Line
NPPD Distributed (Buffalo County Solar)	10.00	NPPD	Kearney Northeast	On-Line
SPS Distributed (Dumas 19th St)	20.00	SPS	Dumas 19th Street 115kV	On-Line
SPS Distributed (Etter)	20.00	SPS	Etter 115kV	On-Line
SPS Distributed (Hopi)	10.00	SPS	Hopi 115kV	On-Line
SPS Distributed (Jal)	10.00	SPS	S Jal 115kV	On-Line
SPS Distributed (Lea Road)	10.00	SPS	Lea Road 115kV	On-Line
SPS Distributed (Monument)	10.00	SPS	Monument 115kV	On-Line
SPS Distributed (Moore E)	25.00	SPS	Moore East 115kV	On-Line
SPS Distributed (Ocotillo)	10.00	SPS	S_Jal 115kV	On-Line
SPS Distributed (Sherman)	20.00	SPS	Sherman 115kV	On-Line
SPS Distributed (Spearman)	10.00	SPS	Spearman 69kV	On-Line
SPS Distributed (TC-Texas County)	20.00	SPS	Texas County 115kV	On-Line
SPS Distributed (Yuma)	2.57	SPS	SP-Yuma 69kV	On-Line

B: Power Flow Study Results

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEA (MVA)	RATEB(MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	9	0	20SP	J343	FROM->TO	CHARLOT5 161.00 - CROSSTOWN 161KV CKT 1	259	259	0.03033	101.9185	IATAN - STRANGER CREEK 345KV CKT 1
FDNS	9	0	25SP	J343	FROM->TO	CHARLOT5 161.00 - CROSSTOWN 161KV CKT 1	259	259	0.03029	110.5136	IATAN - STRANGER CREEK 345KV CKT 1
FDNS	9	0	20SP	J343	TO->FROM	CHARLOT5 161.00 - NORTHEAST 161KV CKT 1	259	259	0.03033	111.142	IATAN - STRANGER CREEK 345KV CKT 1
FDNS	9	0	25SP	J343	TO->FROM	CHARLOT5 161.00 - NORTHEAST 161KV CKT 1	259	259	0.03029	119.9571	IATAN - STRANGER CREEK 345KV CKT 1
FDNS	9	0	15SP	J343	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.22456	99.8	CRESTON - MARYVILLE 161KV CKT 1
FDNS	9	0	15SP	J343	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.17989	96.9	COOPER - ST JOE 345KV CKT 1
FDNS	9	0	15SP	J343	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.17769	95.1	COOPER - FAIRPORT 345KV CKT 1
FDNS	9	0	15G	J343	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.16574	100.9354	LN-FAIRPORT
FDNS	9	0	15G	J343	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.16574	100.9355	STMDSJFASJCO
FDNS	9	0	15SP	J343	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.16511	111.0465	LN-FAIRPORT
FDNS	9	0	15SP	J343	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.16511	111.0465	STMDSJFASJCO
FDNS	9	0	15SP	J343	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.16364	101.257	FAIRPORT 345/161KV TRANSFORMER CKT 3
FDNS	9	0	15SP	J289	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.11869	99.8	CRESTON - MARYVILLE 161KV CKT 1
FDNS	9	0	15SP	J289	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.06368	96.9	COOPER - ST JOE 345KV CKT 1
FDNS	9	0	15SP	J289	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.06189	95.1	COOPER - FAIRPORT 345KV CKT 1
FDNS	9	0	15G	J289	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.05412	100.9354	LN-FAIRPORT
FDNS	9	0	15G	J289	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.05412	100.9355	STMDSJFASJCO
FDNS	9	0	15SP	J289	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.05353	111.0465	LN-FAIRPORT
FDNS	9	0	15SP	J289	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.05353	111.0465	STMDSJFASJCO
FDNS	9	0	15SP	J289	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.05166	101.257	FAIRPORT 345/161KV TRANSFORMER CKT 3
FDNS	9	0	15SP	J329	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.03486	99.8	CRESTON - MARYVILLE 161KV CKT 1
FDNS	9	0	15SP	J344	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.03287	99.8	CRESTON - MARYVILLE 161KV CKT 1
FDNS	9	0	15SP	J285	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.03208	99.8	CRESTON - MARYVILLE 161KV CKT 1
FDNS	9	0	15SP	J285	FROM->TO	CLARINDA - MARYVILLE 161KV CKT 1	153	168	0.02898	96.9	COOPER - ST JOE 345KV CKT 1
FDNS	9	0	15SP	J285	FROM->TO	COOPER - ST JOE 345KV CKT 1	1073	1195	0.16013	99.2	COOPER - FAIRPORT 345KV CKT 1
FDNS	9	0	15SP	J316	FROM->TO	COOPER - ST JOE 345KV CKT 1	1073	1195	0.14627	99.2	COOPER - FAIRPORT 345KV CKT 1
FDNS	9	0	15SP	J320	FROM->TO	COOPER - ST JOE 345KV CKT 1	1073	1195	0.13484	99.2	COOPER - FAIRPORT 345KV CKT 1
FDNS	9	0	15SP	J329	FROM->TO	COOPER - ST JOE 345KV CKT 1	1073	1195	0.13232	99.2	COOPER - FAIRPORT 345KV CKT 1
FDNS	9	0	15SP	J344	FROM->TO	COOPER - ST JOE 345KV CKT 1	1073	1195	0.12533	99.2	COOPER - FAIRPORT 345KV CKT 1
FDNS	9	0	15SP	J289	FROM->TO	COOPER - ST JOE 345KV CKT 1	1073	1195	0.11256	99.2	COOPER - FAIRPORT 345KV CKT 1
FDNS	9	0	15SP	J343	FROM->TO	COOPER - ST JOE 345KV CKT 1	1073	1195	0.07623	99.2	COOPER - FAIRPORT 345KV CKT 1
FDNS	9	0	15SP	J343	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.16645	100.7249	FALLOW 3 345.00 - GRIMES 345KV CKT 1
FDNS	9	0	15SP	J343	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.16388	104.5725	928-NORWALK
FDNS	9	0	15SP	J343	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.16356	104.6614	MADISON COUNTY - RLHILLS3 345.00 345KV CKT 1
FDNS	9	0	20SP	J343	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.15758	97.3	928-NORWALK
FDNS	9	0	25SP	J343	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.15755	99.1	928-NORWALK
FDNS	9	0	20SP	J343	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.15734	97.3	MADISON COUNTY - RLHILLS3 345.00 345KV CKT 1
FDNS	9	0	25SP	J343	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.15731	99.2	MADISON COUNTY - RLHILLS3 345.00 345KV CKT 1
FDNS	9	0	15SP	J289	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.15362	100.7249	FALLOW 3 345.00 - GRIMES 345KV CKT 1
FDNS	9	0	15SP	J289	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.15042	104.5725	928-NORWALK
FDNS	9	0	15SP	J289	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.14981	104.6614	MADISON COUNTY - RLHILLS3 345.00 345KV CKT 1
FDNS	9	0	20SP	J289	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.14184	97.3	928-NORWALK
FDNS	9	0	25SP	J289	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.1418	99.1	928-NORWALK
FDNS	9	0	20SP	J289	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.14136	97.3	MADISON COUNTY - RLHILLS3 345.00 345KV CKT 1
FDNS	9	0	25SP	J289	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.14132	99.2	MADISON COUNTY - RLHILLS3 345.00 345KV CKT 1
FDNS	9	0	15SP	J329	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.12209	104.5725	928-NORWALK
FDNS	9	0	15SP	J329	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.12155	104.6614	MADISON COUNTY - RLHILLS3 345.00 345KV CKT 1
FDNS	9	0	15SP	J329	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.11734	100.7249	FALLOW 3 345.00 - GRIMES 345KV CKT 1
FDNS	9	0	15SP	J344	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.11501	104.5725	928-NORWALK
FDNS	9	0	15SP	J344	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.1145	104.6614	MADISON COUNTY - RLHILLS3 345.00 345KV CKT 1
FDNS	9	0	15SP	J344	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.11025	100.7249	FALLOW 3 345.00 - GRIMES 345KV CKT 1
FDNS	9	0	20SP	J329	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.10899	97.3	928-NORWALK
FDNS	9	0	25SP	J329	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.10892	99.1	928-NORWALK
FDNS	9	0	20SP	J329	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.10861	97.3	MADISON COUNTY - RLHILLS3 345.00 345KV CKT 1
FDNS	9	0	25SP	J329	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.10854	99.2	MADISON COUNTY - RLHILLS3 345.00 345KV CKT 1
FDNS	9	0	20SP	J344	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.10154	97.3	928-NORWALK
FDNS	9	0	25SP	J344	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.10146	99.1	928-NORWALK
FDNS	9	0	20SP	J344	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.10118	97.3	MADISON COUNTY - RLHILLS3 345.00 345KV CKT 1
FDNS	9	0	25SP	J344	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.1011	99.2	MADISON COUNTY - RLHILLS3 345.00 345KV CKT 1
FDNS	9	0	15SP	J320	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.0409	104.5725	928-NORWALK
FDNS	9	0	15SP	J320	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.04078	104.6614	MADISON COUNTY - RLHILLS3 345.00 345KV CKT 1
FDNS	9	0	20SP	J320	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.0379	97.3	928-NORWALK
FDNS	9	0	25SP	J320	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.03785	99.1	928-NORWALK
FDNS	9	0	20SP	J320	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.03782	97.3	MADISON COUNTY - RLHILLS3 345.00 345KV CKT 1
FDNS	9	0	25SP	J320	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.03777	99.2	MADISON COUNTY - RLHILLS3 345.00 345KV CKT 1
FDNS	9	0	15SP	J320	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.0364	100.7249	FALLOW 3 345.00 - GRIMES 345KV CKT 1
FDNS	9	0	15SP	J285	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.03156	104.5725	928-NORWALK
FDNS	9	0	15SP	J285	FROM->TO	COUNCIL BLUFFS - SUB 3456 345KV CKT 1	956	956	0.0315	104.6614	MADISON COUNTY - RLHILLS3 345.00 345KV CKT 1
FDNS	9	0	15SP	J343	TO->FROM	CROSSTOWN - NORTHEAST 161KV CKT 1	259	259	0.03134	106.2983	IATAN - STRANGER CREEK 345KV CKT 1
FDNS	9	0	15SP	J289	TO->FROM	CROSSTOWN - NORTHEAST 161KV CKT 1	259	259	0.02909	106.2983	IATAN - STRANGER CREEK 345KV CKT 1
FDNS	9	0	15SP	J343	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.04382	104.7175	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15SP	J343	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.04382	104.9059	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15SP	J289	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.04314	104.7175	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEA (MVA)	RATEB(MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	9	0	15SP	J289	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.04314	104.9059	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15G	J343	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.04266	96.7	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15G	J343	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.04266	97	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15G	J289	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.04199	96.7	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15G	J289	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.04199	97	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	20SP	J343	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.04173	98.1	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	20SP	J343	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.04173	98.1	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15SP	J285	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.04097	104.7175	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15SP	J285	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.04097	104.9059	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	20SP	J289	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.04085	98.1	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	20SP	J289	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.04085	98.1	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15G	J285	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03983	96.7	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15G	J285	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03983	97	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	20SP	J285	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.0385	98.1	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	20SP	J285	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.0385	98.1	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15SP	J316	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03845	104.7175	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15SP	J316	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03845	104.9059	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15SP	J329	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03821	104.7175	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15SP	J329	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03821	104.9059	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15SP	J320	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.0373	104.7175	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15SP	J320	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.0373	104.9059	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15G	J316	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03729	96.7	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15G	J316	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03729	97	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15SP	J344	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03728	104.7175	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15SP	J344	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03728	104.9059	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15G	J329	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03705	96.7	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15G	J329	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03705	97	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15G	J320	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03612	96.7	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15G	J320	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03612	97	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15G	J344	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03611	96.7	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15G	J344	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03611	97	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	20SP	J316	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03601	98.1	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	20SP	J316	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03601	98.1	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	20SP	J329	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03521	98.1	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	20SP	J329	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03521	98.1	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	20SP	J320	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03473	98.1	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	20SP	J320	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.03473	98.1	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	20SP	J344	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.0342	98.1	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	20SP	J344	FROM->TO	HAWTHORN (HAWT 20) 345/161/13.8KV TRANSFORMER CKT 20	500	550	0.0342	98.1	HAWTHORN (HAWT 22) 345/161/13.8KV TRANSFORMER CKT 22
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.05351	103.4247	FT THOMPSON - GRAND ISLAND 345KV CKT 1
FDNS	9	0	20SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.0507	96.1	FT THOMPSON - HOLT.CO3 345.00 345KV CKT 1
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04684	98.7	HOSKINS - SHELL CREEK 345KV CKT 1
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04339	98.5	FT RANDAL - SIOUX CITY 230KV CKT 1
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04306	96.1	RAUN - SUB 3451 FT CAL 345KV CKT 1
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04255	97.6	HOSKINS - RAUN 345KV CKT 1
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04219	95.2	RASMUSN - UTICA JCT 230KV CKT 1
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04209	100.8628	DAK02WAPAB2
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04171	100.7191	FT RANDAL - UTICA JCT 230KV CKT 1
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04161	95.7	ONEILL - SPENCER 115KV CKT 1
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04161	95.9	FT RANDAL - SPENCER 115KV CKT 1
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04161	95.9	LN-WAPA6
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04161	95.9	NEB001NPPB2
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04124	95.3	GRIMES - LEHIGH 345KV CKT 1
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04097	95.1	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04091	96.6	ALBION - PETERSBURG 115KV CKT 1
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04091	96.8	PETERSBRG.N7115.00 - PETERSBURG 115KV CKT Z1
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04089	96.1	DIXONCO 230.00 - HOSKINS 230KV CKT 1
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04065	95.1	KEYSTONE - SIDNEY 345KV CKT 1
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04017	95.4	WAPA-OG-2
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04001	95.2	GEN336153 1-WATERFORD UNIT#3
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04001	95.2	GEN344225 1-1CAL G1 25.000
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04001	95.3	GEN337911 1-ARKANSAS NUCLEAR ONE UNIT #2
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04001	95.6	GEN635023 3-WALTER SCOTT UNIT 3
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04001	95.7	GEN336821 1-GRAND GULF UNIT
FDNS	9	0	15SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.04001	96	GEN635024 4-WALTER SCOTT UNIT 4
FDNS	9	0	25SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.03921	95.1	RAUN - SUB 3451 FT CAL 345KV CKT 1
FDNS	9	0	25SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.03855	97.1	HOSKINS - RAUN 345KV CKT 1
FDNS	9	0	25SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.03789	96.6	LN-WAPA6
FDNS	9	0	25SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.03789	96.6	NEB001NPPB2
FDNS	9	0	25SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.03692	99.6	DAK02WAPAB2
FDNS	9	0	25SP	J316	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.03639	95.7	WAPA-OG-2
FDNS	9	0	15SP	J320	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.03451	103.4247	FT THOMPSON - GRAND ISLAND 345KV CKT 1
FDNS	9	0	15SP	J320	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.03354	98.7	HOSKINS - SHELL CREEK 345KV CKT 1

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEA (MVA)	RATEB(MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	9	0	20SP	J320	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.03219	96.1	FT THOMPSON - HOLT.CO3 345.00 345KV CKT 1
FDNS	9	0	15SP	J320	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.02954	97.6	HOSKINS - RAUN 345KV CKT 1
FDNS	9	0	15SP	J320	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.02905	96.1	RAUN - SUB 3451 FT CAL 345KV CKT 1
FDNS	9	0	15SP	J285	TO->FROM	KELLY - MEADOWGROVE4230.00 230KV CKT 1	368	368	0.0287	98.7	HOSKINS - SHELL CREEK 345KV CKT 1
FDNS	9	0	15SP	J343	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.06247	111.142	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15SP	J343	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.06247	112.4975	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15G	J343	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.06001	107.6274	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15G	J343	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.06001	108.3495	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	25SP	J343	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.05865	98.3	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	25SP	J343	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.05865	99	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	20SP	J343	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.05863	101.8587	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	20SP	J343	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.05863	102.941	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15SP	J289	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.0556	111.142	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15SP	J289	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.0556	112.4975	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15G	J289	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.05315	107.6274	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15G	J289	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.05315	108.3495	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	25SP	J289	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.05121	98.3	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	25SP	J289	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.05121	99	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	20SP	J289	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.05119	101.8587	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	20SP	J289	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.05119	102.941	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15SP	J285	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.04215	111.142	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15SP	J285	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.04215	112.4975	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15G	J285	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03972	107.6274	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15G	J285	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03972	108.3495	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15SP	J316	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03779	111.142	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15SP	J316	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03779	112.4975	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	25SP	J285	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03748	98.3	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	25SP	J285	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03748	99	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	20SP	J285	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03746	101.8587	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	20SP	J285	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03746	102.941	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15G	J316	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03535	107.6274	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15G	J316	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03535	108.3495	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15SP	J329	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03494	111.142	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15SP	J329	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03494	112.4975	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15SP	J320	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03391	111.142	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15SP	J320	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03391	112.4975	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	25SP	J316	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03357	98.3	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	25SP	J316	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03357	99	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	20SP	J316	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03329	101.8587	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	20SP	J316	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03329	102.941	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15G	J329	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03251	107.6274	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15G	J329	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03251	108.3495	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15SP	J344	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03241	111.142	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15SP	J344	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03241	112.4975	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15G	J320	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03142	107.6274	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15G	J320	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.03142	108.3495	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15G	J344	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.02998	107.6274	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15G	J344	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.02998	108.3495	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	25SP	J320	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.02906	98.3	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	25SP	J320	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.02906	99	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	20SP	J320	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.02901	101.8587	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	20SP	J320	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.02901	102.941	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	25SP	J329	FROM->TO	NASHUA (NASH 11) 345/161/13.8KV TRANSFORMER CKT 11	650	715	0.02855	99	HAWTHORN - NASHUA 345KV CKT 1
FDNS	9	0	15SP	J316	TO->FROM	OGALLALA - SIDNEY 230KV CKT 1	320	320	0.03348	105.847	KEYSTONE - SIDNEY 345KV CKT 1
FDNSLock	9	0	15G	J316	TO->FROM	OGALLALA - SIDNEY 230KV CKT 1	320	320	0.03249	113.4249	KEYSTONE - SIDNEY 345KV CKT 1
FDNS	9	0	20SP	J316	TO->FROM	OGALLALA - SIDNEY 230KV CKT 1	320	320	0.03006	97.2	KEYSTONE - SIDNEY 345KV CKT 1
FDNS	9	0	25SP	J316	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03592	99.2	BORDER 7345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	9	0	25SP	J316	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03592	101.2376	BORDER 7345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	9	0	25SP	J316	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03592	101.9208	BORDER 7345.00 - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J316	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03592	104.192	BORDER 7345.00 - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J285	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03554	99.2	BORDER 7345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	9	0	25SP	J285	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03554	101.2376	BORDER 7345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	9	0	25SP	J285	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03554	101.9208	BORDER 7345.00 - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J285	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03554	104.192	BORDER 7345.00 - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J343	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03524	99.2	BORDER 7345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	9	0	25SP	J343	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03524	101.2376	BORDER 7345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	9	0	25SP	J343	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03524	101.9208	BORDER 7345.00 - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J343	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03524	104.192	BORDER 7345.00 - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J289	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03503	99.2	BORDER 7345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	9	0	25SP	J289	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03503	101.2376	BORDER 7345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	9	0	25SP	J289	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03503	101.9208	BORDER 7345.00 - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J289	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03503	104.192	BORDER 7345.00 - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J316	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03495	99	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEA (MVA)	RATEB(MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	9	0	25SP	J316	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03495	99	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J316	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03495	100.8684	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J316	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03495	100.8684	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J285	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03447	99	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J285	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03447	99	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J285	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03447	100.8684	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J285	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03447	100.8684	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J320	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03444	99.2	BORDER 7345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	9	0	25SP	J320	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03444	101.2376	BORDER 7345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	9	0	25SP	J320	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03444	101.9208	BORDER 7345.00 - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J320	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03444	104.192	BORDER 7345.00 - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J343	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03397	99	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J343	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03397	99	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J343	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03397	100.8684	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J343	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03397	100.8684	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J289	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03379	99	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J289	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03379	99	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J289	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03379	100.8684	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J289	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03379	100.8684	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J329	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.0334	99.2	BORDER 7345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	9	0	25SP	J329	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.0334	101.2376	BORDER 7345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	9	0	25SP	J329	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.0334	101.9208	BORDER 7345.00 - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J329	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.0334	104.192	BORDER 7345.00 - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J320	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03332	99	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J320	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03332	99	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J320	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03332	100.8684	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J320	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03332	100.8684	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J344	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03309	99.2	BORDER 7345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	9	0	25SP	J344	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03309	101.2376	BORDER 7345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	9	0	25SP	J344	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03309	101.9208	BORDER 7345.00 - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J344	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03309	104.192	BORDER 7345.00 - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J316	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03289	100.7895	SPP-SWPS-01
FDNS	9	0	25SP	J316	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03289	103.2234	SPP-SWPS-01
FDNS	9	0	25SP	J316	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03272	99.8	OKLAUNION - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J316	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03272	100.6581	SPSCONT-01
FDNS	9	0	25SP	J316	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03272	102.1221	OKLAUNION - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J316	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03272	103.1162	SPSCONT-01
FDNS	9	0	25SP	J285	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03254	100.7895	SPP-SWPS-01
FDNS	9	0	25SP	J285	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03254	103.2234	SPP-SWPS-01
FDNS	9	0	25SP	J285	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03236	99.8	OKLAUNION - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J285	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03236	100.6581	SPSCONT-01
FDNS	9	0	25SP	J285	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03236	102.1221	OKLAUNION - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J285	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03236	103.1162	SPSCONT-01
FDNS	9	0	25SP	J329	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03211	99	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J329	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03211	99	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J343	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03211	100.7895	SPP-SWPS-01
FDNS	9	0	25SP	J329	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03211	100.8684	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J329	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03211	100.8684	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J343	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03211	103.2234	SPP-SWPS-01
FDNS	9	0	25SP	J289	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03202	100.7895	SPP-SWPS-01
FDNS	9	0	25SP	J289	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03202	103.2234	SPP-SWPS-01
FDNS	9	0	25SP	J343	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03193	99.8	OKLAUNION - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J343	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03193	100.6581	SPSCONT-01
FDNS	9	0	25SP	J343	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03193	102.1221	OKLAUNION - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J343	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03193	103.1162	SPSCONT-01
FDNS	9	0	25SP	J289	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03184	99.8	OKLAUNION - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J289	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03184	100.6581	SPSCONT-01
FDNS	9	0	25SP	J289	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03184	102.1221	OKLAUNION - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J289	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03184	103.1162	SPSCONT-01
FDNS	9	0	25SP	J320	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03183	100.7895	SPP-SWPS-01
FDNS	9	0	25SP	J320	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03183	103.2234	SPP-SWPS-01
FDNS	9	0	25SP	J344	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03179	99	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J344	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03179	99	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J344	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03179	100.8684	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J344	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03179	100.8684	HITCHLAND INTERCHANGE - MOORE COUNTY INTERCHANGE 230KV CKT 1
FDNS	9	0	25SP	J320	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03165	99.8	OKLAUNION - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J320	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03165	100.6581	SPSCONT-01
FDNS	9	0	25SP	J320	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03165	102.1221	OKLAUNION - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J320	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03165	103.1162	SPSCONT-01
FDNS	9	0	25SP	J316	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03108	96.1	SPP-SWPS-02
FDNS	9	0	25SP	J316	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03108	96.1	STATELINE INTERCHANGE - STLN-DEMARC6 230KV CKT 1
FDNS	9	0	25SP	J316	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03108	96.1	STLN-DEMARC6 - SWEETWATER 230KV CKT 1
FDNS	9	0	25SP	J329	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.031	100.7895	SPP-SWPS-01

