PJM April 2015 Queue Generation Affected System Impact Study

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1 Executive Summary

This report documents the Affected System Impacts of twenty (20) projects in the PJM generator interconnection queue on the Midcontinent Independent System Operator ("MISO") transmission system. The projects are listed in Table 1-1.

Table 1-1 List of PJM Group Generation Interconnection Projects

Queue Number	Point of Interconnection(POI)	Size(MW)	Fuel Type	State	TO
X1-020	Dumont-Greentown 765kV	1500	wind	IN	AEP
Y2-103	Zion Energy Center	360	natural gas	IL	ComEd
Y3-013	Zion Energy Center	90	natural gas	IL	ComEd
Y3-073	W.H. Zimmer Station	50	coal	OH	DEOK
Z2-028	Highland-Sammis 345kV & Highland-Mansfield 345kV	800	natural gas	OH	ATSI
Z2-029	Stuart 4	20.5	coal	OH	Dayton
Z2-081	Streator 34.5kV	13.3	methane	IL	ComEd
Z2-087	Pontiac MidPoint-Brokaw 345kV	200	wind	IL	ComEd
Z2-112	Waterford 345kV	97	natural gas	OH	AEP
AA1-013	Hanging Rock 765kV	10	natural gas	OH	AEP
AA1-018	Powerton-Goodings Grove	150	wind	IL	ComEd
AA1-040	Morris	20	natural gas	IL	ComEd
AA1-056	Bay Shore-Fostoria 345kV & Bay Shore-Monroe 345kV	161	natural gas	OH	ATSI
AA1-078	University Park North	20	natural gas	IL	ComEd
AA1-101	Tait 69kV	20	storage	OH	Dayton
AA1-116	Kensington/Kankakee	20	storage	IL	ComEd
AA1-117	Kensington/Kankakee	20	storage	IL	ComEd
AA1-129	Northbrook-Skokie	27	natural gas	IL	ComEd
AA1-146	Nelson	190	natural gas	IL	ComEd

Steady State AC analysis was performed to identify any reliability criteria violations caused by the study generators. The study identified injection constraints in the off peak scenario under both the Near-term (2017) and the Out-year (2024) analysis. Network upgrades were identified and cost allocation was performed. A summary of cost estimates identified for each scenario is provided in Table 1-2, detailed information regarding network upgrades is provided in section 3 of the report.

Table 1-2 Cost Estimate for Proposed Network Upgrades

Monitored Element	Near Term Mitigation Cost	Out Year Mitigation Cost	Queue Projects with Impacts
HOWE-STURGIS 69kV Line	$1,337,000	$1,337,000	X1-020
LAGRANGE – NORTH LAGRANGE 69kV Line	$455,000	$455,000	X1-020
Total cost of upgrades	**$1,792,000**	**$1,792,000**	

The impactful generators will need to mitigate for the out year constraints prior to being granted any injection on the PJM system.

Please note that additional projects have executed a System Impact Study (SIS) with PJM and were part of the list of projects supplied for the April 2015 analysis. These projects are remote to the MISO system and have not been included in this study

2 Study Methodology & Assumptions

2.1 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 PJM group generation requests by the usage of MISO injection criteria, and applicable local planning criteria, especially, Northern Indiana Power Service Co. (NIPSCO) generation interconnection criteria. NIPSCO's Generation Interconnection criteria can be found under section 4.5 of the planning methodology document available at:
https://www.misoenergy.org/Library/Repository/Study/TO%20Planning%20Criteria/NIPSCO%20TO%20Planning%20Criteria.pdf

2.2 Contingency Criteria

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

- NERC Category A with system intact
- NERC Category B contingencies
  - Single element outages, at buses with a nominal voltage of 69 kV and above, in the following areas: NIPS (area 217), DEI (area 208), IPL (area 216), MEC (area 635), CWLD (area 333), CWLP (area 360), CE (area 222), AEP (area 205). 100kV and above in AMMO (area 356), AMIL (area 357),
  - Multiple-element outages initiated by a fault with normal clearing such as multi-terminal lines, in AEP, CE, Ameren, MEC, CWLP, DEI, IPL, NIPS.
- NERC Category C contingencies
  - Selected NERC Category C events.

