Generation Interconnection Feasibility Study Report-Web Version Revised

For

PJM Generation Interconnection Request Queue Position Y2-087

Lewistown – Raystown 230kV Project

August, 2013

Feasibility Study Report

Lewistown – Raystown 230kV Generation Project

Introduction

This Feasibility Study report provides the documentation of an assessment that has been performed by PJM Interconnection LLC (PJM) and FirstEnergy (FE) in response to a request made by Interconnection Customer for the connection of a 150.4 MW (19.55MW Capacity) wind Generation Project (the Project) to the Penelec Transmission System. The IC has proposed commercial operation date of 10/31/2016 for the Project. As per the PJM RTEP study process, the Lewistown – Raystown 230kV (Y2-087) Project assessment was accomplished by: 1. Evaluating the reliability impact of the proposed facilities and connection on the interconnected transmission system by the performance of a power flow study; 2. Ensuring compliance with the NERC, ReliabilityFirst, PJM and FE Reliability Standards by identifying the system reinforcements that will need to be installed for an interconnection of the proposed project; 3. Coordinating and cooperating with the PJM staff and the IC by participating in project meetings and issuing this report as a part of the RTEP study process; 4. Performing a Steady State, Short-Circuit and Dynamics Study as necessary; 5. Conducting all studies in accordance with the PJM Manuals, the "FE Requirements for Transmission Connected Facilities", and the "FE Study Guide".

Connection Facilities

In compliance with the Regional Transmission Expansion Planning (RTEP) protocol, Interconnection Customer has submitted a "Form of Generation Interconnection Feasibility Study Agreement" to PJM and a proposed single line diagram (see Attachment 8) that identifies its plan to construct a 150.4 MW wind Generation Project with a total capability of 150.4 MW (19.55 MW Capacity) near the Lewistown – Raystown 230kV line. For purposes of this report, it has therefore been designated as the Lewistown – Raystown 230kV (Y2-087) Project to reflect its interconnection voltage and its proximity to the Lewistown – Raystown 230kV line.

The interconnection of the Project will be accomplished by constructing a new 230kV 3 breaker ring bus and looping the Lewistown – Raystown 230kV line into the new station. The new 230kV 3 breaker ring bus will be approximately 15.75 miles from Lewistown substation. The IC will be responsible for acquiring all easements, properties and permits that may be required to construct both the new 230kV 3 breaker ring bus interconnection substation and the associated attachment facilities. The IC will also be responsible for the rough grade of the property and an access road to the proposed 3 breaker ring bus site. A summary of the Project direct connection facilities that will be required and their estimated costs are shown on Attachment 3. The one-line is shown in Attachment 2.

PJM Interconnection Study Results

The following are the results of the analysis performed by PJM engineers with respect to the transmission system impacts.

Network Impacts

The Queue Project #Y2-087 was studied as a 150.4MW (Capacity 19.5MW) injection as a tap of the Raystown – Lewistown 230 kV line in the Penelec area. Project #Y2-087 was evaluated for compliance with reliability criteria for summer peak conditions in 2016. Potential network impacts were as follows:

Generator Deliverability

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

None

Light Load Analysis

Light Load Studies to be conducted during later study phases (applicable to wind, coal, nuclear, and pumped storage projects).

Multiple Facility Contingency

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

1. The SHADE GP-ROXBURY 115 kV line (from bus 200522 to bus 200520 ckt 1) loads from 94.16% to 108.65% (**DC power flow**) of its emergency rating (149 MVA) for the bus fault outage of CONTINGENCY DESCRIPTION ('PL100582'). This project contributes approximately 21.59 MW to the thermal violation.

```
CONTINGENCY 'PL100582'                          /*JUNIATA 230KV BUS 2
  DISCONNECT BUS 208005
  END
```

Please refer to Appendix 1 for a table containing the generators having contribution to this flowgate.

2. The SHADE GP-ROXBURY 115 kV line (from bus 200522 to bus 200520 ckt 1) loads from 94.16% to 108.65% (**DC power flow**) of its emergency rating (149 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('PL100547'). This project contributes approximately 21.59 MW to the thermal violation.