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEA (MVA)	RATEB(MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	9	0	25SP	J329	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.031	103.2234	SPP-SWPS-01
FDNS	9	0	25SP	J329	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03081	99.8	OKLAUNION - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J329	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03081	100.6581	SPSCONT-01
FDNS	9	0	25SP	J329	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03081	102.1221	OKLAUNION - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J329	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03081	103.1162	SPSCONT-01
FDNS	9	0	25SP	J344	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03079	100.7895	SPP-SWPS-01
FDNS	9	0	25SP	J344	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03079	103.2234	SPP-SWPS-01
FDNS	9	0	25SP	J285	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03076	96.1	SPP-SWPS-02
FDNS	9	0	25SP	J285	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03076	96.1	STATELINE INTERCHANGE - STLN-DEMARC6 230KV CKT 1
FDNS	9	0	25SP	J285	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03076	96.1	STLN-DEMARC6 - SWEETWATER 230KV CKT 1
FDNS	9	0	25SP	J344	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03061	99.8	OKLAUNION - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J344	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03061	100.6581	SPSCONT-01
FDNS	9	0	25SP	J344	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03061	102.1221	OKLAUNION - TUCO INTERCHANGE 345KV CKT 1
FDNS	9	0	25SP	J344	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03061	103.1162	SPSCONT-01
FDNS	9	0	25SP	J343	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03042	96.1	SPP-SWPS-02
FDNS	9	0	25SP	J343	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03042	96.1	STATELINE INTERCHANGE - STLN-DEMARC6 230KV CKT 1
FDNS	9	0	25SP	J343	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03042	96.1	STLN-DEMARC6 - SWEETWATER 230KV CKT 1
FDNS	9	0	25SP	J289	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03031	96.1	SPP-SWPS-02
FDNS	9	0	25SP	J289	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03031	96.1	STATELINE INTERCHANGE - STLN-DEMARC6 230KV CKT 1
FDNS	9	0	25SP	J289	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03031	96.1	STLN-DEMARC6 - SWEETWATER 230KV CKT 1
FDNS	9	0	25SP	J320	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03002	96.1	SPP-SWPS-02
FDNS	9	0	25SP	J320	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03002	96.1	STATELINE INTERCHANGE - STLN-DEMARC6 230KV CKT 1
FDNS	9	0	25SP	J320	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.03002	96.1	STLN-DEMARC6 - SWEETWATER 230KV CKT 1
FDNS	9	0	25SP	J329	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.02923	96.1	SPP-SWPS-02
FDNS	9	0	25SP	J329	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.02923	96.1	STATELINE INTERCHANGE - STLN-DEMARC6 230KV CKT 1
FDNS	9	0	25SP	J329	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.02923	96.1	STLN-DEMARC6 - SWEETWATER 230KV CKT 1
FDNS	9	0	25SP	J344	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.02902	96.1	SPP-SWPS-02
FDNS	9	0	25SP	J344	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.02902	96.1	STATELINE INTERCHANGE - STLN-DEMARC6 230KV CKT 1
FDNS	9	0	25SP	J344	FROM->TO	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1	560	560	0.02902	96.1	STLN-DEMARC6 - SWEETWATER 230KV CKT 1
FDNS	9	0	15SP	J316	TO->FROM	SIDNEY - SIDNEY TRANSFORMER 230KV CKT 1	400	400	0.03855	105.1219	KEYSTONE - SIDNEY 345KV CKT 1
FDNSLock	9	0	15G	J316	TO->FROM	SIDNEY - SIDNEY TRANSFORMER 230KV CKT 1	400	400	0.03743	107.5999	KEYSTONE - SIDNEY 345KV CKT 1
FDNS	9	0	20SP	J316	TO->FROM	SIDNEY - SIDNEY TRANSFORMER 230KV CKT 1	400	400	0.03475	96.7	KEYSTONE - SIDNEY 345KV CKT 1

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Appendix
G

Transient Stability Results

Plots of stability simulations for 2017 and 2024 shoulder study cases are in separate files which are listed below:

G.1 2017 Shoulder Study Case

AppendixG1_2017SH_Study_Plots.pdf

G.2 2024 Shoulder Study Case

AppendixG2_2024SH_Study_Plots.pdf

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Appendix
H

MWEX Voltage Study Details

Below is the MWEX voltage stability study report provided by ATC.



MWEX Voltage Stability Study
Prepared For
August 2014 MISO West DPP Study

September 4, 2015
American Transmission Company, LLC

Prepared By:
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Summary

This document describes the results of the steady state voltage stability analysis required for the August 2014 cycle (J285, J289, J316, J320, J329, J343, J344, and J382) of the MISO Generation Interconnection Definitive Planning Phase (DPP) in the Western region.

Voltage stability analysis is required to determine if the initial conditions of the DPP system models under study are in a stable state as defined by Power-Voltage (PV) curves of the Minnesota Wisconsin Export Interface (MWEX) for the most severe contingency. MWEX is the summation of the pre-contingent flows on the AS King – Eau Claire 345-kV line measured at AS King and the Arrowhead 230-kV phase shifting transformer (also referred to as phase angle regulator or PAR) measured at the Minnesota Power 230-kV side of the Arrowhead substation. The voltage is measured at the Arrowhead 230-kV bus. Also, normal and emergency voltage limits will be respected in addition to steady state voltage stability limits.

This analysis concentrates on the 2024 shoulder load cases. As shown in Table 1, both the Pre-DPP and Post-DPP scenarios in the 2024 shoulder load cases are voltage stable.

Table 1 – MWEX Margins to Collapse in 2024SH Cases

	Real Power Flows (MW)							
	AHD-SLK[1]	MWEX				Margin to Nose[2]		
Case	N-0	N-0[3] I.C.	N-1[3] I.C.	N-1 I.C. After Phase Shift	N-1 Nose	(MW)	(%)	Notes
Pre-DPP	683	1505	783	721	854	133	16	Voltage Stable
Post-DPP	699	1552	816	721	847	126	15	Voltage Stable

1. As described in the active MWEX Operating Guide, the AHD-SLK interface is a single element PTDF interface measured at the Minnesota Power 230-kV side of the Arrowhead 230-kV phase shifter.
2. Margin to Nose is defined as the MWEX N-1 Nose minus the N-1 Initial Condition After Phase Shift.
3. Initial Condition flows were measured in the unmodified base cases with the most severe contingency plus remedial actions as needed with all transformer taps, switched shunts, and PARs locked.

Model Selection

Each of the four base cases was reviewed before the voltage stability analysis was performed. ATC determined that voltage stability analysis was only necessary using the 2024SH case because the 2024SH MWEX flow is much greater than the 2024SP MWEX flow.

The 2017SH cases are known to be voltage unstable due to non-converging contingencies in the August 2013, August 2013, and August 2012 MISO West DPP near-term models such that MISO includes the Badger Coulee project, Briggs Road – North Madison – Cardinal 345-kV, prior to its expected in-service date of 12/31/2018. The MISO MVP portfolio, including Badger Coulee, is considered the long term voltage stability upgrade. No project has been defined that can be constructed prior to 2017 that will eliminate the voltage instability without the Badger Coulee project. Therefore, voltage stability analysis is not performed on any of the 2017 cases.

Table 2 – Initial Conditions in Each Post-DPP Base Case

	AHD-SLK 345-kV[1]	MWEX		Arrowhead 230-kV		
Case	**N-0 Flow**	**N-0 Flow**	**N-1 Flow[2]**	**N-0 Voltage**	**N-1 Voltage[2]**	**Post-Contingency Events**
2024SH	700	1554	794	1.0114	0.9738	MCCC SPS system operates 2 of 2 Arrowhead 345-kV caps in
2024SP	265	600	310	1.0354	1.0308	None
2017SH	647	1527	777	1.0215	0.9983	MCCC SPS system operates 2 of 2 Arrowhead 345-kV caps in
2017SP	226	583	276	1.0348	1.0296	None
2017SH (no BC)[3]	671	1584	800	1.0138	0.9676	MCCC SPS system operates 2 of 2 Arrowhead 345-kV caps in Stone Lake capacitor in TBW system operates
2017SP (no BC)[3]	224	580	276	1.0349	1.0296	None

1. As described in the active MWEX Operating Guide, the AHD-SLK interface is a single element PTDF interface measured at the Minnesota Power 230-kV side of the Arrowhead 230-kV phase shifter.
2. N-1 Flow and N-1 Voltage were measured in the unmodified base cases with the worst contingency plus remedial actions as needed with all transformer taps, switched shunts, and PARs locked. The Stone Lake 345-kV reactor is not modeled because it is not in service in any of the cases.
3. The 2017 base cases contain the Badger Coulee project, Briggs Road – North Madison – Cardinal 345-kV, as a base assumption. This project has an expected in-service date of 12/31/2018 and was removed for these measurements.

Model Notes

The Stone Lake 345-kV shunt reactor is not modeled in this analysis because it is not in-service in any of the cases studied.

The Arrowhead LTC modeling and impedance was updated and the new Lublin Over-current Protection Scheme was implemented.

The generation interconnection requests were dispatched in the following manner in the 2024 shoulder cases.

1. All of the NRIS requests are not dispatched in the Pre-DPP case and dispatched to 100% of their requested capacity in the Post-DPP case.
    a. J285, J289, J316, J343, and J344 has fuel type = Wind.
    b. J329 has fuel type = Hydro.
2. J320 is an ERIS request for 55 MW winter capacity increase of a combined cycle power plant with fuel type = Gas. J320 is not dispatched in the Pre-DPP case and is dispatched to 27.5 MW in the Post-DPP case. This is consistent with the MISO assumption that combined cycle power plants are dispatched to 50% of their capacity in shoulder cases.
3. J382 is an NRIS-only request for 48.3 MW at an existing simple cycle combustion turbine power plant with fuel type = Gas. J382 is not dispatched in either the Pre-DPP or the Post-DPP case. This is consistent with the MISO assumption that simple cycle combustion turbines are not dispatched in shoulder cases.

Results

Table 3 shows the Control Points for situations when the Arrowhead PAR is in automatic mode and when it is in manual mode. When the Arrowhead PAR is in manual mode the taps can only be adjusted by system operators and will not respond to any other control settings.

Table 3 – MWEX Measurements to Determine Control Point – 2024SH

	N-0 MWEX Measurements (MW)					Incremental Transfer[6] (MW)	
Case	**Nose[1]**	**Collapse[2]**	**IROL[3]**	**SOL[4]**	**Control Point[5]**	**To Nose**	**To Collapse**
Pre-DPP Automatic PAR	1702	1855	1762	1702	1662	870	1620
Pre-DPP Manual PAR	N/A	N/A	1702	1532	1501	N/A	N/A
Post-DPP Automatic PAR	1698	1844	1752	1698	1652	650	1360
Post-DPP Manual PAR	N/A	N/A	1698	1528	1498	N/A	N/A

1. Nose: the N-0 flow that corresponds to the point of bifurcation, which is identified as the last transfer that results in a post-contingent, net positive change in real power flow on MWEX.
2. Collapse: the last solving post-contingent transfer step.
3. IROL (Interconnection Reliability Operating Limit) = 0.95 x Collapse.
   a. Manual PAR IROL = Minimum of Automatic PAR IROL and Automatic PAR SOL.
4. SOL (System Operating Limit) = Minimum of Nose and IROL.
   a. Manual PAR SOL = 0.90 x Automatic PAR SOL.
5. Control Point = Minimum of 0.98 x SOL, 0.95 x IROL, and IROL – 100.
6. Incremental Transfer = Total transfer from Source to Sink modeled in addition to the base case initial conditions.

Table 4 shows the Control Points for the flows on Arrowhead to Stone Lake 345-kV line with the PAR in both automatic and manual mode. The measurements made on Arrowhead – Stone Lake 345-kV are made in the same manner as described in the active standing operating guide, 2015-S-004-N-MWEX_ArrowheadStonelakeR10.pdf, from the Minnesota Power Arrowhead 230-kV bus. In manual mode the taps can only be adjusted by system operators and will not respond to any other settings.

Table 4 – AHD-SLK Measurements to Determine Control Point – 2024SH

	N-0 AHD-SLK Measurements (MW)				
Case	**Nose[1]**	**Collapse[2]**	**IROL[3]**	**SOL[4]**	**Control Point[5]**
Pre-DPP Automatic PAR	761	814	N/A	761	745
Pre-DPP Manual PAR	N/A	N/A	N/A	685	671
Post-DPP Automatic PAR	756	807	N/A	756	741
Post-DPP Manual PAR	N/A	N/A	N/A	680	667

1. Nose: the N-0 flow that corresponds to the point of bifurcation, which is identified as the last transfer that results in a post-contingent, net positive change in real power flow on MWEX.
2. Collapse: the last solving post-contingent transfer step.
3. IROL (Interconnection Reliability Operating Limit) is not defined for the AHD-SLK interface.
4. SOL (System Operating Limit): Nose.
   a. Manual PAR SOL = 0.90 x Automatic PAR SOL.
5. Control Point = Minimum of 0.98 x SOL.

Figure 1 shows the pre-contingent MWEX flows and the pre-contingent Arrowhead PAR flows. The Arrowhead PAR and additional actions are then modeled in Figure 2 to establish the margin required in the ATC criteria. All Arrowhead PAR settings are subject to change based on annual assessments.

The starting point for each curve represents the base case initial conditions with an intact system.

- Pre-DPP
  - MWEX flow = 1505 MW
  - Arrowhead PAR flow = 685 MW
  - Arrowhead 230-kV voltage = 1.0147 p.u.
- Post-DPP
  - MWEX flow = 1552 MW
  - Arrowhead PAR flow = 700 MW
  - Arrowhead 230-kV voltage = 1.009 p.u.

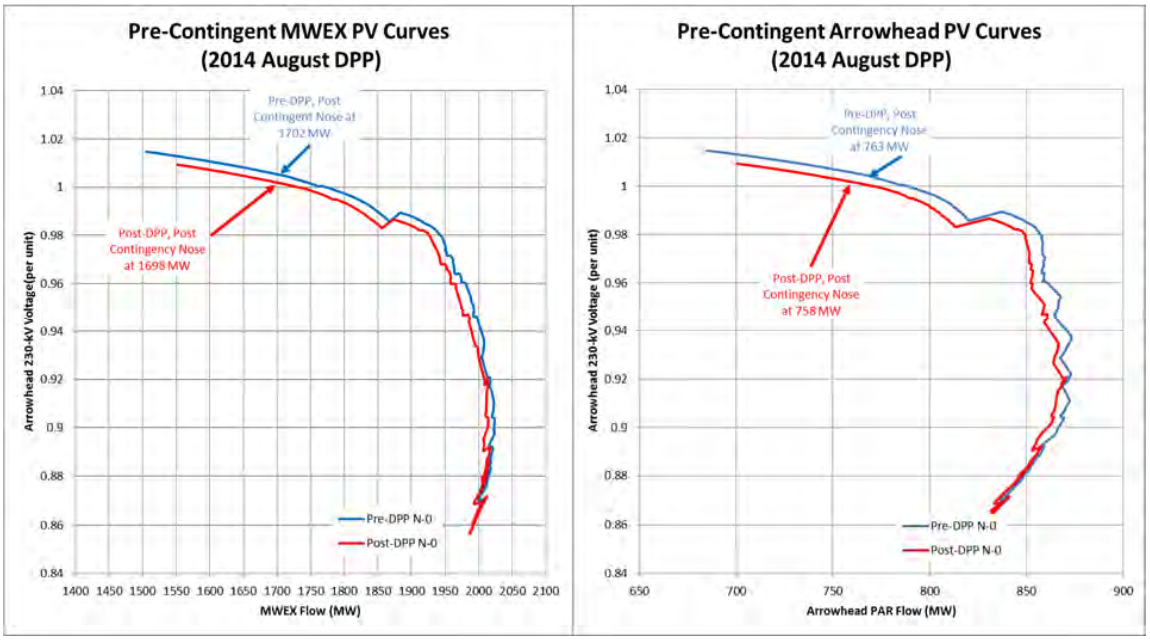


Figure 1 – MWEX and Arrowhead PAR Pre-Contingent PV Curves

The red and blue curves in Figure 2 show the MWEX flows immediately after the most severe contingency, the Monroe County Council Creek (MCCC) Special Protection System (MCCC SPS), the future Timberwolf and Hilltop overload tripping systems, and the Arrowhead 345-kV capacitors switch in. The Lublin protection scheme and Stone Lake 345-kV capacitors do not operate.

The violet and green curves in Figure 2 show the MWEX flows after the most severe contingency, remediation systems listed above operate, and the Arrowhead PAR and Stinson PAR adjustments.

The starting point for each curve represents the base case initial conditions with the worst contingency and ensuing actions as described above.

- Pre-DPP before PAR operates (blue curve)
    - MWEX flow = 783 MW (equal to Arrowhead PAR flow)
    - Arrowhead 230-kV voltage = 0.984 p.u.
- Pre-DPP after PAR operates (purple curve)
    - MWEX flow = 721 MW (equal to Arrowhead PAR flow)
    - Arrowhead 230-kV voltage = 0.997 p.u.
- Post-DPP before PAR operates (red curve)
    - MWEX flow = 816 MW (equal to Arrowhead PAR flow)
    - Arrowhead 230-kV voltage = 0.973 p.u.
- Post-DPP after PAR operates (green curve)
    - MWEX flow = 721MW (equal to Arrowhead PAR flow)
    - Arrowhead 230-kV voltage = 1.007 p.u.

