MITSUBISHI ELECTRIC POWER PRODUCTS, INC.
POWER SYSTEMS ENGINEERING DIVISION
530 KEYSTONE DRIVE
WARRENDALE, PA 15086, U.S.A.

Phone: (724) 778-5111 Fax: (724) 778-5149
Home Page: www.meppi.com

Midcontinent Independent System Operator (MISO)

Affected System Impact Restudy SPP DISIS-2016-001-1

Technical Report

REP-0379
Revision #08

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Submitted By:
Mitsubishi Electric Power Products, Inc. (MEPPI)
Power Systems Engineering Division
Warrendale, PA

Title: **Affected System Impact Restudy SPP DISIS-2016-001-1: Technical Report REP-0379**
Date: February 2019
Author: Nicholas W. Tenza; Senior Engineer, Power Systems Engineering Division *Nicholas W. Tenza*
Approved: Donald J. Shoup; General Manager, Power Systems Engineering Division *Donald J. Shoup*

EXECUTIVE SUMMARY

The Midcontinent Independent System Operator ("MISO") requested an Affected System Impact Study ("SIS") Restudy for the Southwest Power Pool ("SPP") Definitive Interconnection System Impact Study ("DISIS"). This report documents the impacts of thirteen (13) projects in the SPP generator queue on the MISO transmission system. The SPP study projects are listed in Table ES-1.

Table ES-1
Interconnection Projects Evaluated

Queue #	Capacity	Service	Fuel Type	Area	Proposed Point of Interconnection
GEN-2015-089	200	ER	Wind	WAPA	Utica 230 kV Substation
GEN-2016-004	201.6	ER/NR	Wind	WAPA	Leland Olds 230 kV
GEN-2016-007	100.05	ER	Wind	WAPA	Valley City 115 kV
GEN-2016-017	250.7	ER	Wind	WAPA	Tap Fort Thompson - Leland Olds 345 kV
GEN-2016-021	300	ER	Wind	NPPD	Hoskins 345 kV
GEN-2016-023	150.53	ER	Wind	WAPA	Tap Laramie River - Sidney 345 kV
GEN-2016-029	150.53	ER	Wind	WAPA	Tap Laramie River - Sidney 345 kV
GEN-2016-043	230	ER	Wind	NPPD	Hoskins 345 kV
GEN-2016-050	250.7	ER	Wind	NPPD	Tap Axtell - Post Rock 345 kV
GEN-2016-052	3.3 (increase)	ER	Wind	WAPA	Hilken 230 kV
GEN-2016-053	3.3 (increase)	ER	Wind	WAPA	Hilken 230 kV
GEN-2016-054	3.4 (increase)	ER	Wind	WAPA	Wessington Springs 230 kV
GEN-2016-075	50	ER	Wind	WAPA	Grand Prairie 345 kV

This study was performed using an MTEP 2017 series model case with study snapshot of year 2022. With the MISO MTEP 2017 base reliability transmission projects included in the case, the

study results indicate that SPP GEN-2016-004 and SPP GEN-2016-017 are conditional on projects Briggs Road to N Madison 345 kV transmission line and Briggs Road (North LaCrosse) substation being in service. At the time of the study the expected in service date of these projects is 12/31/2018. These base line reliability projects are part of N LaCrosse-N Madison-Cardinal-Hickory Creek 345 kV MISO MVP project.

Tables ES-2 and ES-3 lists the thermal overloads and voltage violations, respectively, identified in this study. There were no voltage constraints or thermal constraints that required mitigation as a result of this study.

Table ES-2
Thermal Constraints Identified

MISO Area Transmission Elements				
Monitored Facility	**From Bus Owner**	**To Bus Owner**	**Rate B (MVA)**	**Notes**
635200 RAUN 3 345 645451 S3451 3 345 1	MEC	OPPD	956	No mitigation required MEC end of line is rated for 1152 MVA. Thermal overload observed on OPPD end

Table ES-3
Voltage Constraints Identified

Bus Voltages Outside of Threshold				
Bus Number	**Bus Name**	**Base kV**	**Bus Owner**	**Notes**
617036	GRE-MAYHEW 8	69	GRE	No mitigation required
617044	GRE-PIP 2 8	69	GRE	No mitigation required
617053	GRE-MINDEN 8	69	GRE	No mitigation required

No transient stability constraints were identified for the addition of the thirteen SPP projects in the 2022 Summer Shoulder scenarios. The Study case showed similar performance as the respective Benchmark case and did not affect the transient stability of the system.

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SECTION 1: BACKGROUND AND OBJECTIVE

The objective of this report is to provide MISO with the deliverables for the "Affected System Impact Re-Study SPP DISIS-2016-001-1." MISO requested an Affected System Impact Study for thirteen (13) generation interconnections for 2022 Summer Shoulder conditions and 2022 Summer Peak conditions, which requires a steady-state analysis and stability analysis. The study projects in this DISIS-2016-001-1 group study are queued after the MISO DPP-2016-Feb study cycle.

The Siemens Power Technologies International PSS/E power system simulation program Version 33.10.0 and PowerGEM's TARA 1802 was used for this study. MISO provided the steady-state and stability database cases for 2022 Summer Shoulder and 2022 Summer Peak conditions. This impact study required a steady-state analysis to determine if any SPP study projects contribute to thermally overloaded lines or bus voltages that exceed normal or emergency operating conditions. The stability analysis was performed to determine if any SPP study projects contribute to adverse impacts on the MISO transmission system including generator tripping, rotor angle oscillation instability, voltage recovery issues, and voltage instability. Table 1-1 is a list of SPP study projects that were examined for this study. Refer to Appendix D for one-line diagrams of the projects and their point of interconnection.

Table 1-1
Interconnection Projects Evaluated

Queue #	Capacity	Service	Fuel Type	Area	Proposed Point of Interconnection
GEN-2015-089	200	ER	Wind	WAPA	Utica 230 kV Substation
GEN-2016-004	201.6	ER/NR	Wind	WAPA	Leland Olds 230 kV
GEN-2016-007	100.05	ER	Wind	WAPA	Valley City 115 kV
GEN-2016-017	250.7	ER	Wind	WAPA	Tap Fort Thompson - Leland Olds 345 kV
GEN-2016-021	300	ER	Wind	NPPD	Hoskins 345 kV
GEN-2016-023	150.53	ER	Wind	WAPA	Tap Laramie River - Sidney 345 kV
GEN-2016-029	150.53	ER	Wind	WAPA	Tap Laramie River - Sidney 345 kV
GEN-2016-043	230	ER	Wind	NPPD	Hoskins 345 kV
GEN-2016-050	250.7	ER	Wind	NPPD	Tap Axtell - Post Rock 345 kV
GEN-2016-052	3.3	ER	Wind	WAPA	Hilken 230 kV
GEN-2016-053	3.3	ER	Wind	WAPA	Hilken 230 kV
GEN-2016-054	3.4	ER	Wind	WAPA	Wessington Springs 230 kV
GEN-2016-075	50	ER	Wind	WAPA	Grand Prairie 345 kV

SECTION 2: STEADY-STATE ANALYSIS

The steady-state analysis was performed to evaluate the thermal flow and voltage impact of the SPP study generators on the MISO transmission system.

2.1 Model Development

The following DPP February 2016 West Phase III study case load profiles were used for the study (includes MISO queue projects up to DPP-2016-FEB):

- 2022 Summer Shoulder
  - StudyCase-MISO17_2022_SH90__TA_Pass3-DPP 2016-FEB_West_Ph3_180411.sav
- 2022 Summer Peak
  - StudyCase-MISO17_2022_SUM__TA_Pass3-DPP 2016-FEB_West_Ph3_180411.sav

The DPP-2016-Feb-West Phase III network upgrades were implemented in to the steady-state cases as provided and were confirmed to be in the case. Refer to Table 2-1 for a summary of the Phase III network upgrades included in this study.

Table 2-1
DPP-2016-Feb-West Phase III Network Upgrades

Project Name	Project Description
Add_Blackhawk-Cap-150.py	Add 150 Mvar capacitor bank to Blackhawk 345 kV
Add_J438POI-Cap-25.py	Add 25 Mvar capacitor bank to J438 POI 161 kV
Add_Lathrop-Cap-25.py	Add 25 Mvar capacitor bank to Lathrop 161 kV
Add_Midport-Cap-25.py	Add 25 Mvar capacitor bank to Midport 161 kV
Add_Montezuma-Cap-100.py	Add 100 Mvar capacitor bank to Montezuma 345 kV
Add_Oakes-Cap-10.py	Add 10 Mvar capacitor bank to Oakes 41.6 kV
Big Stone-Browns Valley 230 Upgrade.idv	Uprate Big Stone – Browns Valley 230 kV line rating to 383 MVA
Bondurant-Montezuma 345 kV Uprate Ph3.py	Uprate Bondurant – Montezuma 345 kV line rating to 1083 MVA

Boone Jct-Sub T FD 161 kV Uprate.py	Reconductor MEC section of Boone JCT – Sub T FD 161 kV line (update impedance and line rating)
CIPCO DPP-2016-FEB Mitigation.idv	Reconductor MQOKET – Wyoming 161 kV line Uprate Liberty – Dundee 161 kV line rating to 327 MVA
Deere NE-Washburn 161 kV Uprate.py	Uprate Deere NE – Washburn 161 kV line rating to 272 MVA
Feb2016_DPP_Phase3_Rating Corrections_ITCM.idv	Ratings changes to several 161 kV and 115 kV lines to reflect ITC rating methodology
Franklin-Wall Lake 161 kV Uprate.py	Uprate Franklin – Wall Lake 161 kV line rating to 204 MVA
Granger Tap-100th&54th 161 kV Uprate Ph3.py	Uprate Granger Tap – 100th & 54th 161 kV line rating to 513 MVA
Grimes-Beaver Creek 345 kV Uprate.py	Uprate Grimes – Beaver Creek 345 kV line rating to 1222 MVA
Grimes-Sycamore 345 kV Ckt 2 Uprate.py	Uprate Grimes – Sycamore 345 kV line (ckt 2) rating to 1319 MVA
Hazel Creek TR Upgrade.idv	Hazel Creek transformer upgrade to 672 MVA
Hazleton-Washburn 161 kV Uprate.py	Reconductor Hazleton – Washburn 161 kV (update impedance and MVA rating)
J530 POI-Hills 345 kV Uprate.py	Uprate J530 POI – Hills 345 kV line rating to 1152 MVA
JohnsonJct-Morris-upgrade.py	Rebuild Johnson JCT – Morris 115 kV line to 477 ACSR
JohnsonJct-Ortonville_Rebuild.idv	Rebuild GRE Johnson JCT – Ortonville 115 kV line
Lock_Salem-xfmr_Taps.py	Lock both 345/161 kV transformer taps at Salem
Lundquist-Deere NE 161 kV Uprate.py	Uprate Lundquist – Deere NE 161 kV line rating to 272 MVA
Panther Mcleod upgrade.idv	Uprate GRE-Panther – HUC-McLeod 230 kV line rating to 450 MVA
Parnell-J438 POI 161 kV Uprate.py	Uprate J438 POI – Parnell 161 kV line rating to 274 MVA
Webster-Sub T FD 161 kV Uprate.py	Reconductor Webster – Sub T FD 161 kV line (update impedance and MVA rating)

The SPP study cases were built by adding and dispatching the SPP queue projects to the MISO study cases. The details of each SPP interconnection request study projects are listed in Table 1-1. The SPP study projects and SPP higher queued projects were dispatched per MISO criteria to the entire SPP footprint, where generators were scaled in proportion to the available reserve.

2.2 Study Assumptions

This affected system impact study was conducted with all the participating generators and higher queued SPP generators. This study group includes higher queued SPP generators and requested study SPP generators in South Dakota (east, west, and south central), North Dakota (west and east), and Nebraska. SPP provided a status update of projects that have withdrawn from the generation queue. Refer to Table 2-2 for a list of projects that have withdrawn from the queue and the status of the project in the Summer Peak and Summer Shoulder Benchmark case. There were a total of 5 prior queued projects that were required to be switched offline in both the Summer Shoulder and Summer Peak Benchmark case.

