

***Generation Interconnection
Feasibility Study Report***

For

***PJM Generation Interconnection Request
Queue Position AB2-190***

***Hopewell – Surry 230kV
112MW Capacity / 160MW Energy***

September / 2016

Introduction

This Feasibility Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 36.2, as well as the Feasibility Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is Virginia Electric and Power Company (VEPCO).

Preface

The intent of the Feasibility Study is to determine a plan, with high level estimated cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the IC. The IC may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the IC may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the Feasibility Study, but the actual allocation will be deferred until the Impact Study is performed.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The IC is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by ITO, the costs may be included in the study.

General

The IC has proposed a solar generating facility located in Prince George County, VA. The installed facilities will have a total capability of 240 MW with 168 MW of this output being recognized by PJM as capacity. This queue request is for an additional 160 MW with 112 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 6/03/2017. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

Queue AB2-190 will interconnect with the ITO transmission system via a new three breaker ring bus switching station that connects on the Hopewell – Surry 230kV line #240 (north side).

Cost Summary

The AB2-190 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	\$1,200,000
Direct Connection Network Upgrades	\$5,200,000
Non Direct Connection Network Upgrades	\$ 800,000
Total Costs	\$7,200,000

In addition, the AB2-190 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	\$24,115,000
Previously Identified Upgrades	\$0
Total Costs	\$24,115,000

Cost allocations for these upgrades will be provided in the System Impact Study Report.

Attachment Facilities

Generation Substation: Install metering and associated protection equipment. Estimated Cost \$600,000.

Transmission: Construct approximately one span of 230 kV Attachment line between the generation substation and a new AB2-190 230 kV Switching Substation. The estimated cost for this work is \$1,200,000.

The estimated total cost of the Attachment Facilities is \$1,800,000. It is estimated to take 18-24 months to complete this work. These costs do not include CIAC Tax Gross-up. The single line is shown below in Attachment 1.

Direct Connection Cost Estimate

Substation: Establish the new 230 kV AB2-190 Switching Substation (interconnection substation). The estimated cost of this work scope is \$5,200,000. It is estimated to take 24-36 months to complete this work.

Non-Direct Connection Cost Estimate

Transmission: Install transmission structure in-line with transmission line to allow the proposed interconnection switching station to be interconnected with the transmission system. Estimated cost is \$800,000 dollars and is estimated to take 24-30 months to complete.

Remote Terminal Work: During the Facilities Study, ITO's System Protection Engineering Department will review transmission line protection as well as anti-islanding required to accommodate the new generation and interconnection substation. System Protection Engineering will determine the minimal acceptable protection requirements to reliably interconnect the proposed generating facility with the transmission system. The review is based on maintaining system reliability by reviewing ITO's protection requirements with the known transmission system configuration which includes generating facilities in the area. This review may determine that transmission line protection and communication upgrades are required at remote substations.

Reinforcement: Rebuild of the Chesterfield-Basin 230kV line. It is estimated to take 44 – 48 months to complete and it is estimated to cost \$18,615,000 to resolve the deficiency.

Reinforcement: Upgrade the Prince George 230/115kV transformer. It is estimated to take 24-28 months to complete and it is estimated to cost \$5,500,000 to resolve this deficiency.

Interconnection Customer Requirements

ITO's Facility Connection Requirements as posted on PJM's website

<http://www.pjm.com/~media/planning/plan-standards/private-dominion/facility-connection-requirements1.ashx>

An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than

100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

Voltage Ride Through Requirements - The Customer Facility shall be designed to remain in service (not trip) for voltages and times as specified for the Eastern Interconnection in Attachment 1 of NERC Reliability Standard PRC-024-1, and successor Reliability Standards, for both high and low voltage conditions, irrespective of generator size, subject to the permissive trip exceptions established in PRC-024-1 (and successor Reliability Standards).

Frequency Ride Through Requirements - The Customer Facility shall be designed to remain in service (not trip) for frequencies and times as specified in Attachment 2 of NERC Reliability Standard PRC-024-1, and successor Reliability Standards, for both high and low frequency condition, irrespective of generator size, subject to the permissive trip exceptions established in PRC-024-1 (and successor Reliability Standards).

Reactive Power - The Generation Interconnection Customer shall design its non-synchronous Customer Facility with the ability to maintain a power factor of at least 0.95 leading to 0.95 lagging measured at the generator's terminals.

Revenue Metering and SCADA Requirements

PJM Requirements

The IC will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Sections 24.1 and 24.2.

Network Impacts

The Queue Project AB2-190 was evaluated as a 160.0 MW (Capacity 128.0 MW) uprate to the AA2-177 project tapping the Hopewell-Surry 230kV line in the ITO area. Project AB2-190 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-190 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
LN 259	CONTINGENCY 'LN 259' OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00 END
LN 208-259	CONTINGENCY 'LN 208-259' OPEN BRANCH FROM BUS 314286 TO BUS 314309 CKT 1 /* 6CHSTF A 230.00 - 6IRON208 230.00 OPEN BRANCH FROM BUS 314309 TO BUS 314338 CKT 1 /* 6IRON208 230.00 - 6SOUWEST 230.00 OPEN BUS 314309 /* ISLAND OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00 END
LN 259-2065	CONTINGENCY 'LN 259-2065' OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00 OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1 /* 6BASIN 230.00 - 6SPRUNCE 230.00 END
BASIN 230 B#2	CONTINGENCY 'BASIN 230 B#2' /* OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1 OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 OPEN BRANCH FROM BUS 314276 TO BUS 314274 CKT 2 END