2.3 Monitored Elements

Table 2-1 Monitored Area outlines the list of areas monitored for this study.

Table 2-1 Monitored Area

Area #	Voltage	Area ID	Area Name
207	69kV and above	HE	Hoosier Energy
208	69kV and above	DEI	Duke Energy Indiana
210	69kV and above	SIGE	Southern Indiana Gas & Electric Company
216	69kV and above	IPL	Indianapolis Power & Light Company
217	69kV and above	NIPS	Northern Indiana Public Service Company
333	69kV and above	CWLD	Columbia, MO Water and Light
356	100kV and above	AMMO	Ameren Missouri
357	100kV and above	AMIL	Ameren Illinois
360	69kV and above	CWLP	City of Springfield (IL) Water Light & Power
361	69kV and above	SIPC	Southern Illinois Power Cooperative

Area #	Voltage	Area ID	Area Name
295	69kV and above	WEC	Wisconsin Electric Power Company (ATC)
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	ALTW	Alliant Energy West
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	WPC	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)

2.4 Model Development

The following MTEP base case load profiles were used for the study:

- 2017 Shoulder
- 2017 Summer Peak
- 2024 Shoulder
- 2024 Summer Peak

The study cases were built by adding and dispatching the appropriate queue projects to the base cases. The detail of each PJM interconnection request is listed in Table 1-1. The study projects were dispatched per MISO criteria to the entire PJM footprint, where generators were scaled in proportion to the available reserve.

2.5 Study Assumptions

This affected system impact study was conducted with all the participating generators operating together as a group. Analysis was not performed on individual generating units or subsets of the generating units unless specifically noted otherwise. Higher queued PJM projects were modeled as outlined in Appendix A of the report. 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.

3 Steady State Analysis

3.1 Near Term (2017) Analysis

Criteria violations were identified in the near term analysis for the off peak scenario. The summer peak analysis did not identify any violations. The following table lists the constraints identified. Proposed Network Upgrades (NU) for mitigating the constraints identified in the Near-term (2017) scenario is listed in Table 3-2.

Table 3-1 Near-Term Constraints

Monitored Element	Pre Gen flow	Post gen flow	Rating	Post Gen Loading %	ContDescr	Constraint criteria	X1-020	Z2-081
HOWE-STURGIS 69kV Line	48.3	50.3	47	107%	P2_4_LA-TIE	NIPS Facility Impact	4.2%	
LAGRANGE – NORTH LAGRANGE 69kV Line	41.0	43.0	41	105%	P2_4_LA-TIE	NIPS Facility Impact	4.8%	

Table 3-2 Proposed Near-Term Network Upgrades

Monitored Element	Constraint	Mitigation	Planning Level Estimate	Queue Projects with Impacts
HOWE-STURGIS 69kV Line	Conductor thermal limit.	Rebuild of 1.91 miles of 69kV circuit on the NIPSCO side, expected post-upgrade rating 55MVA.	$1,337,000	X1-020
		Rebuild 2.83 miles of 69kV circuit on the AEP side.	$3,400,000	
LAGRANGE – NORTH LAGRANGE 69kV Line	Conductor thermal limit.	Rebuild of 0.65 miles of 69kV circuit on the NIPSCO side, expected post-upgrade rating 47 MVA.	$455,000	X1-020

3.2 Out Year (2024) Analysis

Criteria violations were also identified in the Out year analysis for the off peak scenario. The summer peak analysis did not identify any violations. The following table lists the constraints identified. Proposed Network Upgrades (NU) for mitigating the constraints identified in the Out-year (2024) scenario is listed in Table 3-4.

