Midwest ISO
SPA-2014-May-Missouri
System Impact Study
Final Report

Prepared for Midwest ISO by

Ameren Services
Transmission Planning

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I. Executive Summary

This report presents the results of the SPA-2014-May-MO System Impact Study for generation interconnection project J255. The project involves connecting an HVDC line originating in western Kansas to the MISO service territory. The interconnection customer's rectifier station (345kV ac to 600kV dc) will be located in Spearville, Kansas, with their 345kV ac bus connected to wind farm feeds and also to ITC's 345kV Clark Substation. A 600kV dc line will be built from Spearville to a 500 MW inverter station (600kV dc to 345kV ac) near Ameren's Maywood Substation. The Point Of Interconnection (POI) will be the Maywood 345kV bus. The 600kV dc line will continue from the customer's Maywood area facility to eastern Indiana near AEP's Breed Substation, where a 3500 MW inverter station will be built to allow for this dc line to deliver up to 3500 MW at the Breed 345kV bus.

Below is a summary of the J255 project. (As specified in the interconnection customer's requested scope of work, the 3500 MW delivery at Breed was included in the load flow models, but was not evaluated for constraints in this system impact study.)

Project ID	Point of Interconnection	Type	Capacity (MW)
J255	Maywood 345kV Bus	Transmission Connection	500*

*This connection was studied at 100% of capacity under both summer peak and summer shoulder-peak conditions.

A. *Thermal Contingency Analysis*

As specified in the interconnection customer's requested scope of work, the scope of this J255 study was to be limited to identifying injection-related constraints for the Maywood interconnection based on single contingency NERC Category B events only. No Local Planning Criteria were to be tested – except for transfer capability. In addition, there was to be no testing for voltage-related constraints.

The analysis uncovered no injection-related constraints for the 500 MW Maywood interconnection. The analysis did flag a high number of contingency overloads related to the 3500 MW injection at the Breed 345kV bus. But, the J255 distribution factor for these overloaded facilities is less than 5% and, by the scope of the work specified by the interconnection customer, the injection at Breed was not considered generation-under-study for this System Impact Study.

B. Transfer Capability Analysis

Transfer capability analysis was performed to determine whether the injection from the transmission connection would materially decrease Ameren's import capability. The analysis included simulations with and without the customer's injection at Maywood.

The import capability study identified no import scenarios for which the proposed connection would both limit the import transfer to below the 2000 MW threshold and also reduce the import transfer by more than 200 MW. As such, no import constraints are to be assessed to the J255 injection at Maywood.

C. Short Circuit Analysis

No short-circuit analysis should be required for this connection because the customer's HVDC line should not contribute current to an ac short circuit (except for its rated load current).

D. Stability Analysis

At the customer's request, analysis was not performed to determine whether the study connection would have any adverse impacts on the stability of the transmission system.

E. Summary of Costs

At the customer's request, no cost estimates will be provided as part of this System Impact Study – including the cost to physically connect the customer's 345kV ac bus to the Maywood 345kV bus.

II. Introduction

The purpose of the study was to identify any injection-related constraints on the transmission system for the transmission connection project having MISO project J255. The project involves connecting an HVDC line originating in western Kansas to the MISO service territory. The interconnection customer's rectifier station (345kV ac to 600kV dc) will be located in Spearville, Kansas, with their 345kV ac bus connected to wind farm feeds and also to ITC's 345kV Clark Substation. A 600kV dc line will be built from Spearville to a 500 MW inverter station (600kV dc to 345kV ac) near Ameren's Maywood Substation.

The 600kV dc line will continue from the customer's Maywood area facility to eastern Indiana near AEP's Breed Substation, where a 3500 MW inverter station will be built to allow for this dc line to deliver up to 3500 MW at the Breed 345kV bus. As specified in the interconnection customer's requested scope of work, the 3500MW delivery at Breed was included in the models, but was not evaluated for constraints in the J255 study.

The system impact study of this project is referred to as SPA-2014-May-MO. The Point Of Interconnection (POI) will be the Maywood 345kV bus, the general electrical location of which is shown in the Figure II.1 study area map. The requested in-service date for this project is October 31, 2018.

Figure II.1: Study Area Map (CEII)

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Below is a summary of the project.

Project ID	Point of Interconnection	Type	Capacity (MW)
J255	Maywood 345kV Bus	Transmission Connection	500*

*This connection was studied at 100% of capacity under both summer peak and summer shoulder-peak conditions.

The J255 injection at Maywood was assumed to be at 100% of rated capacity during summer peak conditions and 100% of rated capacity for summer off-peak conditions. The off-peak model used for the study has loads at 70% of peak load levels. The J255 customer is required to mitigate all injection, stability, and short circuit constraints, as well as any local planning criteria violations, resulting from the incremental increase in network resource generation. However, as specified in the interconnection customer's requested scope of work, the purpose of this study was to identify injection-related constraints under N-0 and N-1 contingency conditions only, as well as any adverse effects on local transfer capability.

III. Power Flow Analysis

A. Introduction

The power flow analysis considered both MISO criteria and Ameren Transfer Capability (i.e., Import) criteria. MISO constraints are classified as either injected related or non-injected related. For N-0 conditions, a constraint is identified as an injection related constraint if one or more of the following apply:

- The generator has a larger than 5% Distribution Factor on the overloaded facility.
- The overloaded facility is at the study generator's outlet.
- The megawatt impact due to the study generator is greater than or equal to 20% of the applicable (Normal) rating of the overloaded facility.