Contingency Name	Description
25942	CONTINGENCY '25942' /*_ BASIN OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /*L259 BASIN CHESTERFIELD OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1 /*L2065 BASIN SPRUANCE NUG OPEN BRANCH FROM BUS 314274 TO BUS 314276 CKT 2 /*BASIN TX6 END
LN 576	CONTINGENCY 'LN 576' OPEN BRANCH FROM BUS 314322 TO BUS 314914 CKT 1 /* 6MDLTHAN 230.00 - 8MDLTHAN 500.00 OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /* 8MDLTHAN 500.00 - 8NO ANNA 500.00 END
LN 211-228	CONTINGENCY 'LN 211-228' OPEN BRANCH FROM BUS 314287 TO BUS 314303 CKT 1 /* 6CHSTF B 230.00 - 6HOPEWLL 230.00 OPEN BRANCH FROM BUS 314278 TO BUS 314286 CKT 1 /* 6BERMUDA 230.00 - 6CHSTF A 230.00 OPEN BRANCH FROM BUS 314278 TO BUS 314303 CKT 1 /* 6BERMUDA 230.00 - 6HOPEWLL 230.00 OPEN BUS 314278 /* ISLAND END
LN 208-259	CONTINGENCY 'LN 208-259' OPEN BRANCH FROM BUS 314286 TO BUS 314309 CKT 1 /* 6CHSTF A 230.00 - 6IRON208 230.00 OPEN BRANCH FROM BUS 314309 TO BUS 314338 CKT 1 /* 6IRON208 230.00 - 6SOUWEST 230.00 OPEN BUS 314309 /* ISLAND OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00 END
562T563	CONTINGENCY '562T563' /*CARSON OPEN BRANCH FROM BUS 314902 TO BUS 314923 CKT 1 /*CARSON TO MIDLOTHIAN OPEN BRANCH FROM BUS 314914 TO BUS 314902 CKT 1 /*CARSON 500.00 - 8SEPTA 500.00 END

Contingency Name	Description
LN 563	CONTINGENCY 'LN 563' OPEN BRANCH FROM BUS 314902 TO BUS 314914 CKT 1 /* 8CARSON 500.00 - 8MDLTHAN 500.00 END

Summer Peak Analysis - 2020

System Reinforcement responsible by ITO

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution
	Type	Name			From	To	Circuit		Initial	Final	Type	MVA	
1	N-1	LN 259	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	99.48	102.78	ER	399	13.13
2	DCTL	LN 208-259	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	128.16	130.22	ER	399	18.24
3	DCTL	LN 208-259	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	141.69	143.75	ER	399	18.24
4	N-1	LN 259	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	113.02	116.31	ER	399	113.13
5	N-1	LN 576	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	110.39	113.08	ER	399	10.75
6	DCTL	LN 259-2065	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	110.25	112.09	ER	399	16.3
7	BF	BASIN 230 B#2	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	109.96	111.8	ER	399	16.33
8	LFFB	25942	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	109.96	111.8	ER	399	16.33
9	DCTL	LN 208-259	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	141.87	143.93	ER	399	18.24
10	N-1	LN 259	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	113.19	116.48	ER	399	13.13
11	N-1	LN 576	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	110.56	113.26	ER	399	10.75
12	DCTL	LN 259-2065	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	110.43	112.27	ER	399	16.3
13	BF	BASIN 230 B#2	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	110.13	111.97	ER	399	16.33

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution
	Type	Name			From	To			Initial	Final	Type	MVA	
14	LFFB	25942	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	110.13	111.97	ER	399	16.33

PJM baseline project (b2745) will eliminate the identified overloads. The scheduled in service date b2745 is 06/01/2020.

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution
	Type	Name			From	To			Initial	Final	Type	MVA	
15	N-1	LN 259	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	99.48	102.78	ER	399	13.13

Multiple Facility Contingency

(Double Circuit Tower Line contingencies were studied for the full energy output. The contingencies of Line with Failed Breaker and Bus Fault will be performed for the Impact Study.)

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

Contributions to previously identified circuit breakers found to be over-duty:

None

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To	Cir.		Initial	Final	Type	MVA		
16	DCTL	LN 208-259	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	DC	128.16	130.22	ER	399	18.24	1
17	DCTL	LN 208-259	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	141.69	143.75	ER	399	18.24	2
18	N-1	LN 259	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	113.02	116.31	ER	399	13.13	
19	N-1	LN 576	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	110.39	113.08	ER	399	10.75	
20	DCTL	LN 259-2065	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	110.25	112.09	ER	399	16.3	
21	BUS	BASIN 230 B#2	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	109.96	111.8	ER	399	16.33	
22	LFFB	25942	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	109.96	111.8	ER	399	16.33	
23	DCTL	LN 211-228	DVP - DVP	6PRGEORG 230/115 kV transformer	314269	314291	1	DC	114.31	129.95	ER	203	31.71	3
24	DCTL	LN 208-259	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	141.87	143.93	ER	399	18.24	4
25	N-1	LN 259	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	113.19	116.48	ER	399	13.13	
26	N-1	LN 576	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	110.56	113.26	ER	399	10.75	