Table 3-3 Out-Year Constraints

Monitored Element	Pre Gen flow	Post gen flow	Rating	Post Gen Loading %	ContDescr	Constraint criteria	X1-020	Z2-081	AA1-086
HOWE-STURGIS 69kV Line	47.4	49.6	47	105%	P2_4_LA-TIE	NIPS Facility Impact	4.5%		
LAGRANGE – NORTH LAGRANGE 69kV Line	43.2	45.3	41	110%	P2_4_LA-TIE	NIPS Facility Impact	5.1%		

Table 3-4 Proposed Out-Year Network Upgrades

Monitored Element	Constraint	Mitigation	Planning Level Estimate	Queue Projects with Impacts
HOWE-STURGIS 69kV Line	Conductor thermal limit.	Rebuild of 1.91 miles of 69kV circuit on the NIPSCO side, expected post-upgrade rating 55MVA.	$1,337,000	X1-020
		Rebuild 2.83 miles of 69kV circuit on the AEP side.	$3,400,000	
LAGRANGE – NORTH LAGRANGE 69kV Line	Conductor thermal limit.	Rebuild of 0.65 miles of 69kV circuit on the NIPSCO side, expected post-upgrade rating 47 MVA.	$455,000	X1-020

4 Conclusion

The Affected system study identified Steady State thermal violations associated with the interconnection of the Twenty PJM projects. The study identified injection constraints in the off peak scenario under both the Near-term (2017) and the Out-year (2024) analysis. Network upgrades were identified and cost allocation was performed. A summary of cost estimates identified for each scenario is provided in Table 1-2, detailed information regarding network upgrades is provided in section 3 of this report. The impactful generators will need to mitigate for the out year constraints prior to being granted any injection on the PJM system.

Appendix A PJM Higher Queued Projects

A.1 PJM November 2014 Cycle

Queue Number	POI	Size(MW)	Fuel Type	State	TO
V4-033	Desoto- Tanners Creek 345kV	299.2	wind	IN	AEP
W4-004	Madison-Tanners Creek 138kV	90	wind	IN	AEP
W4-008	Madison-Tanners Creek 138kV	90	wind	IN	AEP
X2-006	Baker 345kV	585	CC	KY	AEP
Y3-038	Rockport Unit 1	36	coal	IN	AEP
Z1-035	Lake Erie Wind 69Kv	18	wind	OH	ATSI
Z1-051	DC Cook Unit 2	102	nuclear	MI	AEP
Z1-079	Todhunter-Foster 345kV	513	CC	OH	DEOK
Z1-127	University Park	20	Peaker	IL	ComEd

A.2 PJM May 2014 Cycle

PJM Queue	PJM POI	State	MISO SH Output	MISO SPK Output	Fuel
X1-087	Stillman Valley	IL	0	19	methane
X3-023	S. Greenwich-Willard	OH	60	12	wind
Y2-050	Tidd-Canton Central	OH	371	742	natural gas,CC
Y2-053	Lemoyne 138kV	OH	0	35	Gas
Y3-088	Kendall I	IL	10	20	natural gas,CC
Y3-089	Kendall II	IL	10	20	natural gas,CC
Y3-090	Kendall III	IL	10	20	natural gas,CC
Y3-091	Kendall IV	IL	10	20	natural gas,CC
Y3-103	Valley-Raccoon 138kV	PA	102.5	205	natural gas,CC

A.3 PJM April 2013 Cycle

PJM Queue	PJM POI	State	MISO SH Output	MISO SPK Output	Fuel
V1-024	LaSalle 1	IL	20.0	20.0	nuclear
V1-025	LaSalle 2	IL	20.0	20.0	nuclear
V4-046	Byron 1	IL	20.0	20.0	nuclear
V4-047	Byron 2	IL	20.0	20.0	nuclear
V4-048	Braidwood 1	IL	20.0	20.0	nuclear
V4-049	Braidwood 2	IL	20.0	20.0	nuclear
W2-048	Pontiac MidPoint – Lanesville 345kV	IL	62.5	12.5	wind

