Generation Interconnection System Impact Study Report

For

PJM Generation Interconnection Request Queue Positions AC1-174 and AC1-175

Losantville 345 kV

June 2018

Preface

The intent of the System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer 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. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

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 or merchant transmission upgrade, may also contribute to the need for the same network reinforcement.

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

General

Riverstart Solar Park LLC and Riverstart Solar Park II, LLC (Riverstart Solar) proposes to install PJM Projects #AC1-174 and #AC1-175, a 200.0 MW (76.0 MW Capacity) solar generating facility in Losantville, IN (see Figure 2). The point of interconnection will be a direct connection to AEP's Losantville 345 kV (see Figure 1).

The requested in service date is November 30, 2019.

Attachment Facilities

Point of Interconnection (Losantville 345 kV Substation)

To accommodate the interconnection at the Losantville 345 kV substation, the substation will have to be expanded requiring the installation of two (2) 345 kV circuit breakers and starting a new string (see Figure 1). Installation of associated protection and control equipment, 345 kV line risers, SCADA, and 345 kV revenue metering will also be required.

Losantville Station Work:

- Expand the Losantville 345 kV substation, start a new string, and install two (2) 345 kV circuit breakers (see Figure 1). Installation of associated protection and control equipment, 345 kV line risers, SCADA, and 345 kV revenue metering will also be required.
    - **Estimated Station Cost: $3,000,000**

Non-Direct Connection Cost Estimate

The total preliminary cost estimate for Non-Direct Connection work is given in the following tables below:

For AEP building Direct Connection cost estimates:

Description	Estimated Cost
345 kV Revenue Metering	**$350,000**
Upgrade line protection and controls at the expanded Losantville 345 kV substation.	**$350,000**
Upgrade line protection and control settings at the Desoto 345 kV substation to coordinate with the expanded Losantville 345 kV substation.	**$50,000**
Upgrade line protection and control settings at the Tanners Creek 345 kV substation to coordinate with the expanded Losantville 345 kV substation.	**$50,000**

Total	**$800,000**

Interconnection Customer Requirements

It is understood that Riverstart Solar is responsible for all costs associated with this interconnection. The cost of Riverstart Solar's generating plant and the costs for the line connecting the generating plant to Riverstart Solar's switching station are not included in this report; these are assumed to be Riverstart Solar's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for American Electric Power to provide power for consumption at the developer's facilities. A separate agreement may be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

Requirement from the PJM Open Access Transmission Tariff:

1. 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.

2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

Revenue Metering and SCADA Requirements

PJM Requirements

The Interconnection Customer 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.

AEP Requirements

The Interconnection Customer will be required to comply with all AEP Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "Requirements for Connection of New Facilities or Changes to Existing Facilities Connected to the AEP Transmission System" document located at the following link:

http://www.pjm.com/~/media/planning/plan-standards/private-aep/aep-interconnection-requirements.ashx

Network Impacts

The Queue Projects AC1-174 & AC1-175 were evaluated as a 200.0 MW (Capacity 76.0 MW) injection into the Losantville 345 kV substation in the AEP area. Projects AC1-174 & AC1-175 were evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Projects AC1-174 & AC1-175 were studied with a commercial probability of 100%. Potential network impacts were as follows:

Base Case Used

Summer Peak Analysis – 2020 Case

Contingency Descriptions

The following contingencies resulted in overloads:

Option 1	
Contingency Name	**Description**
8823	CONTINGENCY '8823' OPEN BRANCH FROM BUS 243218 TO BUS 243232 CKT 2 / 243218 05DESOTO 345 243232 05SORENS 345 2 OPEN BRANCH FROM BUS 243225 TO BUS 243232 CKT 1 / 243225 05KEYSTN 345 243232 05SORENS 345 1 END
8468_B2	CONTINGENCY '8468_B2' OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 2 / 242528 05SPORN 345 248005 06KYGER 345 2 END
349_B2_TOR21	CONTINGENCY '349_B2_TOR21' OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 1 / 242528 05SPORN 345 248005 06KYGER 345 1 END
8702_B2_TOR2543	CONTINGENCY '8702_B2_TOR2543' OPEN BRANCH FROM BUS 243218 TO BUS 243232 CKT 2 / 243218 05DESOTO 345 243232 05SORENS 345 2 END
P1-#..B2 TERMINAL-EAST BEND 4516	CONTINGENCY 'P1-#..B2 TERMINAL-EAST BEND 4516' OPEN BRANCH FROM BUS 249575 TO BUS 249565 CKT 1 END