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To	Cir.		Initial	Final	Type	MVA		
27	DCTL	LN 259-2065	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	110.43	112.27	ER	399	16.3	
28	BUS	BASIN 230 B#2	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	110.13	111.97	ER	399	16.33	
29	LFFB	25942	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	110.13	111.97	ER	399	16.33	
30	LFFB	562T563	DVP - DVP	6CHSTF B-6BASIN 230 kV line	314287	314276	1	DC	117.86	119.52	ER	470	17.29	5
31	N-1	LN 563	DVP - DVP	6CHSTF B-6BASIN 230 kV line	314287	314276	1	DC	103.19	106.22	ER	470	14.22	

Steady-State Voltage Requirements

(Summary of the VAR requirements based upon the results of the steady-state voltage studies)

To be determined during Impact Study.

Stability and Reactive Power Requirement for Low Voltage Ride Through

(Summary of the VAR requirements based upon the results of the dynamic studies)

To be determined during Impact Study.

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
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Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
# 1, 2	6CHARCTY-6LAKESD 230 kV line	Rebuild 21.32 miles of the Chesterfield - Lakeside 230kV transmission line by 6/1/2020	b2745	\$
# 3 – 8	6MESSER-6CHARCTY 230 kV line	Rebuild 21.32 miles of the Chesterfield - Lakeside 230kV transmission line by 6/1/2020	b2745	\$
# 9 – 13	6CHSTF B-6MESSER 230 kV line	Rebuild 21.32 miles of the Chesterfield - Lakeside 230kV transmission line by 6/1/2020	b2745	\$
# 30, 31	6CLUBHSE 230/115 kV transformer	Upgrade the Clubhouse 230/115kV transformer	Pending	\$5,500,000
Total New Network Upgrades				\$5,500,000

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
# 16	6CHARCTY-6LAKESD 230 kV line	Rebuild 21.32 miles of the Chesterfield - Lakeside 230kV transmission line by 6/1/2020	b2745	
# 17 – 22	6MESSER-6CHARCTY 230 kV line	Rebuild 21.32 miles of the Chesterfield - Lakeside 230kV transmission line by 6/1/2020	b2745	
# 23	6PRGEORG 230/115 kV transformer	Upgrade of the Prince George 230/115kV transformer.	Pending	\$5,500,000
# 24 – 29	6CHSTF B-6MESSER 230 kV line	Rebuild 21.32 miles of the Chesterfield - Lakeside 230kV transmission line by 6/1/2020	b2745	

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
# 22	6CHSTF B-6BASIN 230 kV line	Rebuild the Chesterfield-Basin 230kV line	Pending	\$18,615,000
Total New Network Upgrades				\$24,115,000

Potential Congestion due to Local Energy Deliverability

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The IC can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution
	Type	Name			From	To	Circuit		Initial	Final	Type	MVA	
32	N-1	LN 259	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	DC	109.69	111.55	ER	399	16.42
33	N-1	LN 259	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	DC	109.87	111.72	ER	399	16.42
34	N-1	LN 563	DVP - DVP	6CHSTF B-6BASIN 230 kV line	314287	314276	1	DC	117.61	119.31	ER	470	17.78

Light Load Analysis

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

ITO Analysis

ITO assessed the impact of the proposed Queue Project #AB2-190 interconnection of a 160.0 MW Energy (128.0 MW Capacity) injection into the ITO's Transmission System, for compliance with NERC Reliability Criteria on ITO's Transmission System. The system was assessed using the summer 2020 RTEP case provided to ITO by PJM. When performing a generation analysis, ITO's main analysis will be load flow study results under single contingency (both normal and stressed system conditions). ITO Criteria considers a transmission facility overloaded if it exceeds 94% of its emergency rating under normal and stressed system conditions. A full listing of ITO's Planning Criteria and interconnection requirements can be found in the ITO's Facility Connection Requirements which are publicly available at: <http://www.dom.com>.

The results of these studies evaluate the system under a limited set of operating conditions and do not guarantee the full delivery of the capacity and associated energy of this proposed generation facility under all operating conditions. NERC Planning and Operating Reliability Criteria allow for the re-dispatch of generating units to resolve projected and actual deficiencies in real time and planning studies. Specifically NERC Category C Contingency Conditions (Bus Fault, Tower Line, N-1-1, and Stuck Breaker scenarios) allow for re-dispatch of generating units to resolve potential reliability deficiencies. For ITO's Planning Criteria the re-dispatch of generating units for these contingency conditions is allowed as long as the projected loading does not exceed 100% of a facility Load Dump Rating.

As part of its generation impact analysis, the ITO routinely evaluates the impact that a proposed new generation resource will have under maximum generation conditions, stress system conditions and import/export system conditions (greater than 20 MW). The results of these studies are discussed in more detail below.

Category B Analysis (Single Contingency):

1. System Normal – No deficiencies identified
2. Critical System Condition (No Surry 230 kV Unit) – No deficiencies identified.

Category C Analysis: (Multiple Facility Analysis)

1. Bus Fault - No deficiencies identified
2. Line Stuck Breaker - No deficiencies identified
3. Tower Line – No deficiencies identified

Import/Export Analysis (Single Contingency) are tabulated in Table A and B below.