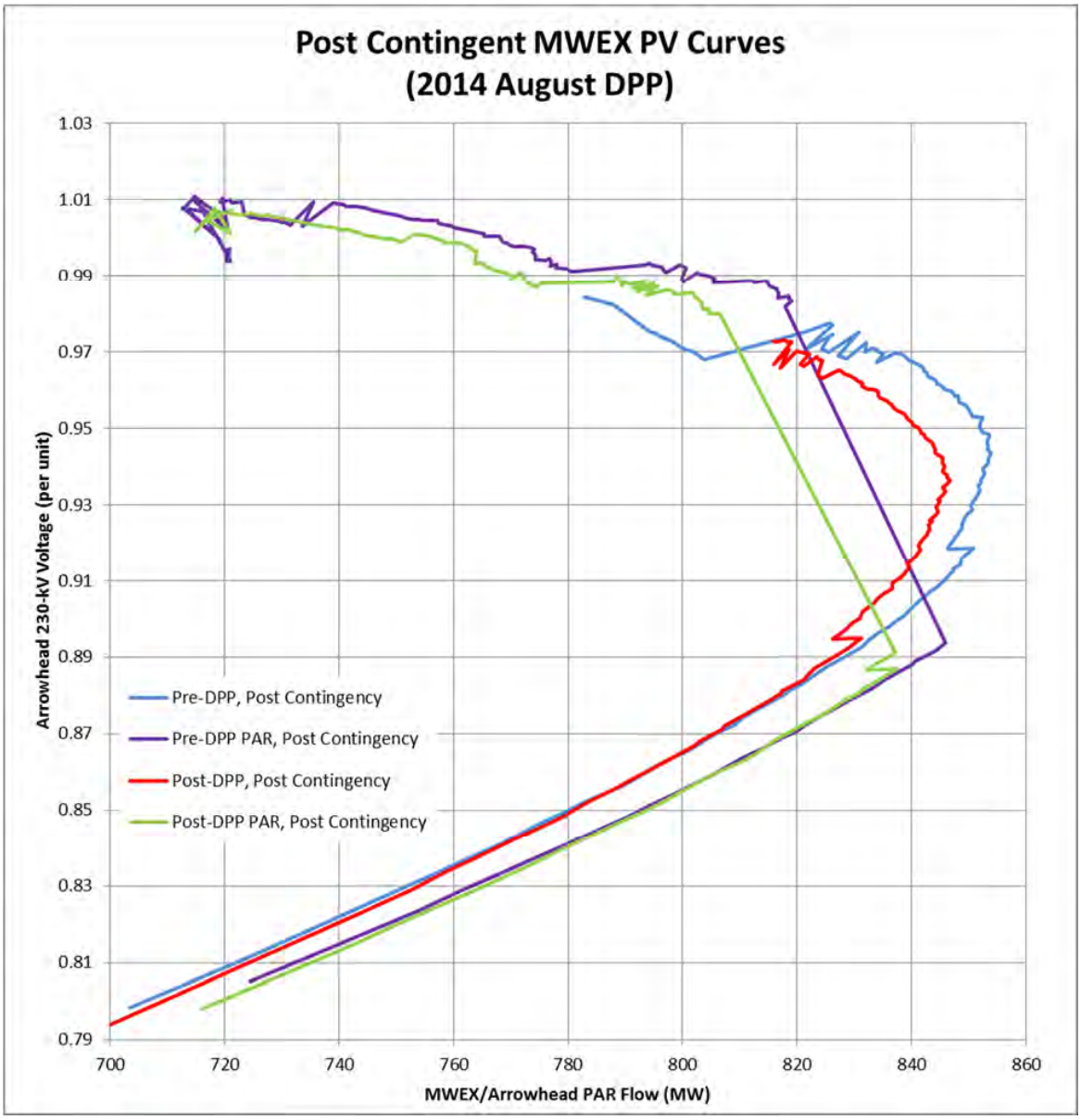


Figure 2 – MWEX Post-Contingent PV Curves

Additional Considerations

Normal and emergency voltage limits will be respected in addition to steady state voltage stability limits. For example, in Figure 2 the Post-DPP, Post Contingency (red curve) would have SOL calculated based on the flow at the most restricting limit which is the emergency minimum voltage of 0.95 per unit which occurs at a MWEX flow of approximately 840 MW.

Conclusion

The results of this analysis show that both the Pre-DPP and Post-DPP scenarios in the 2024 shoulder load cases are voltage stable. There are no violations of ATC criteria in either the Pre or Post DPP cases. No network upgrades will be assigned to the interconnection customers.

Appendix

Background

This MWEX (Minnesota-Wisconsin Export Interface) assessment analyzes generation interconnection requests in the MISO Definitive Planning Phase, or DPP. MWEX consists of the summation of flows on the 345-kV AS King – Eau Claire – Arpin line and the flow through the 230-kV Arrowhead phase shifting transformer or phase angle regulator (PAR) measured at Minnesota Power Arrowhead 230-kV bus. By performing voltage stability analysis with the most severe contingency for the interface the IROL, SOL, and Control Point operating limits are determined for the Arrowhead PAR.

Assumptions & Methodology

All analysis was performed consistent with the annual MWEX assessment to the extent possible except that only the intact system with the most severe contingency was reviewed and no transient stability simulations were performed. The operating limits (SOL, IROL, and Control Point) were determined for the Arrowhead PAR in both automatic and manual control modes as described below. The control point is used to define the flows that MISO will bind to in the day ahead and real time markets.

To be consistent with ATC Planning Criteria version 17, issued on 08/03/2015, which was the latest approved Planning Criteria when this analysis began, this study defined voltage stability violations as follows. These requirements are based on ATC Planning Criteria v17 Section 1.1.5 items 1 and 2.

1. The initial condition results in a post-contingent solution on the unstable side of the PV curve.
2. The initial condition results in a post-contingent solution on the stable side of the PV curve but the Arrowhead PAR is unable to restore the 10% margin with 14 taps.
3. The initial condition results in a post-contingent nose (i.e. point of bifurcation) occurring at a voltage greater than the minimum emergency voltage. This measurement is made before the PAR operates at the Arrowhead 230-kV bus which has a minimum emergency voltage of 0.95 p.u.

ATC Planning Criteria **v17**[1] Section 1.1.5 items 1 and 2:

> 1.1.5. Planning Horizon Steady State Voltage Stability
>
> 1) The nose of the steady state bus P-V curve should be at or below the applicable bus voltage limit as coordinated with the applicable Planning Coordinator and/or by any applicable Transmission Owner(s) (e.g., the MWEX limitation of 95 percent of nominal voltage at the Arrowhead 230 kV bus) to assure adequate system voltage stability and reactive power resources for NERC Category A, B, and C events. Different values may be appropriate for areas of the system that contain fast acting reactive power devices (e.g., FACTS devices). If additional voltage stability limitations are discovered on the ATC system, then further analysis will be conducted to determine the appropriate course of action based on the probability and impact of the situation.
>
> 2) The steady state operating point at all ATC buses should be at least 10 percent away from the nose of the bus P-V curve and above the applicable low voltage limit to assure adequate system voltage stability and reactive power resources for NERC Category A, B and C events. The pre-contingency voltage stability margin should be adequate to avoid voltage instability for the most severe applicable contingency. This 10 percent voltage stability margin is chosen to reflect uncertainties in load forecasting and modeling, as well as to provide a reasonable reliability margin. Exceptions to the 10 percent margin requirement may be

1 https://www.misoenergy.org/Library/Repository/Study/TO Planning Criteria/ATC TO Planning Criteria.pdf

> granted if there are feasible system adjustments which can reliably restore the 10 percent margin post contingent within 30 minutes.
>
> [Note that dynamic voltage stability must be assessed to determine whether voltage instability (collapse) may occur during the transition from acceptable steady state pre-contingent (Category A) voltage stability to acceptable steady state post-contingent (Category B or C) voltage stability.]

Consistent with the MISO annual operations assessment, all analysis was performed with the Voltage Security Assessment Tool (VSAT), an industry accepted software package for voltage stability analysis. Existing and planned SPS, overload tripping systems, and fast switching reactive devices were modeled to operate as designed.

The power transfer is sourced from load in Minnesota Power, Great River Energy, and Xcel Energy-Minnesota. The power transfer is partially sunk to Wisconsin and partially to areas to the south and east. The Wisconsin sink is 40% of the total sink and is defined as load in We Energies (excluding load in the Upper Peninsula of Michigan), Wisconsin Public Service, Alliant Energy East, and Madison Gas and Electric. The remaining 60% of the sink is defined as load in ComEd and AEP. Both real and reactive power are scaled in the source and sink subsystems. The incremental change of the source decreases the load in 10 MW intervals, and the change in the sink increases the load in 10 MW intervals.

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Appendix

I

Short Circuit Analysis

I.1 J285 Short Circuit Analysis Report by MEC

I.2 J289 Short Circuit Analysis Report by MEC

I.3 J316 Short Circuit Analysis Report by Siemens PTI

I.4 J329 Short Circuit Analysis Report by MEC

I.5 J343 Short Circuit Analysis Report by MEC

I.6 J344 Short Circuit Analysis Report by MEC & ITCM

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J285 Short Circuit Study Performed by MEC

The scope of this facilities study included a review of the available fault current at the proposed 345 kV interconnection substation for J285 and nearby substations both with and without the Interconnection Customer interconnected. The fault currents were used to identify if any existing circuit breakers become overdutied because of the proposed Interconnection Customer. The study reviewed single-line-to-ground (SLG) fault current levels and three phase (3PH) fault current levels. The study did not include potential facility upgrades required because of the DPP system impact studies or Optional Studies. In addition, the study did not include any contribution from the proposed HVDC interconnection and the facilities that may be required to interconnect that HVDC facility. Depending on the nature of future, required facility upgrades, an additional review may be necessary. The results of the analysis are summarized in the following table.

Table 1. Single-Line-to-Ground (SLG) and Three Phase (3PH) Fault Currents with and without J285

					SLG Fault Current Comparison			3 PH Fault Current Comparison		
Bus Number	Bus Name	English Name	Base kV	Owner	Base SLG w/o new wind farm	SLG with new wind farm	SLG Difference w/ wind farm vs Base	Base 3PH w/o new wind farm	3PH with with new wind farm	3PH Difference w/ wind farm vs Base
635368	J285 Int Sub	J285 Int Sub/Obrien County	345	MEC	8,623	10,157	1,534	10,277	11,428	1,152
	J285 Colllector	J285 Colllector	34.5	IC	N/A	28,326	N/A		25,739	N/A
635400	HIGHLND 3	Highland	345	MEC	10,698	11,234	536	10,829	11,593	764
635369	KOSSUTH 3	Kossuth Co	345	MEC	7,872	7,994	122	10,697	10,913	216
631138	LAKEFLD3	Lakefield	345	ITCM	11,583	11,787	204	12,432	12,732	301
635401	SHD415 9	Highland 34.5 kV Bus 1	34.5	MEC	17,841	17,884	42	17,812	17,893	82
635402	SHD425 9	Highland 34.5 kV Bus 2	34.5	MEC	17,841	17,884	42	17,812	17,893	82
635403	SHD435 9	Highland 34.5 kV Bus 3	34.5	MEC	17,841	17,884	42	17,812	17,893	82
635200	RAUN 3	Raun	345	MEC	27,046	27,207	161	24,375	24,586	212
636000	WEBSTER3	Webster	345	MEC	9,312	9,345	33	11,412	11,486	74
631197	LEDYARD3	Leyard (MVP) (Winnco West)	345	ITCM	7,818	7,893	75	10,634	10,799	165
601034	NOBLES 3	Nobles Co	345	XEL	Not in Short Circuit Model			Not in Short Circuit Model		
601029	LKFLDXL3	Xcel Lakefield Gen / GRE	345	XEL/GRE	17,868	17,983	115	12,599	12,749	150
631193	HUNTLEY3	Huntley (MVP) Winnebago	345	ITCM	7,387	7,443	56	9,527	9,660	133
631041	LAKEFLD5	Lakefield	161	ITCM	15,273	15,411	138	16,845	17,038	193
640226	HOSKINS3	Hoskins	345	NPPD	9,160	9,163	3	9,979	9,988	9
645451	S3451 3	Sub 3451 (Ft. Calhoun)	345	OPPD	19,749	19,753	4	21,696	21,708	12
635201	RAUN 5	Raun	161	MEC	32,307	32,365	58	26,265	26,348	83
636010	LEHIGH 3	Lehigh	345	MEC	9,211	9,230	20	11,890	11,944	54
652564	SIOUXCY3	WAPA Sioux City	345	WAPA	12,039	12,054	14	13,589	13,630	41
636001	WEBSTER5	Webster	161	MEC	16,649	16,671	22	17,378	17,422	44
631198	COLBY3	Colby (MVP) Lime Creek	345	ITCM	7,827	7,840	13	9,098	9,133	35
601006	SPLT RK3	Split Rock	345	XEL	6,156	6,157	1	6,472	6,476	4
631045	WNBAGOS5	Winnebago	161	ITCM	11,570	11,615	46	12,703	12,790	86
631042	FOX LK 5	Fox Lake	161	ITCM	6,366	6,383	17	8,376	8,419	43
631040	HRN LK 5	Heron Lake	161	ITCM	3,984	3,990	6	4,803	4,817	14

The results of the short circuit analysis showed the three phase fault current at the interconnection substation 345 kV bus to be 10,277 Amps without the Interconnection Customer included and 11,428 Amps with the Interconnection Customer included (based upon the assumed modeling information for the tie-line, generator step-up transformers, wind turbines, grounding transformers, and other collector system assumptions). In specifying equipment or completing equipment settings such as voltage control systems, the Interconnection Customer should be aware that fault currents are subject to change and may increase or decrease at the Point of Interconnection because of additions and/or retirements of the transmission system and/or area generation or system contingencies.

As shown in the table, the changes in fault current at buses around the Point of Interconnection are relatively small. Based on the Transmission Owner's short circuit criteria, no Transmission Owner short circuit constraints appear for the Interconnection Customer's project. The applicable bus results in table were shared with other potentially impacted transmission owners if the modeled change in fault current was greater than 100 Amps. A protective relay coordination review will be required if the Interconnection Customer's project proceeds, and the Interconnection Customer will need to provide relay settings to the Transmission Owner. In addition, continued communication and coordination will be required for the parties to meet NERC Standard PRC-001 and PRC-005.

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J274 and J289 Short Circuit Study Performed by MEC

The scope of this facilities study included a review of the available fault current at the proposed 161 kV interconnection substation for J274 and the later queued J289 and nearby substations both with and without the Interconnection Customer interconnected. The fault currents were used to identify if any existing circuit breakers become overdutied because of the proposed Interconnection Customer. The study reviewed single-line-to-ground (SLG) fault current levels and three phase (3PH) fault current levels. The study did not include potential facility upgrades required because of the DPP system impact studies or Optional Studies. Depending on the nature of the facility upgrades, an additional review may be necessary. The results of the analysis are summarized in the following table.

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Table 1. Single-Line-to-Ground (SLG) and Three Phase (3PH) Fault Currents with and without J274 and J289

			SLG Fault Current Comparison				3 Phase Fault Current Comparison		
Bus Name	Base kV	Owner	Base SLG w/o new wind farm	SLG with J274 & J289	Difference w/ J274 & J289 vs Base		Base 3PH w/o new wind farm	3PH with J274 & J289	Difference w/ J274 & J289 vs Base
J274_SUB	161	MEC	5,454	7,346	1,892		7,154	7,872	718
J274_Collector	34.5	IC	1,161	6,487	5,326		4,784	13,615	8,831
WNTRST 5	161	CIPCO	6,336	6,861	525		7,912	8,258	346
CRESTON5	161	WAPA	8,512	8,972	460		9,014	9,389	374
5MARYVL	161	AECI	4,596	4,608	13		6,058	6,087	29
WNTRSET8	69	CIPCO	6,380	6,459	79		6,320	6,353	33
ANITA TP5 (tap)	161	CIPCO	4,649	4,642	(7)		5,211	4,871	(340)
BROOKST5 (tap)	161	MEC	4,126	4,156	30		5,092	5,141	49
NORWLK5	161	MEC	22,933	23,034	101		21,479	21,639	160
CRESTN 8	69	WAPA	11,922	12,045	123		10,134	10,247	113
SLAKEN 8	69	CIPCO	606	606	-		1,035	1,035	-
SLAKES 8	69	CIPCO	604	604	-		1,033	1,033	-
WINCOR 8 (tap)	69	CIPCO	4,075	4,097	22		5,329	5,347	18
PATTREC8	69	CIPCO	2,998	3,008	10		4,523	4,535	11
ECRESTN8	69	ITCM	579	579	0		992	992	0
ANITA 5	161	CIPCO	4,630	4,642	13		4,845	4,871	26
CLRNDA 5	161	MEC	5,654	5,674	20		6,049	6,085	37
BROOKS 5	161	MEC	2,837	2,851	14		3,733	3,759	26
BOONVIL5	161	MEC	18,098	18,127	29		20,756	20,810	54
NORWLK3	345	MEC	13,738	13,752	15		15,061	15,104	44
GRENFLD5	161	MEC	18,414	18,449	35		20,989	21,077	88
DENISON	161	WAPA	5,723	5,726	3		5,277	5,283	6
FAIRPORT	161	SJLP	14,233	14,236	3		12,885	12,892	7

The results of the short circuit analysis showed the three phase fault current at the interconnection substation 161 kV bus to be 7,154 Amps without the Interconnection Customer included and 7,872 Amps with the Interconnection Customer included (based upon the assumed modeling information for the generator step-up transformer, wind turbines, grounding transformers, and other collector system assumptions). In specifying equipment or completing equipment settings such as voltage control systems, the Interconnection Customer should be aware that fault currents are subject to change and may increase or decrease at the interconnection point because of additions and/or retirements of the transmission system and/or area generation or system contingencies.

As shown in the table, the changes in fault current at buses around the point of interconnection are relatively small. Based on the Transmission Owner's short circuit criteria, no Transmission Owner short circuit constraints appear for the Interconnection Customer's project. The applicable bus results in the table were shared with other potentially impacted transmission owners if the modeled change in fault current was greater than 100 Amps. No short circuit constraints were identified by the transmission owners. A protective relay coordination review will be required as the Interconnection Customer's projects proceed, and the Interconnection Customer relay settings will need to be provided to the Transmission Owner. In addition, continued communication and coordination will be required for the parties to meet NERC Standard PRC-001 and PRC-005.

J316 Short Circuit Facility Study

Introduction

A short circuit analysis was performed by Siemens PTI to assess the impact of the J316 generating facility (89 GE 1.7 MW doubly fed wind farm) on the adequacy of existing circuit breakers and related equipment in the Project area.

Short Circuit Model

An ASPEN short circuit database including positive, negative and zero sequence parameters of the MDU system and its neighboring systems was provided by the MISO. This starting short circuit model is listed below:

- Short Circuit Model: "MDU Model 081715.dxt"

The J316 short circuit study model was developed as follows:

- Turned on generators which were local to the Point of Interconnection (POI) of the Project but were offline in the starting short circuit model (Table 1).
- The J316 wind generating facility with its sequence parameters was added at tap bus between Tatanka - Ellendale 230 kV line via a 230-34.5 kV station transformer (Z=9.5% at 99 MVA, X/R is 40, YG-YG), and a 34.5-0.69 kV equivalent padmount transformer (Z=5.75% at 162.8 MVA, X/R is 7.5, D-YG).
- Per ASPEN's guidelines, the J316 doubly fed wind machine (Type 3) was represented using the conventional generator model without current limits, and impedances of the machine were set as follows:
    - Zero sequence impedance (Z_0): j999 pu
    - Negative sequence impedance (Z_2): j0.2 011pu
    - Positive sequence impedances (subtransient, transient and synchronous) (Z_1): j0.2011 pu

Table 1: Local Generators Which Were Turn On

ASPEN Bus Name	ID	Starting Case Status	Benchmark Case Status	J316 Study Case Status
Bow WF singl 0.675kV	1	Offline	Online	Online
Bowdle WF G 0.675kV	1	Offline	Online	Online
COY MDU9 24.kV	1	Offline	Online	Online
EDG-WF singl 0.675kV	1	Offline	Online	Online
Ell WF singl 0.675kV	1	Offline	Online	Online
Ellen WF gen 0.675kV	1	Offline	Online	Online
HESKET 3G 0.48kV	1	Offline	Online	Online
LINTON GEN 1 13.8kV	1	Offline	Online	Online
LINTON GEN 2 13.8kV	1	Offline	Online	Online

ASPEN Bus Name	ID	Starting Case Status	Benchmark Case Status	J316 Study Case Status
LINTON GEN 3 13.8kV	1	Offline	Online	Online
PARSHAL6 69.kV	1	Offline	Online	Online
SPROLE Gen 0.48kV	1	Offline	Online	Online

Short Circuit Analysis

Short circuit analysis was performed on the study case (with the J316 project) and benchmark case (without the J316 project). The following classical assumptions for fault simulation were used in the short circuit analysis, as suggested in the ASPEN OneLiner documentation:

- The prefault voltage was set to 1.0 pu;
- Set all the current limits of the generator to zero;
- All loads, shunts and transformer magnetizing branches were ignored.

Three-phase (3PH) and Single Line to Ground (SLG) faults were simulated on buses within the Study Project area. The results of short circuit currents with J316 (study case) and without J316 (benchmark case) are listed in Table 2. With the addition of the J316 wind generating facility, the maximum increase in the 3PH short circuit current is 1211.1 amps (30.51%), and the maximum increase in the SLG short circuit current is 688.6 amps (17.86%), which are both observed at the Ellendale 230 kV substation bus.

Summary of Short Circuit Analysis

As shown in Table 2, the change in fault current at buses around the J316 POI is relatively higher. Based on the MDU's short circuit criteria, no MDU short circuit constraints appear for the Interconnection Customer's project. The applicable bus results in the table were shared with other potentially impacted transmission owners if the modeled change in fault current was greater than 100 Amps, and no short circuit constraints were identified.