Table 2-2
Study Projects That Have Withdrawn From the Generation Queue

Ref. No.	Project	POI Bus Name	POI Bus Number	Gen Number	Online in Benchmark Case		MW Removed from Benchmark Case	
					West Summer	West Shoulder	West Summer	West Shoulder
1	GI-1007	Antelope Valley	659101	659407	Yes	Yes	26.8	172
2	MPC01200	Maple River 230 kV	657754	-	No	No	-	-
3	GIA-052	Remington 138 kV	301369	-	No	No	-	-
4	GEN-2010-045	Bucker 345 kV	531501	-	No	No	-	-
5	GEN-2012-040	Chilocco 138 kV	521198	-	No	No	-	-
6	GEN-2013-010	Tap Spearville - Post Rock 345 kV	562334	-	No	No	-	-
7	GEN-2014-004IS	Charlie Creek 345 kV	659183	659127	Yes	Yes	59.8	373
8	GEN-2014-013	Gaines Gen Tap	528611	528501	Yes	Yes	181.1	165.8
9	GEN-2014-047	Crossroads 345 kV	527656	-	No	No	-	-

10	GEN-2015-022	Swisher 115 kV	525212	-	No	No	-	-
11	GEN-2015-031	Swisher - Amarillo South 230 kV		-	No	No	-	-
12	GEN-2015-039	Deaf Smith - Plant X 230 kV		-	No	No	-	-
13	GEN-2015-040	Mustang 230 kV	527149	-	No	No	-	-
14	GEN-2015-058	Atoka 115 kV	527786	-	No	No	-	-
15	GEN-2015-078	Mustang 115 kV	527146	-	No	No	-	-
16	GEN-2015-083	Sumner 138 kV	532984	-	No	No	-	-
17	GEN-2016-060	Belle Plain 138 kV	533063	-	No	No	-	-
18	GEN-2016-148	Hardy 138 kV	520213	-	No	No	-	-
19	GEN-2016-168	West Higginsville 69 kV	543102	-	No	No	-	-
20	GEN-2016-169	Hobbs 345 kV	527896	-	No	No	-	-
21	GI-0723	Tap Formit - Summit 115 kV	652522	652345	Yes	Yes	7.7	49.5
22	GI-1209	Ft Randall 115 kV	652510	-	No	No	-	-
23	GI-1301	Summit - Watertown 115 kV	652001	652004	Yes	Yes	14	87.3

Refer to Appendix A for a list of higher queued SPP generators and Appendix B for a list of higher queued MISO generators. In the summer shoulder scenario wind plants are dispatched at 100% nameplate rating in the study group and in the summer peak scenario wind plants are dispatched at 15.6% nameplate rating. The results obtained in this analysis may change if any of the data or assumptions made during the development of the study models is revised.

2.3 Study Criteria

All interconnection requirements are based on the applicable MISO Interconnection Planning Criteria and in accordance with the NERC Reliability Standards. Steady state violations of applicable planning criteria were attributed to the SPP group generation requests by the usage of MISO injection criteria, and applicable local planning criteria. The simulation software that was utilized for this analysis was Siemen's PTI PSS/E Version 33.10.0 and PowerGEM's TARA 1802.

2.3.1 MISO 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 Cumulative MW Impact from study generators is greater than or equal to 20% of the applicable (normal or Emergency) facility rating, where study generators whose Individual MW Impact is greater than 5% of the facility rating and have a DFAX greater than 5% will be responsible to mitigate the Cumulative MW Impact Constraint, or
4) 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 generation projects in the study group must mitigate thermal injection constraints in order to obtain unconditional Interconnection Service.

2.3.2 TOS' Local Planning Criteria

A constraint is identified as an injection constraint if it violates applicable Transmission Owner FERC filed Local Planning Criteria.

2.4 Contingency Criteria

A comprehensive list of contingencies was considered for steady-state analysis:

- NERC Category P0 with system intact (no contingencies)

- NERC category P1, P2, P4, P5, P7 contingencies
  - Single element outages (P7 referred to N-1 contingency event), at buses with a nominal voltage of 69 kV and above in the following areas: CWLD (area 333), AMMO (area 356), AMIL (area 357), CWLP (area 360), SIPC (area 361), WEC (area 295), MIUP (area 296), MH (area 667), ALTE (area 694), WPS (area 696), MGE (area 697), UPPC (area 698), 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), DPC (area 680), 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), BEPC-SPP (area 659), and INDN (area 545).
- NERC Category P3
  - Selected NERC Category P3 events provided by ad-hoc study group in the study region.

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

2.5 Monitored Elements

Table 2-3 is a list of elements that were monitored in the MISO area.

Table 2-3
Monitored MISO Areas

Area #	Voltage	Area ID	Area Name
295	69kV and above	WEC	Wisconsin Electric Power Company (ATC)
296	69kV and above	MIUP	Michigan Upper Peninsula (ATC)
333	69kV and above	CWLD	Columbia, MO Water and Light
356	69kV and above	AMMO	Ameren Missouri
357	69kV and above	AMIL	Ameren Illinois
360	69kV and above	CWLP	City Water Light & Power (Springfield)
361	69kV and above	SIPC	Southern Illinois Power Co.
600	69kV and above	XEL	Xcel Energy North
608	69kV and above	MP	Minnesota Power & Light
613	69kV and above	SMMPA	Southern Minnesota Municipal Power Association
615	69kV and above	GRE	Great River Energy
620	69kV and above	OTP	Otter Tail Power Company

627	69kV and above	ITCM	ITC Midwest
633	69kV and above	MPW	Muscatine Power & Water
635	69kV and above	MEC	MidAmerican Energy
661	69kV and above	MDU	Montana-Dakota Utilities Co.
680	69kV and above	DPC	Dairyland Power Cooperative
694	69kV and above	ALTE	Alliant Energy East (ATC)
696	69kV and above	WPS	Wisconsin Public Service Corporation (ATC)
697	69kV and above	MGE	Madison Gas and Electric Company (ATC)
698	69kV and above	UPPC	Upper Peninsula Power Company (ATC)

2.6 Steady-State Analysis Results

This section lists the results from the steady-state analysis.

2.6.1 Summer Peak (2022) Steady-State Analysis

No constraints were identified in the 2022 Summer Peak Scenario.

2.6.2 Summer Shoulder (2022) Steady-State Analysis

Thermal and voltage constraints were identified for the 2022 Summer Shoulder Scenario. Refer to Table 2-4 for a summary of the thermal constraints identified and Table 2-5 for a summary of the voltage constraints identified.

Table 2-4
Summary of Thermal Constraints for 2022 Summer Shoulder

Constraint	Contflow (MVA)	Rating (MVA)	Loading (%)	Contingency	Criteria for Constraint	G15-089	G16-021	G16-043
635200 RAUN 3 345 645451 S3451 3 345 1	1073.49	956	112.29	P1	DFAX > 20% Gen Outlet Contingency	16.79%	22.7%	22.7%

After discussion with the Transmission Owners for the respective transmission lines in Table 2-4, it was determined that the Raun to Calhoun (S3451) 345 kV line rating shown in the table (and PSS/E) is the line rating on OPPD's end of the line. The line rating on MEC's end of the Raun to Calhoun (S3451) 345 kV line is 1152 MVA and therefore, no mitigation is required for MEC for the Raun to Calhoun (S3451) 345 kV thermal constraint.

Table 2-5
Summary of Voltage Constraints for 2022 Summer Shoulder

Bus Number	Bus Name	Base kV	Area Owner	Pre-Proejct V (p.u.)	Post-Proejct V (p.u.)	Voltage Degradation	Criteria
617036	GRE-MAYHEW 8	69	GRE	0.923	0.911	1.13%	0.92 to 1.10 p.u.
617044	GRE-PIPE 2 8	69	GRE	0.928	0.917	1.13%	0.92 to 1.10 p.u.
617053	GRE-MINDEN 8	69	GRE	0.924	0.912	1.13%	0.92 to 1.10 p.u.

After discussion with the Transmission Owner ("TO"), no mitigation is required for the voltage constraints observed in Table 2-5. It was noted that low bus voltages have been observed in previous studies for similar outages. This area is a local load-serving area and GRE expects to address these low bus voltages in future planning studies. Therefore, there is no need to identify upgrades for these three constraints.

2.7 Steady-State Analysis Conclusions

The Affected System Study identified Steady State thermal violations associated with the interconnection of the thirteen SPP projects. The study identified a thermal overload as well as voltage violations in the shoulder scenario for 2022 analysis. These violations did result in study constraints and therefore, no mitigation is required.

SECTION 3: TRANSIENT STABILITY ANALYSIS

The transient stability analysis was performed to evaluate the transient stability impact of the SPP study generators on the MISO transmission system for regional faults in the WAPA and NPPD area. The transient stability analysis was performed with PSS/E Version 33.10.0.

3.1 Model Development

The following DPP-2016-Feb-West Phase III Study case stability files were used for the study:

- 2022 Summer Shoulder
  - StudyCase-2022_SH90_DS_Ph3_181009.sav

The DPP-2016-Feb-West Phase III network upgrades were implemented in to the stability case as provided and were confirmed to be in the case. Refer to Table 3-1 for a summary of the Phase III network upgrades included in this study.

Table 3-1
DPP-2016-Feb-West Phase III Network Upgrades

Project Name	Project Description
Add_Blackhawk-Cap-150.py	Add 150 Mvar capacitor bank to Blackhawk 345 kV
Add_J438POI-Cap-25.py	Add 25 Mvar capacitor bank to J438 POI 161 kV
Add_Lathrop-Cap-25.py	Add 25 Mvar capacitor bank to Lathrop 161 kV
Add_Midport-Cap-25.py	Add 25 Mvar capacitor bank to Midport 161 kV
Add_Montezuma-Cap-100.py	Add 100 Mvar capacitor bank to Montezuma 345 kV
Add_Oakes-Cap-10.py	Add 10 Mvar capacitor bank to Oakes 41.6 kV
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Bondurant-Montezuma 345 kV Uprate Ph3.py	Uprate Bondurant – Montezuma 345 kV line rating to 1083 MVA
Boone Jct-Sub T FD 161 kV Uprate.py	Reconductor MEC section of Boone JCT – Sub T FD 161 kV line (update impedance and line rating)

CIPCO DPP-2016-FEB Mitigation.idv	Reconductor MQOKET – Wyoming 161 kV line Uprate Liberty – Dundee 161 kV line rating to 327 MVA
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Granger Tap-100th&54th 161 kV Uprate Ph3.py	Uprate Granger Tap – 100th & 54th 161 kV line rating to 513 MVA
Grimes-Beaver Creek 345 kV Uprate.py	Uprate Grimes – Beaver Creek 345 kV line rating to 1222 MVA
Grimes-Sycamore 345 kV Ckt 2 Uprate.py	Uprate Grimes – Sycamore 345 kV line (ckt 2) rating to 1319 MVA
Hazel Creek TR Upgrade.idv	Hazel Creek transformer upgrade to 672 MVA
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Lock_Salem-xfmr_Taps.py	Lock both 345/161 kV transformer taps at Salem
Lundquist-Deere NE 161 kV Uprate.py	Uprate Lundquist – Deere NE 161 kV line rating to 272 MVA
Panther Mcleod upgrade.idv	Uprate GRE-Panther – HUC-McLeod 230 kV line rating to 450 MVA
Parnell-J438 POI 161 kV Uprate.py	Uprate J438 POI – Parnell 161 kV line rating to 274 MVA
Webster-Sub T FD 161 kV Uprate.py	Reconductor Webster – Sub T FD 161 kV line (update impedance and MVA rating)

The SPP Study cases were built by adding and dispatching the SPP study projects to the Benchmark cases (MISO Study cases). The details of each SPP interconnection request study project is listed in Table 1-1. The SPP study projects were dispatched to their maximum power output to the entire SPP footprint, where generators were scaled in proportion to the available reserve.

3.2 Study Criteria

All interconnections must be compliant with MISO criteria and will be required to provide mitigation to obtain Interconnection Service for the following:

- System instability
- Transient voltage constraints
- Damping violation

3.2.1 MISO Criteria

The faults selected for this analysis were evaluated based on the following MISO criteria:

- All on-line generating units are stable.
- No unexpected generator tripping.
- Post-fault transient voltage limits: 1.2 p.u. maximum, 0.7 p.u. minimum.
- 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.
- Per local TO's planning criteria, specific transient voltage limits are applied to specific buses, areas, or companies that have different requirements.

A bus is considered a transient voltage constraint if both of the following conditions are met (all transient voltage constraints must be resolved before a project can receive Interconnection Service):

- The bus transient voltage is outside of specified transient voltage limits during the transient period, and
- The bus voltage is at least 0.01 p.u. worse than the Benchmark case voltage for the same contingency.

3.3 List of Contingencies

The contingencies listed in Table 3-2 were simulated using the 2022 Summer Shoulder stability package. Simulations were performed using both the Benchmark case and Study case. The contingencies were performed by simulating a one second state-state run followed by the disturbance and element lost as described in Table 3-2.

Table 3-2
List and Description of Stability Contingencies

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Fault scenarios were first simulated using the Study cases. After the contingencies were completed, the results were reviewed and evaluated against the criteria in section 3.3. If any contingency exhibited voltage instability, angular instability, or voltage deviation outside of stated criteria, the Benchmark case was simulated for the respective contingency to compare the results. Any new stability or angular issues attributed to the study project were flagged and reported.

3.4 Transient Stability Analysis Results

This section lists the results from the transient stability analysis.

3.4.1 Summer Shoulder (2022) Transient Stability Analysis

Stability results for the 2022 summer shoulder case showed no stability constraints for the disturbances simulated for this study (refer to Table 3-1 for a list and description of contingencies).

3.5 Transient Stability Analysis Conclusions

No transient stability constraints were identified for the addition of the thirteen SPP projects in the 2022 Summer Shoulder scenario. The Study case showed similar performance as the respective Benchmark case and did not affect the transient stability of the system.