Table A: Import Study Results

Import Study Results			
Area	Summer 2020	Summer 2020 with	Limiting Element

		AB2-190	
AEP	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
APS	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
CPL	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
PJM	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'

Table B: Export Study Results

Export Study Results			
Area	Summer 2020	Summer 2020 with AB2-190	Limiting Element
AEP	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
APS	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
CPL	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
PJM	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576' 6CHSTF B-6BASIN 230 kV line for single contingency outage of 'LN 563'

ITO's Planning Criteria indicates a need to have approximately 2000 MW of import and export capability. The results of these import and export studies indicate that the proposed interconnection will impact ITO's import or export capability.

Affected System Analysis & Mitigation

Duke, Progress & TVA Impacts:

Duke Carolina, Progress, & TVA Impacts to be determined during later study phases (as applicable).

Attachment 1.

Flowgate Appendices – Option 1

Appendices

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gauge other generators impact. When a flowgate is identified in multiple analysis the appendix is presented for only the analysis with the greatest overload.

It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

Appendix 1

(DVP - DVP) The 6CHARCTY-6LAKESD 230 kV line (from bus 314225 to bus 314227 ckt 1) loads from 128.16% to 130.22% (**DC power flow**) of its emergency rating (399 MVA) for the tower line contingency outage of 'LN 208-259'. This project contributes approximately 18.24 MW to the thermal violation.

CONTINGENCY 'LN 208-259'

OPEN BRANCH FROM BUS 314286 TO BUS 314309 CKT 1 /* 6CHSTF A
230.00 - 6IRON208 230.00

OPEN BRANCH FROM BUS 314309 TO BUS 314338 CKT 1 /* 6IRON208
230.00 - 6SOUWEST 230.00

OPEN BUS 314309 /* ISLAND

OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 -
6CHSTF B 230.00

END

Bus Number	Bus Name	Full Contribution
315065	1CHESTF6	37.27
315077	1HOPHCF1	2.16
315078	1HOPHCF2	2.16
315079	1HOPHCF3	2.16
315080	1HOPHCF4	3.28
315076	1HOPPOLC	1.84
315073	1STONECA	5.67
314784	1WEYRHSB	0.65
314539	3UNCAMP	0.86
314541	3WATKINS	0.25
314229	6MT R221	-0.33
315074	CIR_AB2-152	0.88
315075	CIR_AB2-152	0.87
292791	U1-032 E	2.95
900672	V4-068 E	0.11
901082	W1-029E	13.47
902241	W2-022 C OP1	0.49
902242	W2-022 E OP1	3.31
903520	W3-066 C1OP1	0.98
903531	W3-066 C2OP1	0.98
903522	W3-066 E1OP1	6.53
903532	W3-066 E2OP1	6.53
907092	X1-038 E	2.14
913392	Y1-086 E	0.63
914231	Y2-077	0.87
916042	Z1-036 E	13.57

916192	Z1-068 E	0.53
917122	Z2-027 E	0.31
917332	Z2-043 E	0.34
917342	Z2-044 E	0.18
917592	Z2-099 E	0.16
921162	AA1-063AC	3.19
921163	AA1-063AE	1.5
918512	AA1-065 E OP	1.48
918562	AA1-072 E	0.06
921552	AA1-134 C	2.89
921553	AA1-134 E	1.24
921562	AA1-135 C	2.95
921563	AA1-135 E	1.26
921572	AA1-138 C	3.
921573	AA1-138 E	1.28
921752	AA2-053 C	3.25
921753	AA2-053 E	1.4
921762	AA2-057 C	2.34
921763	AA2-057 E	1.17
921772	AA2-059 C	0.72
921773	AA2-059 E	0.33
921862	AA2-068 C	0.76
921863	AA2-068 E	0.35
920022	AA2-086 E	0.09
921982	AA2-088 C	2.33
921983	AA2-088 E	3.8
922032	AA2-105 C	0.85
922033	AA2-105 E	0.4
922072	AA2-113 C	0.85
922073	AA2-113 E	0.4
922442	AA2-165 C	0.32
922443	AA2-165 E	0.15
922472	AA2-169 C	0.71
922473	AA2-169 E	0.32
922512	AA2-174 C	0.15
922513	AA2-174 E	0.16
922522	AA2-177 C	6.38
922523	AA2-177 E	2.74
922532	AA2-178 C	2.96
922533	AA2-178 E	1.27
922602	AB1-013 C	0.89
922603	AB1-013 E	5.97
922722	AB1-053 C	0.44
922723	AB1-053 E	0.25
922732	AB1-054 C	2.47