For N-1 conditions, a constraint is identified as an injection related constraint if one or more of the following apply:

- The generator has a larger than 20% Distribution Factor on the overloaded facility under post contingency conditions.
- The overloaded facility or the overload-causing contingency is at the study generator's outlet.
- The megawatt impact due to the study generator is greater than or equal to 20% of the applicable (Emergency) rating of the overloaded facility.

The power flow analysis included the evaluation of all single contingencies within the study area (Missouri, Illinois, Iowa, Indiana, and Ohio).

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Ameren Local Planning Criteria requires a transfer analysis to check for import limitations. Ten import scenarios were tested for contingencies which limit Ameren's incremental import capability to below 2000 MW with the added study generation. A minimum reduction in FCITC of 200 MW and a minimum distribution factor of 3.0% are required to assess a facility upgrade to the generator(s).

B. *Ad-hoc Study Group Participation*

MISO system impact studies are facilitated using ad-hoc study groups made up of affected transmission owners. The participants in the ad-hoc study group formed for this system impact study include representatives from Ameren, Duke, Northern Indiana Public Service (NIPSCO), AEP, Commonwealth Edison (ComEd), Vectren, MidAmerican Energy Company (MEC), City Water Light and Power (CWLP), International Transmission Company (ITC Midwest), Prairie Power Inc. (PPI), Associated Electric Coop Inc. (AECI), Southern Illinois Power Company (SIPC) and Pennsylvania-New Jersey-Maryland (PJM). These companies participated in the study process, providing information related to their systems.

C. *Contingencies*

The following summarizes the specific criteria that were deemed applicable and were evaluated in this study:

1. System performance under normal conditions (N-0),
2. System performance under single transmission contingency conditions (N-1),
3. System performance under Ameren generator outage conditions (N-1),
4. Ameren simultaneous import capability

Evaluation of single contingencies included the outage of generators, lines, and transformers as defined in the contingency files. MISO provided these explicit contingency files for the following areas: AMIL, AMMO, ALTW, ComEd, CWLP, HE, IPL, MEC, NIPSCO, SIGE, and SIPC. Typically these contingencies represent all elements out during a fault condition with normal relay operation.

The contingency analysis also considered the outage of all branches individually as represented in the power flow model for the above areas and also for AECI, AEP, CWLD, DEI, FE, INDN, ITCT, KACY, KCPL, LES, METC, MIPU, NPPD, OPPD, OVEC, and WAPA . These outages typically represent the opening of a breaker without a fault. All of these contingencies fall under the NERC Category B definition.

The contingency analyses were performed using the d/c analysis in the PSS/MUST program. The distribution factors for constrained facilities were calculated within MUST.

D. Monitored Areas and Elements

Monitored facilities included all branches or tie lines rated 69 kV or higher in the areas mentioned in Section C, with the exception of AMIL and AMMO where only a few of the 69 kV branches are explicitly included in the models, plus the following areas: ALTE, DPC, GRE, MDU, MGE, MH, MP, MPW, OTP, SMMPA, UPPC, WEC, WPS, and XEL. The monitored area for the Ameren import analysis included only Ameren facilities rated 100 kV or higher.

E. Power Flow Models

MISO provided a power flow model based on the 2013 MTEP, 2024 SUPK model. This model represents the forecasted 2024 summer peak conditions in the MISO footprint. MISO also provided a power flow model based upon forecasted 2024 summer off-peak loads, 70% of peak loading. These models include applicable higher-queued generator projects from MISO and PJM queues.

For these models, the transmission connection of the customer's 600kV dc line to the Maywood 345kV bus (via an inverter station) was modeled as a 500MW, 0.7kV generator connected (through 34.5kV transformation) to the Maywood 345kV bus. Two separate models (summer and off-peak) were created by switching this Maywood generator off and making up the power from the MISO areas.

F. Higher Queued Projects

Higher queued generation projects that required a representation in the power flow model are listed below in Table III.1, which shows the MISO and PJM project identification, location, generation type, and output capacity.

Table III.1
Higher Queued Generation

Project ID	Point of Interconnection	Type	Capacity (MW)
G549	Williams Substation 69 kV	Wind	20
G587	Winthrop 69 kV Substation	Wind	20
G620	Kenyon - Dodge 69 kV	Wind	19
G621	Golf - Wookstock 34.5 kV	Wind	20
G761	ITC Midwest Keokuk West - Keokuk Hydro 69kV	Coal	28
G798	ITC Midwest Fernald 115kV Substation	Wind	150
G806	Ameren Coffeen Unit #2	Coal	19
G826	Xcel Lakefield Generation SW - Lakefield Junction 345kV	Wind	200
G830	GRE McHenry substation	Wind	99
G858	XEL Black Oak 69 kV Substation	Wind	38
G921	Ameren Coffeen Plant 345 kV	Coal	0
G947	ITCM Whispering Wilows 161kV Substation	Wind	99