Table 1

Generator Deliverability

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

None

Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

AC1-175 Multiple Facility Contingency														
	Contingency				Bus				Loading		Rating			
#	Type	Name	Affected Area	Facility Description	From	To	Cir.	PF	Initial	Final	Type	MVA	MW Con.	FG App.
1	DCTL	8823	AEP - AEP	05DESOTO-05JAY 138 kV line	243278	243319	1	AC	97.67	100.89	ER	393	14.9	

Table 2

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)

Note: Please see Appendices for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Appendix.

AC1-175 Contribution to Previously identified Overloads														
	Contingency				Bus				Loading		Rating			
#	Type	Name	Affected Area	Facility Description	From	To	Cir.	PF	Initial	Final	Type	MVA	MW Con.	FG App.
1	DCTL	P1-#..B2 TERMINAL-EAST BEND 4516	AEP – DEO&K	05TANNER-08M.FORT 345 kV line	243233	249567	1	AC	107.28	108.34	ER	1409	15.17	

Table 3

Steady-State Voltage Requirements

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

Stability Analysis

No problems identified

Affected System Analysis & Mitigation

LGEE Impacts:

None

MISO Impacts:

None

Duke, Progress & TVA Impacts:

None

OVEC Impacts:

None

Delivery of Energy Portion of Interconnection Request

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 developer 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.

AC1-175 Delivery of Energy Portion of Interconnection Request

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	PF	Loading Initial	Loading Final	Rating Type	Rating MVA	MW Con.	FG App.
1	N-1	8702_B2_TOR2543	AEP - AEP	05KEYSTN-05SORENS 345 kV line	243225	243232	1	AC	106.64	111.46	NR	897	43.27	
2	N-1	P1-#..B2 TERMINAL-EAST BEND 4516	AEP - DEO&K	05TANNER-08M.FORT 345 kV line	243233	249567	1	AC	110.19	112.13	NR	1409	39.92	
3	N-1	8468_B2	OVEC-AEP	06KYGER-05SPORN	248005	242528	1	AC	132.77	134.0	NR	1017	14.65	
4	N-1	349_B2_TOR21	OVEC-AEP	06KYGER-05SPORN	248005	242528	2	AC	139.06	140.34	NR	971	14.65	

Table 4

New System Reinforcements

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

#	Overloaded Facility	Upgrade Description	Schedule	Estimated Cost
#1	05DESOTO-05JAY 138 kV line	Replace the Jay breaker G (1200A) Replace the Jay Switch (1200A) Replace Jay Riser (1590 AAC 61 Str.) Replace the Jay Bus (1590 AAC 61 Str.) Replace the Desoto Switch (1200A) The Jay Area Improvements project will replace the limiting elements identified above.	Work to be completed March 2018	**N/A**

Table 5

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)

(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

#	Overloaded Facility	Upgrade Description	Schedule	Estimated Cost
#1	05TANNER-08M.FORT 345 kV line	B2634.1 - Replace metering BCT on Tanners Creek CB T2 with a slip over CT with higher thermal rating in order to remove 1193 MVA limit on facility (Miami Fort-Tanners Creek 345 kV line) B2831.1 – Upgrade the Tanner Creek – Miami Fort 345 kV circuit (AEP Portion)	Work to be completed June 2018	**N/A**

Table 6

Schedule

It is anticipated that the time between receipt of executed agreements and Commercial Operation may range from 12 to 18 months if no line work is required. If line work is required, construction time would be between 24 to 36 months after signing an interconnection agreement.

Note: The time provided between anticipated normal completion of System Impact, Facilities Studies, subsequent execution of ISA and ICSA documents, and the proposed Backfeed Date is shorter than usual and may be difficult to achieve.

Conclusion

Based upon the results of this System Impact Study, the construction of the 200.0 MW (76.0 MW Capacity) Riverstart Solar generating facility (PJM Project #AC1-174 and #AC1-175) will require the following additional interconnection charges. This plan of service will interconnect the proposed solar generating facility in a manner that will provide operational reliability and flexibility to both the AEP system and the Riverstart Solar generating facility.