922733	AB1-054 E	1.21
922882	AB1-077 C	1.01
922883	AB1-077 E	6.74
923262	AB1-132 C OP	5.96
923263	AB1-132 E OP	2.55
923572	AB1-173 C OP	0.98
923573	AB1-173 E OP	0.46
923582	AB1-173AC OP	0.98
923583	AB1-173AE OP	0.46
923801	AB2-015 C OP	3.8
923802	AB2-015 E OP	2.76
923831	AB2-022 C	0.66
923832	AB2-022 E	0.35
923851	AB2-025 C	1.62
923852	AB2-025 E	0.73
923911	AB2-031 C OP	0.98
923912	AB2-031 E OP	0.48
923981	AB2-039 C OP	5.75
923982	AB2-039 E OP	4.71
923991	AB2-040 C OP	3.32
923992	AB2-040 E OP	2.51
924011	AB2-042 C OP	6.67
924012	AB2-042 E OP	5.32
924071	AB2-051 C OP	39.01
924072	AB2-051 E OP	6.06
924381	AB2-087 C	0.19
924382	AB2-087 E	0.09
924501	AB2-099 C	0.2
924502	AB2-099 E	0.09
924511	AB2-100 C	5.57
924512	AB2-100 E	2.74
924761	AB2-128 C	4.77
924762	AB2-128 E	1.88
924811	AB2-134 C OP	8.19
924812	AB2-134 E OP	10.94
924931	AB2-147 C	1.18
924932	AB2-147 E	1.92
924941	AB2-149 C OP	1.56
924942	AB2-149 E OP	2.55
924951	AB2-150 C OP	1.18
924952	AB2-150 E OP	1.92
924961	AB2-152	2.21
925051	AB2-160 C OP	4.18
925052	AB2-160 E OP	6.82
925061	AB2-161 C OP	1.99

925062	AB2-161 E OP	3.24
925121	AB2-169 C OP	2.01
925122	AB2-169 E OP	1.81
925141	AB2-171 C OP	1.75
925142	AB2-171 E OP	2.85
925171	AB2-174 C OP	3.17
925172	AB2-174 E OP	2.87
925281	AB2-186 C	0.18
925282	AB2-186 E	0.08
925291	AB2-188 C OP	0.73
925292	AB2-188 E OP	0.33
925331	AB2-190 C	14.59
925332	AB2-190 E	3.65

Appendix 2

(DVP - DVP) The 6MESSER-6CHARCTY 230 kV line (from bus 314228 to bus 314225 ckt 1) loads from 141.69% to 143.75% (**DC power flow**) of its emergency rating (399 MVA) for the tower line contingency outage of 'LN 208-259'. This project contributes approximately 18.24 MW to the thermal violation.

CONTINGENCY 'LN 208-259'

OPEN BRANCH FROM BUS 314286 TO BUS 314309 CKT 1 /* 6CHSTF A
230.00 - 6IRON208 230.00

OPEN BRANCH FROM BUS 314309 TO BUS 314338 CKT 1 /* 6IRON208
230.00 - 6SOUWEST 230.00

OPEN BUS 314309 /* ISLAND

OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 -
6CHSTF B 230.00

END

Bus Number	Bus Name	Full Contribution
315065	1CHESTF6	37.27
315077	1HOPHCF1	2.16
315078	1HOPHCF2	2.16
315079	1HOPHCF3	2.16
315080	1HOPHCF4	3.28
315076	1HOPPOLC	1.84
315073	1STONECA	5.67
314784	1WEYRHSB	0.65
314539	3UNCAMP	0.86
314541	3WATKINS	0.25
314229	6MT R221	-0.33
315074	CIR_AB2-152	0.88
315075	CIR_AB2-152	0.87
292791	U1-032 E	2.95
900672	V4-068 E	0.11
901082	W1-029E	13.47
902241	W2-022 C OP1	0.49
902242	W2-022 E OP1	3.31
903520	W3-066 C1OP1	0.98
903531	W3-066 C2OP1	0.98
903522	W3-066 E1OP1	6.53
903532	W3-066 E2OP1	6.53
907092	X1-038 E	2.14
913392	Y1-086 E	0.63

914231	Y2-077	0.87
916042	Z1-036 E	13.57
916192	Z1-068 E	0.53
917122	Z2-027 E	0.31
917332	Z2-043 E	0.34
917342	Z2-044 E	0.18
917592	Z2-099 E	0.16
921162	AA1-063AC	3.19
921163	AA1-063AE	1.5
918512	AA1-065 E OP	1.48
918562	AA1-072 E	0.06
921552	AA1-134 C	2.89
921553	AA1-134 E	1.24
921562	AA1-135 C	2.95
921563	AA1-135 E	1.26
921572	AA1-138 C	3.
921573	AA1-138 E	1.28
921752	AA2-053 C	3.25
921753	AA2-053 E	1.4
921762	AA2-057 C	2.34
921763	AA2-057 E	1.17
921772	AA2-059 C	0.72
921773	AA2-059 E	0.33
921862	AA2-068 C	0.76
921863	AA2-068 E	0.35
920022	AA2-086 E	0.09
921982	AA2-088 C	2.33
921983	AA2-088 E	3.8
922032	AA2-105 C	0.85
922033	AA2-105 E	0.4
922072	AA2-113 C	0.85
922073	AA2-113 E	0.4
922442	AA2-165 C	0.32
922443	AA2-165 E	0.15
922472	AA2-169 C	0.71
922473	AA2-169 E	0.32
922512	AA2-174 C	0.15
922513	AA2-174 E	0.16
922522	AA2-177 C	6.38
922523	AA2-177 E	2.74
922532	AA2-178 C	2.96
922533	AA2-178 E	1.27
922602	AB1-013 C	0.89
922603	AB1-013 E	5.97
922722	AB1-053 C	0.44