SECTION 4: CONCLUSIONS

This study was performed using an MTEP 2017 series model case with study snapshot of year 2022. With the MISO MTEP 2017 base reliability transmission projects included in the case, the study results indicate that SPP GEN-2016-004 and SPP GEN-2016-017 are conditional on projects Briggs Road to N Madison 345 kV transmission line and Briggs Road (North LaCrosse) substation being in service. At the time of the study the expected in service date of these projects is 12/31/2018. These base line reliability projects are part of N LaCrosse-N Madison-Cardinal-Hickory Creek 345 kV MISO MVP project.

Thermal violations and voltage violations associated with the interconnection of the thirteen SPP projects were identified but were determined to be non-constraints. Therefore, there were no network upgrades identified for this study.

No transient stability constraints were identified for the addition of the thirteen SPP projects in the 2022 Summer Shoulder scenario. The Study case showed similar performance as the respective Benchmark case and did not affect the transient stability of the system.

The generators which are conditional on MISO baseline reliability projects will need to mitigate for the identified constraints prior to being granted full injection on the SPP system. If the generator would elect to proceed on a limited operation basis, then the impacting generator(s) will be subject to injection limits identified from MISO's Annual and Quarterly studies.

APPENDIX A: LIST OF HIGHER QUEUED SPP GENERATORS

Study	Generation Interconnection Number	GEN Area	Type	Pmax (MW)	MISO SH Output	MISO SPK Output	Service	Group
PQ	GEN-2003-021N	NPPD	Wind	60	60.00	9.36	ER	09 NEB
PQ	GEN-2003-021N	NPPD	Wind	15	15.00	2.34	ER	09 NEB
PQ	GEN-2004-023N	NPPD	Coal	75	75.00	75.00	ER	09 NEB
PQ	GEN-2006-020N	NPPD	Wind	42	42.00	6.55	ER	09 NEB
PQ	GEN-2006-038N005	NPPD	Wind	80	80.00	12.48	ER	09 NEB
PQ	GEN-2006-038N019	NPPD	Wind	80	80.00	12.48	ER	09 NEB
PQ	GEN-2007-011N08	NPPD	Wind	81	81.00	12.64	ER	09 NEB
PQ	GEN-2008-119O	OPPD	Wind	60	60.00	9.36	ER	09 NEB
DIS-09-1	GEN-2006-037N1	NPPD	Wind	74.8	74.80	11.67	ER	09 NEB
DIS-09-1	GEN-2006-044N	NPPD	Wind	40.5	40.50	6.32	ER	09 NEB
DIS-09-1	GEN-2008-086N02	NPPD	Wind	100.3	100.30	15.65	ER	09 NEB
DIS-09-1	GEN-2008-086N02	NPPD	Wind	100.3	100.30	15.65	ER	09 NEB
DIS-09-1	GEN-2008-129	KCPL	CT	40	0.00	40.00	ER	13 NE-KS & NW-MO
DIS-09-1	GEN-2008-129	KCPL	CT	40	0.00	40.00	ER	13 NE-KS & NW-MO
DIS-10-1	GEN-2009-040	WERE	Wind	73.8	73.80	11.51	ER	09 NEB
DIS-10-2	GEN-2010-041	OPPD	Wind	10.5	10.50	1.64	ER	09 NEB
DIS-10-2	GEN-2010-051	NPPD	Wind	200	200.00	31.20	ER	09 NEB
DIS-10-2	GEN-2010-036	WERE	Hydro	0.15	0.15	0.15	ER	13 NE-KS & NW-MO
DIS-10-2	GEN-2010-036	WERE	Hydro	0.18	0.18	0.18	ER	13 NE-KS & NW-MO
DIS-10-2	GEN-2010-036	WERE	Hydro	0.2	0.20	0.20	ER	13 NE-KS & NW-MO
DIS-10-2	GEN-2010-036	WERE	Hydro	0.17	0.17	0.17	ER	13 NE-KS & NW-MO
DIS-10-2	GEN-2010-036	WERE	Hydro	0.2	0.20	0.20	ER	13 NE-KS & NW-MO
DIS-10-2	GEN-2010-036	WERE	Hydro	1.3	1.30	1.30	ER	13 NE-KS & NW-MO
DIS-10-2	GEN-2010-036	WERE	Hydro	1	1.00	1.00	ER	13 NE-KS & NW-MO
DIS-10-2	GEN-2010-036	WERE	Hydro	0.2	0.20	0.20	ER	13 NE-KS & NW-MO
DIS-10-2	GEN-2010-036	WERE	Hydro	1	1.00	1.00	ER	13 NE-KS & NW-MO
DIS-10-2	GEN-2010-036	WERE	Hydro	1.3	1.30	1.30	ER	13 NE-KS & NW-MO
DIS-10-2	GEN-2010-036	WERE	Hydro	0.2	0.20	0.20	ER	13 NE-KS & NW-MO
DIS-11-1	GEN-2011-018	NPPD	Wind	73.6	73.60	11.48	ER/NR	09 NEB
DIS-11-1	GEN-2011-027	NPPD	Wind	120	120.00	18.72	ER/NR	09 NEB

DIS-11-1	GEN-2011-011	KCPL	Coal	50	50.00	50.00	ER	13 NE-KS & NW-MO
DIS-11-2	GEN-2011-056	NPPD	Hydro	3.6	3.60	3.60	ER	09 NEB
DIS-11-2	GEN-2011-056A	NPPD	Hydro	3.6	3.60	3.60	ER	09 NEB
DIS-11-2	GEN-2011-056B	NPPD	Hydro	4.5	4.50	4.50	ER	09 NEB
DIS-11-2-PQ	NPPD Distributed (North Platte - Lexington)	NPPD	Hydro	18	18.00	18.00	ER	09 NEB
DIS-11-2-PQ	NPPD Distributed (North Platte - Lexington)	NPPD	Hydro	18	18.00	18.00	ER	09 NEB
DIS-11-2-PQ	NPPD Distributed (North Platte - Lexington)	NPPD	Hydro	18	18.00	18.00	ER	09 NEB
DIS-12-2	GEN-2012-021	LES	Gas	4.8	0.00	4.80	ER	09 NEB
DIS-13-1	GEN-2013-002	LES	Wind	50.6	50.60	7.89	ER/NR	09 NEB
DIS-13-1	GEN-2013-008	NPPD	Wind	1.2	1.20	0.19	ER	09 NEB
DIS-13-2	GEN-2013-019	LES	Wind	73.6	73.60	11.48	ER/NR	09 NEB
DIS-13-2	GEN-2013-032	NPPD	Wind	204	204.00	31.82	ER	09 NEB
DIS-14-1	GEN-2014-004	NPPD	Wind	3.96	3.96	0.62	ER	09 NEB
DIS-14-2	GEN-2014-031	NPPD	Wind	35.8	35.80	5.58	ER/NR	09 NEB
DIS-14-2	GEN-2014-032	NPPD	Wind	5.11	5.11	0.80	ER/NR	09 NEB
DIS-14-2	GEN-2014-032	NPPD	Wind	5.11	5.11	0.80	ER/NR	09 NEB
DIS-14-2	GEN-2014-039	NPPD	Wind	73.39	73.39	11.45	ER/NR	09 NEB
DIS-14-2	GEN-2014-021	KCPL	Wind	158	158.00	24.65	ER/NR	13 NE-KS & NW-MO
DIS-14-2	GEN-2014-021	KCPL	Wind	142	142.00	22.15	ER/NR	13 NE-KS & NW-MO
DIS-15-1	GEN-2015-007	NPPD	Wind	160	160.00	24.96	ER	09 NEB
DIS-15-1-PQ	GEN-2007-017IS	WAPA	Wind	166	166.00	25.90	ER/NR	09 NEB
DIS-15-1-PQ	GEN-2007-018IS	WAPA	Wind	234	234.00	36.50	ER/NR	09 NEB
DIS-15-1	GEN-2015-023	NPPD	Wind	150.36	150.36	23.46	ER/NR	09 NEB
DIS-15-1	GEN-2015-023	NPPD	Wind	150.36	150.36	23.46	ER/NR	09 NEB
DIS-15-1	GEN-2015-005	KCPL	Wind	16.11	16.11	2.51	ER	13 NE-KS & NW-MO
DIS-15-1	GEN-2015-005	KCPL	Wind	184	184.00	28.70	ER	13 NE-KS & NW-MO
DIS-15-2-PQ	GEN-2002-009IS	WAPA	Wind	40.5	40.50	6.32	ER/NR	15 E-SD
DIS-15-2-PQ	GEN-2007-013IS	WAPA	Wind	50	50.00	7.80	ER/NR	15 E-SD
DIS-15-2-PQ	GEN-2007-014IS	WAPA	Wind	100	100.00	15.60	ER/NR	15 E-SD
DIS-15-2-PQ	GEN-2009-018IS	WAPA	Wind	99.5	99.50	15.52	ER	15 E-SD
DIS-15-2-PQ	GEN-2010-003IS	WAPA	Wind	34	34.00	5.30	ER/NR	15 E-SD

DIS-15-2-PQ	GEN-2013-009IS	WAPA	Wind	19.5	19.50	3.04	ER	15 E-SD
DIS-15-2-PQ	GEN-2007-023IS	WAPA	Wind	49.5	49.50	7.72	ER/NR	15 E-SD
DIS-15-2-PQ	GEN-2013-001IS	WAPA	Wind	89.7	89.70	13.99	ER	15 E-SD
DIS-15-2-PQ	GEN-2010-001IS	WAPA	Wind	99	99.00	15.44	ER/NR	15 E-SD
DIS-15-2-PQ	GEN-2009-001IS	WAPA	Wind	200	200.00	31.20	ER/NR	15 E-SD
DIS-15-2-PQ	GEN-2012-014IS	WAPA	Wind	100.34	100.34	15.65	ER	15 E-SD
DIS-15-2-PQ	GEN-2014-001IS	WAPA	Wind	103.7	103.70	16.18	ER	15 E-SD
DIS-15-2-PQ	GEN-2005-008IS	WAPA	Wind	49.5	49.50	7.72	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2006-015IS	WAPA	Wind	49.5	49.50	7.72	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2007-027IS	WAPA	Wind	99	99.00	15.44	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2010-007IS	WAPA	Wind	172.5	172.50	26.91	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2009-026IS	WAPA	Wind	106.5	106.50	16.61	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2014-014IS	WAPA	Wind	151.5	151.50	23.63	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2014-006IS	WAPA	Gas	47	0.00	47.00	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2014-006IS	WAPA	Gas	47	0.00	47.00	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2012-006IS	WAPA	Gas	47	0.00	47.00	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2014-006IS	WAPA	Gas	9.44	0.00	9.44	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2014-006IS	WAPA	Gas	9.44	0.00	9.44	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2014-006IS	WAPA	Gas	9.44	0.00	9.44	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2014-006IS	WAPA	Gas	9.44	0.00	9.44	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2014-006IS	WAPA	Gas	9.44	0.00	9.44	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2014-006IS	WAPA	Gas	9.44	0.00	9.44	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2014-006IS	WAPA	Gas	9.44	0.00	9.44	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2014-006IS	WAPA	Gas	9.44	0.00	9.44	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2014-006IS	WAPA	Gas	9.44	0.00	9.44	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2014-006IS	WAPA	Gas	9.44	0.00	9.44	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2014-006IS	WAPA	Gas	9.44	0.00	9.44	ER/NR	16 W-ND
DIS-15-2-PQ	GEN-2014-006IS	WAPA	Gas	9.44	0.00	9.44	ER/NR	16 W-ND

DIS-15-2-PQ	GEN-2014-010IS	WAPA	Wind	150	150.00	23.40	ER/NR	16 W-ND
DIS-15-2	GEN-2015-053	NPPD	Wind	50.12	50.12	7.82	ER	09 NEB
DIS-15-2	GEN-2015-076	NPPD	Wind	79.2	79.20	12.36	ER	09 NEB
DIS-15-2	GEN-2015-076	NPPD	Wind	79.2	79.20	12.36	ER	09 NEB
DIS-15-2	GEN-2015-087	NPPD	Wind	66	66.00	10.30	ER/NR	09 NEB
DIS-15-2	GEN-2015-088	NPPD	Wind	300	300.00	46.80	ER/NR	09 NEB
DIS-15-2	GEN-2015-046	WAPA	Wind	300	300.00	46.80	ER/NR	16 W-ND
DIS-15-2	GEN-2015-096	WAPA	Wind	150	150.00	23.40	ER/NR	16 W-ND
DIS-15-2	GEN-2015-098	WAPA	Wind	100	100.00	15.60	ER/NR	16 W-ND