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Project ID	Point of Interconnection	Type	Capacity (MW)
H008	ITC Midwest Richfield 69 kV Substation	Wind	36
H009	ITC Midwest Traer - Marshalltown 161 kV	Wind	150
H021	Wellsburg 115kV Substation	Wind	138.6
H048	Xcel Paynesville 69 kV Substation	Wind	50
H061	Vasa 69 kV substation	Wind	39
H062	Goodhue 69 kV Substation	Wind	39
H071	Xcel Black Oak 69 kV Substation	Wind	40
H081	Brookings County - Lyon County 345kV	Wind	201
H096	Grand Junction - Perry 161 kV	Wind	50
J026	Adams 161 kV Substation	Wind	50
J034	New Holland 138 kV Substation	Wind	175
J054	DEM Kokomo - Noblesville 230kV	Wind	197.8
J075	Bauer - Rapson 345 kV	Wind	150
J092	Scranton substation	Wind	20
J097	ITC Midwest Denmark - Newport 161kV	Wind	200
J118	MEC Drager - Grand Junction 161 kV	Wind	50
J161	Bauer - Rapson 345 kV	Wind	155
J183	Split Rock Substation	Wind	200
J191	Rolling Hills 345 kV Substation	Wind	101.2
J196	Vermillion 138 kV Substation	Wind	50
J199	Slate Substation	Wind	120
J200	RM Heskett Station 115 kV & 41.6 kV	Gas	99
J202	ITC Atlanta - Tuscola 115 kV	Wind	101
J215	Stillwell 345 kV	Gas	670
J232	Baldwin Station	Coal	35
J233	ITC Midwest Marshalltown 161 (Sutherland) Substation	Gas	700
J235	Bauer - Rapson 345 kV	Wind	110
J238	Eagle Valley 138kV Substation	Gas	725
J239	Merdosia Unit 4	Coal	200
J256	NIPSCO Plymouth 69kV	Gas	8
J262	OTP Jamestown 345/115 kV substation	Wind	100
J263	OTP Jamestown 345/115 kV Substation	Wind	100
J274	Winterset - Creston 161 kV	Wind	100
J276	Sheldon South	Wind	150
J278	Pleasant Valley Station 161kV	Wind	200
J279	Raun 345 kV Substation	Coal	30
J288	Atwater - Grove City 69kV	Wind	40
J290	230 kV Rugby to Glenboro	Wind	150
Q039	Kewanee 138kV	Wind	105
Q049	Dresden 345kV	Nuclear	70
Q050	Dresden 345kV	Nuclear	70
Q051	Quad City 345kV	Nuclear	140
Q057	Steward - Waterman 138kV	Wind	240
R016	Lena 138kV	Wind	126
R030	Pontiac Mid-Point 345kV	Wind	500
R033	Nelson 345kV	Gas	600
R26	MEC Cooper - Booneville 345 kV	Wind	400
R39	Raun - Lakefield Junction	Wind	500
R42	Lehigh 345 kV Substation	Wind	250
R49	Pomeroy Generating station	Wind	12

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Project ID	Point of Interconnection	Type	Capacity (MW)
R65	R34 Expansion	Wind	92
S036	Kankakee 138kV	Wind	175
S037	Kankakee 138kV	Wind	175
U3-031	Lincoln Generating Facility	Gas	40
X3-028	Breed 345kV	HVDC	3500

G. Study Project

In the power flow models, the J255 injection at Maywood was represented by an equivalent generator at the POI. The below Table III.2 shows the study generation project for this system impact study. Note that the J255 customer's 3500MW injection at the Breed 345kV bus was included in the power flow models. But, as specified in the interconnection customer's requested scope of work, this was not considered "generation under study" for this system impact study. This 3500MW injection was included in all of the cases, regardless of whether the 500 MW generator at Maywood was shown as On or Off.

Table III.2
Study Generation

Project ID	Point of Interconnection	Type	Capacity (MW)
J255	Maywood 345kV Bus	Transmission Connection	500

H. Power Flow Analysis Results – MISO Criteria

Base case (N-0) conditions, with all transmission elements in service, were monitored for transmission line or transformer loadings exceeding 100% of their Normal ratings. For N-0 conditions, a constraint is identified as an injection related constraint if one or more of the following apply:

- The generator has a larger than 5% Distribution Factor on the overloaded facility.
- The overloaded facility is at the study generator's outlet.
- The megawatt impact due to the study generator is greater than or equal to 20% of the applicable (Normal) rating of the overloaded facility.

No transmission elements were identified as injection related constraints under these criteria. Of the transmission elements loaded beyond 100% of their Normal ratings with the study generator on, none had a study project distribution factor exceeding 1.0%.

Single transmission contingencies (N-1) were simulated over the entire study area. Transmission elements that were loaded over 100% of their summer emergency ratings

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under a single contingency were flagged for review. For N-1 conditions, a constraint is identified as an injection related constraint if one or more of the following apply:

- The generator has a larger than 20% Distribution Factor on the overloaded facility under post contingency conditions.
- The overloaded facility or the overload-causing contingency is at the study generator's outlet.
- The megawatt impact due to the study generator is greater than or equal to 20% of the applicable (Emergency) rating of the overloaded facility.

No transmission elements were identified as injection related constraints under these criteria.

Non-injection constraints are defined as elements that are loaded to greater than 100% of their summer emergency rating under a single contingency and have a distribution factor of between 5% and 20%. These constraints do not require mitigation from the generator but are typically listed here for informational purposes. No transmission elements were identified as non-injection constraints under these criteria.