CONTINGENCY 'PL100547' /*AT JUNIATA SUB LEWISTOWN 230KV CB FAILED
DISCONNECT BRANCH FROM BUS 208005 TO BUS 200513 CKT 1
DISCONNECT BUS 208005
END

Please refer to Appendix 2 for a table containing the generators having contribution to this flowgate.

3. The SHADE GP-ROXBURY 115 kV line (from bus 200522 to bus 200520 ckt 1) loads from 94.16% to 108.65% (**DC power flow**) of its emergency rating (149 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('PL100546'). This project contributes approximately 21.59 MW to the thermal violation.

CONTINGENCY 'PL100546' /*AT JUNIATA SUB DAUPHIN 230KV CB FAILED
DISCONNECT BUS 207955
DISCONNECT BUS 208005
END

Please refer to Appendix 3 for a table containing the generators having contribution to this flowgate.

Short Circuit
(Summary form of Cost allocation for breakers will be inserted here if any)

A short circuit analysis has been performed by PJM showing that no circuit breakers are newly over dutied with the addition of the Project to the FE transmission system. The study also showed no significant fault current contribution to the breakers which are near the over-duty limit.

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)

1. The LEWISTWN-JUNI BU2 230 kV line (from bus 200513 to bus 208005 ckt 1) loads from 104.87% to 106.54% (**DC power flow**) of its normal rating (488 MVA) for non-contingency condition. This project contributes approximately 8.12 MW to the thermal violation.

Please refer to Appendix 4 for a table containing the generators having contribution to this flowgate.

2. The LEWISTWN-JUNI BU2 230 kV line (from bus 200513 to bus 208005 ckt 1) loads from 108.6% to 109.9% (**DC power flow**) of its emergency rating (617 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('KEYSTONE_JACKMTN1_1'). This project contributes approximately 8.07 MW to the thermal violation.

CONTINGENCY 'KEYSTONE_JACKMTN1_1' /* 500/500KV, AREA 225/225.
DISCONNECT BRANCH FROM BUS 200011 TO BUS 200071 CKT 1
END

Please refer to Appendix 5 for a table containing the generators having contribution to this flowgate.

3. The SHADE GP-ROXBURY 115 kV line (from bus 200522 to bus 200520 ckt 1) loads from 101.6% to 116.1% (**DC power flow**) of its emergency rating (149 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('PL100548'). This project contributes approximately 21.6 MW to the thermal violation.

CONTINGENCY 'PL100548' /*AT JUNIATA SUB 230KV BUS TIE CB FAILED
DISCONNECT BUS 208004
DISCONNECT BUS 208005
END

Please refer to Appendix 6 for a table containing the generators having contribution to this flowgate.

4. The LEWISTWN-JUNI BU2 230 kV line (from bus 200513 to bus 208005 ckt 1) loads from 129.6% to 139.72% (**DC power flow**) of its emergency rating (617 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('PJM3B1'). This project contributes approximately 62.39 MW to the thermal violation.

CONTINGENCY 'PJM3B1' /* KEYSTONE BUS BREAKER 3
DISCONNECT BRANCH FROM BUS 200071 TO BUS 200011 CKT 1 /* JUNIATA KEYSTONE 500 500 /* BUS 200072 => 200071 (JACKMNT1)
DISCONNECT BRANCH FROM BUS 200011 TO BUS 200810 TO BUS 200907 CKT 4/* KEYSTONE KEYSTONE 500 230 #4
END

Please refer to Appendix 7 for a table containing the generators having contribution to this flowgate.

5. The LEWISTWN-JUNI BU2 230 kV line (from bus 200513 to bus 208005 ckt 1) loads from 135.29% to 145.33% (**DC power flow**) of its emergency rating (617 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('C2_PN500-SB-2'). This project contributes approximately 61.97 MW to the thermal violation.

```
CONTINGENCY 'C2_PN500-SB-2'                          /* JACKS MTN CB
  DISCONNECT BRANCH FROM BUS 200011 TO BUS 200071 CKT 1
  DISCONNECT BRANCH FROM BUS 200071 TO BUS 200009 CKT 1
  END
```

Please refer to Appendix 8 for a table containing the generators having contribution to this flowgate.