APPENDIX B: LIST OF HIGHER QUEUED MISO GENERATORS

MISO Project Number	State	County	Trans. Owner	Point Of Interconnection	Max Output	Fuel Type	Service Type
J432	SD	Brookings	XEL	Brookings 345 kV	98	Wind	NRIS
J460	MN	Lincoln	GRE	Brookings-H081 345 kV line	200	Wind	NRIS
J475	IA	Poweshiek	MEC	Montezuma 345 kV	200	Wind	NRIS
J485	MN	Olmsted	RPU	West Side 161 kV	46.85	CT	NRIS
J488	SD	Grant, Roberts	OTP	Big Stone-Ellendale 345 kV	151.8	Wind	ERIS
J489	SD	Grant, Roberts	OTP	Big Stone-Ellendale 345 kV	151.8	Wind	ERIS
J493	MN	Yellow Medicine	OTP	Big Stone-Brookings 345 kV	150	Wind	NRIS
J495	IA	Winnebago	ITCM	Ledyard-Colby 345 kV line	200	Wind	NRIS
J498	IA	Boone, Greene	MEC	Grimes-Lehigh 345 kV	340	Wind	NRIS
J499	IA	Adair, Madison	MEC	Fallow-Grimes 345 kV	340	Wind	NRIS
J500	IA	Adair	MEC	New substation at intersection of Boone-Atchison 345 kV and Rolling Hills-Madison Co 345 kV	500	Wind	NRIS
J504	IA	Linn	ITCM	Bertram-Duane Anronld 161 kV (0.5 mi from Duane Arnold)	50	Solar	NRIS
J506	IA	Plymouth	MEC	Raun-Lakefield Jct 345 kV	200	Wind	NRIS
J510	SD	Deuel	OTP	Scandinavia Township	266 sum / 284.5 win	CT	NRIS
J514	IA	Marshall	ITCM	Marshalltown substation	30 sum / 65 win	CC	NRIS
J523	MN	Mower	ITCM	Adams 161 kV	50	Solar	NRIS
J524	IA	Webster	MEC	Webster 161 kV	100	Solar	NRIS
J525	MN	Murray	XEL	Lake Wilson–Hadely 69 kV	33	Solar	NRIS
J526	SD	Deuel	OTP	Brooking Co-Big Stone South 345 kV	300	Wind	NRIS
J527	IA	Adair	MEC	Booneville-Cooper 345 kV	250	Wind	NRIS
J528	IA	Adair	MEC	Rolling Hills-Madison 345 kV	200	Wind	NRIS
J529	IA	Palo Alto	MEC	Obrien-Kossuth 345 kV	250	Wind	NRIS
J530	IA	Iowa	MEC	Montezuma-Hills 345 kV	250	Wind	NRIS
J534	IA	Humboldt, Kossuth	MEC	Kossuth–Webster 345 kV	250	Wind	NRIS
J535	IA	Sac	MEC	J411–Lehigh 345 kV	210	Wind	NRIS
J351	IN	St. Joseph	NIPS	Stillwell 345 kV	705 sum / 715 win	CC	NRIS
J468	IL	Douglas	AMIL	Sidney-Kansas West 345 kV line	202	Wind	NRIS
J515	IN	Benton, Warren	DEI	Cayuga 345 kV	400	Wind	ERIS
J533	MI	Gratiot	METC	Slate 345 kV	200	Wind	NRIS
J538	MI	Hillsdale	METC	Moore Rd-Dowling 138 kV	150	Wind	NRIS
J540	MI	Kalkaska	WPSC	Kalkaska County	48.6	CT	NRIS Only
J505	WI	Manitowoc	ATC	Tapped at the Mishicott-Kewaunee 138 kV line (1.06 miles away from Kewaunee)	100	Solar	NRIS

APPENDIX C: STEADY-STATE STUDY CONTINGENCIES

Con File	Con Type	Number of Contingencies
DPP-2016Feb-West_Ph2_Outlet_Contingency.con	P1	66
DPP_2016Feb-West_Ph2_Master-P1-West-1.con	P1	10349
DPP_2016Feb-West_Ph2_Master-P1-Other-1.con	P1	5432
DPP_2016Feb-West_Ph2_Master-P1-Other-2.con	P1	4560
SPP_Outlet.con	P1	28
P1_AMRN_MTEP17-2022TA.con	P1	714
P1_CWLD_MTEP17-2022TA.con	P1	19
P1_CWLP_MTEP17-2022TA.con	P1	60
P1_PPI_MTEP17-2022TA.con	P1	5
P1_SIPC_MTEP17-2022TA.con	P1	22
ComEd_RTEP_Cat_P1.con	P1	467
P1_AECI_MTEP17-2022TA.con	P1	24
P1_CE_MTEP17-2022TA.con	P1	27
P1_WAPA_MTEP17-2022TA.con	P1	53
P1-4_AMRN_MTEP17-2022TA.con	P1	25
P1-4_CWLP_MTEP17-2022TA.con	P1	7
P1-4_SIPC_MTEP17-2022TA.con	P1	2
P1-4_WAPA_MTEP17-2022TA.con	P1	2
20170808_CHC-NLL_Eden2.con	P1	19
MEC-DPP2016FEB West Ph2 2022 Cat P1 09.15.2017.con	P1	148
P1_AMES_MTEP17-2022TA.con	P1	9
P1_ATC_MTEP17-2022TA.con	P1	1359
P1_BEPC_MTEP17-2022TA.con	P1	3
P1_CBPC_MTEP17-2022TA.con	P1	2
P1_CFU_MTEP17-2022TA.con	P1	10
P1_CIPCO_MTEP17-2022TA.con	P1	10
P1_DPC_MTEP17-2022TA.con	P1	119
P1_ITCM_MTEP17-2022TA.con	P1	421
P1_MDU_MTEP17-2022TA.con	P1	119
P1_MP_MTEP17-2022TA.con	P1	510
P1_MPC_MTEP17-2022TA.con	P1	34
P1_MPW_MTEP17-2022TA.con	P1	31
P1_XEL_MTEP17-2022TA.con	P1	1270
P1-4_ATC_MTEP17-2022TA.con	P1	166
P1-4_DPC_MTEP17-2022TA.con	P1	3

P1-4_GRE_MTEP17-2022TA.con	P1	31
P1-4_ITCM_MTEP17-2022TA.con	P1	23
P1-4_MDU_MTEP17-2022TA.con	P1	14
P1-4_MP_MTEP17-2022TA.con	P1	45
P1-4_MPC_MTEP17-2022TA.con	P1	7
P1-4_OTP_MTEP17-2022TA.con	P1	25
P1-4_SMMPA_MTEP17-2022TA.con	P1	2
P1-4_XEL_MTEP17-2022TA.con	P1	64
P2-P7_AMRN_MTEP17-2022TA1.con	P2-P7	1064
P2-P7_CWLD_MTEP17-2022TA.con	P2-P7	18
P2-P7_CWLP_MTEP17-2022TA.con	P2-P7	60
P2-P7_PPI_MTEP17-2022TA.con	P2-P7	5
P2-P7_SIPC_MTEP17-2022TA.con	P2-P7	2
ComEd_RTEP_Cat_P2-P7.con	P2-P7	1164
P2-P7_AECI_MTEP17-2022TA.con	P2-P7	15
P2-P7_CE_MTEP17-2022TA.con	P2-P7	79
P2-P7_WAPA_MTEP17-2022TA.con	P2-P7	17
MEC-DPP2016FEB West Ph2 2022 Cat P2 09.15.2017.con	P2	704
MEC-DPP2016FEB West Ph2 2022 Cat P5 09.15.2017.con	P5	98
MEC-DPP2016FEB West Ph2 2022 Cat P7 09.15.2017.con	P7	44
P2-P7_AMES_MTEP17-2022TA.con	P2-P7	10
P2-P7_ATC_MTEP17-2022TA.con	P2-P7	2166
P2-P7_BEPC_MTEP17-2022TA.con	P2-P7	4
P2-P7_CBPC_MTEP17-2022TA.con	P2-P7	11
P2-P7_CFU_MTEP17-2022TA.con	P2-P7	17
P2-P7_CIPCO_MTEP17-2022TA.con	P2-P7	52
P2-P7_DPC_MTEP17-2022TA.con	P2-P7	68
P2-P7_GRE_MTEP17-2022TA.con	P2-P7	239
P2-P7_ITCM_MTEP17-2022TA.con	P2-P7	480
P2-P7_MDU_MTEP17-2022TA.con	P2-P7	150
P2-P7_MP_MTEP17-2022TA.CON	P2-P7	365
P2-P7_MPC_MTEP17-2022TA.con	P2-P7	115
P2-P7_MPW_MTEP17-2022TA.CON	P2-P7	210
P2-P7_MRES_MTEP17-2022TA.CON	P2-P7	40
P2-P7_OTP_MTEP17-2022TA.con	P2-P7	222
P2-P7_RPU_MTEP17-2022TA.con	P2-P7	30
P2-P7_SMMPA_MTEP17-2022TA.con	P2-P7	39
P2-P7_XEL_MTEP17-2022TA.con	P2-P7	1319

APPENDIX D: STUDY PROJECT ONE-LINE DIAGRAMS

CEII INFORMATION REDACTED

APPENDIX E: STUDY PROJECT DYNAMIC DATA

E.1 GEN-2015-089

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/
/ ***** GEN-2015-089 *****
/
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/
/
/ GE 116m 2.00MW (gewt_p32_v600.lib)
/
563232 'USRMDL' 1  'GEWTG2'  1 1 4 18 3 5
     0  100      0      0
      2.0000    0.80000    0.50000    0.90000     1.2200     1.2000
      2.0000    0.40000    0.80000     10.000    0.20000E-01  0.0000
      0.0000    0.50000    0.16700    0.90000    0.92500     0.0000   /
563232 'USRMDL' 1  'GEWTE2'  4 0 12 67 18 9
       563232      0          0          1          0          0
          0      0          0          1          0          0
     0.15000     2.000     1.0000     0.0000     0.0000    0.50000E-01  3.0000
     0.60000    1.1200    0.40000E-01 0.43600   -0.43600     1.1000    0.20000E-01
     0.45000        -0.45000       60.000         0.10000         0.90000
      1.1000         40.000         0.50000        1.4500         0.50000E-01
      0.50000E-01      1.0000        0.15000        0.96000         0.99600
      1.0040         1.0400        1.00000        1.0000         1.00000
      0.40000         1.0000        0.20000        1.0000         0.25000
     -1.0000         14.0000        25.000         3.0000         -0.90000
      8.0000         0.2000        10.000         1.0000         1.7000
      1.22           1.2500        5.0000         0.0000         0.0000
      0.000          0.25000E-02     1.0000        5.5000         0.10000
     -1.0000         0.10000        0.0000         0.10000        -0.10000
      0.70000        0.12000       -0.12000   /
563232 'USRMDL' 1  'GEWTT1'      5   0   1   5   4   3   0
       3.7030      0.0000      0.0000      1.8800      1.5000   /
0 'USRMDL'  0 'GEWGC1' 8   0   3   6   0   4
       563232      '1' 0
       9999.0      5.0000      30.000      9999.0      9999.0
       30.000   /
0 'USRMDL'  0 'GEWTA1'     8   0   3   9   1   4
       563232      '1'  0
       20.000      0.0000      27.000     -4.0000      0.0000      1.2250
       56.500      104.00      1200.0   /
0 'USRMDL'  0 'GEWTP1'     8   0   3   10   3   3
       563232      '1'  0
      0.30000      150.00      25.000      3.0000      30.000
      -4.0000      27.000     -10.000      10.000      1.0000   /
0 'USRMDL'  0 'GEWPLT' 8  0  2  0  0  17        563232      '1'    /
/ZVRT
0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1  563232  563232  '1'  0 0 0  0.40000  5.0000   1.000  0.08 /
0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1  563232  563232  '1'  0 0 0  0.60000  5.0000   1.700  0.08 /
0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1  563232  563232  '1'  0 0 0  0.70000  5.0000   2.500  0.08 /
0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1  563232  563232  '1'  0 0 0  0.75000  5.0000   3.000  0.08 /
0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1  563232  563232  '1'  0 0 0  0.85000  5.0000  10.000  0.08 /
0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1  563232  563232  '1'  0 0 0  0.90000  5.0000  600.00  0.08 /
0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1  563232  563232  '1'  0 0 0  0.00000  1.1200  300.00  0.08 /
0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1  563232  563232  '1'  0 0 0  0.00000  1.1500   30.00  0.08 /
0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1  563232  563232  '1'  0 0 0  0.00000  1.2000    2.00  0.08 /
0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1  563232  563232  '1'  0 0 0  0.00000  1.2500    0.50  0.08 /
0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1  563232  563232  '1'  0 0 0  0.00000  1.3800    0.30  0.08 /
0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1  563232  563232  '1'  0 0 0  0.00000  1.5000    0.03  0.08 /
0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1  563232  563232  '1'  0 0 0  0.00000  1.6000    0.01  0.08 /
/
```

E.2 GEN-2016-004