922723	AB1-053 E	0.25
922732	AB1-054 C	2.47
922733	AB1-054 E	1.21
922882	AB1-077 C	1.01
922883	AB1-077 E	6.74
923262	AB1-132 C OP	5.96
923263	AB1-132 E OP	2.55
923572	AB1-173 C OP	0.98
923573	AB1-173 E OP	0.46
923582	AB1-173AC OP	0.98
923583	AB1-173AE OP	0.46
923801	AB2-015 C OP	3.8
923802	AB2-015 E OP	2.76
923831	AB2-022 C	0.66
923832	AB2-022 E	0.35
923851	AB2-025 C	1.62
923852	AB2-025 E	0.73
923911	AB2-031 C OP	0.98
923912	AB2-031 E OP	0.48
923981	AB2-039 C OP	5.75
923982	AB2-039 E OP	4.71
923991	AB2-040 C OP	3.32
923992	AB2-040 E OP	2.51
924011	AB2-042 C OP	6.67
924012	AB2-042 E OP	5.32
924071	AB2-051 C OP	39.01
924072	AB2-051 E OP	6.06
924381	AB2-087 C	0.19
924382	AB2-087 E	0.09
924501	AB2-099 C	0.2
924502	AB2-099 E	0.09
924511	AB2-100 C	5.57
924512	AB2-100 E	2.74
924761	AB2-128 C	4.77
924762	AB2-128 E	1.88
924811	AB2-134 C OP	8.19
924812	AB2-134 E OP	10.94
924931	AB2-147 C	1.18
924932	AB2-147 E	1.92
924941	AB2-149 C OP	1.56
924942	AB2-149 E OP	2.55
924951	AB2-150 C OP	1.18
924952	AB2-150 E OP	1.92
924961	AB2-152	2.21
925051	AB2-160 C OP	4.18

925052	AB2-160 E OP	6.82
925061	AB2-161 C OP	1.99
925062	AB2-161 E OP	3.24
925121	AB2-169 C OP	2.01
925122	AB2-169 E OP	1.81
925141	AB2-171 C OP	1.75
925142	AB2-171 E OP	2.85
925171	AB2-174 C OP	3.17
925172	AB2-174 E OP	2.87
925281	AB2-186 C	0.18
925282	AB2-186 E	0.08
925291	AB2-188 C OP	0.73
925292	AB2-188 E OP	0.33
925331	AB2-190 C	14.59
925332	AB2-190 E	3.65

Appendix 3

(DVP - DVP) The 6PRGEORG 230/115 kV transformer (from bus 314269 to bus 314291 ckt 1) loads from 114.31% to 129.95% (**DC power flow**) of its emergency rating (203 MVA) for the tower line contingency outage of 'LN 211-228'. This project contributes approximately 31.71 MW to the thermal violation.

CONTINGENCY 'LN 211-228'

OPEN BRANCH FROM BUS 314287 TO BUS 314303 CKT 1 /* 6CHSTF B
230.00 - 6HOPEWLL 230.00
OPEN BRANCH FROM BUS 314278 TO BUS 314286 CKT 1 /* 6BERMUDA
230.00 - 6CHSTF A 230.00
OPEN BRANCH FROM BUS 314278 TO BUS 314303 CKT 1 /* 6BERMUDA
230.00 - 6HOPEWLL 230.00
OPEN BUS 314278 /* ISLAND
END

Bus Number	Bus Name	Full Contribution
315119	1GRAVEL3	1.96
315120	1GRAVEL4	1.97
315121	1GRAVEL5	1.94
315122	1GRAVEL6	1.97
315077	1HOPHCF1	4.12
315078	1HOPHCF2	4.12
315079	1HOPHCF3	4.12
315080	1HOPHCF4	6.25
315076	1HOPPOLC	3.52
315073	1STONECA	10.8
315116	1SURRY 1	20.47
315074	CIR_AB2-152	1.69
315075	CIR_AB2-152	1.66
292791	U1-032 E	5.63
914231	Y2-077	1.66
922522	AA2-177 C	11.1
922523	AA2-177 E	4.76
924011	AB2-042 C OP	8.93
924012	AB2-042 E OP	7.12
924811	AB2-134 C OP	14.23
924812	AB2-134 E OP	19.02
924961	AB2-152	4.22
925331	AB2-190 C	25.37
925332	AB2-190 E	6.34

Appendix 4

(DVP - DVP) The 6CHSTF B-6MESSER 230 kV line (from bus 314287 to bus 314228 ckt 1) loads from 141.87% to 143.93% (**DC power flow**) of its emergency rating (399 MVA) for the tower line contingency outage of 'LN 208-259'. This project contributes approximately 18.24 MW to the thermal violation.

CONTINGENCY 'LN 208-259'

OPEN BRANCH FROM BUS 314286 TO BUS 314309 CKT 1 /* 6CHSTF A
230.00 - 6IRON208 230.00

OPEN BRANCH FROM BUS 314309 TO BUS 314338 CKT 1 /* 6IRON208
230.00 - 6SOUWEST 230.00

OPEN BUS 314309 /* ISLAND

OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 -
6CHSTF B 230.00

END

Bus Number	Bus Name	Full Contribution
315065	1CHESTF6	37.27
315077	1HOPHCF1	2.16
315078	1HOPHCF2	2.16
315079	1HOPHCF3	2.16
315080	1HOPHCF4	3.28
315076	1HOPPOLC	1.84
315073	1STONECA	5.67
314784	1WEYRHSB	0.65
314539	3UNCAMP	0.86
314541	3WATKINS	0.25
314229	6MT R221	-0.33
315074	CIR_AB2-152	0.88
315075	CIR_AB2-152	0.87
292791	U1-032 E	2.95
900672	V4-068 E	0.11
901082	W1-029E	13.47
902241	W2-022 C OP1	0.49
902242	W2-022 E OP1	3.31
903520	W3-066 C1OP1	0.98
903531	W3-066 C2OP1	0.98
903522	W3-066 E1OP1	6.53
903532	W3-066 E2OP1	6.53
907092	X1-038 E	2.14
913392	Y1-086 E	0.63