Table 2: J316 Short Circuit Analysis Results

ASPEN Bus Number	ASPEN Bus Name	ASPEN Base kV	LOCATION	AREA	ZONE	Benchmark Case without the J316 Wind Project		Study Case with the J316 Wind Project		% change of Short Circuit Amps	
						3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG	1LG
1831	MAPLER2T	345	MAPLER2T	1	1	4691.4	5772.5	4717.1	5798.5	0.55%	0.45%
1812	MAPLER1T	345	MAPLER1T	1	1	4681.4	5759.1	4706.9	5785	0.54%	0.45%
1703	MAPLERV3	345	MAPLERV3	1	1	4187.5	4843.5	4207.2	4861.1	0.47%	0.36%
1704	BUFFALO3	345	BUFFALO3	1	1	3825.3	3677.4	3840.7	3686.9	0.40%	0.26%
1828	BUFFALOT	345	BUFFALOT	1	1	1155.6	1388.3	1160.1	1392.7	0.39%	0.32%
1711	GROTON 3	345	GROTON 3	1	1	4180.1	3766.8	4194.1	3774.3	0.33%	0.20%
1706	JAMESTN3	345	JAMESTN3	1	1	3601	3327.7	3609.7	3332.7	0.24%	0.15%
1702	WATERTN3	345	WATERTN3	1	1	6373.9	5782.8	6388	5790.5	0.22%	0.13%
1802	CENTER T	345	CENTER T	27	1	14329.3	17000	14358.1	17027.3	0.20%	0.16%
1859	HURON T	345	HURON T	1	1	7274.7	6448.1	7283.6	6452.7	0.12%	0.07%
1707	CENTER 3	345	CENTER 3	23	1	6877.7	6805.1	6885.5	6810.2	0.11%	0.07%
1708	LELANDO3	345	LELANDO3	21	1	14062.2	15762.6	14072.2	15771.1	0.07%	0.05%
1710	HURON 3	345	HURON 3	1	1	3928.9	3503.6	3931	3504.7	0.05%	0.03%
1700	ANTELOP3	345	ANTELOP3	21	1	13462.8	16007.5	13469.1	16013.6	0.05%	0.04%
1823	F THOM1T	345	F THOM1T	1	1	13788.6	10913.4	13794.6	10915.9	0.04%	0.02%
1841	F THOM2T	345	F THOM2T	1	1	13788.6	10913.4	13794.6	10915.9	0.04%	0.02%

ASPEN Bus Number	ASPEN Bus Name	ASPEN Base kV	LOCATION	AREA	ZONE	Benchmark Case without the J316 Wind Project		Study Case with the J316 Wind Project		% change of Short Circuit Amps	
						3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG	1LG
1716	BELFELD3	345	BELFELD3	21	1	3972.4	3812.7	3973.7	3813.5	0.03%	0.02%
1709	CHARLCR3	345	CHARLCR3	21	1	4996.4	5146.9	4998	5148	0.03%	0.02%
1701	FTTHOMP3	345	FTTHOMP3	1	1	7164.1	6713.1	7165.6	6713.9	0.02%	0.01%
1712	SIOUXCY3	345	SIOUXCY3	1	1	12744.6	11567.5	12745.7	11568.1	0.01%	0.01%
1714	SIDNEY 3	345	SIDNEY 3	1	1	5446.5	4914.5	5446.6	4914.5	0.00%	0.00%
11117	J316_SUB	230	J316_SUB	661	1636	-	-	5140.2	1.1	-	-
1505	ELLENMD4	230	ELLENMD4	7	1	3969.9	3856	5181	4544.6	30.51%	17.86%
0	Tatanka TP	230	Ellendal	7	1	4064.5	3832	5238.2	4461	28.88%	16.41%
0	MERR	230		7	1	4229.1	3906.2	5150.2	4390.5	21.78%	12.40%
0	MERRICOURT	230		7	1	4228.3	3905.5	5149	4389.6	21.77%	12.40%
0	Tatanka SB	230	Ellendal	1	1	3740.8	3981.5	4487.2	4514.7	19.95%	13.39%
1551	WISHEK 4	230	WISHEK 4	7	1	3742.9	2917.4	4114.7	3061.4	9.93%	4.94%
1506	FORMANO4	230	FORMANO4	28	1	4497.4	3976.4	4858.8	4158.9	8.04%	4.59%
1508	HANKNSN4	230	HANKNSN4	28	1	5510	4807.1	5675.8	4890.3	3.01%	1.73%
1533	WHAPETN4	230	WHAPETN4	28	1	5537.6	5177.5	5619.9	5225.2	1.49%	0.92%
1599	BROWNSV4	230	BROWNSV4	28	1	4948	4074.1	5007.1	4100.6	1.19%	0.65%
1527	HESKETT4	230	HESKETT4	2	1	12573.9	11610.2	12679.3	11670.3	0.84%	0.52%
0	MANDAN	230	Mandan	1	1	13198.1	12433	13302.6	12495	0.79%	0.50%

ASPEN Bus Number	ASPEN Bus Name	ASPEN Base kV	LOCATION	AREA	ZONE	Benchmark Case without the J316 Wind Project		Study Case with the J316 Wind Project		% change of Short Circuit Amps	
						3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG	1LG
1502	FERGSFL4	230	FERGSFL4	1	1	4613.4	4378.7	4646	4398.3	0.71%	0.45%
0	WARD4	230		31	1	12239.9	11060.5	12312.6	11100.2	0.59%	0.36%
1549	MAPLERV4	230	MAPLERV4	1	1	6908	8489.4	6945	8526.8	0.54%	0.44%
1558	SHEYNNE4	230	SHEYNNE4	1	1	6394.7	7499.7	6423.7	7526.4	0.45%	0.36%
1501	BIS WAPA W	230	BIS WAPA	31	1	12741.2	11625.1	12797.1	11656.4	0.44%	0.27%
0	BIS WAPA E	230	BIS WAPA	31	1	12714.3	11600	12769.9	11631.1	0.44%	0.27%
1534	BIGSTON4	230	BIGSTON4	1	1	8568.3	10255.5	8605.7	10291.2	0.44%	0.35%
1594	BIGSMDU4	230	BIGSMDU4	1	1	8288.2	9984.6	8323.2	10018.4	0.42%	0.34%
1578	HENNING4	230	HENNING4	1	1	4019.5	3597.4	4034.3	3605.4	0.37%	0.22%
1579	RUSH LT4	230	RUSH LT4	1	1	4029.8	3575.1	4043.6	3582.3	0.34%	0.20%
1879	SHEYNNET	230	SHEYNNET	1	1	4348.5	5212.6	4361.9	5225.5	0.31%	0.25%
1528	JAMESTN4	230	JAMESTN4	1	1	6857.3	6564.3	6876.5	6576.1	0.28%	0.18%
1524	FARGO 4	230	FARGO 4	1	1	5688.9	6691.1	5704.7	6705.7	0.28%	0.22%
1842	FERGUSFT	230	FERGUSFT	1	1	2899.7	3521.9	2907.7	3529.8	0.28%	0.22%
1580	RUSH LK4	230	RUSH LK4	1	1	3159.9	2540.9	3168.4	2544.6	0.27%	0.15%
1813	MAPLERVT	230	MAPLERVT	1	1	3687.8	4328.7	3697.2	4337.4	0.25%	0.20%
1516	WATERTN4	230	WATERTN4	1	1	10759.3	15515.8	10785.4	15552	0.24%	0.23%
1535	BLAIR 4	230	BLAIR 4	1	1	7752.6	5798	7770.6	5804.6	0.23%	0.11%

ASPEN Bus Number	ASPEN Bus Name	ASPEN Base kV	LOCATION	AREA	ZONE	Benchmark Case without the J316 Wind Project		Study Case with the J316 Wind Project		% change of Short Circuit Amps	
						3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG	1LG
1837	BIGSTONT	230	BIGSTONT	1	1	4948.3	5743.1	4959.2	5752.9	0.22%	0.17%
1542	MOORHD 4	230	MOORHD 4	1	1	4607.4	4655.2	4617.3	4662	0.21%	0.15%
1556	AUDUBON4	230	AUDUBON4	1	1	3497.1	2912	3504.1	2915.2	0.20%	0.11%
1522	CENTER 4	230	CENTER 4	23	1	16846.6	18404.5	16877.4	18429.2	0.18%	0.13%
1805	FARGO T	230	FARGO T	1	1	3947.1	4810.4	3954.2	4817.4	0.18%	0.15%
1548	WINGER 4	230	WINGER 4	1	1	4503.2	4475.4	4510.7	4480.4	0.17%	0.11%
1560	CENTERDC 1	230	CENTERDC	23	1	17776.6	20428.4	17806.2	20454.7	0.17%	0.13%
1605	CENTERDC	230	CENTERDC	23	1	15358.3	17997.3	15378	18015.5	0.13%	0.10%
1532	GRANITF4	230	GRANITF4	1	1	7456.5	7214.8	7465.9	7220.6	0.13%	0.08%
1512	MORRIS 4	230	MORRIS 4	1	1	3926.1	3441.3	3931	3443.8	0.12%	0.07%
1814	MORRIS T	230	MORRIS T	1	1	2986.8	3063	2990.3	3065.4	0.12%	0.08%
1810	HURON42T	230	HURON42T	1	1	6419.6	7230.7	6426.9	7236.9	0.11%	0.09%
1846	HURON41T	230	HURON41T	1	1	6200.3	6987.3	6207.1	6993	0.11%	0.08%
1604	PICKERT4	230	PICKERT4	1	1	3694.6	3042.9	3698.6	3044.7	0.11%	0.06%
1547	PRAIRIE4	230	PRAIRIE4	1	1	5453.6	6267.2	5459.4	6272.4	0.11%	0.08%
1509	HURON 4	230	HURON 4	1	1	9585.1	8746.1	9595.2	8751.6	0.11%	0.06%
1545	WASHBRN(LO)	230	WASHBRN4	1	1	9433.8	7379.7	9442.1	7383.2	0.09%	0.05%
1540	LELANDO4	230	LELANDO4	21	1	19398.1	21061	19414.1	21073.8	0.08%	0.06%

ASPEN Bus Number	ASPEN Bus Name	ASPEN Base kV	LOCATION	AREA	ZONE	Benchmark Case without the J316 Wind Project		Study Case with the J316 Wind Project		% change of Short Circuit Amps	
						3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG	1LG
1507	GARRISN4	230	GARRISN4	1	1	10725.9	11309.2	10734.5	11315.8	0.08%	0.06%
0	BASIN EL4	230	BASIN EL	21	1	17579.3	17935.1	17592.4	17944.5	0.07%	0.05%
1538	DICKNSN4	230	DICKNSN4	3	1	4895.3	4515.8	4898.3	4517.5	0.06%	0.04%
1517	WILLMAR4	230	WILLMAR4	1	1	3200.1	2850.2	3201.8	2851.1	0.05%	0.03%
1544	STANTON4	230	STANTON4	1	1	18713.2	17976.4	18723.1	17982.5	0.05%	0.03%
1808	GRANITFT	230	GRANITFT	1	1	4147.2	4466.7	4149.3	4468.4	0.05%	0.04%
1603	BELFELD4	230	BELFELD4	21	1	5561.9	5662.4	5564.4	5664.2	0.04%	0.03%
1577	DRAYTON4	230	DRAYTON4	1	1	4990.5	4855.1	4992.3	4856.3	0.04%	0.02%
1526	GLENHAM4	230	GLENHAM4	7	1	3216.9	3027.7	3218	3028.4	0.03%	0.02%
1514	RAMSEY 4	230	RAMSEY 4	1	1	3614	3171.9	3615.2	3172.5	0.03%	0.02%
1521	FTTHOMP4	230	FTTHOMP4	1	1	15740.2	16149.2	15745.4	16152.8	0.03%	0.02%
1503	CCRKTAP4	230	CCRKTAP4	1	1	16699	15401.5	16704.2	15404.5	0.03%	0.02%
1537	COAL CK4	230	COAL CK4	1	1	19772	22969.4	19777.8	22974.7	0.03%	0.02%
1519	BIG BEN4	230	BIG BEN4	1	1	13088.1	14182.5	13091.2	14185	0.02%	0.02%
1543	OAHE 4	230	OAHE 4	31	1	11918.5	13337.5	11920.8	13339.3	0.02%	0.01%
0	RHAME 4	230	Rhame	1	1	2963	2742.8	2963.5	2743.1	0.02%	0.01%
1836	WIILMART	230	WIILMART	1	1	1218.7	1476.4	1218.9	1476.7	0.02%	0.02%
1510	LOGAN 4	230	LOGAN 4	1	1	4465.3	4132.3	4465.9	4132.6	0.01%	0.01%

ASPEN Bus Number	ASPEN Bus Name	ASPEN Base kV	LOCATION	AREA	ZONE	Benchmark Case without the J316 Wind Project		Study Case with the J316 Wind Project		% change of Short Circuit Amps	
						3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG	1LG
0	BOWMAN	230	BOWMAN	3	1	2602.6	2470.3	2602.9	2470.6	0.01%	0.01%
1576	STORLA 4	230	STORLA 4	1	1	4420.4	3359.8	4420.9	3360	0.01%	0.01%
1591	LETELER4	230	LETELER4	1	1	6723.4	6346.6	6724.1	6347	0.01%	0.01%
1570	SIOUXFL4	230	SIOUXFL4	1	1	5353.1	5252.2	5353.6	5252.5	0.01%	0.01%
1523	DAWSON 4	230	DAWSON 4	31	1	3335.7	3699	3336	3699.3	0.01%	0.01%
1569	LAKPLAT4	230	LAKPLAT4	1	1	5205.8	3645.4	5206.2	3645.6	0.01%	0.01%
1574	SIOUXCY4	230	SIOUXCY4	1	1	15793.2	16320.3	15794.1	16321	0.01%	0.00%
1567	FTRANDL4	230	FTRANDL4	1	1	9315.5	9452.9	9316	9453.3	0.01%	0.00%
1588	CORNWLS4	230	CORNWLS4	1	1	4936	2610.5	4936.1	2610.5	0.00%	0.00%
1592	LAVEREN4	230	LAVEREN4	1	1	12428.3	10006.4	12428.5	10006.5	0.00%	0.00%
1586	DORSEY 4	230	DORSEY 4	1	1	23477.7	30053.3	23477.9	30053.5	0.00%	0.00%
0	OM COTEAU 2	230	OM COTEA	1	1	1451.6	1862.4	1451.6	1862.5	0.00%	0.01%
1152	SIOUXCY5	161	SIOUXCY5	1	1	16863.1	17871.1	16863.7	17871.5	0.00%	0.00%
1208	ELLENMD5	115	ELLENMD5	7	1	5305.3	6024.4	6068.9	6658.9	14.39%	10.53%
0	ELLENDALE 5	115	ELLENMD5	1	1	5302.2	6019.7	6064.4	6652.8	14.38%	10.52%
1210	FORMAN 5	115	FORMAN 5	28	1	6411.8	6309	6630.4	6448.6	3.41%	2.21%
0	WISHEK-5	115	WISHEK 5	7	1	2558.5	2950.3	2634.2	3017.3	2.96%	2.27%
1299	WISHEK 5	115	WISHEK 5	7	1	2559.7	2951.9	2635.4	3019	2.96%	2.27%

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						3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG	1LG
1187	HOVING 5	115	HOVING 5	1	1	4046.7	3256.3	4116.1	3286.1	1.71%	0.92%
1200	ABERDEN5	115	ABERDEN5	1	1	4948.1	4737.7	5022.8	4783	1.51%	0.96%
0	AB IND PK	115	AB IND P	1	1	3733.4	3383.1	3775.7	3406.2	1.13%	0.68%
1279	GROTON 5	115	GROTON 5	1	1	9962.9	9914.1	10011.2	9945.9	0.48%	0.32%
1188	BUFFALO5	115	BUFFALO5	1	1	3543.7	4312.4	3557.4	4326	0.39%	0.32%
1229	VALLEYC5	115	VALLEYC5	1	1	2837.3	2403.9	2848.2	2409.1	0.38%	0.22%
0	MANDAN	115	Mandan	1	1	17715	19240.5	17776.8	19289.4	0.35%	0.25%
1296	SUMMIT 5	115	SUMMIT 5	1	1	4332.8	2987.1	4347.5	2991.8	0.34%	0.16%
1213	HESKETT5	115	HESKETT5	2	1	17784.2	19812	17843.5	19861.4	0.33%	0.25%
0	HESKETT 5	115	HESKETT5	1	1	17745	19770.3	17804.1	19819.6	0.33%	0.25%
0	HESK 3 5	115	HESKETT	1	1	17419.5	19094.6	17476.1	19140.2	0.32%	0.24%
1241	FERGUSF5	115	FERGUSF5	1	1	5992.1	7304.6	6010.7	7323.1	0.31%	0.25%
1280	HOOTLK 5	115	HOOTLK 5	1	1	5872.9	7225.7	5889.4	7242.4	0.28%	0.23%
1251	MAPLERV5	115	MAPLERV5	1	1	7437.9	8933.4	7457.5	8952.4	0.26%	0.21%
1281	JAMESTN5	115	JAMESTN5	1	1	8868.1	10118	8891.4	10138.4	0.26%	0.20%
1259	REDFELD5	115	REDFELD5	1	1	3182.4	2543.9	3190.6	2547.5	0.26%	0.14%
0	BISMARK WAPA	115	BISMARK	31	1	14358.4	15346.5	14395.3	15374.8	0.26%	0.18%
1234	BIS JCT5	115	BIS JCT5	2	1	14290.4	15057.4	14326.9	15084.7	0.26%	0.18%

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						3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG	1LG
1126	SHEYNNE5	115	SHEYNNE5	1	1	6826.8	8034.1	6843.3	8049.4	0.24%	0.19%
1122	BRISTOL5	115	BRISTOL5	1	1	4072.7	2716.2	4082.5	2719.1	0.24%	0.11%
1204	CASSCTY5	115	CASSCTY5	1	1	6686.6	8133.6	6702.5	8149.3	0.24%	0.19%
1225	REDRVR 5	115	REDRVR 5	1	1	6663.1	7934.4	6678.8	7949.4	0.24%	0.19%
1202	BIGSTON5	115	BIGSTON5	1	1	9917.5	11518.9	9939.3	11538.6	0.22%	0.17%
0	Bis Jct Cap	115	Bis Jct	1	1	10819.5	11256	10840.4	11271.3	0.19%	0.14%
1189	HIWY12 5	115	HIWY12 5	1	1	8549.2	8559.4	8565.1	8570	0.19%	0.12%
1209	FARGO 5	115	FARGO 5	1	1	8074.5	9956.7	8089.5	9972	0.19%	0.15%
1260	WATERTN5	115	WATERTN5	1	1	11642.6	13876.8	11661.1	13894.2	0.16%	0.13%
1274	EDGELEY5	115	EDGELEY5	28	1	2954.2	3410.8	2958.7	3414.8	0.15%	0.12%
1290	ORTONVL5	115	ORTONVL5	1	1	6856.3	6206.2	6866	6211.5	0.14%	0.09%
1849	MAPLER6T	115	MAPLER6T	1	1	4490.1	4891.4	4496.2	4896.3	0.14%	0.10%
1231	GRANTCO5	115	GRANTCO5	1	1	4436.3	3517.7	4441.8	3520	0.12%	0.07%
1128	PEL RPD5	115	PEL RPD5	1	1	3084.7	2599.9	3088.3	2601.7	0.12%	0.07%
0	WAPAED-WF5	115		31	1	2030.7	2530.7	2032.8	2532.9	0.10%	0.09%
1236	HURON 5	115	HURON 5	1	1	11864.4	13316.5	11876.6	13326.8	0.10%	0.08%
1261	WINGER 5	115	WINGER 5	1	1	6320.2	7514.1	6326.3	7520	0.10%	0.08%
1157	FALCONR5	115	FALCONR5	1	1	9176.8	11838.2	9185.5	11847.9	0.09%	0.08%

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						3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG	1LG
1834	Grand Fork5	115	GrandF	1	1	9214.4	12005.6	9223.1	12015.6	0.09%	0.08%
1244	GRNDFKS5	115	GRNDFKS5	1	1	9215.8	12000.6	9224.5	12010.5	0.09%	0.08%
1127	FRAZEET5	115	FRAZEET5	1	1	2789.1	2625.3	2791.7	2626.8	0.09%	0.06%
1258	PRAIRIE5	115	PRAIRIE5	1	1	9169.4	11225.3	9177.8	11233.8	0.09%	0.08%
1232	AUDUBON5	115	AUDUBON5	1	1	2868.6	2838.2	2871.1	2839.8	0.09%	0.06%
1293	REDFLD 5	115	REDFLD 5	1	1	3644.8	2824.9	3647.6	2826	0.08%	0.04%
1297	ULRCHTP5	115	ULRCHTP5	1	1	2798.9	2683.2	2801	2684.6	0.08%	0.05%
1164	BRANDN 5	115	BRANDN 5	1	1	3015.7	2685.7	3017.6	2686.7	0.06%	0.04%
1169	HURONWP5	115	HURONWP5	1	1	8023.6	8257.2	8028.2	8260.5	0.06%	0.04%
1168	FERTILE5	115	FERTILE5	1	1	3902	3085.8	3904.1	3086.8	0.05%	0.03%
1139	ARLNGTN5	115	ARLNGTN5	1	1	4528.3	3399.9	4530.7	3400.8	0.05%	0.03%
1269	GRANITF5	115	GRANITF5	1	1	8024.8	8811.2	8028.9	8814.4	0.05%	0.04%
1163	ALEXAND5	115	ALEXAND5	1	1	2959.2	2636.7	2960.6	2637.5	0.05%	0.03%
1272	CRKSTON5	115	CRKSTON5	1	1	3552.9	2572.8	3554.4	2573.3	0.04%	0.02%
1237	COYOTE 5	115	COYOTE 5	2	1	9541.1	10605.9	9544.7	10608.8	0.04%	0.03%
1268	BEULAH 5	115	BEULAH 5	2	1	9051.7	7712.9	9055	7714.5	0.04%	0.02%
1270	CARIGTN5	115	CARIGTN5	1	1	2497.8	2020.4	2498.7	2020.8	0.04%	0.02%
1142	BROOKNG5	115	BROOKNG5	1	1	3792.2	3895.2	3793.5	3896.1	0.03%	0.02%