```
/
/ ***** GEN-2016-004  *****
/
/
/
/
/ Vestas V110 VCSS 2.0MW (VestasWT_7_6_0_PSSE32.lib) & V136 GS 3.6MW (VestasGS_8_1_1_PSSE32.lib)
/ 9 units
587033 'USRMDL' '1'  'VWCOR6' 1 1 2 45 23 104 1 0
 2000.0000 690.0000 903.3041 700.0000 2.6200 0.9676 0.0232
 1.9807 8.3333 1.9807 8.3333 30.0000 0.2000 1.2000
 0.1000 0.0012 0.9925 0.0474 1.6118 0.0000 351.8584
 161.5343 0.0300 0.0000 0.0300 0.3000 0.0000 1.0000
 0.3183 4.9736 2812227.1900 43.2960 90.0120 600000.0000 3.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000/
0 'USRMDL' 0 'VWVAR6' 8 0 2 0 0 30 587033 '1'  /
0 'USRMDL' 0 'VWLVR6' 8 0 3 65 10 35 587033 '1' 1
 0.9000 0.0010 0.1500 18.6316 74.5430 74.5430 74.5430
 0.5000 1.0000 2.6200 0.9676 1.2000 0.5000 690.0000
 903.3041 0.3500 0.0500 0.2500 0.0200 3.0000 4.0000
 9999.0000 0.0232 0.9000 0.9000 0.0500 0.0000 0.0100
 0.0000 2.0000 0.0000 1.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 /
0 'USRMDL' 0 'VWPWR6' 8 0 3 30 7 10 587033 '1' 1
 1.0000 0.5000 -0.5000 0.6988 0.8844 0.9800 0.9600
 0.2000 0.2000 1.0000 1.0000 0.0000 0.0000 0.1000
 0.1000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 /
0 'USRMDL' 0 'VWMEC6' 8 0 2 10 8 0 587033 '1'
 2000.0000 422.2301 4736.7543 420.7500 83.5000 6188.8071 39.3992
 0.0000 0.0000 0.0000 /
0 'USRMDL' 0 'VWMEA6' 8 0 2 10 8 5 587033 '1'
 0.1000 0.1000 0.1000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000/
0 'USRMDL' 0 'VWVPR6' 0 2 7 30 0 18 587033 '1'  1 1 0 0 0
 0.8500 11.0000 0.8500 11.0000 0.9000 60.0000 1.1000
 60.0000 1.1500 2.0000 1.2000 0.0800 1.2500 0.0050
 1.2500 0.0050 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.1500 0.8000 2.7000 0.8500 3.5000
 0.9000 5.0000 /
0 'USRMDL' 0 'VWFPR6' 0 2 3 12 0 7 587033 '1'  0
 56.4000 0.2000 56.4000 0.2000 56.4000 0.2000 63.6000
 0.2000 63.6000 0.2000 63.6000 0.2000 /
/
```

E.2 GEN-2016-004 (continued)

```
/ 51 units
587036 'USRMDL' '1'  'GSCOR1' 1 1 2 45 23 104 1 0
     3600       650  4522.135       0.01          0          0          0
     0.35      7.85                0.0001                   940      -3700       3700      -3450
     3450      0.97                  0.85                  0.75                  1                 20                  0
        0         0                     0                  0.03                 0.3                  0                  0
        0         0                     0                     0                   0                  0                  0
        0         0                     0                     0                   0                  0                  0
        0         0            0.0000 /
0 'USRMDL' 0 'GSVAR1' 8 0 2 0 0 30 587036 '1'/
0 'USRMDL' 0 'GSLVR1' 8 0 3 65 10 35 587036 '1' 1
     0.85         0                   0.6                    10                 200       100       200
        0      1.08                 0.005                 1.005                1.44                0.9583                650
 4522.135         0                     0                     0                   0                  0                  0
        0         0                     0                   0.9                   0                  2                 0.01
      1.3         0                     2                     1                   0                1.05                 -1
      1.2      0.85                  0.15                  0.05                 0.1                0.49                0.5
      0.8      0.39                   0.4                     0                   0                0.05                0.9
      1.1      0.08                   0.8                   0.9                 1.1                 1.2                0.1
      2.5       0.6             1200.264        60                  1                  1                 1.25
      1.2 0.7000 /
0 'USRMDL' 0 'GSPWR1' 8 0 3 30 7 10 587036 '1' 0
        1    0.6111                -0.6111               -0.2902               0.5288               0.8973               0.9304
        0         0                   0.1                   0.1                  20                  20                0.032
    0.032         0                  0.85                   0.9                0.93                1.08                 1.1
      1.2         1                   1.4                     0                   0                  0                  0
        0 0.0000 /
0 'USRMDL' 0 'GSMEA1' 8 0 2 10 8 5 587036 '1'
    0.032     0.032                     0                     0                   0                  0                  0
        0         0            0.0000 /
0 'USRMDL' 0 'GSVPR1' 0 2 7 30 0 18 587036 '1'  1 1 0 0 0
     0.85      10.2                  0.85                  10.2                 0.9                 60                 1.1
     3600      1.21                     2                  1.36                0.15                1.36                0.15
     1.36      0.15                     0                     0                   0                  0                  0
        0         0                  0.55                   0.7                 2.6                 0.7                 2.6
      0.7 2.6000 /
0 'USRMDL' 0 'GSFPR1' 0 2 3 12 0 7 587036 '1'  0
     56.4       0.2                  56.4                   0.2                56.4                 0.2                63.6
      0.2      63.6                   0.2                  63.6          0.2000 /
/
```

E.3 GEN-2016-007

```
/
/ ***** GEN-2016-007  *****
/
/
/
/
/ Vestas V126 GS 3.45MW (VestasGS_8_1_1_PSSE32.lib)
/ (29 units)
587053 'USRMDL' '1'  'GSCOR1' 1 1 2 45 23 104 1 0
     3450       650  4333.713       0.01                0                0                0
     0.35                7.85               0.0001              940     -3700     3700     -3300
     3300      0.97                0.85               0.75                1               20                 0
        0                 0                 0               0.03               0.3                 0                 0
        0                 0                 0                 0                 0                 0                 0
        0                 0                 0                 0                 0                 0                 0
        0                 0            0.0000 /
0 'USRMDL' 0 'GSVAR1' 8 0 2 0 0 30 587053 '1'/
0 'USRMDL' 0 'GSLVR1' 8 0 3 65 10 35 587053 '1' 1
     0.85                 0                0.6                10               200       100       200
        0               1.08               0.005              1.005              1.44            0.9565               650
 4333.713         0                 0                 0                 0                 0                 0
        0                 0                 0               0.9                 0                 2              0.01
      1.3                 0                 2                 1                 0              1.05                -1
      1.2              0.85              0.15              0.05               0.1              0.49               0.5
      0.8              0.39               0.4                 0                 0              0.05               0.9
      1.1              0.08               0.8               0.9               1.1               1.2               0.1
      2.5               0.6          1200.264        60                 1                 1              1.25
      1.2            0.7000 /
0 'USRMDL' 0 'GSPWR1' 8 0 3 30 7 10 587053 '1' 1
        1            0.6377           -0.6377           -0.3061            0.5556             0.902             0.944
        0                 0               0.1               0.1                20                20             0.032
    0.032                 0               0.85               0.9              0.93              1.08               1.1
      1.2                 1                 1.4                 0                 0                 0                 0
        0            0.0000 /
0 'USRMDL' 0 'GSMEA1' 8 0 2 10 8 5 587053 '1'
    0.032             0.032                 0                 0                 0                 0                 0
        0                 0            0.0000 /
0 'USRMDL' 0 'GSVPR1' 0 2 7 30 0 18 587053 '1'  1 1 0 0 0
     0.85                10.2               0.85              10.2               0.9                60               1.1
     3600      1.21                2               1.36              0.15              1.36              0.15
     1.36              0.15                 0                 0                 0                 0                 0
        0                 0              0.55               0.7               2.6               0.7               2.6
      0.7            2.6000 /
0 'USRMDL' 0 'GSFPR1' 0 2 3 12 0 7 587053 '1'  0
     56.4               0.2              56.4               0.2              56.4               0.2              63.6
      0.2              63.6               0.2              63.6          0.2000 /
/
```

E.4 GEN-2016-017

```
/
/ ***** GEN-2016-017  *****
/
/
/
/
/ GE 2.3 116 (gewt_p32_v600.lib)
/ (109 units)
 587133 'USRMDL' 1  'GEWTG2'  1 1 4 18 3 5
      0  109     0     0
      2.3000    0.80000    0.50000    0.90000     1.2200     1.2000
      2.0000    0.40000    0.80000     10.000    0.20000E-01  0.0000
      0.0000    0.50000    0.16700    0.90000    0.92500     0.0000   /
 587133 'USRMDL' 1  'GEWTE2'  4 0 12 67 18 9
       587133      0          0          1          0          0
         0      0          0          1          0          0
     0.15000     2.000     1.0000     0.0000     0.0000    0.50000E-01  3.0000
     0.60000     1.1200    0.40000E-01  0.43600    -0.43600     1.1000    0.20000E-01
     0.45000          -0.45000       60.000         0.10000         0.90000
      1.1000         40.000         0.50000        1.4500         0.50000E-01
      0.50000E-01       1.0000         0.15000        0.96000         0.99600
      1.0040          1.0400         1.00000        1.0000          1.00000
      0.40000          1.0000         0.20000        1.0000          0.25000
     -1.0000         14.0000         25.000         3.0000         -0.90000
      8.0000          0.2000         10.000         1.0000          1.7000
      1.22           1.2500         5.0000         0.0000          0.0000
      0.000          0.25000E-02     1.0000         5.5000          0.10000
     -1.0000          0.10000         0.0000         0.10000         -0.10000
      0.70000          0.12000        -0.12000   /
 587133 'USRMDL' 1  'GEWTT1'      5   0   1   5   4   3   0
       3.2200      0.0000      0.0000      1.8800      1.5000   /
 0 'USRMDL'  0 'GEWGC1' 8   0   3   6   0   4
       587133     '1 ' 0
       9999.0      5.0000      30.000      9999.0      9999.0
       30.000   /
 0 'USRMDL'  0 'GEWTA1'     8   0   3   9   1   4
       587133     '1 '  0
       20.000      0.0000      27.000     -4.0000      0.0000      1.2250
       56.500      104.00      1200.0   /
 0 'USRMDL'  0 'GEWTP1'     8   0   3   10   3   3
       587133     '1 '  0
      0.30000      150.00      25.000      3.0000      30.000
      -4.0000      27.000     -10.000      10.000      1.0000   /
 0 'USRMDL'  0 'GEWPLT' 8  0  2  0  0  17        587133      '1 '    /
/ZVRT
   0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1     587133   587133  '1 '     0 0 0      0.40000     5.0000      1.0000     0.08 /
   0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1     587133   587133  '1 '     0 0 0      0.60000     5.0000      1.7000     0.08 /
   0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1     587133   587133  '1 '     0 0 0      0.70000     5.0000      2.5000     0.08 /
   0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1     587133   587133  '1 '     0 0 0      0.75000     5.0000      3.0000     0.08 /
   0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1     587133   587133  '1 '     0 0 0      0.85000     5.0000     10.0000     0.08 /
   0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1     587133   587133  '1 '     0 0 0      0.90000     5.0000    600.0000     0.08 /
   0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1     587133   587133  '1 '     0 0 0      0.00000     1.1200    300.0000     0.08 /
   0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1     587133   587133  '1 '     0 0 0      0.00000     1.1500     30.0000     0.08 /
   0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1     587133   587133  '1 '     0 0 0      0.00000     1.2000      2.0000     0.08 /
   0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1     587133   587133  '1 '     0 0 0      0.00000     1.2500      0.5000     0.08 /
   0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1     587133   587133  '1 '     0 0 0      0.00000     1.3800      0.3000     0.08 /
   0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1     587133   587133  '1 '     0 0 0      0.00000     1.5000      0.0300     0.08 /
   0 'USRMDL'  0  'VTGTPA' 0 2 6 4 0 1     587133   587133  '1 '     0 0 0      0.00000     1.6000      0.0100     0.08 /
/
```

E.5 GEN-2016-021