914231	Y2-077	0.87
916042	Z1-036 E	13.57
916192	Z1-068 E	0.53
917122	Z2-027 E	0.31
917332	Z2-043 E	0.34
917342	Z2-044 E	0.18
917592	Z2-099 E	0.16
921162	AA1-063AC	3.19
921163	AA1-063AE	1.5
918512	AA1-065 E OP	1.48
918562	AA1-072 E	0.06
921552	AA1-134 C	2.89
921553	AA1-134 E	1.24
921562	AA1-135 C	2.95
921563	AA1-135 E	1.26
921572	AA1-138 C	3.
921573	AA1-138 E	1.28
921752	AA2-053 C	3.25
921753	AA2-053 E	1.4
921762	AA2-057 C	2.34
921763	AA2-057 E	1.17
921772	AA2-059 C	0.72
921773	AA2-059 E	0.33
921862	AA2-068 C	0.76
921863	AA2-068 E	0.35
920022	AA2-086 E	0.09
921982	AA2-088 C	2.33
921983	AA2-088 E	3.8
922032	AA2-105 C	0.85
922033	AA2-105 E	0.4
922072	AA2-113 C	0.85
922073	AA2-113 E	0.4
922442	AA2-165 C	0.32
922443	AA2-165 E	0.15
922472	AA2-169 C	0.71
922473	AA2-169 E	0.32
922512	AA2-174 C	0.15
922513	AA2-174 E	0.16
922522	AA2-177 C	6.38
922523	AA2-177 E	2.74
922532	AA2-178 C	2.96
922533	AA2-178 E	1.27
922602	AB1-013 C	0.89
922603	AB1-013 E	5.97
922722	AB1-053 C	0.44

922723	AB1-053 E	0.25
922732	AB1-054 C	2.47
922733	AB1-054 E	1.21
922882	AB1-077 C	1.01
922883	AB1-077 E	6.74
923262	AB1-132 C OP	5.96
923263	AB1-132 E OP	2.55
923572	AB1-173 C OP	0.98
923573	AB1-173 E OP	0.46
923582	AB1-173AC OP	0.98
923583	AB1-173AE OP	0.46
923801	AB2-015 C OP	3.8
923802	AB2-015 E OP	2.76
923831	AB2-022 C	0.66
923832	AB2-022 E	0.35
923851	AB2-025 C	1.62
923852	AB2-025 E	0.73
923911	AB2-031 C OP	0.98
923912	AB2-031 E OP	0.48
923981	AB2-039 C OP	5.75
923982	AB2-039 E OP	4.71
923991	AB2-040 C OP	3.32
923992	AB2-040 E OP	2.51
924011	AB2-042 C OP	6.67
924012	AB2-042 E OP	5.32
924071	AB2-051 C OP	39.01
924072	AB2-051 E OP	6.06
924381	AB2-087 C	0.19
924382	AB2-087 E	0.09
924501	AB2-099 C	0.2
924502	AB2-099 E	0.09
924511	AB2-100 C	5.57
924512	AB2-100 E	2.74
924761	AB2-128 C	4.77
924762	AB2-128 E	1.88
924811	AB2-134 C OP	8.19
924812	AB2-134 E OP	10.94
924931	AB2-147 C	1.18
924932	AB2-147 E	1.92
924941	AB2-149 C OP	1.56
924942	AB2-149 E OP	2.55
924951	AB2-150 C OP	1.18
924952	AB2-150 E OP	1.92
924961	AB2-152	2.21
925051	AB2-160 C OP	4.18

925052	AB2-160 E OP	6.82
925061	AB2-161 C OP	1.99
925062	AB2-161 E OP	3.24
925121	AB2-169 C OP	2.01
925122	AB2-169 E OP	1.81
925141	AB2-171 C OP	1.75
925142	AB2-171 E OP	2.85
925171	AB2-174 C OP	3.17
925172	AB2-174 E OP	2.87
925281	AB2-186 C	0.18
925282	AB2-186 E	0.08
925291	AB2-188 C OP	0.73
925292	AB2-188 E OP	0.33
925331	AB2-190 C	14.59
925332	AB2-190 E	3.65

Appendix 5

(DVP - DVP) The 6CHSTF B-6BASIN 230 kV line (from bus 314287 to bus 314276 ckt 1) loads from 117.86% to 119.52% (**DC power flow**) of its emergency rating (470 MVA) for the line fault with failed breaker contingency outage of '562T563'. This project contributes approximately 17.29 MW to the thermal violation.