Steady-State Voltage Requirements
(Results of the steady-state voltage studies should be inserted here)

To be determined

Stability and Reactive Power Requirement
(Results of the dynamic studies should be inserted here)

To be determined

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

1, 2, 3. The SHADE GP-ROXBURY 115 kV line:
At the Shade Gap SS, upgrade 500 MCM copper conductor on the Roxbury line. Replace 800A wave trap on the same line terminal. Reconductor the 13.6 mile Roxbury – Shade Gap line with 336 kcmil ACSS, replacing the existing 336 kcmil ACSR conductor. It is assumed that most of the structures will not be replaced or rehabbed. Estimated Cost with tax: $8,733,800; Estimated Cost without tax: $6,741,500; Estimated Time: 33 months

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)

1, 2, 4, 5. The LEWISTWN-JUNI BU2 230 kV line:

PENELEC portion: See the "Interconnected Transmission Owner's Analysis Results" section of this report.

PPL portion: The proposed upgrade will consist of rebuilding approximately 0.9 miles of 1033 kcmil ACSR, (current ratings 494/624 MVA Summer Normal/Emergency based on conductor temperature at 125C) with new 1590 kcmil ACSR (new ratings 648/802MVA Summer Normal/Emergency conductor temperature at 125C). The existing structures will be removed and new steel monopoles will be installed for the upgraded 230kV circuit. Estimated cost: **$2,064,960 w/o tax**
In addition, there are some minor substation modifications required in the Juniata 230kV yard to accommodate the higher ampacity rating of the line. The scope of the work at Juniata is the replacement of the existing Lewistown disconnect switches. The existing switches are 1200A switches and will be replaced with 2000A switches to match the ratings of the new line. Estimated cost: **$120,000 w/o tax**

All other Penelec reinforcements are described in the "Interconnected Transmission Owner's Analysis Results" section of this report

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.
Only the most severely overloaded conditions are listed. 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 will study all overload conditions associated with the overloaded element(s) identified.

1. The LEWISTWN-JUNI BU2 230 kV line (from bus 200513 to bus 208005 ckt 1) loads from 132.18% to 144.99% (**DC power flow**) of its normal rating (488 MVA) for non-contingency condition. This project contributes approximately 62.5 MW to the thermal violation.

Interconnected Transmission Owner's Analysis Results

The following was generated by FirstEnergy (Pennsylvania Electric Company or "Penelec") the Interconnected Transmission Owner, based upon its analysis, as well as that of PJM, for mitigation of the project's impacts on the transmission and lower voltage system as applicable. It includes the costs and schedules for any system upgrades.
Costs for affected Transmission owners other than FirstEnergy are included and reported in the "New System Reinforcements" and "Contribution to Previously Identified System Reinforcements" sections of the "PJM Interconnection Study Results" above.

Power Flow Analysis

A Power Flow study was conducted to determine the reliability impact of the proposed Lewistown – Raystown 230kV (Y2-087) Project on the FE Transmission System. This included the performance of a contingency analysis to identify any facility overload or voltage condition that violates the FE Planning Criteria. Any such violation that is either directly attributable to this project or for which it will have a shared responsibility is included in this report with a least cost plan identified to mitigate them.

The Power Flow Analysis was performed using a 2016 summer peak load base case provided by the PJM staff. This base case included a detailed representation of the Penelec transmission system in the area of the Lewistown - Raystown 230kV line. A simulation of all possible contingencies within the NERC and FE Planning Standards that are impacted by the Project was conducted to test for criteria compliance.

The conclusion from this analysis is that there are new upgrades required for the Project. Additionally, the PJM findings show that there are criteria violations which may have an impact on network congestion and local energy deliverability. The IC may therefore be subject to generation curtailment in order to mitigate these violations.

Short Circuit and Dynamics Analysis

A short circuit analysis has been performed by PJM and the findings were confirmed by FE. The findings show that no circuit breakers are newly over dutied with the addition of the Project to the FE transmission system. The study also showed no significant fault current contribution to the breakers which are near the over-duty limit.