The study did identify a number of elements loaded to greater than 100% of their summer emergency rating under a single contingency and having a distribution factor between 1% and 5%. These are listed in the below tables III.3 (summer peak) and III.4 (summer off-peak) for informational purposes. The large number of overloads on these two tables is due to the models having 3500 MW of generation injected into the Breed 345kV bus (representing the injection from the customer's 600kV dc line) with no additional outlet facilities modeled. As a result, many lines in this part of the system show up as overloaded. For instance, the Meadow – Reynolds 345kV line is loaded to 152% of its normal rating under N-0 conditions in the off-peak model; this Normal loading far exceeds the line's emergency rating. As a result, a large number of contingency overloads were flagged for the Meadow – Reynolds 345kV line; one (loss of Jefferson-Rockport 765kV line) had loading exceeding 200% of the line's emergency rating in the off-peak model. Note that these overloaded facilities did not show up as injection-related constraints because the J255 distribution factor is well below required levels and the 3500 MW generator at Breed is not generation-under-study for this system impact study.

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Table III.3
2024 Summer Peak N-1 Overloads Having 1% - 5% Distribution Factors

** From bus **	** To bus **	CKT	Cont MW	Base Flow	Rate B	Cont Ld%	Contingency Description	Cont. MW with J255 OFF	MW Diff with J255	J255 D.F.	MW Diff % of Rate B
243213 05BREED 345	254539 16WHEAT 345	1	***1092.8***	387.6	956.0	***114***	243208 05JEFRSO 765 243209 05ROCKPT 765 1	1079.6	13.2	0.025	1.4
243217 05DEQUIN 345	243878 05MEADOW 345	1	***1047.1***	585.7	971.0	***108***	243217 05DEQUIN 345 243878 05MEADOW 345 2	1041.1	6.0	0.012	0.6
243217 05DEQUIN 345	243878 05MEADOW 345	2	***1047.1***	585.5	971.0	***108***	243217 05DEQUIN 345 243878 05MEADOW 345 1	1041.1	6.0	0.012	0.6
243878 05MEADOW 345	255205 17REYNOLDS 345	1	***1397.4***	939.6	971.0	***144***	243208 05JEFRSO 765 243209 05ROCKPT 765 1	1391	6.4	0.014	0.7
243878 05MEADOW 345	255205 17REYNOLDS 345	1	***1227.7***	939.6	971.0	***126***	243207 05GRNTWN 765 243208 05JEFRSO 765 1	1222.5	5.2	0.011	0.5
243878 05MEADOW 345	255205 17REYNOLDS 345	1	***1171.2***	939.6	971.0	***121***	243229 05OLIVE 345 243878 05MEADOW 345 1	1165.3	5.9	0.013	0.6
243878 05MEADOW 345	255205 17REYNOLDS 345	1	***1069.6***	939.6	971.0	***110***	243209 05ROCKPT 765 243210 05SULLVA 765 1	1063.3	6.3	0.014	0.6
243878 05MEADOW 345	255205 17REYNOLDS 345	1	***1045.6***	939.6	971.0	***108***	249505 08CAYUGA 345 249516 08NUCOR 345 1	1040.3	5.3	0.012	0.5
243878 05MEADOW 345	255205 17REYNOLDS 345	1	***1011.7***	939.6	971.0	***104***	249516 08NUCOR 345 249529 08WHITST 345 1	1006.4	5.3	0.012	0.5
243878 05MEADOW 345	255205 17REYNOLDS 345	1	***994.9***	939.6	971.0	***103***	243217 05DEQUIN 345 249524 08WESTW2 345 2	990.4	4.5	0.010	0.5
243878 05MEADOW 345	255205 17REYNOLDS 345	1	***994.9***	939.6	971.0	***103***	249524 08WESTW2 345 249873 08WESTW2 138 1	990.4	4.5	0.010	0.5
243878 05MEADOW 345	255205 17REYNOLDS 345	1	***993.2***	939.6	971.0	***102***	249504 08CAYSUB 345 249505 08CAYUGA 345 1	986.8	6.4	0.014	0.7
243878 05MEADOW 345	255205 17REYNOLDS 345	1	***988.5***	939.6	971.0	***102***	243217 05DEQUIN 345 249525 08WESTWD 345 1	984	4.5	0.010	0.5
243878 05MEADOW 345	255205 17REYNOLDS 345	1	***988.5***	939.6	971.0	***102***	249525 08WESTWD 345 249874 08WESTWD 138 1	984	4.5	0.010	0.5
243878 05MEADOW 345	255205 17REYNOLDS 345	1	***987.4***	939.6	971.0	***102***	249608 08CAYUGA 230 249615 08FRNKFT 230 1	982.7	4.7	0.010	0.5
243878 05MEADOW 345	255205 17REYNOLDS 345	1	***974.3***	939.6	971.0	***100***	249625 08NEWLON 230 249635 08WEBSTE 230 1	969.6	4.7	0.010	0.5
243878 05MEADOW 345	255205 17REYNOLDS 345	1	***972.6***	939.6	971.0	***100***	270853 PONTIAC ; R 345 348847 7BROKAW 345 1	967.3	5.3	0.011	0.5
270810 LOCKPORT ; B 345	274702 KENDALL ;BU 345	1	***-1554.3***	-1019.0	1479.0	***105***	270811 LOCKPORT ; R 345 274703 KENDALL ;RU 345 1	-1540.2	-14.1	-0.028	1.0

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Table III.4
2024 Summer Off-Peak N-1 Overloads Having 1% - 5% Distribution Factors