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						3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG	1LG
1166	PLUMMER5	115	PLUMMER5	1	1	3227.6	2770.3	3228.7	2770.9	0.03%	0.02%
1156	DRAYTON5	115	DRAYTON5	1	1	7397	8436.7	7399.1	8438.6	0.03%	0.02%
1201	BARLOW 5	115	BARLOW 5	1	1	2486.1	2043.8	2486.8	2044.2	0.03%	0.02%
1207	DICKNSN5	115	DICKNSN5	3	1	5188.5	5856.2	5189.9	5857.4	0.03%	0.02%
1130	BURR 5	115	BURR 5	1	1	3708.8	3155.6	3709.8	3156.1	0.03%	0.02%
0	MATH GAS	115	DCKINSON	3	1	4532.5	4441.1	4533.7	4441.9	0.03%	0.02%
1277	GARRISN5	115	GARRISN5	1	1	11308.4	12961	11311.3	12963.7	0.03%	0.02%
1235	CANBY 5	115	CANBY 5	1	1	3996.2	3828.2	3997.2	3828.8	0.03%	0.02%
1159	THRVFLS5	115	THRVFLS5	1	1	2539.5	2285.8	2540.1	2286.2	0.02%	0.02%
0	GREEN RIVER	115	GREEN RI	3	1	4259.3	3789.2	4260.3	3789.7	0.02%	0.01%
1273	DEVILSL5	115	DEVILSL5	1	1	4695.3	5347.2	4696.4	5348.2	0.02%	0.02%
1176	LAWRENC5	115	LAWRENC5	1	1	16015.2	16411.4	16018.9	16414	0.02%	0.02%
1292	RAMSEY 5	115	RAMSEY 5	1	1	4881.7	5895.9	4882.8	5897	0.02%	0.02%
0	DICKWEST5	115	Dickinsn	1	1	3967.4	3479.9	3968.2	3480.3	0.02%	0.01%
1150	WOONSKT5	115	WOONSKT5	1	1	4867.6	3681.5	4868.4	3681.8	0.02%	0.01%
1143	FLANDRU5	115	FLANDRU5	1	1	3240.6	3000.8	3241	3001	0.01%	0.01%
1154	STORLA 5	115	STORLA 5	1	1	6109.6	6018.2	6110.3	6018.6	0.01%	0.01%
1131	TORONTO5	115	TORONTO5	1	1	1770.7	1179.9	1770.9	1180	0.01%	0.01%

ASPEN Bus Number	ASPEN Bus Name	ASPEN Base kV	LOCATION	AREA	ZONE	Benchmark Case without the J316 Wind Project		Study Case with the J316 Wind Project		% change of Short Circuit Amps	
						3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG	1LG
1252	MCHENRY5	115	MCHENRY5	1	1	6395.5	6029.3	6396.1	6029.7	0.01%	0.01%
1283	LEEDS 5	115	LEEDS 5	1	1	3386.5	3112.9	3386.8	3113.1	0.01%	0.01%
1177	LINCNCO5	115	LINCNCO5	1	1	7227.6	6076.2	7228.2	6076.4	0.01%	0.00%
1148	SIOUXFL5	115	SIOUXFL5	1	1	7549.1	8679.3	7549.7	8679.8	0.01%	0.01%
1295	SNAKECK5	115	SNAKECK5	1	1	4005.4	3143	4005.7	3143.1	0.01%	0.00%
1170	MITCHEL5	115	MITCHEL5	1	1	3059.8	3071.7	3060	3071.9	0.01%	0.01%
1215	LAKOTA 5	115	LAKOTA 5	1	1	1886.1	2356.8	1886.2	2357	0.01%	0.01%
1147	MTVERN 5	115	MTVERN 5	1	1	4521.3	4261.8	4521.5	4261.9	0.00%	0.00%
1175	GRANT 5	115	GRANT 5	1	1	2996.1	2367.2	2996.2	2367.2	0.00%	0.00%
1141	BERSFRD5	115	BERSFRD5	1	1	3450.1	2967.7	3450.2	2967.7	0.00%	0.00%
1171	TRIPP 5	115	TRIPP 5	1	1	2652.9	1966.1	2652.9	1966.2	0.00%	0.01%
3606	FORMAN 6	69	FORMAN 6	28	1	2740.3	2836.6	2757.8	2849.1	0.64%	0.44%
3603	MAPLERV6	69	MAPLERV6	1	1	7842.4	8896.6	7854	8906.6	0.15%	0.11%
3605	EDGELEY6	69	EDGELEY6	28	1	2887.3	3264	2891.2	3267.3	0.14%	0.10%
0	GROTON6	69	GROTON	1	1	3715.8	4103.4	3719.8	4106.6	0.11%	0.08%
0	ORDWAY6	69	ORDWAY	1	1	2608.9	2775.4	2610.9	2776.9	0.08%	0.05%
0	GROTON 9	69	GROTON	1	1	1765.8	2204.4	1766.8	2205.3	0.06%	0.04%
3602	HESKETT6	69	HESKETT6	2	1	4078.7	4403.9	4080.5	4405.3	0.04%	0.03%

ASPEN Bus Number	ASPEN Bus Name	ASPEN Base kV	LOCATION	AREA	ZONE	Benchmark Case without the J316 Wind Project		Study Case with the J316 Wind Project		% change of Short Circuit Amps	
						3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG	1LG
0	Pickert 8	69		1	1	3924.7	4098.1	3926	4099.1	0.03%	0.02%
3618	OM COTEAU 1	69	OM COTEA	1	1	4833.8	6202.7	4834	6202.8	0.00%	0.00%
809	MEDORA 7	57.2	MEDORA 7	3	1	1700.3	1774.5	1700.3	1774.5	0.00%	0.00%
504	ELLENMD8	41.6	ELLENMD8	7	1	3255.4	3517.5	3348.6	3589.4	2.86%	2.04%
0	OAKS 8	41.6	OAKS 8	1	1	2524.9	397.7	2554.7	398.2	1.18%	0.13%
538	WISHEK 8 1	41.6	WISHEK 8	7	1	2626.9	2874.2	2649.5	2892.4	0.86%	0.63%
0	FORMAN T	41.6	FORMAN T	1	1	3682.3	0	3708	0	0.70%	0.00%
534	LINTON 8	41.6	LINTON 8	7	1	1256.9	1449.7	1263.5	1455.5	0.53%	0.40%
0	HANKSON9	41.6	HANKSON	1	1	3631.9	0.1	3644.5	0.1	0.35%	0.00%
0	BIS-CE JCT8	41.6	BIS-CE J	42	1	9723.2	10157.7	9729.4	10162.2	0.06%	0.04%
514	BIS JCT8	41.6	BIS JCT8	2	1	9725.6	10159.9	9731.7	10164.5	0.06%	0.05%
0	EDGELEY8	41.6	EDGELEY	1	1	3184	226.1	3185.9	226.1	0.06%	0.00%
0	JAMESTN8	41.6	JAMEST	1	1	3600.7	663.3	3602.5	663.3	0.05%	0.00%
506	HESKETT8	41.6	HESKETT8	2	1	4593.7	4347.6	4594.6	4348.2	0.02%	0.01%
0	MAN_COL_41.6	41.6	MANDAN	12	1	2738.2	2815.3	2738.7	2815.7	0.02%	0.01%
543	HEB.WEB8	41.6	HEB.WEB8	2	1	2567	2656.9	2567.4	2657.2	0.02%	0.01%
2919	TESOROSB8	41.6	TESOROSB	2	1	3990.3	3204.4	3990.9	3204.7	0.02%	0.01%
0	Pickert T	41.6		1	1	1698	0	1698.2	0	0.01%	0.00%

ASPEN Bus Number	ASPEN Bus Name	ASPEN Base kV	LOCATION	AREA	ZONE	Benchmark Case without the J316 Wind Project		Study Case with the J316 Wind Project		% change of Short Circuit Amps	
						3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG	1LG
503	DICKNSN8	41.6	DICKNSN8	3	1	4395.5	3748.1	4395.9	3748.3	0.01%	0.01%
0	DICKWEST8	41.6	Dickinsn	1	1	4526.8	5247.9	4527.2	5248.3	0.01%	0.01%
526	BEULAH 8	41.6	BEULAH 8	2	1	4626.9	4683.5	4627.2	4683.7	0.01%	0.00%
523	N ENGLD8	41.6	N ENGLD8	3	1	1694.7	1819.7	1694.8	1819.8	0.01%	0.01%
513	MEDORA 8	41.6	MEDORA 8	3	1	2599.2	2711.4	2599.3	2711.5	0.00%	0.00%
0	WASHBURN 8	41.6	WASHBURN	1	1	1969.1	0.1	1969.1	0.1	0.00%	0.00%
11116	J316_COLHI	34.5	J316_COL	661	1636	-	-	21014.6	7.5	-	-
0	Tatanka SB2	34.5	Ellendal	1	1	16014.9	12361.4	16594.3	12587.4	3.62%	1.83%
0	Tatanka SB1	34.5	Ellendal	1	1	16002.5	12349.7	16576.7	12573.7	3.59%	1.81%
0	Tatanka D2	34.5	Ellendal	1	1	16027.8	12336.1	16601.9	12558.9	3.58%	1.81%
0	Tatanka D	34.5	Ellendal	1	1	15892.3	12275.7	16456.9	12496.5	3.55%	1.80%
0	Tatanka D1	34.5	Ellendal	1	1	15974.4	12308.3	16541.9	12529.1	3.55%	1.79%
0	ABERDEN CY D	34.5	ABERDEN	1	1	3554.7	4615.2	3574	4636.8	0.54%	0.47%
0	SIEBRECHT D	34.5	SIEBRECH	1	1	6048.3	7815.7	6065.9	7835.2	0.29%	0.25%
0	AB IND PK D	34.5	AB IND P	1	1	2259.7	2939.2	2264.3	2944.3	0.20%	0.17%
0	WAPAED-WF9	34.5		31	1	5193.5	7231.1	5197.5	7236.3	0.08%	0.07%
0	EDGELEY WF D	34.5	EDGELEY	1	1	1882.6	2294.5	1883.5	2295.4	0.05%	0.04%
424	AVS1 9	24	AVS1 9	1	1	131020.2	93803.3	131040	93810.2	0.02%	0.01%

ASPEN Bus Number	ASPEN Bus Name	ASPEN Base kV	LOCATION	AREA	ZONE	Benchmark Case without the J316 Wind Project		Study Case with the J316 Wind Project		% change of Short Circuit Amps	
						3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG	1LG
425	AVS2 9	24	AVS2 9	1	1	131055.8	93846.1	131075.6	93853	0.02%	0.01%
417	CENTER 9	22	CENTER 9	1	1	79023.4	56010.8	79049.3	56019.5	0.03%	0.02%
427	LELAN41G	22	LELAN41G	1	1	82556.8	59411.9	82567.2	59415.6	0.01%	0.01%
431	CENTER 2	20	CENTER 2	1	1	131182	37217.8	131237.6	37220.8	0.04%	0.01%
428	LELAN32G	20	LELAN32G	1	1	129421.4	93644.1	129441.1	93651.2	0.02%	0.01%
430	STANTON9	18	STANTON9	1	1	96325.3	0.9	96329.9	0.9	0.00%	0.00%
0	Ramsey T	14.4		1	1	9567.9	0	9568.4	0	0.01%	0.00%
0	ELLENDALE T	13.8	ELLENDAL	7	1	36665.4	9.6	41228.6	9.6	12.45%	0.00%
0	ELLEN 5137	13.8	ELLEN 51	1	1	36633.5	9.6	41188.3	9.6	12.43%	0.00%
0	ELLEN 5138	13.8	ELLEN 51	1	1	36633.5	9.6	41188.3	9.6	12.43%	0.00%
0	Tatanka T2	13.8	Ellendal	1	1	19912.2	0	21010.1	0	5.51%	0.00%
0	Tatanka T1	13.8	Ellendal	1	1	19860.1	0	20945.7	0	5.47%	0.00%
0	WISHEK T	13.8	WISHEK T	7	1	3672.6	0	3689.2	0	0.45%	0.00%
0	ABERDEN Tert	13.8	ABERDEN	1	1	6571.4	0	6597.6	0	0.40%	0.00%
0	SIEBRET Tert	13.8	SIEBRET	1	1	10003.8	0	10023.6	0	0.20%	0.00%
0	AB IN P Tert	13.8	AB IN P	1	1	4161.8	0	4168	0	0.15%	0.00%
0	GROTON9	13.8	GROTON	1	1	21716.5	0	21740.7	0	0.11%	0.00%
0	SIEBRET Gen	13.8	SIEBRET	1	1	14854	4.9	14865.3	4.9	0.08%	0.00%

ASPEN Bus Number	ASPEN Bus Name	ASPEN Base kV	LOCATION	AREA	ZONE	Benchmark Case without the J316 Wind Project		Study Case with the J316 Wind Project		% change of Short Circuit Amps	
						3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG	1LG
0	MANDAN	13.8	Mandan	1	1	32280.5	0	32303	0	0.07%	0.00%
0	WAPAED-WF	13.8		31	1	11181	12078.3	11188.4	12084	0.07%	0.05%
0	WATERT 9	13.8	WATERT	1	1	40524.6	0	40548.4	0	0.06%	0.00%
0	HESKETT	13.8	HESKETT	1	1	26217.3	0	26230.6	0	0.05%	0.00%
0	WATERT9	13.8	WATERT	1	1	34065.6	0	34081.8	0	0.05%	0.00%
0	HESK 3 GEN	13.8	HESKETT	1	1	57597.2	7.2	57616.8	7.2	0.03%	0.00%
0	EDGELEY WF9	13.8	EDGELEY	1	1	3009	0	3009.9	0	0.03%	0.00%
407	HESKTWO9	13.8	HESKTWO9	2	1	51467.6	6.8	51478.1	6.8	0.02%	0.00%
0	HESK 2 GEN	13.8	HESK 2 G	1	1	51482.5	6.8	51493	6.8	0.02%	0.00%
0	Garrison G1	13.8	Garrison	1	1	58877.6	42977.2	58884.7	42980.2	0.01%	0.01%
0	Garrison G2	13.8	Garrison	1	1	58877.6	42977.2	58884.7	42980.2	0.01%	0.01%
0	Garrison G3	13.8	Garrison	1	1	58877.6	42977.2	58884.7	42980.2	0.01%	0.01%
0	HESK 1 GEN	13.8	HESK 1 G	1	1	17424.3	6.7	17426.4	6.7	0.01%	0.00%
406	HESKONE9	13.8	HESKONE9	2	1	17424.8	6.7	17426.9	6.7	0.01%	0.00%
0	DRAYTON T1	13.8	DRAYTON	1	1	22667	0	22669.3	0	0.01%	0.00%
0	HESKETT69T	13.8	HESKETT6	1	1	4477.3	0	4477.7	0	0.01%	0.00%
0	Garrison G4	13.8	Garrison	1	1	37558.1	31443.5	37560.5	31444.5	0.01%	0.00%
0	Garrison G5	13.8	Garrison	1	1	37558.1	31443.5	37560.5	31444.5	0.01%	0.00%

ASPEN Bus Number	ASPEN Bus Name	ASPEN Base kV	LOCATION	AREA	ZONE	Benchmark Case without the J316 Wind Project		Study Case with the J316 Wind Project		% change of Short Circuit Amps	
						3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG	1LG
0	DRAYTON T2	13.8	DRAYTON	1	1	13513.4	0	13514.2	0	0.01%	0.00%
0	HESK FD Fan	13.8	Heskett	1	1	12259.9	6.8	12260.5	6.8	0.00%	0.00%
0	OM COTEAU T1	13.8	OM COTEA	1	1	14777.1	0	14777.4	0	0.00%	0.00%
0	OM COTEAU T2	13.8	OM COTEA	1	1	14787	0	14787.3	0	0.00%	0.00%
0	Garrison T	13.8	Garrison	1	1	6679	0	6679.1	0	0.00%	0.00%
0	MERR T1	13.8	MERR	12	1	0	0	0	0	0.00%	0.00%
0	MERR T2	13.8	MERR	12	1	0	0	0	0	0.00%	0.00%
0	JAMEST-KU6A	13.2	JAMEST	1	1	21797.9	4716.4	21812.8	4716.8	0.07%	0.01%
0	JAMEST-KU3A	13.2	JAMEST	1	1	21853.1	4718.1	21868	4718.5	0.07%	0.01%
0	Winger T	13.2		1	1	20059.9	0	20066.8	0	0.03%	0.00%
0	Prairie T5	13.2		1	1	23307	0	23313.2	0	0.03%	0.00%
0	GR-KY1A	13.2	GROTON	1	1	5003.8	0	5005.1	0	0.03%	0.00%
0	ORDWAY9	13.2	ORDWAY	1	1	3963	0	3963.8	0	0.02%	0.00%
0	GR-KY2A	13.2	GROTON	1	1	2242.8	0	2243.1	0	0.01%	0.00%
0	Belfield T	13.2		1	1	20422.5	0	20424.7	0	0.01%	0.00%
0	DICKIN BASIN	13.2	DICKIN B	1	1	15118.7	0	15120.1	0	0.01%	0.00%
0	ELEND P D	12.5	ELEND P	17	1	452.9	460.8	453.4	461.2	0.11%	0.09%
0	Ventura D	7.2	VENTURA	7	1	503.9	2.5	504.1	2.5	0.04%	0.00%

ASPEN Bus Number	ASPEN Bus Name	ASPEN Base kV	LOCATION	AREA	ZONE	Benchmark Case without the J316 Wind Project		Study Case with the J316 Wind Project		% change of Short Circuit Amps	
						3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG Fault Short Circuit Amps	1LG Fault Short Circuit Amps	3LG	1LG
0	ED-GT	7.2	EDGELEY	1	1	446.2	0	446.2	0	0.00%	0.00%
0	JT-KX1A	7.2	JAMEST	1	1	456	0	456	0	0.00%	0.00%
0	BEUL-KRP 2	6.9	BEUL-KRP	2	1	9201.4	25	9201.6	25	0.00%	0.00%
0	BEUL-KRP 1	6.9	BEUL-KRP	2	1	9202.2	24.9	9202.4	24.9	0.00%	0.00%
0	HESK AUX 2	2.4	HESK AUX	2	1	28282.4	0.9	28283	0.9	0.00%	0.00%
0	HESK AUX 1	2.4	HESK AUX	2	1	8353.5	0.9	8353.6	0.9	0.00%	0.00%
0	Tatanka G100	0.575	Tatanka	1	1	1094777.5	686409.1	1116523.1	692048	1.99%	0.82%
0	Tatanka G75	0.575	Tatanka	1	1	953391.9	620602.4	969769.9	625188	1.72%	0.74%
0	Tatanka G25	0.575	Tatanka	1	1	471152.3	352736.5	475141	354221.5	0.85%	0.42%
0	HESK EXC1	0.3	HESK EXC	1	1	6645.9	0	6645.9	0	0.00%	0.00%

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J329 Short Circuit Study Performed by MEC

The scope of this MISO requested study includes a review of the available fault current at the proposed 69 kV interconnection substation for J329 (the existing Pella West substation) and nearby substations both with and without the Interconnection Customer interconnected. The fault currents were used to identify if any existing circuit breakers become overdutied because of the proposed Interconnection Customer. The study reviewed single-line-to-ground (SLG) fault current levels and three phase (3PH) fault current levels. The study did not include potential facility upgrades required because of the DPP system impact studies or Optional Studies. Depending on the nature of the facility upgrades, an additional review may be necessary. The results of the analysis are summarized in the following table.