PJM Queue	PJM POI	State	MISO SH Output	MISO SPK Output	Fuel
W3-046	Powerton 345kV – Katydid 345kV	IL	208.0	51.6	wind
W4-005	Pontiac Midpoint – Latham 345kV	IL	351.0	70.2	wind
X1-096	Loretto-Kings Creek 138kV	MD	150.0	30	wind
X2-022	Pontiac Midpoint-Lanesville II	IL	189.0	37.8	wind
X2-031	Krayn 115kV	PA	50.0	10	wind
X2-052	Dumont-Olive 345kV	IN	0	675.0	natural gas
X3-051	Flatlick 765kV	OH	0	610.0	natural gas
X4-020	Peach Bottom-TMI #1 500kV I	PA	0	800.0	natural gas
X4-021	Peach Bottom-TMI #2 500kV II	PA	0	320.0	natural gas
X4-025	Millbrook Park 138kV	KY	80.0	80.0	coal
Y1-030	Forest 69kV	OH	100.0	20	wind
Y1-065	Rock Spring 500kV	MD	0	852.0	natural gas

A.4 PJM April 2013 Cycle

PJM Queue	PJM POI	State	MISO SH Output	MISO SPK Output	Fuel
T130	Convoy – East Lima 345kV	OH	300	60	wind
T131	Lincoln – Sterling 138kV	OH	150	30	wind
T142	Southwest Lima – Marysville 345kV	OH	300	60	wind
T148	Caledonia Wind II 100 MW	IL	100	20	wind
T94	Cook – Palesades 345kV	MI	0	1035	natural gas
T99	Caledonia Wind 100 MW	IL	100	20	wind
U2-028A_AT1	Ironville 138kV	OH	135	135	other
U2-072	East Lima – Marysville 345kV	OH	300	60	wind
U3-021	Silver Lake – Cherry Valley 345kV	IL	0	100	natural gas
	Normandy-Kewanee 138kV	IL	0	100	natural gas
V1-011	Haviland 138kV	OH	100	20	wind
V1-012	Haviland 138kV	OH	150	30	wind
V2-006	East Leipsic 138kV	OH	150	30	wind
V3-007	Desoto-Tanners Creek #1 345kV	IN	200	40	wind
V3-008	Desoto-Tanners Creek #1 345kV	IN	200	40	wind
V3-009	Desoto-Tanners Creek #1 345kV	IN	200	40	wind

PJM Queue	PJM POI	State	MISO SH Output	MISO SPK Output	Fuel
V4-010	Tiffin Center 138kV	OH	200	40	wind
V4-015	Fostoria Central 138kV	OH	66.6	13.32	wind
V4-016	Valley 138kV	MI	200	40	wind
W1-072A_AT5	Lemoyne 345kV	OH	0	40	natural gas
W2-001	Fostoria Central 138kV	OH	66.6	13.32	wind
W3-059A_At6	Avery – Greenfield 138kV	OH	99	19.8	wind
W3-088	South West Lima 345kV	OH	200	40	wind
W3-128	Sporn – Waterford 345kV	OH	0	652	natural gas
W3-170	Buckskin 69kV	OH	0	12	solar
X1-027A_AT12	Davis Besse – Beaver 345kV	OH	500	100	wind
Y1-006	Jubal Early – Austinville 138kV	VA	72	14.4	wind
Y1-069	Bay Shore – Fostoria Central 345kV	OH	0	799	natural gas

A.5 PJM April 2012 Cycle

PJM Queue #	ProjectName	State	MISO SH Output	MISO SPK Output	Fuel Type
Q49	Dresden 345kV	IL	45	45	nuclear
Q50	Dresden 345kV	IL	58	58	nuclear
Q51	Quad City 345kV	IL	30	30	nuclear
Q57	Steward-Waterman 138kV	IL	22	4.4	wind
R16	Lena 138kV	IL	126	25.2	wind
R30	Pontiac Mid-Point 345kV	IL	500	100	wind
R33	Nelson 345kV	IL	0	600	natural gas
S27	Blue Mound I	IL	198	39.6	wind
S28	Blue Mound II	IL	198	39.6	wind
S36	Kankakee 138kV	IL	175	35	wind
S37	Kankakee 138kV	IL	175	35	wind
S55	Zion 345kV	IL	0	510	natural gas
S57	Hvdc	IL	3500	1192	HVDC
U1-054	Calumet	IL	0	54	natural gas
U3-031	Lincoln Generating Facility	IL	0	40	natural gas
U4-033	University Park North	IL	0	36	natural gas
05MLCS	Meadow Lake	IL	600	120	wind
Q01, Q03	Fowler Ridge	IN	750	150	wind