** From bus ** ** To bus ** CKT	Cont MW	Base Flow	Rate B	Cont Ld%	Contingency Description	Cont. MW with J255 OFF	MW Diff with J255	J255 D.F.	MW Diff % of Rate B
242940 05MUSKNG 345 242947 05WATERF 345 1	-1912.9	-1507.2	1806	106	242516 05MOUNTN 765 242920 05BELMON 765 1	-1904.0	-8.9	-0.010	0.5
243212 05BENTON 345 243215 05COOK 345 1	-2045.1	-1306.3	1887	108	243215 05COOK 345 256019 18PALISD 345 2	-2027.3	-17.8	-0.041	0.9
243212 05BENTON 345 256019 18PALISD 345 1	2165.0	1327.1	1859	117	243215 05COOK 345 256019 18PALISD 345 2	2144.2	20.8	0.049	1.1
243213 05BREED 345 254539 16WHEAT 345 1	1847.6	912.7	956	193	243208 05JEFRSO 765 243209 05ROCKPT 765 1	1832.2	15.4	0.026	1.6
243213 05BREED 345 254539 16WHEAT 345 1	1186.8	912.7	956	124	243209 05ROCKPT 765 243210 05SULLVA 765 1	1171.2	15.6	0.026	1.6
243213 05BREED 345 254539 16WHEAT 345 1	1093.2	912.7	956	114	249505 08CAYUGA 345 249516 08NUCOR 345 1	1078.9	14.3	0.023	1.5
243213 05BREED 345 254539 16WHEAT 345 1	1068.4	912.7	956	112	243213 05BREED 345 243216 05DARWIN 345 1	1054.9	13.5	0.022	1.4
243213 05BREED 345 254539 16WHEAT 345 1	1068.4	912.7	956	112	243216 05DARWIN 345 243221 05EUGENE 345 1	1054.9	13.5	0.022	1.4
243213 05BREED 345 254539 16WHEAT 345 1	1054.2	912.7	956	110	249516 08NUCOR 345 249529 08WHITST 345 1	1039.9	14.3	0.023	1.5
243213 05BREED 345 254539 16WHEAT 345 1	1048.2	912.7	956	110	249508 08DRESSR 345 249521 08SUGCRK 345 1	1032.0	16.2	0.026	1.7
243213 05BREED 345 254539 16WHEAT 345 1	1036.9	912.7	956	109	Gen 16PETERSBURG 22.0 Unit ID 3	1024.1	12.8	0.021	1.3
243213 05BREED 345 254539 16WHEAT 345 1	1036.1	912.7	956	108	Gen 16PETERSBURG 22.0 Unit ID 4	1023.4	12.7	0.021	1.3
243213 05BREED 345 254539 16WHEAT 345 1	1036.5	912.7	956	108	243221 05EUGENE 345 249504 08CAYSUB 345 1	1021.3	15.2	0.025	1.6
243213 05BREED 345 254539 16WHEAT 345 1	1026.8	912.7	956	107	249504 08CAYSUB 345 249505 08CAYUGA 345 1	1011.6	15.2	0.024	1.6
243213 05BREED 345 254539 16WHEAT 345 1	1018.7	912.7	956	107	242924 05HANG R 765 243208 05JEFRSO 765 1	1004.9	13.8	0.021	1.4
243213 05BREED 345 254539 16WHEAT 345 1	1013.3	912.7	956	106	243213 05BREED 345 243217 05DEQUIN 345 1	999.7	13.6	0.022	1.4
243213 05BREED 345 254539 16WHEAT 345 1	1011.5	912.7	956	106	Gen 16PETERSBURG 22.0 Unit ID 2	998.6	12.9	0.021	1.3
243213 05BREED 345 254539 16WHEAT 345 1	993.6	912.7	956	104	346809 7CASEY 345 347340 7KANSAS 345 1	979.8	13.8	0.021	1.4
243213 05BREED 345 254539 16WHEAT 345 1	992.7	912.7	956	104	CSYW-SDNY-1	979.0	13.7	0.021	1.4
243213 05BREED 345 254539 16WHEAT 345 1	986.7	912.7	956	103	249521 08SUGCRK 345 347340 7KANSAS 345 1	970.6	16.1	0.026	1.7
243213 05BREED 345 254539 16WHEAT 345 1	984.1	912.7	956	103	Unit:251861 08GIB1 24.0 Id:1	971.0	13.1	0.021	1.4
243213 05BREED 345 254539 16WHEAT 345 1	984.1	912.7	956	103	Unit:251862 08GIB2 24.0 Id:2	971.0	13.1	0.021	1.4
243213 05BREED 345 254539 16WHEAT 345 1	984.1	912.7	956	103	Unit:251863 08GIB3 24.0 Id:3	971.0	13.1	0.021	1.4
243213 05BREED 345 254539 16WHEAT 345 1	982.9	912.7	956	103	Unit:251865 08GIB5 24.0 Id:5	969.9	13.0	0.021	1.4
243213 05BREED 345 254539 16WHEAT 345 1	983.2	912.7	956	103	Unit:251864 08GIB4 24.0 Id:4	970.1	13.1	0.021	1.4
243213 05BREED 345 254539 16WHEAT 345 1	971.7	912.7	956	102	242865 05JEFRSO 345 243208 05JEFRSO 765 1	957.7	14.0	0.022	1.5
243213 05BREED 345 254539 16WHEAT 345 1	971.7	912.7	956	102	242865 05JEFRSO 345 248000 06CLIFTY 345 Z1	957.7	14.0	0.022	1.5
243213 05BREED 345 254539 16WHEAT 345 1	968.8	912.7	956	101	NIPS1	955.3	13.5	0.021	1.4
243213 05BREED 345 254539 16WHEAT 345 1	966.7	912.7	956	101	243206 05DUMONT 765 246999 05SORENS 765 1	953.2	13.5	0.021	1.4
243213 05BREED 345 254539 16WHEAT 345 1	965.8	912.7	956	101	243878 05MEADOW 345 255205 17REYNOLDS 345 1	952.3	13.5	0.021	1.4
243213 05BREED 345 254539 16WHEAT 345 1	964.8	912.7	956	101	Gen 16PETERSBURG 20.0 Unit ID 1	951.6	13.2	0.021	1.4
243215 05COOK 345 256019 18PALISD 345 2	2105.6	1295.0	1859	113	243212 05BENTON 345 256019 18PALISD 345 1	2086.0	19.6	0.047	1.1
243215 05COOK 345 256019 18PALISD 345 2	1984.8	1295.0	1859	107	243212 05BENTON 345 243215 05COOK 345 1	1967.4	17.4	0.041	0.9
243217 05DEQUIN 345 243878 05MEADOW 345 1	1128.2	631.0	971	116	243217 05DEQUIN 345 243878 05MEADOW 345 2	1126.2	2.0	0.011	0.2
243217 05DEQUIN 345 243878 05MEADOW 345 2	1128.2	630.9	971	116	243217 05DEQUIN 345 243878 05MEADOW 345 1	1126.2	2.0	0.011	0.2