Table 1. Single-Line-to-Ground (SLG) and Three Phase (3PH) Fault Currents
without Pella Diesels online
with and without J329

				SLG Fault Current Comparison				3 Phase Fault Current Comparison		
Bus Number	Bus Name	Base kV	Owner	Base SLG w/o J329	SLG with J329	SLG Difference w/ J329 vs Base		Base 3PH w/o J329	3PH with J329	3PH Difference w/ J329 vs Base
638061	PELLA W8	69	Pella	5,137	5,718	581		6,050	7,423	1,373
635841	PRY CTY8	69	MEC	4,297	4,321	24		6,716	6,804	88
638060	PELLA PLNT8	69	Pella	4,818	5,229	411		6,313	7,507	1,195
638063	PELLA SESS8	69	Pella	5,038	5,451	413		6,616	7,818	1,202
630053	NEWTON 8	69	ITCM	10,439	10,460	21		10,567	10,597	31
635671	DMOINES8	69	MEC	31,847	31,882	35		28,015	28,055	40
635871	BEACON 8	69	MEC	20,307	20,596	289		18,734	19,105	370
638062	PELLA E8	69	Pella	4,386	4,676	291		6,106	7,049	943
635870	BEACON 5	161	MEC	12,239	12,335	96		12,808	12,963	154
635853	KNOXIND8	69	MEC	2,743	2,745	2		4,430	4,437	7
635875	MAHASKA8	69	MEC	6,633	6,664	31		9,190	9,280	89
635872	OSKY 8	69	MEC	8,316	8,365	49		11,391	11,529	139
635873	M AVE 8	69	MEC	5,816	5,840	24		8,861	8,946	85
630050	POWESHK8	69	ITCM	9,973	10,063	90		9,619	9,743	124

Without the Pella diesels online, the results of the short circuit analysis showed the three phase fault current at the interconnection substation (Pella West) 69 kV bus to be 6,050 Amps without the Interconnection Customer included and 7,423 Amps with the Interconnection Customer

included (based upon the modeling information provided for the generators, generator step-up transformers, and 69 kV tie between the generation substation and Pella West). With the Pella diesels online and the Interconnection customer online, the three phase fault current increases to 8,183 Amps and the single-line-ground fault current increases to 6,006 Amps. In specifying equipment or completing equipment settings such as voltage control systems, the Interconnection Customer should be aware that fault currents are subject to change and may increase or decrease at the interconnection point because of additions and/or retirements of the transmission system and/or area generation or system contingencies.

As shown in the table, the changes in fault current at non-Pella buses around the point of interconnection are comparatively small. Based on MidAmerican's short circuit criteria, no MidAmerican short circuit constraints appear for the Interconnection Customer's project. The applicable bus results in the table were shared with other potentially impacted transmission owners if the modeled change in fault current was greater than 100 Amps. A protective relay coordination review will be required as the Interconnection Customer's project proceeds, and the Interconnection Customer relay settings will need to be provided to the City of Pella's electric utility division and MidAmerican.

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J343 Short Circuit Study Performed by MEC

The scope of this facilities study included a review of the available fault current at the proposed 161 kV interconnection substation for J343 and nearby substations both with and without the Interconnection Customer interconnected. The fault currents were used to identify if any existing circuit breakers become overdutied because of the proposed Interconnection Customer. The study reviewed single-line-to-ground (SLG) fault current levels and three phase (3PH) fault current levels. The study did not include potential facility upgrades required because of the DPP system impact studies or Optional Studies. Depending on the nature of the facility upgrades, an additional review may be necessary. The results of the analysis are summarized in the following table.

Table 1. Single-Line-to-Ground (SLG) and Three Phase (3PH) Fault Currents with and without J343

				SLG Fault Current Comparison				3PH Fault Current Comparison		
Bus Number	Bus Name	Base kV	Owner	Base SLG w/o new wind farm	SLG with new wind farm	SLG Difference w/ wind farm vs Base		Base 3PH w/o new wind farm	3PH with new wind farm	3PH Difference w/ wind farm vs Base
	J343 Int Sub	161	MEC	4,233	5,875	1,642		5,327	6,271	944
	J343 Collector	34.5	IC	N/A	18,661	NA		N/A	16,484	NA
652560	CRESTON5	161	WAPA	8,990	9,415	425		9,409	9,902	493
635034	CLRNDA 5	161	MEC	5,689	5,993	305		6,104	6,433	329
652569	CRESTON8	69	WAPA	12,052	12,170	118		10,253	10,391	138
635645	MCKSBRG 3	161	MEC	7,358	7,436	78		7,888	8,053	165
631070	ANITA 5	161	CIPCO	4,642	4,655	13		4,864	4,895	31
300097	5MARYVL	161	KCPL/AECI	4,612	4,668	56		6,093	6,213	120
635032	HASTING5	161	MEC	5,970	6,014	44		7,049	7,136	87
635035	CLARNDA8	69	MEC	9,598	9,790	192		7,700	7,870	169
631078	WNTRST 5	161	CIPCO	6,880	6,904	24		8,284	8,359	75
631072	GU CTR 5	161	ITCM	3,649	3,653	4		4,325	4,339	14
652561	DENISON5	161	WAPA	5,727	5,730	3		5,281	5,288	7
635031	BUNGE 5	161	MEC	19,237	19,256	19		23,007	23,062	55
635033	HASTING8	69	MEC	9,578	9,615	37		9,247	9,311	64
635050	SHENAND8	69	MEC	2,417	2,421	4		3,907	3,926	18
635065	REDOAK 8	69	MEC	2,423	2,428	5		3,743	3,763	20

The results of the short circuit analysis showed the three phase fault current at the interconnection substation 161 kV bus to be 5,327 Amps without the Interconnection Customer included and 6,271 Amps with the Interconnection Customer included (based upon the assumed modeling information for the generator step-up transformer, wind turbines, grounding transformers, and other collector system assumptions). In specifying equipment or completing equipment settings such as voltage control systems, the Interconnection Customer should be aware that fault currents are subject to change and may increase or decrease at the interconnection point because of additions and/or retirements of the transmission system and/or area generation or system contingencies.

As shown in the table, the changes in fault current at buses around the point of interconnection are relatively small. Based on the Transmission Owner's short circuit criteria, no Transmission Owner short circuit constraints appear for the Interconnection Customer's project. The applicable bus results in the table were shared with other potentially impacted transmission owners if the modeled change in fault current was greater than 100 Amps. No short circuit constraints were identified by the transmission owners. A protective relay coordination review will be required as the Interconnection Customer's project proceeds, and the Interconnection Customer relay settings will need to be provided to the Transmission Owner. In addition, continued communication and coordination will be required for the parties to meet NERC Standard PRC-001 and PRC-005.

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CRITICAL ENERGY INFRASTRUCTURE INFORMATION NOTICE

The materials contained in this document and attachments include Critical Energy Infrastructure Information (CEII). All materials designated as CEII must be handled and protected per the requirements in FERC CEII Policy. There may be additional requirements for CEII materials in the future.

J344 Abbreviated Short Circuit Study Performed by MEC & ITCM

The scope of this MISO requested study includes a review of the available fault current at MidAmerican substations near the J344 interconnection substation both with and without the Interconnection Customer interconnected. The fault currents were used to identify if any existing MidAmerican circuit breakers become overdutied because of the proposed Interconnection Customer. The study reviewed single-line-to-ground (SLG) fault current levels and three phase (3PH) fault current levels. The study did not include potential facility upgrades required because of the DPP system impact studies or Optional Studies. Depending on the nature of the facility upgrades, an additional review may be necessary. The results of the analysis are summarized in the following table.

Table 1. Single-Line-to-Ground (SLG) and Three Phase (3PH) Fault Currents with and without J344

				SLG Fault Current Comparison				3 Phase Fault Current Comparison		
Bus Number	Bus Name	Base kV	Owner	Base SLG w/o new wind farm	SLG with new wind farm	SLG Difference w/ wind farm vs Base		Base 3PH w/o new wind farm	3PH with new wind farm	3PH Difference w/ wind farm vs Base
635871	BEACON 8	69	MEC	20,373	20,596	223		18,770	19,105	334
635870	BEACON 5	161	MEC	12,044	12,335	290		12,587	12,963	376
635875	MAHASKA8	69	MEC	6,637	6,664	26		9,196	9,280	83
635872	OSKY 8	69	MEC	8,320	8,365	45		11,398	11,529	131
635873	M AVE 8	69	MEC	5,814	5,840	26		8,862	8,946	84
630050	POWESHK8	69	ITCM	9,798	10,063	265		9,574	9,743	169
631113	POWESHK5	161	ITCM	7,182	8,101	919		9,572	10,247	676

The results of the short circuit analysis showed the three phase fault current at the Beacon 161 kV bus to be 12,587 Amps without the Interconnection Customer included and 12,963 Amps with the Interconnection Customer included (based upon the assumed modeling information for the generator step-up transformer, wind turbines, grounding transformers, and other collector system assumptions). In specifying equipment or completing equipment settings such as voltage control systems, the Interconnection Customer should be aware that fault currents are subject to change and may increase or decrease at the interconnection point because of additions and/or retirements of the transmission system and/or area generation or system contingencies.

As shown in the table, the changes in fault current at MidAmerican buses around the point of interconnection are comparatively small. Based on MidAmerican's short circuit criteria, no MidAmerican short circuit constraints appear for the Interconnection Customer's project. The applicable bus results in the table were shared with ITC Midwest. A protective relay coordination review will be required as the Interconnection Customer's project proceeds, and the Interconnection Customer and ITC Midwest's relay settings will need to be shared with MidAmerican. In addition, continued communication and coordination will be required as necessary for the parties to meet NERC Standard PRC-001, PRC-005, and future standards.

ITCM evaluated the impacts of expected fault current from the J344 generation project based on CAPE modeling of the 169 MW wind generation. No ITCM upgrades were required to accommodate the expected fault current from project J344. A summary of the impact and breakers' ratings at ITCM's Poweshiek County substation are provided below:

- Existing Fault Current: 3PH: 8821.9 A; SLG: 6686.3 A
- Expected Fault Current w/ J344: 3PH: 9564.4 A; SLG: 8339.4 A

Poweshiek Co Breaker #	IR (kA)
1060, 1072, 872, 972	40
176, 177	40
272	20
172, 372	19

Appendix

J

2017 Cost Allocation Results

J.1 Distribution Factor (DF) and MW Contribution Results for Cost Allocation

Table J-1: Distribution Factor and MW Contribution on Constraints for Thermal NU Cost Allocation in 2017

Table J-2: Distribution Factor and MW Contribution on Constraints for Voltage Support NU Cost Allocation in 2017

Table J-1: Distribution Factor and MW Contribution on Constraints for Thermal NU Cost Allocation in 2017

Monitored Element	Contingency	Cont Type	Summary GIP With Impact	Comments	J320 27.5 55	J289 20 4	J285 250 50	J316 150 30	J329 55 55	J343 150 30	J344 169 33.8	J382 0 48.3		J320 27.5 55	J289 20 4	J285 250 50	J316 150 30	J329 55 55	J343 150 30	J344 169 33.8	J382 0 48.3
541251 MARYVLE5 161 635034 CLRNDA 5 161 1	300097 5MARYVL 161 652560 CRESTON5 161 1 CRESTON5 161 - 5MARYVL 161 1	B	J343,	2017 SH	0.00	0.00	0.00	0.00	0.00	33.08	0.00	0.00		0.01060	0.09990	0.01665	0.01146	0.01749	0.22050	0.01536	0.00000
620263 FORMN 7 115 620363 FORMAN 4 230 620163 FORMN 9 41.6 1	620327 HANKSON4 230 620363 FORMAN 4 230 1 HANKSON4 230 - FORMAN 4 230 1	B	J316, J316,	2017 SH	0.00	0.00	0.00	37.96	0.00	0.00	0.00	0.00		-0.00221	-0.00148	-0.00215	0.25307	-0.00162	-0.00142	-0.00163	0.00000
620362 OAKES 4 230 620363 FORMAN 4 230 1	B3.ELN-XF ELLENDL4 230 - ELLENDL7 115 - ELLENDL9 13.8 1	B	J316, J316,	2017 SH	0.00	0.00	0.00	83.22	0.00	0.00	0.00	0.00		-0.00737	-0.00278	-0.00421	0.55480	-0.00353	-0.00259	-0.00362	0.00000
620362 OAKES 4 230 620363 FORMAN 4 230 1	660000 ABDNJCT7 115 661027 ELLENDL7 115 1 ABDNJCT7 115 - ELLENDL7 115 1	B	J316, J316,	2017 SH	0.00	0.00	0.00	83.22	0.00	0.00	0.00	0.00		-0.00737	-0.00278	-0.00421	0.55480	-0.00353	-0.00259	-0.00362	0.00000
631110 WAPELLO5 161 631112 APANOSE5 161 1	J344-Outlet1 J344_SUB 161 - POWESHK5 161 1	B	J344-Outlet1	2017 SH	0.00	0.00	0.00	0.00	0.00	0.00	16.29	0.00		0.00831	0.01153	0.00956	0.00767	0.06046	0.00656	0.09641	0.00000
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	300097 5MARYVL 161 652560 CRESTON5 161 1 CRESTON5 161 - 5MARYVL 161 1	B	J343, J343,	2017 SH	0.00	0.00	0.00	0.00	0.00	67.24	0.00	0.00		0.00510	0.18567	0.00627	0.00402	0.01922	0.44824	0.01724	0.00000
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	635001 CBLUFFS5 161 635030 RIVRBND5 161 1 CBLUFFS5 161 - RIVRBND5 161 1	B	J343, J343,	2017 SH	0.00	0.00	0.00	0.00	0.00	54.09	0.00	0.00		0.00435	0.11617	0.00588	0.00389	0.01308	0.36057	0.01168	0.00000
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	635030 RIVRBND5 161 635031 BUNGE 5 161 1 RIVRBND5 161 - BUNGE 5 161 1	B	J343, J343,	2017 SH	0.00	0.00	0.00	0.00	0.00	54.09	0.00	0.00		0.00435	0.11617	0.00588	0.00389	0.01308	0.36057	0.01168	0.00000
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	P12:161:MEC:CBEC-River Bend-Bunge CBLUFFS5 161 - RIVRBND5 161 1 RIVRBND5 161 - BUNGE 5 161 1	B	J343, J343,	2017 SH	0.00	0.00	0.00	0.00	0.00	54.09	0.00	0.00		0.00435	0.11617	0.00588	0.00389	0.01308	0.36057	0.01168	0.00000
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	635031 BUNGE 5 161 635032 HASTING5 161 1 BUNGE 5 161 - HASTING5 161 1	B	J343, J343,	2017 SH	0.00	0.00	0.00	0.00	0.00	54.09	0.00	0.00		0.00435	0.11617	0.00588	0.00389	0.01308	0.36057	0.01168	0.00000
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	P13:069:MEC:Hastings 8T1 HASTING5 161 - HASTING8 69.0 1 HASTING5 161 - CLRNDA 5 161 1 BUNGE 5 161 - HASTING5 161 1	B	J343, J343,	2017 SH	0.00	0.00	0.00	0.00	0.00	52.51	0.00	0.00		0.00456	0.11204	0.00630	0.00418	0.01295	0.35005	0.01155	0.00000
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	B2.HK4-EL4 FORMAN 4 230 - FORMN 7 115 - FORMN 9 41.6 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 EDGE SS9 41.6 - OAKES 9 41.6 1	B	J316, J316,	2017 SH	0.00	0.00	0.00	46.21	0.00	0.00	0.00	0.00		-0.00018	-0.00342	-0.00423	0.30805	-0.00293	-0.00344	-0.00284	0.00000
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	620362 OAKES 4 230 661026 ELLENDL4 230 1 OAKES 4 230 - ELLENDL4 230 1	B	J316, J316,	2017 SH	0.00	0.00	0.00	46.24	0.00	0.00	0.00	0.00		-0.00023	-0.00340	-0.00421	0.30825	-0.00292	-0.00342	-0.00283	0.00000
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	B2F.HK4-OA4 FORMAN 4 230 - FORMN 7 115 - FORMN 9 41.6 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1	B	J316, J316,	2017 SH	0.00	0.00	0.00	44.98	0.00	0.00	0.00	0.00		-0.00007	-0.00349	-0.00430	0.29987	-0.00297	-0.00351	-0.00287	0.00000
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	620362 OAKES 4 230 620363 FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1	B	J316, J316,	2017 SH	0.00	0.00	0.00	45.01	0.00	0.00	0.00	0.00		-0.00013	-0.00347	-0.00428	0.30009	-0.00296	-0.00349	-0.00287	0.00000

Table J-1: Distribution Factor and MW Contribution on Constraints for Thermal NU Cost Allocation in 2017

Monitored Element	Contingency	Cont Type	Summary GIP With Impact	Comments	J320 27.5 55	J289 20 4	J285 250 50	J316 150 30	J329 55 55	J343 150 30	J344 169 33.8	J382 0 48.3		J320 27.5 55	J289 20 4	J285 250 50	J316 150 30	J329 55 55	J343 150 30	J344 169 33.8	J382 0 48.3
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	B2.HK4-EL4 FORMAN 4 230 - FORMN 7 115 - FORMN 9 41.6 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 EDGE SS9 41.6 - OAKES 9 41.6 1	B	J316, J316,	2017 SH	0.00	0.00	0.00	46.21	0.00	0.00	0.00	0.00		-0.00018	-0.00342	-0.00423	0.30805	-0.00293	-0.00344	-0.00284	0.00000
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	620362 OAKES 4 230 661026 ELLENDL4 230 1 OAKES 4 230 - ELLENDL4 230 1	B	J316, J316,	2017 SH	0.00	0.00	0.00	46.24	0.00	0.00	0.00	0.00		-0.00023	-0.00340	-0.00421	0.30825	-0.00292	-0.00342	-0.00283	0.00000
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	B2F.HK4-OA4 FORMAN 4 230 - FORMN 7 115 - FORMN 9 41.6 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1	B	J316, J316,	2017 SH	0.00	0.00	0.00	44.98	0.00	0.00	0.00	0.00		-0.00007	-0.00349	-0.00430	0.29987	-0.00297	-0.00351	-0.00287	0.00000
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	620362 OAKES 4 230 620363 FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1	B	J316, J316,	2017 SH	0.00	0.00	0.00	45.01	0.00	0.00	0.00	0.00		-0.00013	-0.00347	-0.00428	0.30009	-0.00296	-0.00349	-0.00287	0.00000
11128 J344_SUB 161 635870 BEACON 5 161 1	ITCM-C501-TR OTTUMWA5 161 - OTTUMWA3 345 1 REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0	C	J344, J344, J344-Outlet-2	2017 SH	0.00	0.00	0.00	0.00	0.00	0.00	73.25	0.00		0.01197	0.00534	0.01462	0.01189	-0.13903	0.00213	0.43342	0.00000
541251 MARYVLE5 161 635034 CLRNDA 5 161 1	ITCM-C304-SW CRESTON5 161 - 5MARYVL 161 1 MCKSBRG 3 161 - CRESTON5 161 1 CRESTON5 161 - CRESTON8 69.0 - CRESTON29 13.8 1	C	J343, J343,	2017 SH	0.00	0.00	0.00	0.00	0.00	42.03	0.00	0.00		0.01069	0.01901	0.01693	0.01197	0.01432	0.28023	0.01284	0.00000
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	P23:161:MEC:Bunge 803 RIVRBND5 161 - BUNGE 5 161 1 CBLUFFS5 161 - RIVRBND5 161 1 BUNGE 5 161 - HASTING5 161 1	C	J343, J343,	2017 SH	0.00	0.00	0.00	0.00	0.00	54.09	0.00	0.00		0.00435	0.11617	0.00588	0.00389	0.01308	0.36057	0.01168	0.00000
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	P23:161:MEC:Bunge 802 BUNGE 5 161 - HASTING5 161 1 RIVRBND5 161 - BUNGE 5 161 1	C	J343, J343,	2017 SH	0.00	0.00	0.00	0.00	0.00	54.09	0.00	0.00		0.00435	0.11617	0.00588	0.00389	0.01308	0.36057	0.01168	0.00000
640386 TWIN CH4 230 652565 SIOUXCY4 230 1	P23:345:MEC:RAUN 0270 RAUN 3 345 - S3451 3 345 1 RAUN 3 345 - HOSKINS3 345 1	B	J285,	2017 SH MAPP SAF	0.00	0.00	12.80	0.00	0.00	0.00	0.00	0.00		0.02406	-0.00307	0.05118	0.02210	0.00005	-0.00999	0.00024	0.00000
640386 TWIN CH4 230 652565 SIOUXCY4 230 1	635200 RAUN 3 345 640226 HOSKINS3 345 1 RAUN 3 345 - HOSKINS3 345 1	B	J285,	2017 SH MAPP SAF	0.00	0.00	8.11	0.00	0.00	0.00	0.00	0.00		0.01633	0.00162	0.03243	0.01389	0.00175	-0.00279	0.00169	0.00000
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	C2.HA4-2525F WAHPETN4 230 - WAHPET2Y 230 1 HANKSON4 230 - WAHPETN4 230 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 EDGE SS9 41.6 - OAKES 9 41.6 1	C	J316, J316,	2017 SH MAPP SAF	0.00	0.00	0.00	46.24	0.00	0.00	0.00	0.00		-0.00002	-0.00352	-0.00438	0.30826	-0.00299	-0.00354	-0.00289	0.00000
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	C2.HA4-2515F BROWNSV4 230 - HANKSON4 230 1 BROWNSV9 41.6 - BROWNSV4 230 1 BIGSTON4 230 - BROWNSV4 230 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 EDGE SS9 41.6 - OAKES 9 41.6 1	C	J316, J316,	2017 SH MAPP SAF	0.00	0.00	0.00	46.24	0.00	0.00	0.00	0.00		-0.00002	-0.00352	-0.00438	0.30826	-0.00299	-0.00354	-0.00289	0.00000

Table J-1: Distribution Factor and MW Contribution on Constraints for Thermal NU Cost Allocation in 2017