Metering

Interconnection Customer will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. These FE requirements are detailed on Attachment 7 of this report.

Compliance Issues

Interconnection Customer will be responsible for meeting all FE criteria as defined in the FE Requirements for Transmission Connected Facilities document. While the voltage analysis is not performed for the feasibility study, any voltage criteria violations that would require the plant to provide reactive power, that determination of reactive power requirements will be determined in the system impact study, which will include the low voltage ride through analysis.

The IC must also meet all PJM, ReliabilityFirst and NERC reliability criteria and operating procedures required for standards compliance. For example, the IC will need to properly locate and report the over and under-voltage and over and under-frequency system protection elements for its units as well as the submission of the generator model and protection data required to satisfy the PJM and ReliabilityFirst audits. Failure to comply with these requirements may result in a disconnection of service if the violation is found to compromise the reliability of the FE system.

FE Facility Upgrades and Costs

The results from the PJM Power Flow Analysis show that there are FE criteria violations that are directly attributable to the capacity of the Project. Therefore in accordance with the RTEP procedures defined in the PJM Open Access Transmission Tariff and PJM Manuals, the IC is responsible for network upgrades. Additionally, the PJM findings show that there are criteria violations which may have an impact on network congestion and local energy deliverability. Interconnection Customer may therefore be subject to generation curtailment in order to mitigate these violations. The direct connection costs are detailed in Attachment 3.

Note that all cost estimates contained in this document were produced without a detailed engineering review and are therefore subject to error. More accurate estimates will be determined as a part of the System Impact Study. Interconnection Customer will be responsible for the actual cost of the direct connection that is implemented. FE herein reserves the right to return to any issues in this document and, upon appropriate justification, request additional monies to complete any reinforcements to the transmission system.

Interconnection Customer Requirements

In addition to the FE facilities, Interconnection Customer will also be responsible for meeting all criteria as specified in the applicable sections of the "FE Requirements for Transmission Connected Facilities" document including:

1. The purchase and installation of a fully rated circuit breaker on the high side of the Y2-087 230/34.5kV step-up transformer.

2. The purchase and installation of the minimum required FE generation interconnection relaying and control facilities. This includes over/under voltage protection, over/under frequency protection, and zero sequence voltage protection relays.

3. The purchase and installation of an 230kV interconnection metering instrument transformer. FE will provide the ratio and accuracy specifications based on the customer load and generation levels.

4. The purchase and installation of a revenue class meter for each unit to measure the power delivered in compliance with the FE standards.

5. The purchase and installation of supervisory control and data acquisition (SCADA) equipment to provide information in a compatible format to the FE Transmission System Control Center.

6. The establishment of dedicated communication circuits for SCADA report to the FE Transmission System Control Center.

7. A compliance with the FE and PJM generator power factor and voltage control requirements.

8. The execution of a back-up service agreement to serve the customer load supplied from the Y2-087 230kV interconnection substation when the units are out-of-service. This assumes the intent of the IC is to net the generation with the load.

9. The rough grade of the property for the Y2-087 230kV interconnection substation and an access road for the delivery of equipment to this site.

The above requirements are in addition to any metering required by PJM.

Summary

Interconnected Transmission Owner: FirstEnergy(Penelec)

The Lewistown – Raystown 230kV (Y2-087) Project direct connection will require the facility upgrades defined in Attachment 3. As shown, the total estimated cost of the 230kV three breaker ring bus substation is $9,223,900. This cost includes a CIAC (Contribution in Aid of Construction) Federal Income Tax Gross Up charge of $2,104,200 **($7,118,700 without tax)**. The tax may or may not be charged based on whether or not this project meets the eligibility requirements of IRS Notice 88-129. The Project is responsible for network upgrades on the FE system as defined in Attachment 5. As shown, the total estimated cost of these upgrades is $70,989,400. This includes a CIAC Tax Gross Up charge of $16,192,700 **($54,796,700 without tax**).