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** From bus ** ** To bus ** CKT	Cont MW	Base Flow	Rate B	Cont Ld%	Contingency Description	Cont. MW with J255 OFF	MW Diff with J255	J255 D.F.	MW Diff % of Rate B
243219 05DUMONT 345 243234 05TWIN B 345 1	1437.6	925.2	1409	102	243219 05DUMONT 345 243234 05TWIN B 345 2	1429.3	8.3	0.021	0.6
243219 05DUMONT 345 243234 05TWIN B 345 2	1437.6	925.2	1409	102	243219 05DUMONT 345 243234 05TWIN B 345 1	1429.3	8.3	0.021	0.6
243219 05DUMONT 345 255113 17STILLWELL 345 1	-1519.0	-717.1	1409	108	243206 05DUMONT 765 270644 WILTON ; 765 1	-1507.5	-11.5	-0.023	0.8
243221 05EUGENE 345 249504 08CAYSUB 345 1	1396.2	924.3	1386	101	243208 05JEFRSO 765 243209 05ROCKPT 765 1	1381.8	14.4	0.028	1.0
243229 05OLIVE 345 274804 UNIV PK N;RP 345 1	-977.0	-519.5	971	101	243206 05DUMONT 765 270644 WILTON ; 765 1	-968.2	-8.8	-0.020	0.9
243878 05MEADOW 345 255205 17REYNOLDS 345 1	2014.9	1408.1	971	208	243208 05JEFRSO 765 243209 05ROCKPT 765 1	2011.8	3.1	0.012	0.3
243878 05MEADOW 345 255205 17REYNOLDS 345 1	1699.4	1408.1	971	175	243229 05OLIVE 345 243878 05MEADOW 345 1	1697.5	1.9	0.011	0.2
243878 05MEADOW 345 255205 17REYNOLDS 345 1	1586.0	1408.1	971	163	243209 05ROCKPT 765 243210 05SULLVA 765 1	1582.8	3.2	0.012	0.3
243878 05MEADOW 345 255205 17REYNOLDS 345 1	1565.3	1408.1	971	161	249505 08CAYUGA 345 249516 08NUCOR 345 1	1562.8	2.5	0.010	0.3
243878 05MEADOW 345 255205 17REYNOLDS 345 1	1560.0	1408.1	971	161	243221 05EUGENE 345 249504 08CAYSUB 345 1	1556.0	4.0	0.013	0.4
243878 05MEADOW 345 255205 17REYNOLDS 345 1	1548.0	1408.1	971	159	249504 08CAYSUB 345 249505 08CAYUGA 345 1	1544.1	3.9	0.013	0.4
243878 05MEADOW 345 255205 17REYNOLDS 345 1	1544.1	1408.1	971	159	243206 05DUMONT 765 270644 WILTON ; 765 1	1541.4	2.7	0.011	0.3
243878 05MEADOW 345 255205 17REYNOLDS 345 1	1531.3	1408.1	971	158	249516 08NUCOR 345 249529 08WHITST 345 1	1528.8	2.5	0.010	0.3
243878 05MEADOW 345 255205 17REYNOLDS 345 1	1463.1	1408.1	971	151	Line 16PETE 345.0 to 16WHEAT 345.0 Circ	1460.5	2.6	0.010	0.3
243878 05MEADOW 345 255205 17REYNOLDS 345 1	1463.4	1408.1	971	151	Line 16WHEAT 345.0 to 05BREED 345.0 Circuit 12	1460.8	2.6	0.010	0.3
243878 05MEADOW 345 255205 17REYNOLDS 345 1	1459.7	1408.1	971	150	270704 LORETTO ; B 345 270926 WILTON ; B 345 1	1457.3	2.4	0.010	0.2
249505 08CAYUGA 345 249516 08NUCOR 345 1	1519.4	1283.9	1386	110	243208 05JEFRSO 765 243209 05ROCKPT 765 1	1512.9	6.5	0.013	0.5
249505 08CAYUGA 345 249516 08NUCOR 345 1	1439.1	1283.9	1386	104	249510 08GIBSON 345 249526 08WHEAT 345 1	1433.2	5.9	0.012	0.4
249505 08CAYUGA 345 249516 08NUCOR 345 1	1436.8	1283.9	1386	104	249526 08WHEAT 345 249530 08EDWDSP 345 1	1431.0	5.8	0.012	0.4
249505 08CAYUGA 345 249516 08NUCOR 345 1	1427.9	1283.9	1386	103	249508 08DRESSR 345 249521 08SUGCRK 345 1	1419.0	8.9	0.017	0.6
249505 08CAYUGA 345 249516 08NUCOR 345 1	1404.9	1283.9	1386	101	Line 16WHEAT 345.0 to 05BREED 345.0 Circuit 12	1397.1	7.8	0.015	0.6
249505 08CAYUGA 345 249516 08NUCOR 345 1	1404.3	1283.9	1386	101	Line 16PETE 345.0 to 16WHEAT 345.0 Circ	1396.6	7.7	0.015	0.6
249505 08CAYUGA 345 249516 08NUCOR 345 1	1400.7	1283.9	1386	101	249500 08AMO 345 249530 08EDWDSP 345 1	1394.8	5.9	0.012	0.4
249505 08CAYUGA 345 249516 08NUCOR 345 1	1397.6	1283.9	1386	101	Line 16PETE 345.0 to 16THOMPS 345.0 Cir	1391.5	6.1	0.012	0.4
249505 08CAYUGA 345 249516 08NUCOR 345 1	1396.1	1283.9	1386	101	NIPS1	1390.1	6.0	0.013	0.4
249516 08NUCOR 345 249529 08WHITST 345 1	1242.0	1006.5	1195	104	243208 05JEFRSO 765 243209 05ROCKPT 765 1	1235.5	6.5	0.013	0.5
270704 LORETTO ; B 345 270926 WILTON ; B 345 1	1445.3	1094.8	1280	113	270717 DRESDEN ; R 345 270853 PONTIAC ; R 345 1	1427.0	18.3	0.039	1.4
270704 LORETTO ; B 345 270926 WILTON ; B 345 1	1421.5	1094.8	1280	111	270607 COLLINS ; 765 270644 WILTON ; 765 1	1407.3	14.2	0.031	1.1
270704 LORETTO ; B 345 270926 WILTON ; B 345 1	1340.2	1094.8	1280	105	270607 COLLINS ; 765 802031 S-057 765 1	1327.2	13.0	0.028	1.0
270810 LOCKPORT ; B 345 274702 KENDALL ;BU 345 1	-1780.9	-1166.5	1479	120	270811 LOCKPORT ; R 345 274703 KENDALL ;RU 345 1	-1766.9	-14.0	-0.026	0.9
270810 LOCKPORT ; B 345 274702 KENDALL ;BU 345 1	-1525.7	-1166.5	1479	103	274702 KENDALL ;BU 345 274703 KENDALL ;RU 345 Z1	-1506.4	-19.3	-0.037	1.3
270811 LOCKPORT ; R 345 274703 KENDALL ;RU 345 1	-1795.3	-1194.4	1656	108	270810 LOCKPORT ; B 345 274702 KENDALL ;BU 345 1	-1781.3	-14.0	-0.026	0.8
274702 KENDALL ;BU 345 349662 7TAZEWELL 345 1	-629.3	-468.4	598	105	274702 KENDALL ;BU 345 801070 R-079 TAP 345 1	-615.2	-14.1	-0.028	2.4
274702 KENDALL ;BU 345 349662 7TAZEWELL 345 1	-605.4	-468.4	598	101	SPS-0303&BT___	-587.7	-17.7	-0.035	3.0