CONTINGENCY '562T563'

/*CARSON

OPEN BRANCH FROM BUS 314902 TO BUS 314923 CKT 1

/*CARSON TO

MIDLOTHIAN

OPEN BRANCH FROM BUS 314914 TO BUS 314902 CKT 1

/*CARSON 500.00

- 8SEPTA 500.00

END

Bus Number	Bus Name	Full Contribution
315065	1CHESTF6	37.6
315077	1HOPHCF1	2.
315078	1HOPHCF2	2.
315079	1HOPHCF3	2.
315080	1HOPHCF4	3.03
315076	1HOPPOLC	1.7
315073	1STONECA	5.23
314784	1WEYRHSB	0.81
314539	3UNCAMP	1.01
314541	3WATKINS	0.29
315074	CIR_AB2-152	0.82
315075	CIR_AB2-152	0.81
292791	U1-032 E	2.73
900672	V4-068 E	0.13
901082	W1-029E	15.9
902241	W2-022 C OP1	0.62
902242	W2-022 E OP1	4.13
907092	X1-038 E	2.52
913392	Y1-086 E	0.74
914231	Y2-077	0.8
916042	Z1-036 E	16.18
916302	Z1-086 E	3.97
917122	Z2-027 E	0.36
917332	Z2-043 E	0.42
917342	Z2-044 E	0.24
917512	Z2-088 E OP1	3.18
917592	Z2-099 E	0.19

LTF	AA1-058	0.31
921162	AA1-063AC	3.88
921163	AA1-063AE	1.83
921172	AA1-064 C	3.54
921173	AA1-064 E	1.66
918512	AA1-065 E OP	1.81
921182	AA1-067 C	0.67
921183	AA1-067 E	0.29
918562	AA1-072 E	0.07
921552	AA1-134 C	3.41
921553	AA1-134 E	1.46
921562	AA1-135 C	3.71
921563	AA1-135 E	1.59
921572	AA1-138 C	3.57
921573	AA1-138 E	1.53
921752	AA2-053 C	3.99
921753	AA2-053 E	1.71
921762	AA2-057 C	3.01
921763	AA2-057 E	1.51
921772	AA2-059 C	0.86
921773	AA2-059 E	0.39
921862	AA2-068 C	0.96
921863	AA2-068 E	0.44
920022	AA2-086 E	0.1
921982	AA2-088 C	2.79
921983	AA2-088 E	4.55
922032	AA2-105 C	1.05
922033	AA2-105 E	0.49
922072	AA2-113 C	1.05
922073	AA2-113 E	0.49
922442	AA2-165 C	0.41
922443	AA2-165 E	0.2
922472	AA2-169 C	0.9
922473	AA2-169 E	0.42
922512	AA2-174 C	0.18
922513	AA2-174 E	0.2
922522	AA2-177 C	6.05
922523	AA2-177 E	2.59
922532	AA2-178 C	3.57
922533	AA2-178 E	1.53
922602	AB1-013 C	1.08
922603	AB1-013 E	7.22
922722	AB1-053 C	0.53
922723	AB1-053 E	0.3
922732	AB1-054 C	2.96

922733	AB1-054 E	1.46
922882	AB1-077 C	1.19
922883	AB1-077 E	7.95
922922	AB1-081 C OP	3.64
922923	AB1-081 E OP	1.56
923262	AB1-132 C OP	7.23
923263	AB1-132 E OP	3.1
923572	AB1-173 C OP	1.19
923573	AB1-173 E OP	0.55
923582	AB1-173AC OP	1.19
923583	AB1-173AE OP	0.55
923801	AB2-015 C OP	4.48
923802	AB2-015 E OP	3.25
923851	AB2-025 C	1.86
923852	AB2-025 E	0.84
923911	AB2-031 C OP	1.18
923912	AB2-031 E OP	0.58
923941	AB2-035 C	0.14
923942	AB2-035 E	0.06
923981	AB2-039 C OP	6.11
923982	AB2-039 E OP	5.
923991	AB2-040 C OP	4.
923992	AB2-040 E OP	3.02
924011	AB2-042 C OP	6.74
924012	AB2-042 E OP	5.38
924151	AB2-059 C OP	4.29
924152	AB2-059 E OP	2.21
924381	AB2-087 C	0.24
924382	AB2-087 E	0.11
924391	AB2-088 C	0.17
924392	AB2-088 E	0.08
924401	AB2-089 C	0.81
924402	AB2-089 E	0.42
924491	AB2-098 C	0.22
924492	AB2-098 E	0.1
924501	AB2-099 C	0.25
924502	AB2-099 E	0.11
924511	AB2-100 C	6.62
924512	AB2-100 E	3.26
924761	AB2-128 C	5.67
924762	AB2-128 E	2.23
924811	AB2-134 C OP	7.76
924812	AB2-134 E OP	10.38
924931	AB2-147 C	1.41
924932	AB2-147 E	2.29

924941	AB2-149 C OP	1.71
924942	AB2-149 E OP	2.78
924951	AB2-150 C OP	1.41
924952	AB2-150 E OP	2.29
924961	AB2-152	2.04
925051	AB2-160 C OP	3.9
925052	AB2-160 E OP	6.36
925061	AB2-161 C OP	2.11
925062	AB2-161 E OP	3.44
925121	AB2-169 C OP	2.51
925122	AB2-169 E OP	2.26
925141	AB2-171 C OP	2.07
925142	AB2-171 E OP	3.37
925171	AB2-174 C OP	3.8
925172	AB2-174 E OP	3.44
925281	AB2-186 C	0.22
925282	AB2-186 E	0.09
925291	AB2-188 C OP	0.88
925292	AB2-188 E OP	0.4
925331	AB2-190 C	13.83
925332	AB2-190 E	3.46