```
/
/ ***** GEN-2016-021  *****
/
/
/
/
/ Vestas V110 VCSS 2.0MW (VestasWT_7_6_0_PSSE32.lib)
/ (150 units)
587153 'USRMDL' '1'  'VWCOR6' 1 1 2 45 23 104 1 0
      2000        690   903.3041        700        2.62                0.9676                0.0232
1.9807      8.3333      1.9807      8.3333      30.0000      0.2000      1.2000
0.1000      0.0012      0.9925      0.0474      1.6118      0.0000      351.8584
161.5343     0.0300      0.0000      0.0300      0.3000      0.0000      1.0000
0.3183      4.9736      2812227.1900   43.2960      90.0120      600000.0000   3.0000
0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
          0                       0              0.0000 /
0 'USRMDL' 0 'VWVAR6' 8 0 2 0 0 30 587153 '1'/
0 'USRMDL' 0 'VWLVR6' 8 0 3 65 10 35 587153 '1' 1
        0.9                   0.001                   0.15               18.6316                74.543                74.543                74.543
0.5000      1.0000      2.6200      0.9676      1.2000      0.5000      690.0000
903.3041     0.3500      0.0500      0.2500      0.0200      3.0000      4.0000
9999.0000    0.0232      0.9000      0.9000      0.0500      0.0000      0.0100
0.0000      2.0000      0.0000      1.0000      0.0000      0.0000      0.0000
0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
0.0000      0.0000 /
0 'USRMDL' 0 'VWPWR6' 8 0 3 30 7 10 587153 '1' 1
          1                     0.5                    -0.5               0.6988                0.8844                  0.98                  0.96
0.2000      0.2000      1.0000      1.0000      0.0000      0.0000      0.1000
0.1000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
0.0000      0.0000 /
0 'USRMDL' 0 'VWMEC6' 8 0 2 10 8 0 587153 '1'
      2000   422.2301   4736.754      420.75        83.5               6188.807     39.3992
0.0000      0.0000      0.0000 /
0 'USRMDL' 0 'VWMEA6' 8 0 2 10 8 5 587153 '1'
0.1000      0.1000      0.1000      0.0000      0.0000      0.0000      0.0000
          0                       0              0.0000 /
0 'USRMDL' 0 'VWVPR6' 0 2 7 30 0 18 587153 '1'  1 1 0 0 0
       0.85                     11                   0.85                     11                    0.9                     60                    1.1
60.0000     1.1500      2.0000      1.2000      0.0800      1.2500      0.0050
1.2500      0.0050      0.0000      0.0000      0.0000      0.0000      0.0000
0.0000      0.0000      0.1500      0.8000      2.7000      0.8500      3.5000
0.9000      5.0000 /
0 'USRMDL' 0 'VWFPR6' 0 2 3 12 0 7 587153 '1'  0
       56.4                    0.2                   56.4                    0.2                   56.4                    0.2                   63.6
        0.2                   63.6                    0.2                   63.6              0.2000 /
/
```

E.6 GEN-2016-023

```
/
/***** GEN-2016-023 *****
/
/
/ GE 1.79 MW & GE 2.0 MW Wind Generators
/
/
/    7 x 1.79 MW (bus#587095)
587095  'USRMDL'  1  'GEWTG2'  1 1 4 18 3 5
     0   7    1        0
     1.7900     0.8000     0.5000     0.9000     1.2200     1.2000
     2.0000     0.4000     0.8000     10.000     0.2000E-01  0.0000
     0.0000     0.5000     0.1670     0.9000     0.9250     0.0000     /
587095  'USRMDL'  1  'GEWTE2'  4 0 12 67 18 9
     587095     0        0        1        0        0
     0        0        0        1        0        1
     0.1500     18.000     5.0000     0.0000     0.0000     0.5000E-01  3.0000
     0.6000     1.1200     0.4000E-01  0.4360     -0.4360    1.1200     0.2000E-01
     0.4500     -0.4500    60.00      0.1000     0.9000
     1.1000     40.00      0.5000     1.450      0.5000E-01
     0.5000E-01  1.000      0.1500     0.9600     0.9960
     1.0040     1.040      1.000      0.9500     0.9500
     0.4000     1.000      0.2000     1.000      0.2500
     -1.000     14.00      25.00      3.000      -0.9000
     8.0000     0.2000     10.00      1.000      1.700
     1.1200     1.250      5.000      0.000      0.000
     0.0000     0.2500E-02  1.000      5.500      0.1000
     -1.0000    0.1000     0.000      0.1000     -0.1000
     0.7000     0.1200     -0.1200    /
587095  'USRMDL'  1  'GEWTT1'       5   0   1   5   4   3   0
     4.6300     0.0000     0.0000     1.8800     2.3000     /
0 'USRMDL'  0 'GEWGC1' 8   0   3   6   0   4
     587095     '1'       0
     9999.0     5.0000     30.000     9999.0     9999.0
     30.000   /
0 'USRMDL'  0 'GEWTA1'      8   0   3   9   1   4
     587095     '1'       0
     20.000     0.0000     27.000     -4.0000    0.0000     1.2250
     35.250     72.000     1200.0     /
0 'USRMDL'  0 'GEWTP1'      8   0   3   10   3   3
     587095     '1'       0
     0.3000     150.00     25.000     3.0000     30.000
     -4.0000    27.000     -10.000    10.000     1.0000     /
0 'USRMDL'  0 'GEWPLT' 8  0  2  0  0  17   587095     '1'       /
/
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587095  587095  '1'  0 0 0  0.20   5.000    1.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587095  587095  '1'  0 0 0  0.40   5.000    1.70  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587095  587095  '1'  0 0 0  0.60   5.000    2.20  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587095  587095  '1'  0 0 0  0.75   5.000    3.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587095  587095  '1'  0 0 0  0.85   5.000   10.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587095  587095  '1'  0 0 0  0.90   5.000  600.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587095  587095  '1'  0 0 0  0.00   1.101    1.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587095  587095  '1'  0 0 0  0.00   1.150    0.50  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587095  587095  '1'  0 0 0  0.00   1.175    0.20  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587095  587095  '1'  0 0 0  0.00   1.200    0.10  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587095  587095  '1'  0 0 0  0.00   1.300    0.01  0.08 /
/
0 'USRMDL' 0 'FRQTPA' 0 2 6 4 0 1  587095  587095  '1'  0 0 0 57.00  63.000   10.00  0.08 /
0 'USRMDL' 0 'FRQTPA' 0 2 6 4 0 1  587095  587095  '1'  0 0 0 54.00 100.000    1.00  0.08 /
0 'USRMDL' 0 'FRQTPA' 0 2 6 4 0 1  587095  587095  '1'  0 0 0 51.00  66.000    0.25  0.08 /
```

E.6 GEN-2016-023 (continued)

```
/
/    69 x 2.00 MW (bus#587093)
587093  'USRMDL'  1  'GEWTG2'  1 1 4 18 3 5
     0  69     1        0
     2.0000     0.8000     0.5000     0.9000     1.2200     1.2000
     2.0000     0.4000     0.8000     10.000     0.2000E-01  0.0000
     0.0000     0.5000     0.1670     0.9000     0.9250     0.0000     /
587093  'USRMDL'  1  'GEWTE2'  4 0 12 67 18 9
     587093     0        0        1        0        0
     0        0        0        1        0        1
     0.1500     18.000     5.0000     0.0000     0.0000     0.5000E-01   3.0000
     0.6000     1.1200     0.4000E-01  0.4360     -0.4360    1.1200     0.2000E-01
     0.4500     -0.4500    60.00      0.1000     0.9000
     1.1000     40.00      0.5000     1.450      0.5000E-01
     0.5000E-01  1.000     0.1500     0.9600     0.9960
     1.0040     1.040      1.000      0.9500     0.9500
     0.4000     1.000      0.2000     1.000      0.2500
     -1.000     14.00      25.00      3.000      -0.9000
     8.0000     0.2000     10.00      1.000      1.700
     1.1200     1.250      5.000      0.000      0.000
     0.0000     0.2500E-02  1.000     5.500      0.1000
     -1.0000    0.1000     0.000      0.1000     -0.1000
     0.7000     0.1200     -0.1200    /
587093  'USRMDL'  1  'GEWTT1'       5   0   1   5   4   3   0
     4.6300     0.0000     0.0000     1.8800     2.3000     /
0 'USRMDL'  0 'GEWGC1' 8   0   3   6   0   4
     587093     '1'       0
     9999.0     5.0000     30.000     9999.0     9999.0
     30.000     /
0 'USRMDL'  0 'GEWTA1'      8   0   3   9   1   4
     587093     '1'       0
     20.000     0.0000     27.000     -4.0000    0.0000     1.2250
     35.250     72.000     1200.0     /
0 'USRMDL'  0 'GEWTP1'      8   0   3   10   3   3
     587093     '1'       0
     0.3000     150.00     25.000     3.0000     30.000
     -4.0000    27.000     -10.000    10.000     1.0000     /
0 'USRMDL'  0 'GEWPLT' 8  0  2  0  0  17   587093     '1'       /
/
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587093  587093  '1'  0 0 0  0.20   5.000    1.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587093  587093  '1'  0 0 0  0.40   5.000    1.70  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587093  587093  '1'  0 0 0  0.60   5.000    2.20  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587093  587093  '1'  0 0 0  0.75   5.000    3.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587093  587093  '1'  0 0 0  0.85   5.000   10.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587093  587093  '1'  0 0 0  0.90   5.000  600.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587093  587093  '1'  0 0 0  0.00   1.101    1.00  0.08 /
```

E.7 GEN-2016-029

```
/
/***** GEN-2016-029 ******
/
/
/ GE 1.79 MW & GE 2.0 MW Wind Generators
/
/    7 x 1.79 MW (bus#587195)
587195  'USRMDL'  1  'GEWTG2'  1 1 4 18 3 5
     0   7    1        0
     1.7900    0.8000    0.5000    0.9000    1.2200    1.2000
     2.0000    0.4000    0.8000    10.000    0.2000E-01  0.0000
     0.0000    0.5000    0.1670    0.9000    0.9250    0.0000    /
587195  'USRMDL'  1  'GEWTE2'  4 0 12 67 18 9
     587195    0        0        1        0        0
     0        0        0        1        0        1
     0.1500    18.000    5.0000    0.0000    0.0000    0.5000E-01  3.0000
     0.6000    1.1200    0.4000E-01  0.4360    -0.4360    1.1200    0.2000E-01
     0.4500    -0.4500    60.00    0.1000    0.9000
     1.1000    40.00    0.5000    1.450    0.5000E-01
     0.5000E-01  1.000    0.1500    0.9600    0.9960
     1.0040    1.040    1.000    0.9500    0.9500
     0.4000    1.000    0.2000    1.000    0.2500
     -1.000    14.00    25.00    3.000    -0.9000
     8.0000    0.2000    10.00    1.000    1.700
     1.1200    1.250    5.000    0.000    0.000
     0.0000    0.2500E-02  1.000    5.500    0.1000
     -1.0000    0.1000    0.000    0.1000    -0.1000
     0.7000    0.1200    -0.1200    /
587195  'USRMDL'  1  'GEWTT1'      5   0   1   5   4   3  0
     4.6300    0.0000    0.0000    1.8800    2.3000    /
0 'USRMDL'  0 'GEWGC1' 8   0   3   6   0   4
     587195    '1'      0
     9999.0    5.0000    30.000    9999.0    9999.0
     30.000   /
0 'USRMDL'  0 'GEWTA1'      8   0   3   9   1   4
     587195    '1'      0
     20.000    0.0000    27.000    -4.0000    0.0000    1.2250
     35.250    72.000    1200.0    /
0 'USRMDL'  0 'GEWTP1'      8   0   3   10   3   3
     587195    '1'      0
     0.3000    150.00    25.000    3.0000    30.000
     -4.0000    27.000    -10.000    10.000    1.0000    /
0 'USRMDL'  0 'GEWPLT' 8  0  2  0  0  17   587195    '1'      /
/
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587195  587195  '1'  0 0 0  0.20   5.000    1.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587195  587195  '1'  0 0 0  0.40   5.000    1.70  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587195  587195  '1'  0 0 0  0.60   5.000    2.20  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587195  587195  '1'  0 0 0  0.75   5.000    3.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587195  587195  '1'  0 0 0  0.85   5.000   10.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587195  587195  '1'  0 0 0  0.90   5.000  600.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587195  587195  '1'  0 0 0  0.00   1.101    1.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587195  587195  '1'  0 0 0  0.00   1.150    0.50  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587195  587195  '1'  0 0 0  0.00   1.175    0.20  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587195  587195  '1'  0 0 0  0.00   1.200    0.10  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587195  587195  '1'  0 0 0  0.00   1.300    0.01  0.08 /
/
0 'USRMDL' 0 'FRQTPA' 0 2 6 4 0 1  587195  587195  '1'  0 0 0 57.00  63.000   10.00  0.08 /
0 'USRMDL' 0 'FRQTPA' 0 2 6 4 0 1  587195  587195  '1'  0 0 0 54.00 100.000    1.00  0.08 /
0 'USRMDL' 0 'FRQTPA' 0 2 6 4 0 1  587195  587195  '1'  0 0 0 51.00  66.000    0.25  0.08 /
```

E.7 GEN-2016-029 (continued)