I. Power Flow Analysis Results – Ameren Criteria

Ameren's Local Planning Criteria requires that any single generator outage paired with any single transmission element be considered a single-contingency event. (For intermittent/ peaking plants, outage of the entire plant is considered a single generator outage.) As specified in the interconnection customer's requested scope of work, this analysis was not performed for this study.

J. Transfer Analysis / Import Capability

Transfer capability analysis was performed to determine whether the J255 injection at Maywood Substation would materially decrease Ameren's import capability.

Study projects are required to meet Ameren's Local Planning Criteria for import capability. Import capability is measured by the first contingency incremental transfer capability (FCITC) as limited by an Ameren transmission facility. Ameren's planning criteria states that a minimum simultaneous import capability of 2000 MW, as measured by FCITC, should be used as a proxy to maintain transmission capability related to generation reserves in the Ameren Missouri (AMMO) or Ameren Illinois (AMIL) footprint. Ten import scenarios are analyzed. Table III.5 summarizes these ten scenarios which involve simultaneous imports to various subsystems in the AMMO and AMIL areas from non-Ameren areas inside and outside the MISO footprint.

The analysis included simulations with and without the Maywood study generator dispatched. The ten import scenarios were tested for contingencies which limit Ameren's incremental import capability to below 2000 MW with the added study generation. A decrease in FCITC of at least 200 MW and a corresponding distribution factor of at least 3.0% are both required for assessing a limiting Ameren facility to the study generator(s).