Based on the scope of the direct connection, it is expected to take a minimum of **two (2) years** from the signing of a Connection Service Agreement to complete the installation required for the Project. This includes a preliminary payment that compensates FE for the first three months of the engineering design work that is related to the construction of the Y2-087 230kV interconnection substation. It also assumes that the IC will provide the property for the Y2-087 230kV interconnection substation and all right-of-way, permits, easements, etc. that will be needed. A further assumption is that there will be no environmental issues with any of the new properties associated with this project, that there will be no delays in acquiring the necessary permits for implementing the defined direct connection and network upgrades, and that PJM will allow all transmission system outages when requested.

Affected Transmission Owner: PPL

The proposed upgrade will consist of rebuilding approximately 0.9 miles of 1033 kcmil ACSR, (current ratings 494/624 MVA Summer Normal/Emergency based on conductor temperature at 125C) with new 1590 kcmil ACSR (new ratings 648/802MVA Summer Normal/Emergency conductor temperature at 125C). The existing structures will be removed and new steel monopoles will be installed for the upgraded 230kV circuit. Estimated cost: **$2,064,960 w/o tax**
In addition, there are some minor substation modifications required in the Juniata 230kV yard to accommodate the higher ampacity rating of the line. The scope of the work at Juniata is the replacement of the existing Lewistown disconnect switches. The existing switches are 1200A switches and will be replaced with 2000A switches to match the ratings of the new line. Estimated cost: **$120,000 w/o tax**

Total Project estimated cost: $64,100,360 plus any applicable taxes

Attachment 1
Project Location

None Provided

Attachment 2
Substation Configuration

Redacted

Attachment 3
Direct Connection Requirements

Upgrade ID	Description	Total Cost	Tax	Cost
PN-S-640	**Y2-087 Interconnect SS:** Install 230kV 3 position ring bus substation near existing Raystown - Lewistown line to serve as interconnection for the PJM Y2-087 generation project.	$6,973,900	$1,590,800	$5,383,100
PN-S-641	**Lewistown SS:** Install new equipment for anti-islanding relaying to new Y2-087 generation.	$250,200	$57,100	$193,100
PN-S-642	**Raystown SS:** Install new equipment for anti-islanding relaying to new Y2-087 generation.	$452,400	$103,200	$349,200
PN-S-643	**Altoona SS:** Install new equipment for anti-islanding relaying to new Y2-087 generation.	$448,900	$102,400	$346,500
PN-S-644	**Bear Rock SS:** Install new equipment for anti-islanding relaying to new Y2-087 generation.	$250,200	$57,100	$193,100
PN-T-173	**Raystown-Lewistown 230kV, Loop to Proposed Wind Farm:** Install a loop, approx. 200' in length, consisting of two guyed 3-pole wood dead-end structures.	$673,600	$153,700	$519,900
EOC	Engineering, Oversight, and Commissioning	$174,700	$39,900	$134,800
TOTAL		$9,223,900	$2,104,200	$7,119,700

Attachment 4
FE Contingency Analysis Results

Refer to PJM analysis results.

Attachment 5
FE Network Facility Reinforcement Conceptual Cost Estimates

Shade Gap – Roxbury 115kV Line

Upgrade ID	Description	Total Cost	Tax	Cost
PN-S-649	**Shade Gap SS:** Upgrade 500 MCM copper conductor on the Roxbury Line. Replace 800A wavetrap on same line terminal.	$83,000	$19,000	$64,000
PN-T-174	**Roxbury-Shade Gap 115kV, Reconductor 13.6 Miles w/ 336 kcmil ACSS:** Reconductor the 13.6 mile line with 336 kcmil ACSS, replacing the existing 336 kcmil ACSR conductor. It is assumed that most of the structures will not be replaced or rehabbed.	$8,650,800	$1,973,300	$6,677,500
TOTAL		$8,733,800	$1,992,300	$6,741,500