Monitored Element	Contingency	Cont Type	Summary GIP With Impact	Comments	J320 27.5 55	J289 20 4	J285 250 50	J316 150 30	J329 55 55	J343 150 30	J344 169 33.8	J382 0 48.3	J320 27.5 55	J289 20 4	J285 250 50	J316 150 30	J329 55 55	J343 150 30	J344 169 33.8	J382 0 48.3
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	C2.ELN4-5135 ELLENDL4 230 - MERRCRT4 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 FORMAN 4 230 - FORMN 7 115 - FORMN 9 41.6 1 HANKSON4 230 - FORMAN 4 230 1	C	J316, J316,	2017 SH MAPP SAF	0.00	0.00	0.00	47.28	0.00	0.00	0.00	0.00	-0.00018	-0.00335	-0.00413	0.31522	-0.00286	-0.00336	-0.00277	0.00000
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	C2F.HA4-2525F WAHPETN9 41.6 - WAHPET2Y 230 1 WAHPETN7 115 - WAHPET2Y 230 1 WAHPETN4 230 - WAHPET2Y 230 1 HANKSON4 230 - WAHPETN4 230 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1	C	J316, J316,	2017 SH MAPP SAF	0.00	0.00	0.00	45.02	0.00	0.00	0.00	0.00	0.00010	-0.00359	-0.00445	0.30011	-0.00303	-0.00362	-0.00293	0.00000
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	C2F.HA4-2515F BROWNSV4 230 - HANKSON4 230 1 BROWNSV9 41.6 - BROWNSV4 230 1 BIGSTON4 230 - BROWNSV4 230 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1	C	J316, J316,	2017 SH MAPP SAF	0.00	0.00	0.00	45.02	0.00	0.00	0.00	0.00	0.00010	-0.00359	-0.00445	0.30011	-0.00303	-0.00362	-0.00293	0.00000
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	C2.ELN4-5150 ELLENDL4 230 - J316_SUB 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 FORMAN 4 230 - FORMN 7 115 - FORMN 9 41.6 1 HANKSON4 230 - FORMAN 4 230 1	C	J316, J316,	2017 SH MAPP SAF	0.00	0.00	0.00	42.04	0.00	0.00	0.00	0.00	-0.00016	-0.00330	-0.00407	0.28025	-0.00282	-0.00331	-0.00273	0.00000
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	C2.HA4-2525F WAHPETN4 230 - WAHPET2Y 230 1 HANKSON4 230 - WAHPETN4 230 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 EDGE SS9 41.6 - OAKES 9 41.6 1	C	J316, J316,	2017 SH MAPP SAF	0.00	0.00	0.00	46.24	0.00	0.00	0.00	0.00	-0.00002	-0.00352	-0.00438	0.30826	-0.00299	-0.00354	-0.00289	0.00000
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	C2.HA4-2515F BROWNSV4 230 - HANKSON4 230 1 BROWNSV9 41.6 - BROWNSV4 230 1 BIGSTON4 230 - BROWNSV4 230 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 EDGE SS9 41.6 - OAKES 9 41.6 1	C	J316, J316,	2017 SH MAPP SAF	0.00	0.00	0.00	46.24	0.00	0.00	0.00	0.00	-0.00002	-0.00352	-0.00438	0.30826	-0.00299	-0.00354	-0.00289	0.00000
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	C2.ELN4-5135 ELLENDL4 230 - MERRCRT4 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 FORMAN 4 230 - FORMN 7 115 - FORMN 9 41.6 1 HANKSON4 230 - FORMAN 4 230 1	C	J316, J316,	2017 SH MAPP SAF	0.00	0.00	0.00	47.28	0.00	0.00	0.00	0.00	-0.00018	-0.00335	-0.00413	0.31522	-0.00286	-0.00336	-0.00277	0.00000
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	C2F.HA4-2525F WAHPETN9 41.6 - WAHPET2Y 230 1 WAHPETN7 115 - WAHPET2Y 230 1 WAHPETN4 230 - WAHPET2Y 230 1 HANKSON4 230 - WAHPETN4 230 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1	C	J316, J316,	2017 SH MAPP SAF	0.00	0.00	0.00	45.02	0.00	0.00	0.00	0.00	0.00010	-0.00359	-0.00445	0.30011	-0.00303	-0.00362	-0.00293	0.00000

Table J-1: Distribution Factor and MW Contribution on Constraints for Thermal NU Cost Allocation in 2017

Monitored Element	Contingency	Cont Type	Summary GIP With Impact	Comments	J320	J289	J285	J316	J329	J343	J344	J382		J320	J289	J285	J316	J329	J343	J344	J382
					27.5	20	250	150	55	150	169	0		27.5	20	250	150	55	150	169	0
					55	4	50	30	55	30	33.8	48.3		55	4	50	30	55	30	33.8	48.3
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	C2F.HA4-2515F BROWNSV4 230 - HANKSON4 230 1 BROWNSV9 41.6 - BROWNSV4 230 1 BIGSTON4 230 - BROWNSV4 230 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1	C	J316, J316,	2017 SH MAPP SAF	0.00	0.00	0.00	45.02	0.00	0.00	0.00	0.00		0.00010	-0.00359	-0.00445	0.30011	-0.00303	-0.00362	-0.00293	0.00000
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	C2.ELN4-5150 ELLENDL4 230 - J316_SUB 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 FORMAN 4 230 - FORMN 7 115 - FORMN 9 41.6 1 HANKSON4 230 - FORMAN 4 230 1	C	J316, J316,	2017 SH MAPP SAF	0.00	0.00	0.00	42.04	0.00	0.00	0.00	0.00		-0.00016	-0.00330	-0.00407	0.28025	-0.00282	-0.00331	-0.00273	0.00000
CORDO;B - NELSO;B 345kV	345-L0404___-R		J285, J344	PJM			23.50				25.15										
QUAD 3-11 - H471 345 kV	345-L15503_B-R		J285, J344	PJM			23.51				25.11										
H471 - Nelson 345 kV	345-L15503_B-R		J285, J344	PJM			23.51				25.11										
J274 POI-Creston 161 kV			J289	SNU		9.48									0.47416						
Jasper-Newton 161 kV			J344	SNU							22.49									0.13310	

Table J-2: Distribution Factor and MW Contribution on Constraints for Voltage Support NU Cost Allocation in 2017

Monitored Element	Location	Contingency	Type	Mitigation	Comments	J320	J289	J285	J316	J329	J343	J344		J320	J289	J285	J316	J329	J343	J344
						27.5	20	250	150	55	150	169		27.5	20	250	150	55	150	169
						55	4	50	30	55	30	33.8		55	4	50	30	55	30	33.8
None																				

J.2 Cost Allocation Details

Table J-3: Network Upgrades Cost Allocation in 2017

Table J-3: Network Upgrades Cost Allocation in 2017

Monitored Element	English Name	Cost	J285	J289	J316	J320	J329	J343	J344	J382
11128 J344_SUB 161 635870 BEACON 5 161 1	J344 Sub-Beacon 161 kV	$25,000	$0	$0	$0	$0	$0	$0	$25,000	$0
541251 MARYVLE5 161 635034 CLRNDA 5 161 1	Maryville-Clarinda 161 kV	$225,000	$0	$0	$0	$0	$0	$225,000	$0	$0
620263 FORMN 7 115 620363 FORMAN 4 230 620163 FORMN 9 41.6 1	Forman 230-115-41.6 kV xfmr	$2,000,000	$0	$0	$2,000,000	$0	$0	$0	$0	$0
620362 OAKES 4 230 620363 FORMAN 4 230 1	Oakes-Forman 230 kV	$20,000	$0	$0	$20,000	$0	$0	$0	$0	$0
631110 WAPELLO5 161 631112 APANOSE5 161 1	Wapello-Apanoose 161 kV	$720,000	$0	$0	$0	$0	$0	$0	$720,000	$0
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	Clarinda-Brooks 161 kV	$225,000	$0	$0	$0	$0	$0	$225,000	$0	$0
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	Aberdeen Jct- Aberdeen Siebrecht 115 kV	$0	$0	$0	$0	$0	$0	$0	$0	$0
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	Aberdeen Jct-Ellendale 115 kV	$4,970,000	$0	$0	$4,970,000	$0	$0	$0	$0	$0
640386 TWIN CH4 230 652565 SIOUXCY4 230 1	Twin Church-Sioux City 230 kV	$0	$0	$0	$0	$0	$0	$0	$0	$0
CORDO;B - NELSO;B 345kV	Cordova-Nelson 345 kV	$0	$0	$0	$0	$0	$0	$0	$0	$0
QUAD 3-11 - H471 345 kV	QUAD 3-11 - H471 345 kV	$0	$0	$0	$0	$0	$0	$0	$0	$0
H471 - Nelson 345 kV	H471 - Nelson 345 kV	$0	$0	$0	$0	$0	$0	$0	$0	$0
J274 POI-Creston 161 kV	J274 POI-Creston 161 kV	$175,000	$0	$32,953	$0	$0	$0	$0	$0	$0
Jasper-Newton 161 kV	Jasper-Newton 161 kV	$50,000	$0	$0	$0	$0	$0	$0	$8,771	$0
Total Cost Per Project for Actual NRIS Elections for each Project		**$8,226,724**	**$0**	**$32,953**	**$6,990,000**	**$0**	**$0**	**$450,000**	**$753,771**	**$0**

Appendix
K

2024 Cost Allocation Results

K.1 Distribution Factor (DF) and MW Contribution Results for Cost Allocation in 2024

Table K-1: Distribution Factor and MW Contribution on Constraints for Thermal NU Cost Allocation in 2024

Table K-2: Distribution Factor and MW Contribution on Constraints for Voltage Support NU Cost Allocation in 2024

Table K-1: Distribution Factor and MW Contribution on Constraints for Thermal NU Cost Allocation in 2024

Monitored Element	Contingency	Cont Type	Summary GIP With Impact	Comments	J320	J289	J285	J316	J329	J343	J344	J382		J320	J289	J285	J316	J329	J343	J344	J382
					27.5	20	250	150	55	150	169	0		27.5	20	250	150	55	150	169	0
					55	4	50	30	55	30	33.8	48.3		55	4	50	30	55	30	33.8	48.3
11117 J316_SUB 230 661098 ELLENDLMVP4 230 1	B2.ELM-MRC4 MERRCRT4 230 - ELLENDLMVP4 230 1	B	J316, J316, J316-Outlet-2	2024 SH	0.00	0.00	0.00	111.18	0.00	0.00	0.00	0.00		-0.00623	-0.00552	-0.00826	0.74119	-0.00575	-0.00531	-0.00574	0.00000
11128 J344_SUB 161 635870 BEACON 5 161 1	OTTUMW1G REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0	B	J344, J344, J344-Outlet-2	2024 SH	0.00	0.00	0.00	0.00	0.00	0.00	89.67	0.00		0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	0.00000
541251 MARYVLE5 161 635034 CLRNDA 5 161 1	300097 5MARYVL 161 652560 CRESTON5 161 1 CRESTON5 161 - 5MARYVL 161 1	B	J343,	2024 SH	0.00	0.00	0.00	0.00	0.00	32.84	0.00	0.00		0.01012	0.09798	0.01479	0.01124	0.01459	0.21895	0.01233	0.00000
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	635001 CBLUFFS5 161 635030 RIVRBND5 161 1 CBLUFFS5 161 - RIVRBND5 161 1	B	J343, J343,	2024 SH	0.00	0.00	0.00	0.00	0.00	53.95	0.00	0.00		0.00422	0.11504	0.00512	0.00383	0.01085	0.35967	0.00928	0.00000
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	300097 5MARYVL 161 652560 CRESTON5 161 1 CRESTON5 161 - 5MARYVL 161 1	B	J343, J343,	2024 SH	0.00	0.00	0.00	0.00	0.00	67.03	0.00	0.00		0.00500	0.18395	0.00539	0.00397	0.01589	0.44686	0.01364	0.00000
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	635030 RIVRBND5 161 635031 BUNGE 5 161 1 RIVRBND5 161 - BUNGE 5 161 1	B	J343, J343,	2024 SH	0.00	0.00	0.00	0.00	0.00	53.95	0.00	0.00		0.00422	0.11504	0.00512	0.00383	0.01085	0.35967	0.00928	0.00000
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	P12:161:MEC:CBEC-River Bend-Bunge CBLUFFS5 161 - RIVRBND5 161 1 RIVRBND5 161 - BUNGE 5 161 1	B	J343, J343,	2024 SH	0.00	0.00	0.00	0.00	0.00	53.95	0.00	0.00		0.00422	0.11504	0.00512	0.00383	0.01085	0.35967	0.00928	0.00000
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	635031 BUNGE 5 161 635032 HASTING5 161 1 BUNGE 5 161 - HASTING5 161 1	B	J343, J343,	2024 SH	0.00	0.00	0.00	0.00	0.00	53.95	0.00	0.00		0.00422	0.11504	0.00512	0.00383	0.01085	0.35967	0.00928	0.00000
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	P13:069:MEC:Hastings 8T1 HASTING5 161 - HASTING8 69.0 1 HASTING5 161 - CLRNDA 5 161 1 BUNGE 5 161 - HASTING5 161 1	B	J343, J343,	2024 SH	0.00	0.00	0.00	0.00	0.00	52.37	0.00	0.00		0.00442	0.11091	0.00550	0.00412	0.01074	0.34915	0.00918	0.00000
11128 J344_SUB 161 635870 BEACON 5 161 1	ITCM-C501-TR OTTUMWA5 161 - OTTUMWA3 345 1 REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0	C	J344, J344, J344-Outlet-2	2024 SH	0.00	0.00	0.00	0.00	0.00	0.00	73.91	0.00		0.01053	0.00356	0.01272	0.01076	-0.13630	0.00127	0.43733	0.00000
11128 J344_SUB 161 635870 BEACON 5 161 1	GENS: OTTUMW1G + BURLIN1G REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0 REMOVE UNIT 1 FROM BUS BURLIN1G 20.0	C	J344, J344, J344-Outlet-2	2024 SH	0.00	0.00	0.00	0.00	0.00	0.00	89.67	0.00		0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	0.00000
11128 J344_SUB 161 635870 BEACON 5 161 1	ITCM-C703-GE MNTZUMA3 345 - HILLS 3 345 1 REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0	C	J344, J344, J344-Outlet-2	2024 SH	0.00	0.00	0.00	0.00	0.00	0.00	88.36	0.00		0.01003	0.00160	0.00953	0.00881	-0.06567	-0.00032	0.52282	0.00000
11128 J344_SUB 161 635870 BEACON 5 161 1	GENS: OTTUMW1G + BVRCH52G REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0 REMOVE UNIT 2 FROM BUS BVRCH52G 20.0	C	J344, J344, J344-Outlet-2	2024 SH	0.00	0.00	0.00	0.00	0.00	0.00	89.67	0.00		0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	0.00000
11128 J344_SUB 161 635870 BEACON 5 161 1	GENS: OTTUMW1G + EMERYST1 REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0 REMOVE UNIT 1 FROM BUS EMERYST1 18.0	C	J344, J344, J344-Outlet-2	2024 SH	0.00	0.00	0.00	0.00	0.00	0.00	89.67	0.00		0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	0.00000
11128 J344_SUB 161 635870 BEACON 5 161 1	GENS: OTTUMW1G + G172_G1 REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0 REMOVE UNIT 1 FROM BUS G172_G1 34.5	C	J344, J344, J344-Outlet-2	2024 SH	0.00	0.00	0.00	0.00	0.00	0.00	89.67	0.00		0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	0.00000
11128 J344_SUB 161 635870 BEACON 5 161 1	GENS: OTTUMW1G + G735_WF5 REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0 REMOVE UNIT 1 FROM BUS G735_WF5 34.5	C	J344, J344, J344-Outlet-2	2024 SH	0.00	0.00	0.00	0.00	0.00	0.00	89.67	0.00		0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	0.00000
11128 J344_SUB 161 635870 BEACON 5 161 1	GENS: OTTUMW1G + LANS5 4G REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0 REMOVE UNIT 4 FROM BUS LANS5 4G 22.0	C	J344, J344, J344-Outlet-2	2024 SH	0.00	0.00	0.00	0.00	0.00	0.00	89.67	0.00		0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	0.00000
11128 J344_SUB 161 635870 BEACON 5 161 1	GENS: OTTUMW1G + ECLIPSEW REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0 REMOVE UNIT W FROM BUS ECLIPSEW 0.69	C	J344, J344, J344-Outlet-2	2024 SH	0.00	0.00	0.00	0.00	0.00	0.00	89.67	0.00		0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	0.00000

Table K-1: Distribution Factor and MW Contribution on Constraints for Thermal NU Cost Allocation in 2024

Monitored Element	Contingency	Cont Type	Summary GIP With Impact	Comments	J320 27.5 55	J289 20 4	J285 250 50	J316 150 30	J329 55 55	J343 150 30	J344 169 33.8	J382 0 48.3		J320 27.5 55	J289 20 4	J285 250 50	J316 150 30	J329 55 55	J343 150 30	J344 169 33.8	J382 0 48.3
11128 J344_SUB 161 635870 BEACON 5 161 1	ITCM-C602-GE REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0 REMOVE UNIT 4 FROM BUS LANS5 4G 22.0	C	J344, J344, J344-Outlet-2	2024 SH	0.00	0.00	0.00	0.00	0.00	0.00	89.67	0.00		0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	0.00000
11128 J344_SUB 161 635870 BEACON 5 161 1	GENS: LOUIS31G + OTTUMW1G REMOVE UNIT 1 FROM BUS LOUIS31G 24.0 REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0	C	J344, J344, J344-Outlet-2	2024 SH	0.00	0.00	0.00	0.00	0.00	0.00	89.67	0.00		0.01022	0.01004	0.01291	0.01068	-0.05720	0.00693	0.53062	0.00000
541251 MARYVLE5 161 635034 CLRNDA 5 161 1	ITCM-C304-SW CRESTON5 161 - 5MARYVL 161 1 MCKSBRG 3 161 - CRESTON5 161 1 CRESTON5 161 - CRESTON8 69.0 - CRESTON29 13.8 1	C	J343, J343,	2024 SH	0.00	0.00	0.00	0.00	0.00	41.86	0.00	0.00		0.01022	0.01708	0.01518	0.01183	0.01185	0.27906	0.01027	0.00000
630388 WINCOR 8 69.0 630389 WINMUNI8 69.0 1	CIPC-102 MCKSBRG 3 161 - CRESTON5 161 1 WNTRST 5 161 - NORWLK5 161 1	C	J289, J289,	2024 SH	0.00	11.17	0.00	0.00	0.00	0.00	0.00	0.00		-0.00036	0.55872	-0.00126	-0.00086	0.00681	0.00237	0.00432	0.00000
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	P23:161:MEC:Bunge 802 BUNGE 5 161 - HASTING5 161 1 RIVRBND5 161 - BUNGE 5 161 1	C	J343, J343,	2024 SH	0.00	0.00	0.00	0.00	0.00	53.95	0.00	0.00		0.00422	0.11504	0.00512	0.00383	0.01085	0.35967	0.00928	0.00000
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	P23:161:MEC:Bunge 803 RIVRBND5 161 - BUNGE 5 161 1 CBLUFFS5 161 - RIVRBND5 161 1 BUNGE 5 161 - HASTING5 161 1	C	J343, J343,	2024 SH	0.00	0.00	0.00	0.00	0.00	53.95	0.00	0.00		0.00422	0.11504	0.00512	0.00383	0.01085	0.35967	0.00928	0.00000
640386 TWIN CH4 230 652565 SIOUXCY4 230 1	635200 RAUN 3 345 640226 HOSKINS3 345 1 RAUN 3 345 - HOSKINS3 345 1	B	J285,	2024 SH MAPP SAF	0.00	0.00	7.66	0.00	0.00	0.00	0.00	0.00		0.01577	0.00169	0.03064	0.01592	0.00172	-0.00260	0.00163	0.00000
640386 TWIN CH4 230 652565 SIOUXCY4 230 1	P23:345:MEC:RAUN 0270 RAUN 3 345 - S3451 3 345 1 RAUN 3 345 - HOSKINS3 345 1	C	J285,	2024 SH MAPP SAF	0.00	0.00	12.00	0.00	0.00	0.00	0.00	0.00		0.02334	-0.00280	0.04798	0.02474	0.00030	-0.00952	0.00046	0.00000
J274 POI-Creston 161 kV			J289	SNU		9.48									0.47416						
Jasper-Newton 161 kV			J344	SNU							22.49									0.13310	
661053 MANDAN 4 230 652296 WARD 4 230 1	Base Case	A	J316	2024 NRIS				14.87									0.09910				
661053 MANDAN 4 230 652296 WARD 4 230 1	661025 COLLINS7 115 661043 HESKETT7 115 1	B	J316	2024 NRIS				15.45									0.10300				
661053 MANDAN 4 230 652296 WARD 4 230 1	661025 COLLINS7 115 661115 TRNPIKE7 115 1	B	J316	2024 NRIS				15.45									0.10300				
661053 MANDAN 4 230 652296 WARD 4 230 1	657791 CENTER 3 345 657951 CNTSHNT3 345 Z1	B	J316	2024 NRIS				15.60									0.10400				
661053 MANDAN 4 230 652296 WARD 4 230 1	657946 PRAIRIE3 345 657951 CNTSHNT3 345 1	B	J316	2024 NRIS				15.60									0.10400				
661053 MANDAN 4 230 652296 WARD 4 230 1	601067 BISON 3 345 620358 BUFFALO3 345 1	B	J316	2024 NRIS				15.72									0.10480				
661053 MANDAN 4 230 652296 WARD 4 230 1	620369 JAMESTN3 345 657791 CENTER 3 345 1	B	J316	2024 NRIS				15.93									0.10620				
661053 MANDAN 4 230 652296 WARD 4 230 1	B2F.BI3-JM3	B	J316	2024 NRIS				16.08									0.10720				
661053 MANDAN 4 230 652296 WARD 4 230 1	620358 BUFFALO3 345 620369 JAMESTN3 345 1	B	J316	2024 NRIS				16.10									0.10730				
661053 MANDAN 4 230 652296 WARD 4 230 1	615901 GRE-STANTON4 230 657756 SQBUTTE4 230 1	B	J316	2024 NRIS				16.19									0.10790				
661053 MANDAN 4 230 652296 WARD 4 230 1	652468 RICHARDTON4 230 661053 MANDAN 4 230 1	B	J316	2024 NRIS				16.73									0.11150				
11117 J316_SUB 230 661098 ELLENDLMVP4 230 1	B2.ELM-MRC4 MERRCRT4 230 - ELLENDLMVP4 230 1	B	J316	2024 NRIS				111.80									0.74530				
661043 HESKETT7 115 661054 MANDAN 7 115 1	B2.MDN-HES4	B	J316	2024 NRIS				20.99									0.13990				
661093 MERRCRT4 230 661098 ELLENDLMVP4 230 1	B2.ELM-TTK4	B	J316	2024 NRIS				98.40									0.65600				