```
/    69 x 2.00 MW (bus#587193)
587193  'USRMDL'  1  'GEWTG2'  1 1 4 18 3 5
     0  69     1        0
     2.0000     0.8000     0.5000     0.9000     1.2200     1.2000
     2.0000     0.4000     0.8000     10.000     0.2000E-01  0.0000
     0.0000     0.5000     0.1670     0.9000     0.9250     0.0000     /
587193  'USRMDL'  1  'GEWTE2'  4 0 12 67 18 9
     587193     0        0        1        0        0
     0        0        0        1        0        1
     0.1500     18.000     5.0000     0.0000     0.0000     0.5000E-01   3.0000
     0.6000     1.1200     0.4000E-01  0.4360     -0.4360    1.1200     0.2000E-01
     0.4500     -0.4500    60.00      0.1000     0.9000
     1.1000     40.00      0.5000     1.450      0.5000E-01
     0.5000E-01  1.000     0.1500     0.9600     0.9960
     1.0040     1.040      1.000      0.9500     0.9500
     0.4000     1.000      0.2000     1.000      0.2500
     -1.000     14.00      25.00      3.000      -0.9000
     8.0000     0.2000     10.00      1.000      1.700
     1.1200     1.250      5.000      0.000      0.000
     0.0000     0.2500E-02  1.000     5.500      0.1000
     -1.0000    0.1000     0.000      0.1000     -0.1000
     0.7000     0.1200     -0.1200    /
587193  'USRMDL'  1  'GEWTT1'       5   0   1   5   4   3   0
     4.6300     0.0000     0.0000     1.8800     2.3000     /
0 'USRMDL'  0 'GEWGC1' 8   0   3   6   0   4
     587193     '1'       0
     9999.0     5.0000     30.000     9999.0     9999.0
     30.000     /
0 'USRMDL'  0 'GEWTA1'      8   0   3   9   1   4
     587193     '1'       0
     20.000     0.0000     27.000     -4.0000    0.0000     1.2250
     35.250     72.000     1200.0     /
0 'USRMDL'  0 'GEWTP1'      8   0   3   10   3   3
     587193     '1'       0
     0.3000     150.00     25.000     3.0000     30.000
     -4.0000    27.000     -10.000    10.000     1.0000     /
0 'USRMDL'  0 'GEWPLT' 8  0  2  0  0  17   587193     '1'       /
/
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587193  587193  '1'  0 0 0  0.20   5.000   1.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587193  587193  '1'  0 0 0  0.40   5.000   1.70  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587193  587193  '1'  0 0 0  0.60   5.000   2.20  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587193  587193  '1'  0 0 0  0.75   5.000   3.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587193  587193  '1'  0 0 0  0.85   5.000  10.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587193  587193  '1'  0 0 0  0.90   5.000 600.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587193  587193  '1'  0 0 0  0.00   1.101   1.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587193  587193  '1'  0 0 0  0.00   1.150   0.50  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587193  587193  '1'  0 0 0  0.00   1.175   0.20  0.08 /
```

E.8 GEN-2016-043

```
/
/***** GEN-2016-043  ******
/
/
/ Vestas V136 GridStreamer 3.6MW & 3.45MW Wind Generators (VestasGS_8_1_1_PSSE32.lib)
/
/(61 units)
 587283 'USRMDL' '1'  'GSCOR1' 1 1 2 45 23 104 1 0
      3600        650  4522.135        0.01                0                0                0
      0.35       7.85                0.0001              940     -3700     3700     -3450
      3450       0.97                  0.85             0.75                1               20                0
         0          0                     0             0.03               0.3                0                0
         0          0                     0                0                 0                0                0
         0          0                     0                0                 0                0                0
         0          0            0.0000 /
 0 'USRMDL' 0 'GSVAR1' 8 0 2 0 0 30 587283 '1'/
 0 'USRMDL' 0 'GSLVR1' 8 0 3 65 10 35 587283 '1' 1
      0.85          0                   0.6               10               200       100       200
         0       1.08                 0.005            1.005              1.44            0.9583               650
 4522.135          0                     0                0                 0                0                0
         0          0                     0              0.9                 0                2              0.01
       1.3          0                     2                1                 0              1.05                -1
       1.2       0.85                  0.15             0.05               0.1              0.49               0.5
       0.8       0.39                   0.4                0                 0              0.05               0.9
       1.1       0.08                   0.8              0.9               1.1               1.2               0.1
       2.5        0.6             1200.264       60                1                1             1.25
       1.2  0.7000 /
 0 'USRMDL' 0 'GSPWR1' 8 0 3 30 7 10 587283 '1' 0
         1     0.6111               -0.6111          -0.2902            0.5288            0.8973            0.9304
         0          0                   0.1              0.1                20               20             0.032
     0.032          0                  0.85              0.9              0.93              1.08               1.1
       1.2          1                   1.4                0                 0                0                0
         0  0.0000 /
 0 'USRMDL' 0 'GSMEA1' 8 0 2 10 8 5 587283 '1'
     0.032      0.032                     0                0                 0                0                0
         0          0            0.0000 /
 0 'USRMDL' 0 'GSVPR1' 0 2 7 30 0 18 587283 '1'  1 1 0 0 0
      0.85       10.2                  0.85             10.2               0.9               60               1.1
      3600       1.21                     2             1.36              0.15             1.36              0.15
      1.36       0.15                     0                0                 0                0                0
         0          0                  0.55              0.7               2.6              0.7               2.6
       0.7  2.6000 /
 0 'USRMDL' 0 'GSFPR1' 0 2 3 12 0 7 587283 '1'  0
      56.4        0.2                  56.4              0.2              56.4              0.2              63.6
       0.2       63.6                   0.2             63.6         0.2000 /
```

E.8 GEN-2016-043 (continued)

```
/(3 units)
 587286 'USRMDL' '1'  'GSCOR1' 1 1 2 45 23 104 1 0
      3450        650  4333.713        0.01                0                0                0
      0.35       7.85                0.0001              940     -3700     3700     -3300
      3300       0.97                  0.85             0.75                1               20                 0
         0          0                     0             0.03               0.3                0                 0
         0          0                     0                0                 0                0                 0
         0          0                     0                0                 0                0                 0
         0          0            0.0000 /
 0 'USRMDL' 0 'GSVAR1' 8 0 2 0 0 30 587286 '1'/
 0 'USRMDL' 0 'GSLVR1' 8 0 3 65 10 35 587286 '1' 1
      0.85          0                   0.6               10               200       100       200
         0       1.08                 0.005            1.005              1.44            0.9565               650
 4333.713          0                     0                0                 0                0                 0
         0          0                     0              0.9                 0                2              0.01
       1.3          0                     2                1                 0              1.05                -1
       1.2       0.85                  0.15             0.05               0.1              0.49               0.5
       0.8       0.39                   0.4                0                 0              0.05               0.9
       1.1       0.08                   0.8              0.9               1.1               1.2               0.1
       2.5        0.6             1200.264       60                1                1                1.25
       1.2  0.7000 /
 0 'USRMDL' 0 'GSPWR1' 8 0 3 30 7 10 587286 '1' 0
         1     0.6377                -0.6377          -0.3061            0.5556             0.902             0.944
         0          0                   0.1              0.1                20               20             0.032
     0.032          0                  0.85              0.9              0.93              1.08               1.1
       1.2          1                   1.4                0                 0                 0                 0
         0  0.0000 /
 0 'USRMDL' 0 'GSMEA1' 8 0 2 10 8 5 587286 '1'
     0.032      0.032                     0                0                 0                 0                 0
         0          0            0.0000 /
 0 'USRMDL' 0 'GSVPR1' 0 2 7 30 0 18 587286 '1'  1 1 0 0 0
      0.85       10.2                  0.85             10.2               0.9                60               1.1
      3600       1.21                     2             1.36              0.15              1.36              0.15
      1.36       0.15                     0                0                 0                 0                 0
         0          0                  0.55              0.7               2.6               0.7               2.6
       0.7  2.6000 /
 0 'USRMDL' 0 'GSFPR1' 0 2 3 12 0 7 587286 '1'  0
      56.4        0.2                  56.4              0.2              56.4               0.2              63.6
       0.2       63.6                   0.2             63.6         0.2000 /
/
```

E.9 GEN-2016-050

```
/
/***** GEN-2016-050  ******
/
/
/ GE 2.3 MW Wind Generators (gewt_p32_v600.lib)
/
/(109 units)
 587353 'USRMDL' 1  'GEWTG2'  1 1 4 18 3 5
     0  109     0         0
     2.3000     0.80000     0.50000     0.9000     1.2200     1.2000
     2.0000     0.40000     0.80000     10.000     0.2000E-01  0.0000
     0.0000     0.50000     0.16700     0.9000     0.9250     0.0000     /
 587353 'USRMDL' 1  'GEWTE2'  4 0 12 67 18 9
     587353     0         0         1         0         0
     0         0         0         1         0         0
     0.1500     2.000      1.0000      0.0000     0.0000     0.5000E-01  3.0000
     0.6000     1.1200      0.4000E-01  0.4360     -0.4360    1.1000     0.20000E-01
     0.4500     -0.450      60.000      0.1000     0.90000
     1.1000     40.000      0.5000      1.4500     0.5000E-01
     0.5000E-01  1.0000      0.1500      0.9600     0.99600
     1.0040     1.0400      1.0000      1.0000     1.00000
     0.4000     1.0000      0.2000      1.0000     0.25000
     -1.000     14.000      25.000      3.0000     -0.9000
     8.0000     0.2000      10.000      1.0000     1.7000
     1.22       1.2500      5.0000      0.0000     0.0000
     0.000      0.2500E-02  1.0000      5.5000     0.10000
     -1.000     0.1000      0.0000      0.1000     -0.1000
     0.7000     0.1200      -0.120      /
 587353 'USRMDL' 1  'GEWTT1'       5   0   1   5   4   3  0
     3.2200     0.0000      0.0000      1.8800     1.5000     /
 0 'USRMDL'  0 'GEWGC1' 8   0   3   6   0   4
     587353     '1'        0
     9999.0     5.0000      30.000      9999.0     9999.0
     30.000     /
 0 'USRMDL'  0 'GEWTA1'      8   0   3   9   1   4
     587353     '1'        0
     20.000     0.0000      27.000      -4.0000    0.0000     1.2250
     56.500     104.00      1200.0      /
 0 'USRMDL'  0 'GEWTP1'      8   0   3   10   3   3
     587353     '1'        0
     0.30000    150.00      25.000      3.0000     30.000
     -4.0000    27.000      -10.000     10.000     1.0000     /
 0 'USRMDL'  0 'GEWPLT' 8  0  2  0  0  17    587353     '1'       /
/
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587353  587353  '1'  0 0 0  0.40  5.0000    1.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587353  587353  '1'  0 0 0  0.60  5.0000    1.70  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587353  587353  '1'  0 0 0  0.70  5.0000    2.50  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587353  587353  '1'  0 0 0  0.75  5.0000    3.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587353  587353  '1'  0 0 0  0.85  5.0000   10.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587353  587353  '1'  0 0 0  0.90  5.0000  600.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587353  587353  '1'  0 0 0  0.00  1.1200  300.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587353  587353  '1'  0 0 0  0.00  1.1500   30.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587353  587353  '1'  0 0 0  0.00  1.2000    2.00  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587353  587353  '1'  0 0 0  0.00  1.2500    0.50  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587353  587353  '1'  0 0 0  0.00  1.3800    0.30  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587353  587353  '1'  0 0 0  0.00  1.5000    0.03  0.08 /
0 'USRMDL' 0 'VTGTPA' 0 2 6 4 0 1  587353  587353  '1'  0 0 0  0.00  1.6000    0.01  0.08 /
/
```

E.10 GEN-2016-052

```
/
/ ***** GEN-2005-008IS & GEN-2016-052  *****
/
/ Replaces WT3G2 659294
/
/ GE 1.6 MW (gewt_p32_v600.lib)
/
/(33 units)
659294  'USRMDL'  1  'GEWTG2'  1 1 4 18 3 5
     0  33     0        0
     1.6000     0.8000     0.5000     0.9000     1.2200     1.2000
     2.0000     0.4000     0.8000     10.000     0.2000E-01  0.0000
     0.0000     0.5000     0.1670     0.9000     0.9250     0.0000     /
659294  'USRMDL'  1  'GEWTE2'  4 0 12 67 18 9
     659294     0        0        1        0        0
     0        0        0        1        0        1
     0.1500     18.000     5.0000     0.0000     0.0000     0.5000E-01  3.0000
     0.6000     1.1200     0.4000E-01  0.4360     -0.4360    1.1200     0.2000E-01
     0.4500     -0.4500     60.00     0.1000     0.9000
     1.1000     40.00     0.5000     1.450     0.5000E-01
     0.5000E-01  1.000     0.1500     0.9600     0.9960
     1.0040     1.040     1.000     0.9500     0.9500
     0.4000     1.000     0.2000     1.000     0.2500
     -1.000     14.00     25.00     3.000     -0.9000
     8.0000     0.2000     10.00     1.000     1.700
     1.1200     1.250     5.000     0.000     0.000
     0.0000     0.2500E-02  1.000     5.500     0.1000
     -1.0000     0.1000     0.000     0.1000     -0.1000
     0.7000     0.1200     -0.1200    /
659294  'USRMDL'  1  'GEWTT1'     5   0   1   5   4   3   0
     4.6300     0.0000     0.0000     1.8800     2.3000     /
0 'USRMDL'  0 'GEWGC1' 8   0   3   6   0   4
     659294     '1'       0
     9999.0     5.0000     30.000     9999.0     9999.0
     30.000     /
0 'USRMDL'  0 'GEWTA1'     8   0   3   9   1   4
     659294     '1'       0
     20.000     0.0000     27.000     -4.0000    0.0000     1.2250
     35.250     72.000     1200.0     /
0 'USRMDL'  0 'GEWTP1'     8   0   3   10   3   3
     659294     '1'       0
     0.3000     150.00     25.000     3.0000     30.000
     -4.0000     27.000     -10.000    10.000     1.0000     /
0  'USRMDL'  0 'GEWPLT' 8  0  2  0  0  17   659294     '1'       /
/
```

E.11 GEN-2016-053