Cost Breakdown for Point of Interconnection (Losantville 345 kV Substation)			
Network Upgrade Type	**Network Upgrade Number**	**Description**	**Estimated Cost**
Non-Direct Connection Cost Estimate	**n5653**	Expand Losantville 345 kV Substation	**$3,000,000**
	n5654	345 kV Revenue Metering	**$350,000**
	n5655	Upgrade line protection and controls at the expanded Losantville 345 kV substation.	**$350,000**
	n5656	Upgrade line protection and control settings at the Desoto 345 kV substation to coordinate with the expanded Losantville 345 kV substation.	**$50,000**
	n5657	Upgrade line protection and control settings at the Tanners Creek 345 kV substation to coordinate with the expanded Losantville 345 kV substation.	**$50,000**
Total Estimated Cost for Project AC1-174 and AC1-175			**$3,800,000**

Table 6

The estimates are preliminary in nature, as they were determined without the benefit of detailed engineering studies. Final estimates will require an on-site review and coordination to determine final construction requirements.

Figure 1: Point of Interconnection (Losantville 345 kV Substation)

Single-Line Diagram

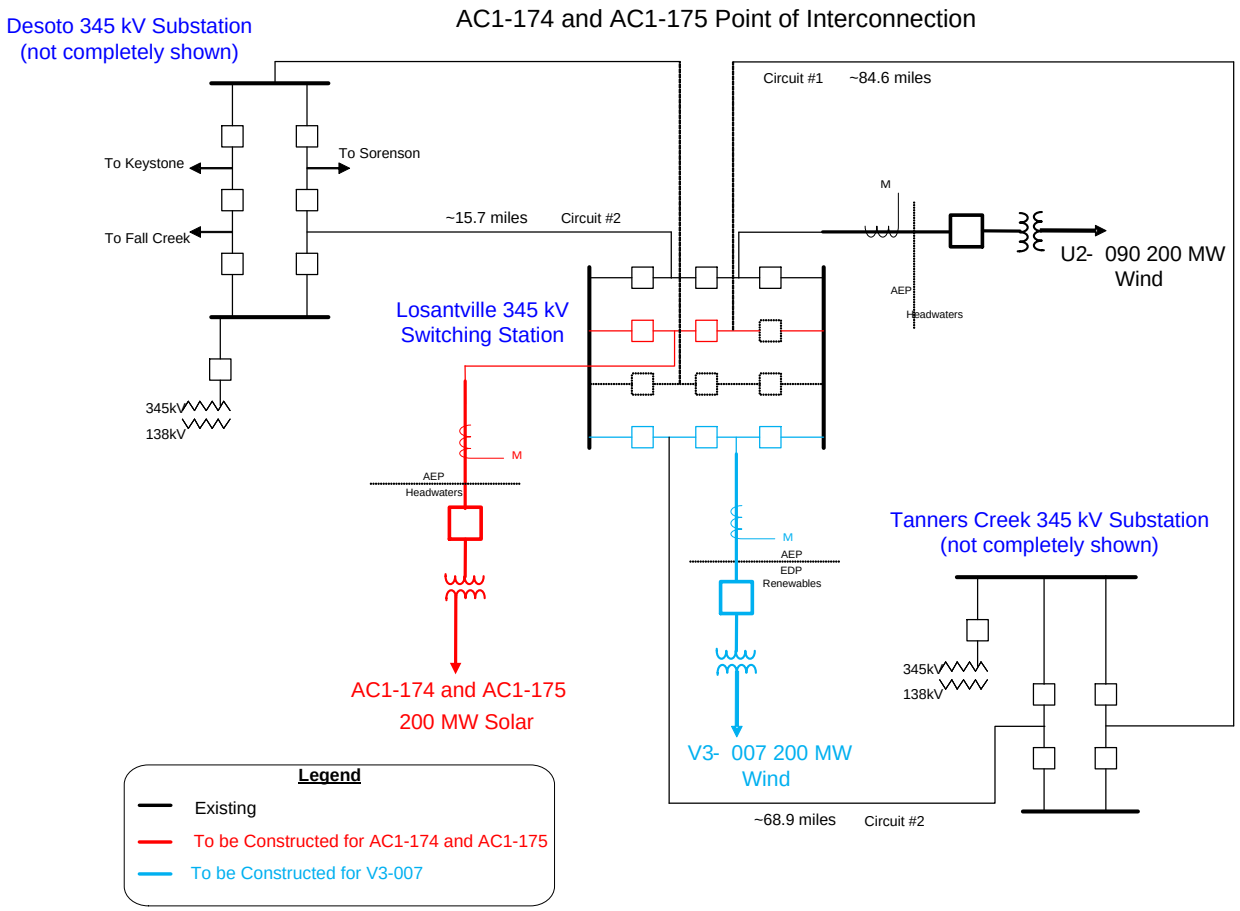
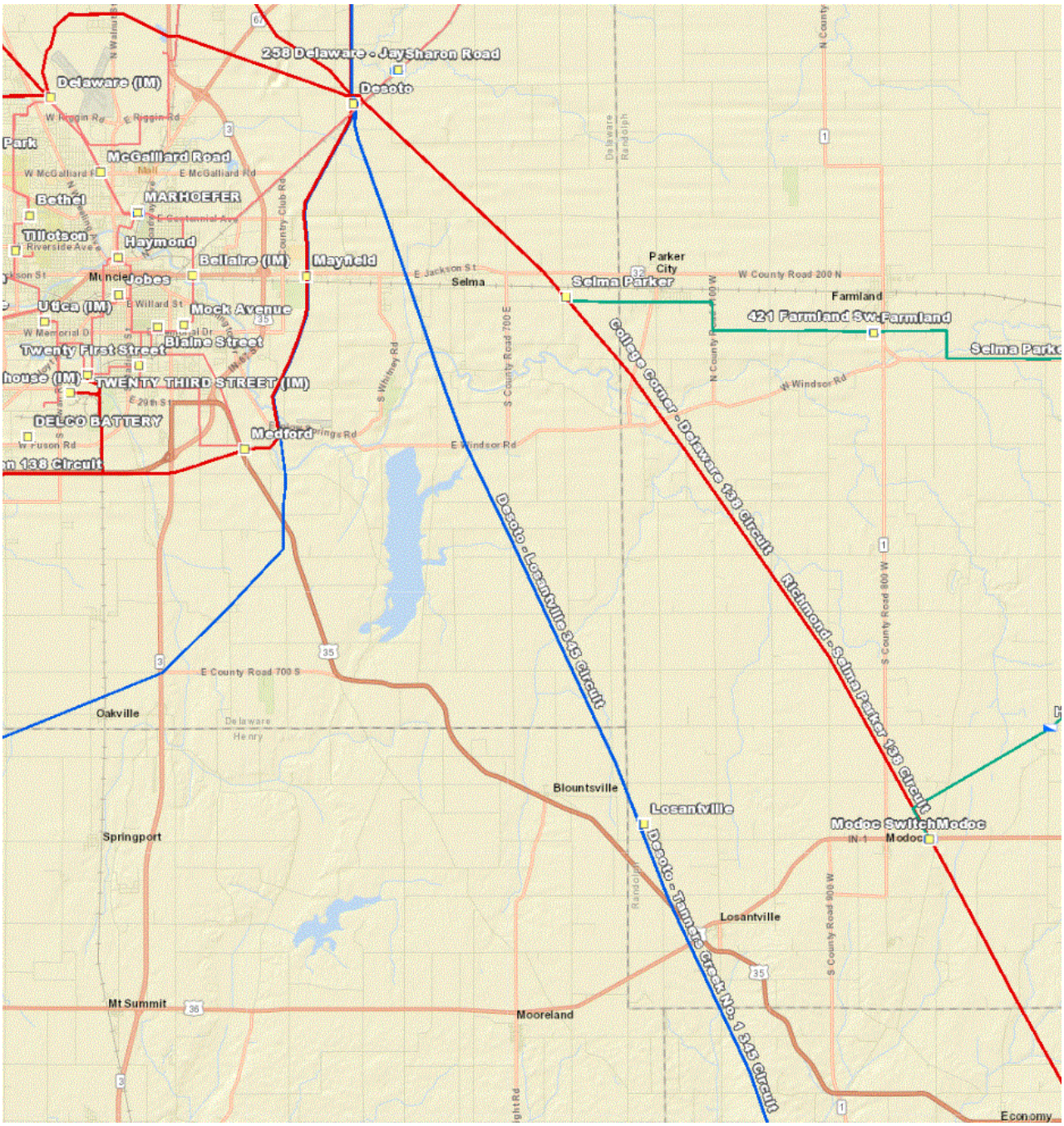


Figure 2: Point of Interconnection (Losantville 345 kV Substation)



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 gage other generators impact.