The import capability study identified no import scenarios for which the study generation would both limit the import transfer to below the 2000 MW threshold and also reduce the import transfer by more than 200 MW. As such, no import constraints are to be assessed to the J255 injection at Maywood.

Table III.5
Import Scenarios Studied

Source	Sink	Comments
WORLD_NOAMRN_E	AMIL_IMA	Imports to all on-line AMIL generators
WORLD_NOAMRN_E	AMMO_IMA	Imports to all on-line AMMO generators
WORLD_NOAMRN_E	IL_138	Imports to on-line generators in Illinois connected to 138 kV
WORLD_NOAMRN_E	IL_345	Imports to on-line generators in Illinois connected to 345 kV
WORLD_NOAMRN_E	IL_COAL	Imports to on-line coal plants in Illinois
WORLD_NOAMRN_E	MO_138	Imports to on-line generators in Missouri connected to 138 kV
WORLD_NOAMRN_E	MO_345	Imports to on-line generators in Missouri connected to 345 kV
WORLD_NOAMRN_E	MO_COAL	Imports to on-line coal plants in Missouri
WORLD_NOAMRN_E	AMIL_BASE	Imports to on-line AMIL base-load generators
WORLD_NOAMRN_E	AMMO_BASE	Imports to on-line AMMO base-load generators

Exhibit 150

K. Conclusions

The power flow analysis included a test of MISO criteria by evaluating system Normal (N-0) conditions and also all single contingencies (N-1) within the study area. No injection related constraints were found. The analysis flagged a high number of contingency overloads related to the customer's 3500 MW injection at the Breed 345kV bus. But, the J255 distribution factor for these overloaded facilities is less than 5% and, by agreement with the interconnection customer, the injection at Breed was not considered generation-under-study for this SPA-2014-May-MO System Impact Study. Also, at the customer's request, this analysis did not include a test of the applicable voltage requirements.

The power flow analysis included a test of Ameren Local Planning Criteria by testing the effect of the 500 MW J255 injection on Ameren's import capability. The analysis identified no import constraints which would need to be mitigated due to the J255 injection at Maywood. As specified in the interconnection customer's requested scope, this analysis did not include a test of Ameren's Line+Generator outage criteria.

V. Short Circuit Analysis

No short-circuit analysis was required because the customer's HVDC line will not contribute current to an ac short circuit (except for its rated load current).

VI. Summary of Costs

As specified in the interconnection customer's requested scope, no cost estimates will be provided as part of the J255 study results – including the cost to physically connect the customer's 345kV ac bus to the Maywood 345kV bus.

Exhibit 150

Appendix 1 – NIPSCO Constraint Analysis

S.No.	CASE	FG #	Monitored Facility	RateA (MVA)	RateB (MVA)	Cont Name	Base Flow (MVA)	Cont Flow (MVA)	DC Cont %Loading - PreQueue	AC Cont %Loading - PreQueue	Current Queue	Earlier Queue	On-Line Reserve Generation	Total Flow(MVA) - Post Queue	Final %Loading - Post Queue
1	*2024 SP - CAT B*	*5380*	*255112 17STJOHN 345 274750 CRETE EC ;BP 345 1*	*1091*	*1399*	*AEPCE_DUMWIL*	*136.8*	*174.3*	*11*	*12.46*	*15.99*	*0*	*1533.59*	*1723.88*	*123.22*
2	*2024 SP - CAT B*	*4524*	*255109 17MUNSTER 345 270677 BURNHAM;0R 345 1*	*1195*	*1195*	*AEPCE_DUMWIL*	*256.1*	*204.1*	*16.83*	*17.08*	*-15.74*	*0*	*-1472.12*	*-1283.76*	*107.43*
3	*2024 SP - CAT C2*	*1878*	*255112 17STJOHN 345 274750 CRETE EC ;BP 345 1*	*1091*	*1399*	*AEP_Dumont_B*	*136.8*	*193*	*12.39*	*13.79*	*16.19*	*0*	*1533.14*	*1742.33*	*124.54*
4	*2024 SP - CAT C2*	*1826*	*255109 17MUNSTER 345 270677 BURNHAM ;0R 345 1*	*1195*	*1195*	*AEP_Dumont_B*	*256.1*	*174.5*	*14.52*	*14.61*	*-16.03*	*0*	*-1471.51*	*-1313.04*	*109.88*
5	*2024 SP - CAT C2*	*2266*	*243219 05DUMONT 345 255113 17STILLWELL 345 1*	*1409*	*1409*	*AEP_Dumont_B*	*292.5*	*94.5*	*5.95*	*6.71*	*-16.28*	*0*	*-1594.29*	*-1516.06*	*107.6*

AEP_Dumont_B	Contingency '**AEP_Dumont_B**' Open Branch from bus 243206 to bus 270644 Ckt 1 /243206 05DUMONT 765 270644 WILTON ; 765 1 Open Branch from bus 243206 to bus 907020 ckt 1 /243206 05DUMONT 765 243207 05GRNTWN 765 1 end
AEPCE_DUMWIL	Contingency '**AEPCE_DUMWIL**' Open branch from bus 243206 to bus 270644 ckt 1 / 243206 05DUMONT 765 270644 WILTO; 765 1 end

Exhibit 150