```
/
/ ***** GEN-2006-015IS & GEN-2016-053 *****
/
/ Replaces WT3G2 659273
/
/ GE 1.6 MW (gewt_p32_v600.lib)
/
/(33 units)
659273  'USRMDL'  2  'GEWTG2'  1 1 4 18 3 5
     0  33     0        0
     1.6000     0.8000     0.5000     0.9000     1.2200     1.2000
     2.0000     0.4000     0.8000     10.000     0.2000E-01  0.0000
     0.0000     0.5000     0.1670     0.9000     0.9250     0.0000     /
659273  'USRMDL'  2  'GEWTE2'  4 0 12 67 18 9
     659273     0        0        1        0        0
     0        0        0        1        0        1
     0.1500     18.000     5.0000     0.0000     0.0000     0.5000E-01  3.0000
     0.6000     1.1200     0.4000E-01  0.4360     -0.4360    1.1200     0.2000E-01
     0.4500     -0.4500    60.00      0.1000     0.9000
     1.1000     40.00      0.5000     1.450      0.5000E-01
     0.5000E-01  1.000     0.1500     0.9600     0.9960
     1.0040     1.040      1.000      0.9500     0.9500
     0.4000     1.000      0.2000     1.000      0.2500
     -1.000     14.00      25.00      3.000      -0.9000
     8.0000     0.2000     10.00      1.000      1.700
     1.1200     1.250      5.000      0.000      0.000
     0.0000     0.2500E-02  1.000     5.500      0.1000
     -1.0000    0.1000     0.000      0.1000     -0.1000
     0.7000     0.1200     -0.1200    /
659273  'USRMDL'  2  'GEWTT1'      5   0   1   5   4   3   0
     4.6300     0.0000     0.0000     1.8800     2.3000    /
0 'USRMDL'  0 'GEWGC1' 8   0   3   6   0   4
     659273     '2'        0
     9999.0     5.0000     30.000     9999.0     9999.0
     30.000     /
0 'USRMDL'  0 'GEWTA1'      8   0   3   9   1   4
     659273     '2'        0
     20.000     0.0000     27.000     -4.0000    0.0000    1.2250
     35.250     72.000     1200.0     /
0 'USRMDL'  0 'GEWTP1'      8   0   3   10   3   3
     659273     '2'        0
     0.3000     150.00     25.000     3.0000     30.000
     -4.0000    27.000     -10.000    10.000     1.0000    /
0  'USRMDL'  0 'GEWPLT' 8  0  2  0  0  17   659273     '2'      /
/
```

E.12 GEN-2016-054

```
/
/ ***** GEN-2006-002IS & GEN-2016-054  *****
/
/ Replaces CIMTR3 662101
/
/ GE 1.6 MW (gewt_p32_v600.lib)
/
/(34 units)
662101  'USRMDL'  1  'GEWTG2'  1 1 4 18 3 5
     0  34     0         0
     1.6000     0.8000     0.5000     0.9000     1.2200     1.2000
     2.0000     0.4000     0.8000     10.000     0.2000E-01  0.0000
     0.0000     0.5000     0.1670     0.9000     0.9250     0.0000     /
662101  'USRMDL'  1  'GEWTE2'  4 0 12 67 18 9
     662101     0         0         1         0         0
     0         0         0         1         0         1
     0.1500     18.000     5.0000     0.0000     0.0000     0.5000E-01  3.0000
     0.6000     1.1200     0.4000E-01  0.4360     -0.4360    1.1200     0.2000E-01
     0.4500     -0.4500     60.00     0.1000     0.9000
     1.1000     40.00     0.5000     1.450     0.5000E-01
     0.5000E-01  1.000     0.1500     0.9600     0.9960
     1.0040     1.040     1.000     0.9500     0.9500
     0.4000     1.000     0.2000     1.000     0.2500
     -1.000     14.00     25.00     3.000     -0.9000
     8.0000     0.2000     10.00     1.000     1.700
     1.1200     1.250     5.000     0.000     0.000
     0.0000     0.2500E-02  1.000     5.500     0.1000
     -1.0000     0.1000     0.000     0.1000     -0.1000
     0.7000     0.1200     -0.1200    /
662101  'USRMDL'  1  'GEWTT1'      5   0   1   5   4   3   0
     4.6300     0.0000     0.0000     1.8800     2.3000     /
0 'USRMDL'  0 'GEWGC1' 8   0   3   6   0   4
     662101     '1'       0
     9999.0     5.0000     30.000     9999.0     9999.0
     30.000     /
0 'USRMDL'  0 'GEWTA1'      8   0   3   9   1   4
     662101     '1'       0
     20.000     0.0000     27.000     -4.0000    0.0000     1.2250
     35.250     72.000     1200.0     /
0 'USRMDL'  0 'GEWTP1'      8   0   3   10   3   3
     662101     '1'       0
     0.3000     150.00     25.000     3.0000     30.000
     -4.0000     27.000     -10.000    10.000     1.0000     /
0  'USRMDL'  0 'GEWPLT' 8  0  2  0  0  17   662101     '1'       /
/
```

E.13 GEN-2016-075

```
/
/ ***** GEN-2007-017IS, GEN-2007-018IS, & GEN-2016-075  *****
/
/ Replaces
/ VWCOR6 652353 & 579456
/
/ V110 VCSS 2.0 MW 60 Hz Mk10 (VestasWT_7_6_0_PSSE32.lib)
/
652353 'USRMDL' '1'  'VWCOR6' 1 1 2 45 23 104 1 0
 2000.0000 690.0000 903.3041 700.0000 2.6200 0.9676 0.0232
 1.9807 8.3333 1.9807 8.3333 30.0000 0.2000 1.2000
 0.1000 0.0012 0.9925 0.0474 1.6118 0.0000 351.8584
 161.5343 0.0300 0.0000 0.0300 0.3000 0.0000 1.0000
 0.3183 4.9736 2812227.1900 43.2960 90.0120 600000.0000 3.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000/
0 'USRMDL' 0 'VWVAR6' 8 0 2 0 0 30 652353 '1'  /
0 'USRMDL' 0 'VWLVR6' 8 0 3 65 10 35 652353 '1' 1
 0.9000 0.0010 0.1500 18.6316 74.5430 74.5430 74.5430
 0.5000 1.0000 2.6200 0.9676 1.2000 0.5000 690.0000
 903.3041 0.3500 0.0500 0.2500 0.0200 3.0000 4.0000
 9999.0000 0.0232 0.9000 0.9000 0.0500 0.0000 0.0100
 0.0000 2.0000 0.0000 1.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 /
0 'USRMDL' 0 'VWPWR6' 8 0 3 30 7 10 652353 '1' 1
 1.0000 0.5000 -0.5000 0.6988 0.8844 0.9800 0.9600
 0.2000 0.2000 1.0000 1.0000 0.0000 0.0000 0.1000
 0.1000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 /
0 'USRMDL' 0 'VWMEC6' 8 0 2 10 8 0 652353 '1'
 2000.0000 422.2301 4736.7543 420.7500 83.5000 6188.8071 39.3992
 0.0000 0.0000 0.0000 /
0 'USRMDL' 0 'VWMEA6' 8 0 2 10 8 5 652353 '1'
 0.1000 0.1000 0.1000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000/
0 'USRMDL' 0 'VWVPR6' 0 2 7 30 0 18 652353 '1'  1 1 0 0 0
 0.8500 11.0000 0.8500 11.0000 0.9000 60.0000 1.1000
 60.0000 1.1500 2.0000 1.2000 0.0800 1.2500 0.0050
 1.2500 0.0050 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.1500 0.8000 2.7000 0.8500 3.5000
 0.9000 5.0000 /
0 'USRMDL' 0 'VWFPR6' 0 2 3 12 0 7 652353 '1'  0
 56.4000 0.2000 56.4000 0.2000 56.4000 0.2000 63.6000
 0.2000 63.6000 0.2000 63.6000 0.2000 /
/
```

E.13 GEN-2016-075 (continued)

```
579456 'USRMDL' '1'  'VWCOR6' 1 1 2 45 23 104 1 0
 2000.0000 690.0000 903.3041 700.0000 2.6200 0.9676 0.0232
 1.9807 8.3333 1.9807 8.3333 30.0000 0.2000 1.2000
 0.1000 0.0012 0.9925 0.0474 1.6118 0.0000 351.8584
 161.5343 0.0300 0.0000 0.0300 0.3000 0.0000 1.0000
 0.3183 4.9736 2812227.1900 43.2960 90.0120 600000.0000 3.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000/
0 'USRMDL' 0 'VWVAR6' 8 0 2 0 0 30 579456 '1'  /
0 'USRMDL' 0 'VWLVR6' 8 0 3 65 10 35 579456 '1' 1
 0.9000 0.0010 0.1500 18.6316 74.5430 74.5430 74.5430
 0.5000 1.0000 2.6200 0.9676 1.2000 0.5000 690.0000
 903.3041 0.3500 0.0500 0.2500 0.0200 3.0000 4.0000
 9999.0000 0.0232 0.9000 0.9000 0.0500 0.0000 0.0100
 0.0000 2.0000 0.0000 1.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 /
0 'USRMDL' 0 'VWPWR6' 8 0 3 30 7 10 579456 '1' 1
 1.0000 0.5000 -0.5000 0.6988 0.8844 0.9800 0.9600
 0.2000 0.2000 1.0000 1.0000 0.0000 0.0000 0.1000
 0.1000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 /
0 'USRMDL' 0 'VWMEC6' 8 0 2 10 8 0 579456 '1'
 2000.0000 422.2301 4736.7543 420.7500 83.5000 6188.8071 39.3992
 0.0000 0.0000 0.0000 /
0 'USRMDL' 0 'VWMEA6' 8 0 2 10 8 5 579456 '1'
 0.1000 0.1000 0.1000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000/
0 'USRMDL' 0 'VWVPR6' 0 2 7 30 0 18 579456 '1'  1 1 0 0 0
 0.8500 11.0000 0.8500 11.0000 0.9000 60.0000 1.1000
 60.0000 1.1500 2.0000 1.2000 0.0800 1.2500 0.0050
 1.2500 0.0050 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.1500 0.8000 2.7000 0.8500 3.5000
 0.9000 5.0000 /
0 'USRMDL' 0 'VWFPR6' 0 2 3 12 0 7 579456 '1'  0
 56.4000 0.2000 56.4000 0.2000 56.4000 0.2000 63.6000
 0.2000 63.6000 0.2000 63.6000 0.2000 /
/
```

E.13 GEN-2016-075 (continued)

```
579459 'USRMDL' '1'  'VWCOR6' 1 1 2 45 23 104 1 0
 2000.0000 690.0000 903.3041 700.0000 2.6200 0.9676 0.0232
 1.9807 8.3333 1.9807 8.3333 30.0000 0.2000 1.2000
 0.1000 0.0012 0.9925 0.0474 1.6118 0.0000 351.8584
 161.5343 0.0300 0.0000 0.0300 0.3000 0.0000 1.0000
 0.3183 4.9736 2812227.1900 43.2960 90.0120 600000.0000 3.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000/
0 'USRMDL' 0 'VWVAR6' 8 0 2 0 0 30 579459 '1'  /
0 'USRMDL' 0 'VWLVR6' 8 0 3 65 10 35 579459 '1' 1
 0.9000 0.0010 0.1500 18.6316 74.5430 74.5430 74.5430
 0.5000 1.0000 2.6200 0.9676 1.2000 0.5000 690.0000
 903.3041 0.3500 0.0500 0.2500 0.0200 3.0000 4.0000
 9999.0000 0.0232 0.9000 0.9000 0.0500 0.0000 0.0100
 0.0000 2.0000 0.0000 1.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 /
0 'USRMDL' 0 'VWPWR6' 8 0 3 30 7 10 579459 '1' 1
 1.0000 0.5000 -0.5000 0.6988 0.8844 0.9800 0.9600
 0.2000 0.2000 1.0000 1.0000 0.0000 0.0000 0.1000
 0.1000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 /
0 'USRMDL' 0 'VWMEC6' 8 0 2 10 8 0 579459 '1'
 2000.0000 422.2301 4736.7543 420.7500 83.5000 6188.8071 39.3992
 0.0000 0.0000 0.0000 /
0 'USRMDL' 0 'VWMEA6' 8 0 2 10 8 5 579459 '1'
 0.1000 0.1000 0.1000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000/
0 'USRMDL' 0 'VWVPR6' 0 2 7 30 0 18 579459 '1'  1 1 0 0 0
 0.8500 11.0000 0.8500 11.0000 0.9000 60.0000 1.1000
 60.0000 1.1500 2.0000 1.2000 0.0800 1.2500 0.0050
 1.2500 0.0050 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.1500 0.8000 2.7000 0.8500 3.5000
 0.9000 5.0000 /
0 'USRMDL' 0 'VWFPR6' 0 2 3 12 0 7 579459 '1'  0
 56.4000 0.2000 56.4000 0.2000 56.4000 0.2000 63.6000
 0.2000 63.6000 0.2000 63.6000 0.2000 /
/
```