Table K-2: Distribution Factor and MW Contribution on Constraints for Voltage Support NU Cost Allocation in 2024

Monitored Element	Location	Contingency	Type	Mitigation	Comments	J320	J289	J285	J316	J329	J343	J344	J382	J320	J289	J285	J316	J329	J343	J344	J382
						27.5	20	250	150	55	150	169	0	27.5	20	250	150	55	150	169	0
						55	4	50	30	55	30	33.8	48.3	55	4	50	30	55	30	33.8	48.3
None																					

K.2 Cost Allocation Details

Table K-3: Network Upgrades Cost Allocation in 2024

Table K-3: Network Upgrades Cost Allocation in 2024

Monitored Element	English Name	Cost	J285	J289	J316	J320	J329	J343	J344	J382
11117 J316_SUB 230 661098 ELLENDLMVP4 230 1	J316 Sub-Ellendale 230 kV	$12,000,000	$0	$0	$12,000,000	$0	$0	$0	$0	$0
11128 J344_SUB 161 635870 BEACON 5 161 1	J344 Sub-Beacon 161 kV	$325,000	$0	$0	$0	$0	$0	$0	$325,000	$0
541251 MARYVLE5 161 635034 CLRNDA 5 161 1	Maryville-Clarinda 161 kV	$225,000	$0	$0	$0	$0	$0	$225,000	$0	$0
630388 WINCOR 8 69.0 630389 WINMUNI8 69.0 1	Wincor-Wincor Muncipal 69 kV	$300,000	$0	$300,000	$0	$0	$0	$0	$0	$0
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	Clarinda-Brooks 161 kV	$70,000	$0	$0	$0	$0	$0	$70,000	$0	$0
640386 TWIN CH4 230 652565 SIOUXCY4 230 1	Twin Church-Sioux City 230 kV	$0	$0	$0	$0	$0	$0	$0	$0	$0
J274 POI-Creston 161 kV	J274 POI-Creston 161 kV	$175,000	$0	$32,953	$0	$0	$0	$0	$0	$0
Jasper-Newton 161 kV	Jasper-Newton 161 kV	$50,000	$0	$0	$0	$0	$0	$0	$8,771	$0
661053 MANDAN 4 230 652296 WARD 4 230 1	Mandan–Ward 230 kV	$7,000,000	$0	$0	$7,000,000	$0	$0	$0	$0	$0
661043 HESKETT7 115 661054 MANDAN 7 115 1	Heskett–Mandan 115 kV	$125,000	$0	$0	$125,000	$0	$0	$0	$0	$0
661093 MERRCRT4 230 661098 ELLENDLMVP4 230 1	Merricourt–Ellendale 230 kV	$15,000,000	$0	$0	$15,000,000	$0	$0	$0	$0	$0
Total Cost Per Project for Actual NRIS Elections for each Project		**$35,086,724**	**$0**	**$332,953**	**$34,125,000**	**$0**	**$0**	**$295,000**	**$333,771**	**$0**

Appendix L

Results for 2017 Scenario

L.1 Results Summary for 2017 Scenario

L.1.1 Total Network Upgrades for all Projects in 2017 Scenario

The total cost of network upgrades in the interconnection plan required for each generation project is listed in Table L-1 for 2017 scenario.

Table L-1: Total Cost of Network Upgrades for Generation Projects in 2017 Scenario

Project Num	ERIS Network Upgrades ($)			Actual NRIS Network Upgrades ($)	Interconnection Facilities ($)		Shared Network Upgrade	Total Cost ($)
	Steady-State & Voltage Stability	Transient Stability	Short-circuit	Deliverability	TO Network Upgrades	TO - Owned Direct assigned		
J285	$0	$0	$0	$0	$1,422,000	$1,422,000	$0	$2,844,000
J289	$0	$0	$0	$0	$3,145,000	$160,000	$32,953	$3,337,953
J316	$6,990,000	$0	$0	$0	$5,151,300	$775,500	$0	$12,916,800
J320	$0	$0	$0	$0	$0	$0	$0	$0
J329	$0	$0	$0	$0	$874,450	$180,000	$0	$1,054,450
J343	$450,000	$0	$0	$0	$2,320,000	$220,000	$0	$2,990,000
J344	$745,000	$0	$0	$0	$4,768,036	$469,504	$8,771	$5,991,311
J382	$0	$0	$0	$0	$0	$0	$0	$0
Total ($)	**$8,185,000**	**$0**	**$0**	**$0**	**$17,680,786**	**$3,227,004**	**$41,724**	**$29,134,514**

L.1.2 Per Project Summary for 2017 Scenario

This Section provides estimated cost of Network Upgrades on a per project basis for the 2017 scenario. The shared cost of Network Upgrades for all generation projects are listed below:

J285 Summary

Network Upgrade	Cost	J285
Not Required	$0	$0
Total Cost Per Project for Actual NRIS Elections for each Project		**$0**

J289 Summary

Network Upgrade	Total Cost	J289
J274 POI-Creston 161 kV	$175,000	$32,953
Total Cost Per Project for Actual NRIS Elections for each Project		**$32,953**

J316 Summary

Network Upgrade	Total Cost	J316
620263 FORMN 7 115 620363 FORMAN 4 230 620163 FORMN 9 41.6 1	$2,000,000	$2,000,000
620362 OAKES 4 230 620363 FORMAN 4 230 1	$20,000	$20,000
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	$4,970,000	$4,970,000
Total Cost Per Project for Actual NRIS Elections for each Project		**$6,990,000**

J320 Summary

Network Upgrade	Total Cost	J320
Not Required	$0	$0
Total Cost Per Project for Actual NRIS Elections for each Project		**$0**

J329 Summary

Network Upgrade	Cost	J329
Not Required	$0	$0
Total Cost Per Project for Actual NRIS Elections for each Project		**$0**

J343 Summary

Network Upgrade	Cost	J343
541251 MARYVLE5 161 635034 CLRNDA 5 161 1	$225,000	$225,000
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	$225,000	$225,000
Total Cost Per Project for Actual NRIS Elections for each Project		**$450,000**

J344 Summary

Network Upgrade	Cost	J344
11128 J344_SUB 161 635870 BEACON 5 161 1	$25,000	$25,000
631110 WAPELLO5 161 631112 APANOSE5 161 1	$720,000	$720,000
Jasper-Newton 161 kV	$50,000	$8,771
Total Cost Per Project for Actual NRIS Elections for each Project		**$753,771**

J382 Summary

Network Upgrade	Cost	J382
Not Required	$0	$0
Total Cost Per Project for Actual NRIS Elections for each Project		**$0**

L.1.3 Cost Allocation for 2017 Scenario

Assuming all generating facilities in the DPP 2014 February West Area group advance, the cost allocation of each NU identified in the study is listed in Appendix J.2. A summary of the costs for total NUs (NUs for ERIS, NRIS, and Interconnection Facilities) allocated to each generating facility is listed in Table L-2 for 2017 scenario.

Table L-2: Summary of Total NU Costs Allocated to Each Generation Project for 2017 Scenario

Project	Max Output (MW)	Total Cost of NU per Project ($)	$/MW	Share %
J285	250	$2,844,000	$11,376	9.76%
J289	20	$3,337,953	$166,898	11.46%
J316	150	$12,916,800	$86,112	44.34%
J320	55	$0	$0	0.00%
J329	55	$1,054,450	$19,172	3.62%
J343	150	$2,990,000	$19,933	10.26%
J344	169	$5,991,311	$35,452	20.56%

Project	Max Output (MW)	Total Cost of NU per Project ($)	$/MW	Share %
J382	48.3	$0	$0	0.00%
Total/Average	**897.3**	**$29,134,514**	**$42,368**	**100.00%**

L.2 Reactive Power Requirement Analysis for 2017 Scenario

Appendix C.1 lists reactive power requirement analysis results in the 2017 summer peak scenario. The results are summarized as following:

- Low voltage violations were observed in the area of J343. Project J343 is required to have ±0.95 power factor to meet FERC Order 661-A.
- No specific reactive power range is required for wind generation projects J285, J289, J316, or J344 to meet FERC Order 661-A.

L.3 Steady-State Analysis for 2017 Scenario

The incremental impact of the proposed interconnection on individual facilities was evaluated by comparing flows and voltages between benchmark cases (without DPP West Area projects) and study cases (with DPP West Area projects). Analysis was performed in the 2017 summer shoulder (SH) and summer peak (SPK) scenarios using PSS®MUST and PSS®E.

L.3.1 2017 Summer Shoulder Contingency Analysis Results

System Intact Conditions

No thermal or voltage constraints were identified for NERC category A (system intact) conditions (Table D-1, Table D-2).

Category B Contingencies

The results in this Section are for analysis of conditions following NERC Category B contingencies. All category B contingencies were converged.

For category B contingencies in the 2017 summer shoulder scenario, thermal constraints are listed in Table D-3. No voltage constraints were identified (Table D-4).

Category C Contingencies

The results in this Section are for analysis of conditions following NERC category C contingencies. MEC, ITCM, CIPCO, and MPW require mitigation of any thermal and voltage constraints on their transmission systems under category C contingencies.

Four category C contingencies (Table D-7) were not converged. They were not converged in the benchmark or study cases. No mitigation plan is required for the study projects for these contingencies.

For category C contingencies in the 2017 summer shoulder scenario, thermal constraints are listed in Table D-5. No voltage constraints were identified (Table D-6).

Worst Thermal Violations

Table L-3 lists worst thermal violations in the 2017 summer shoulder scenario.

L.3.2 2017 Summer Peak Contingency Analysis Results

No thermal or voltage constraints were identified for NERC category A (system intact) conditions (Table D-9, Table D-10).

All category B contingencies were converged. For category B contingencies, no thermal or voltage constraints were identified (Table D-11, Table D-12).

Five category C contingencies (Table D-15) were not converged. They were not converged in the benchmark or study cases. No mitigation plan is required for the study projects. For all converged category C contingencies, in the MEC, ITCM, CIPCO, and MPW systems, no thermal or voltage constraints were identified (Table D-13, Table D-14).

Table L-3: 2017 Shoulder Thermal Constraints, Maximum Screened Loading

Constraint	Rating	Owner	Worst Loading		Contingency	Cont Type	Generator
			(MVA)	(%)			
11128 J344_SUB 161 635870 BEACON 5 161 1	261.0	MEC ITCM	355.7	136.3	ITCM-C501-TR OTTUMWA5 161 - OTTUMWA3 345 1 REMOVE UNIT 1 FROM BUS OTTUMW1G 24.0	C	J344
541251 MARYVLE5 161 635034 CLRNDA 5 161 1	168.0	MEC GMO	197.3	117.4	300097 5MARYVL 161 652560 CRESTON5 161 1 CRESTON5 161 - 5MARYVL 161 1	B	J343
541251 MARYVLE5 161 635034 CLRNDA 5 161 1	168.0	MEC GMO	188.5	112.2	ITCM-C304-SW CRESTON5 161 - 5MARYVL 161 1 MCKSBRG 3 161 - CRESTON5 161 1 CRESTON5 161 - CRESTON8 69.0 - CRESTON29 13.8 1	C	J343
620263 FORMN 7 115 620363 FORMAN 4 230 620163 FORMN 9 41.6 1	140.0	OTP	143.9	102.8	620327 HANKSON4 230 620363 FORMAN 4 230 1 HANKSON4 230 - FORMAN 4 230 1	B	J316
620362 OAKES 4 230 620363 FORMAN 4 230 1	305.0	OTP	313.7	102.8	B3.ELN-XF ELLENDL4 230 - ELLENDL7 115 - ELLENDL9 13.8 1	B	J316
631110 WAPELLO5 161 631112 APANOSE5 161 1	171.0	ITCM	185.3	108.3	J344-Outlet1 J344_SUB 161 - POWESHK5 161 1	B	J344
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	167.9	109.0	300097 5MARYVL 161 652560 CRESTON5 161 1 CRESTON5 161 - 5MARYVL 161 1	B	J343
635034 CLRNDA 5 161 635037 BROOKS 5 161 1	154.0	MEC	160.2	104.1	P23:161:MEC:Bunge 803 RIVRBND5 161 - BUNGE 5 161 1 CBLUFFS5 161 - RIVRBND5 161 1 BUNGE 5 161 - HASTING5 161 1	C	J343

Constraint	Rating	Owner	Worst Loading		Contingency	Cont Type	Generator
			(MVA)	(%)			
660000 ABDNJCT7 115 660001 ABDNSBT7 115 1	128.0	NWPS	140.1	109.5	B2.HK4-EL4 FORMAN 4 230 - FORMN 7 115 - FORMN 9 41.6 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 EDGE SS9 41.6 - OAKES 9 41.6 1	B	J316
660000 ABDNJCT7 115 661027 ELLENDL7 115 1	128.0	NWPS MDU	171.5	134.0	B2.HK4-EL4 FORMAN 4 230 - FORMN 7 115 - FORMN 9 41.6 1 HANKSON4 230 - FORMAN 4 230 1 OAKES 4 230 - FORMAN 4 230 1 OAKES 4 230 - ELLENDL4 230 1 OAKES 9 41.6 - OAKES 4 230 1 OAKES 9 41.6 - OAKES 4 230 2 EDGE SS9 41.6 - OAKES 9 41.6 1	B	J316

L.3.3 Network Upgrades Identified in MISO ERIS Analysis for 2017 Scenario

Based on the MISO steady state analysis, the highest loading of each facility that violates criteria in 2017 scenario (SH, SPK) is summarized in Table L-4. Potential thermal network upgrades are also included.

Costs of the network upgrades identified in the MISO steady state analysis for 2017 scenario are listed in Table L-5.

Table L-4: Network Upgrades for Thermal Constraints in 2017 Scenario, Maximum Screened Loading

Generator	Constraint	Rating	Owner	Worst Loading		Cont Type	Constraint Type	Scenario	Mitigation
				(MVA)	(%)				
J344	J344 Sub-Beacon 161 kV	261.0	MEC ITCM	355.7	136.3	C	DF>Cutoff, MW>20%*Rating, Outlet_Mon	2017 SH	MEC - Beacon terminal requires replacement of line drops to achieve an acceptable Ring Closed rating: $25k; ITCM - Not loss of a single element: Mitigation not required.
J343	Maryville-Clarinda 161 kV	168.0	MEC GMO	197.3	117.4	B	DF>Cutoff, MW>20%*Rating, Outlet Con	2017 SH	MidAmerican's section is clearance and terminal limited. Structure replacements and terminal equipment replacements with an estimated cost of $225k would provide a rating of 199 MVA for MidAmerican's section.
J343	Maryville-Clarinda 161 kV	168.0	MEC GMO	188.5	112.2	C	DF>Cutoff, MW>20%*Rating	2017 SH	MidAmerican's section is clearance and terminal limited. Structure replacements and terminal equipment replacements with an estimated cost of $225k would provide a rating of 199 MVA for MidAmerican's section.
J316	Forman 230-115-41.6 kV xfmr	140.0	OTP	143.9	102.8	B	DF>Cutoff, MW>20%*Rating	2017 SH	Requires additional transformer capacity. Replace existing 230/115/41.6 kV transformer with a larger unit.
J316	Oakes-Forman 230 kV	305.0	OTP	313.7	102.8	B	DF>Cutoff, MW>20%*Rating	2017 SH	Line is clearance limited (sag rate 305 MVA). Will be required to do a phase raiser on one structure to allow adequated clearance. Fixing this one structure will allow the line to be rated at 330 MVA.
J344	Wapello-Apanoose 161 kV	171.0	ITCM	185.3	108.3	B	Outlet Con	2017 SH	Sag mitigation required - planning level estimate is $720k
J343	Clarinda-Brooks 161 kV	154.0	MEC	167.9	109.0	B	DF>Cutoff, MW>20%*Rating	2017 SH	MidAmerican's rating is clearance and terminal limited. Structure replacements and terminal equipment replacements with an estimated cost of $225k would provide a rating of 185 MVA.
J343	Clarinda-Brooks 161 kV	154.0	MEC	160.2	104.1	C	DF>Cutoff, MW>20%*Rating	2017 SH	MidAmerican's rating is clearance and terminal limited. Structure replacements and terminal equipment replacements with an estimated cost of $225k would provide a rating of 185 MVA.

Generator	Constraint	Rating	Owner	Worst Loading		Cont Type	Constraint Type	Scenario	Mitigation
				(MVA)	(%)				
J316	Aberdeen Jct-Aberdeen Siebrecht 115 kV	128.0	NWPS	140.1	109.5	B	DF>Cutoff, MW>20%*Rating	2017 SH	Reconductor the 45 miles of 115 kV from Ellendale – Aberdeen Jct. – Aberdeen Siebrecht with “Hawk” equivalent 477 ACSS, HS285, high temp. conductor, for a cost of approximately $4.9 million.
J316	Aberdeen Jct-Ellendale 115 kV	128.0	NWPS MDU	171.5	134.0	B	DF>Cutoff, MW>20%*Rating	2017 SH	MDU - Upgrade Ellendale Terminal (wave trap, bus & CT): $70k; NWPS - Reconductor the 45 miles of 115 kV from Ellendale – Aberdeen Jct. – Aberdeen Siebrecht with “Hawk” equivalent 477 ACSS, HS285, high temp. conductor, for a cost of approximately $4.9 million.

Table L-5: Network Upgrades and Cost Identified in MISO Steady State Analysis for 2017 Scenario

Constraint	Owner	Mitigation	Cost ($)
J344 Sub-Beacon 161 kV	MEC ITCM	MEC - Beacon terminal requires replacement of line drops to achieve an acceptable Ring Closed rating: $25k; ITCM - Not loss of a single element: Mitigation not required	$25,000
Maryville-Clarinda 161 kV	MEC GMO	MidAmerican's section is clearance and terminal limited. Structure replacements and terminal equipment replacements with an estimated cost of $225k would provide a rating of 199 MVA for MidAmerican's section.	$225,000
Forman 230-115-41.6 kV xfmr	OTP	Requires additional transformer capacity. Replace existing 230/115/41.6 kV transformer with a larger unit.	$2,000,000
Oakes-Forman 230 kV	OTP	Line is clearance limited (sag rate 305 MVA). Will be required to do a phase raiser on one structure to allow adequated clearance. Fixing this one structure will allow the line to be rated at 330 MVA.	$20,000
Wapello-Apanoose 161 kV	ITCM	Sag mitigation required - planning level estimate is $720k	$720,000
Clarinda-Brooks 161 kV	MEC	MidAmerican's rating is clearance and terminal limited. Structure replacements and terminal equipment replacements with an estimated cost of $225k would provide a rating of 185 MVA.	$225,000
Aberdeen Jct-Aberdeen Siebrecht 115 kV	NWPS	Reconductor the 45 miles of 115 kV from Ellendale – Aberdeen Jct. – Aberdeen Siebrecht with “Hawk” equivalent 477 ACSS, HS285, high temp. conductor, for a cost of approximately $4.9 million.	Included in Aberdeen Jct-Ellendale 115 kV
Aberdeen Jct-Ellendale 115 kV	NWPS MDU	MDU - Upgrade Ellendale Terminal (wave trap, bus & CT): $70k; NWPS - Reconductor the 45 miles of 115 kV from Ellendale – Aberdeen Jct. – Aberdeen Siebrecht with “Hawk” equivalent 477 ACSS, HS285, high temp. conductor, for a cost of approximately $4.9 million.	$4,970,000

L.4 Affected System Steady-State Analysis in 2017 Scenario

L.4.1 SAF Analysis for MAPP Companies

For 2017 summer peak and summer shoulder scenarios, the Significantly Affected Facilities (SAF) in the affected MAPP systems are listed in Appendix F.1. Whether these SAF will be mitigated or not will be determined by the affected transmission owning company’s local planning criteria.

For 2017 summer shoulder scenario, the MAPP SAF with their highest loadings and potential network upgrades are listed in Table L-6. No MAPP SAF constraints were identified for 2017 summer peak scenario.