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

(AEP - AEP) The 05DESOTO-05JAY 138 kV line (from bus 243278 to bus 243319 ckt 1) loads from 97.67% to 100.89% (AC power flow) of its emergency rating (393 MVA) for the tower line contingency outage of '8823'. This project contributes approximately 14.9 MW to the thermal violation.

CONTINGENCY '8823'
OPEN BRANCH FROM BUS 243218 TO BUS 243232 CKT 2 / 243218 05DESOTO 345 243232 05SORENS 345 2
OPEN BRANCH FROM BUS 243225 TO BUS 243232 CKT 1 / 243225 05KEYSTN 345 243232 05SORENS 345 1
END

Bus Number	*Bus Name*	*Full Contribution*
247967	*05HDWTR1G E*	*12.96*
247543	*V3-007 C*	*1.94*
247935	*V3-007 E*	*12.96*
247568	*V3-015 C*	*3.32*
247949	*V3-015 E*	*22.24*
923881	*AB2-028 C*	*1.63*
923882	*AB2-028 E*	*10.88*
927851	*AC1-175 C*	*5.66*
927852	*AC1-175 E*	*9.24*
928231	*AC1-212 C*	*1.47*

Appendix 2

(AEP - DEO&K) The 05TANNER-08M.FORT 345 kV line (from bus 243233 to bus 249567 ckt 1) loads from 107.28% to 108.34% (AC power flow) of its normal rating (1409 MVA) for the single line contingency outage of 'P1-#..B2 TERMINAL-EAST BEND 4516'. This project contributes approximately 15.17 MW to the thermal violation.

CONTINGENCY 'P1-#..B2 TERMINAL-EAST BEND 4516'
OPEN BRANCH FROM BUS 249575 TO BUS 249565 CKT 1
END

Bus Number	*Bus Name*	*Full Contribution*
247285	*05AND G1*	*0.81*
247286	*05AND G2*	*0.81*
247287	*05AND G3*	*1.69*
243795	*05HDWTR1G C*	*1.03*
247292	*05KEY G1*	*1.35*
247293	*05KEY G2*	*1.35*
247294	*05KEY G3*	*1.35*
247295	*05KEY G4*	*1.35*
247264	*05LAWG1A*	*12.83*
247265	*05LAWG1B*	*12.83*
247266	*05LAWG1S*	*20.48*
247267	*05LAWG2A*	*12.83*
247268	*05LAWG2B*	*12.83*
247269	*05LAWG2S*	*20.48*
247288	*05RICHG1*	*0.54*
247289	*05RICHG2*	*0.54*
247270	*05RPMNG1*	*1.9*
246991	*05WLD G1 C*	*0.3*
247255	*05WLD G2 C*	*0.32*
243415	*05WWVSTA*	*1.51*
251947	*08EBND2*	*29.83*
247536	*S-071 C*	*0.47*
247543	*V3-007 C*	*5.19*
247568	*V3-015 C*	*4.49*
247588	*W4-004 C*	*2.29*
247589	*W4-008 C*	*2.29*
900404	*X3-028 C*	*100.53*
247621	*Y3-024*	*0.06*
701701	*Y4-071*	*1.65*
LTF	*Z1-043*	*14.18*
917721	*Z2-115 C*	*0.02*

922372	*AA2-148 C*	*4.46*
922982	*AB1-087 C OP*	*36.86*
922992	*AB1-088 C OP*	*36.86*
LTF	*AB2-013*	*8.15*
923881	*AB2-028 C*	*3.74*
924211	*AB2-065 C*	*3.14*
926581	*AC1-059 C*	*11.87*
926872	*AC1-088 C*	*2.4*
927611	*AC1-152*	*20.45*
927821	*AC1-172*	*20.45*
927851	*AC1-175 C*	*15.17*
928231	*AC1-212 C*	*1.66*