Lewistown – Juniata 230kV Line

Upgrade ID	Description	Total Cost	Tax	Cost
PN-T-174	**Juniata-Lewistown 230kV, Rebuild and Reconductor 24.6 Miles:** Rebuild the 24.6 mile FE owned section of the Juniata-Lewistown 230kV line to reconductor with single 1622 kcmil ACSS conductor, replacing the existing single 1033 kcmil ACSR.	$61,807,700	$14,098,200	$47,709,500
PN-S-648	**Lewistown SS:** Upgrade to dual 1033 ACSR Substaton conductor, replace 1600 A wavetrap and replace relaying on the 230kV Juniata Line.	$276,600	$63,100	$213,500
FIBER	**Replace OPGW Fiber on Juniata-Lewistown 230kV, Rebuilt and Reconductored 24.6 Mile line.** Replace the OPGW Fiber on the Rebuilt 24.6 mile FE owned section of the Juniata-Lewistown 230kV line once all new structures are in place with minimal fiber outage.	$171,300	$39,100	$132,200
TOTAL		$62,255,600	$14,200,400	$48,055,200

NOTE: The costs above are limited to FE owned facilities. PPL may need to perform work on their facilities as well.

Attachment 6
FE Network Facility Reinforcement Conceptual One Line Diagrams

Redacted

Attachment 7
FE Revenue Metering Requirements

The FirstEnergy Revenue Metering Requirements may be found in the FirstEnergy Requirements for Transmission Connected Facilities document located at the following links:

www.firstenergycorp.com/feconnect
www.pjm.com/planning/design-engineering/to-tech-standards.aspx

Appendix 1

Bus Number	Bus Name	Full Contribution
200812	ALY HYDR	.02
235567	ARMSTRONG 1	3.87
235569	ARMSTRONG 2	3.85
200857	LAURHILL	4.13
293301	N-039 E	3.76
293802	O-038 E	2.35
294515	P-022 E	.94
290086	Q-036 E	2.36
315446	Q-065	-10.03
296914	R-092 C	.91
296915	R-092 E	3.65
200715	SHAWVL 1	9.11
200722	SHAWVL 2	9.35
200665	SHAWVL 3	13.98
889061	U2-055 C	1.08
889062	U2-055 E	7.3
LTF	V3-012	.89
904761	V4-077 C	.02
904762	V4-077 E	1.36
200852	WARR RDG	.02
907461	X1-109 C	19.12
LTF	X2-042	1.75
LTF	X3-021	3.76
LTF	X3-050	2.89
LTF	X3-096	1.01
LTF	X3-097	1.43
LTF	X3-098	1.35
LTF	X4-041	1.34
LTF	Y1-002	1.78
LTF	Y1-004	.94
LTF	Y2-007	1.35
LTF	Y2-008	1.47
LTF	Y2-040	3.76
LTF	Y2-044	4.67
LTF	Y2-049	3.08
LTF	Y2-056	1.31
LTF	Y2-068	7.17
LTF	Y2-082	4.68
914351	Y2-087 C	2.81
914352	Y2-087 E	18.79

Appendix 2

Bus Number	Bus Name	Full Contribution
200812	ALY HYDR	.02
235567	ARMSTRONG 1	3.87
235569	ARMSTRONG 2	3.85
200857	LAURHILL	4.13
293301	N-039 E	3.76
293802	O-038 E	2.35
294515	P-022 E	.94
290086	Q-036 E	2.36
315446	Q-065	-10.03
296914	R-092 C	.91
296915	R-092 E	3.65
200715	SHAWVL 1	9.11
200722	SHAWVL 2	9.35
200665	SHAWVL 3	13.98
889061	U2-055 C	1.08
889062	U2-055 E	7.3
LTF	V3-012	.89
904761	V4-077 C	.02
904762	V4-077 E	1.36
200852	WARR RDG	.02
907461	X1-109 C	19.12
LTF	X2-042	1.75
LTF	X3-021	3.76
LTF	X3-050	2.89
LTF	X3-096	1.01
LTF	X3-097	1.43
LTF	X3-098	1.35
LTF	X4-041	1.34
LTF	Y1-002	1.78
LTF	Y1-004	.94
LTF	Y2-007	1.35
LTF	Y2-008	1.47
LTF	Y2-040	3.76
LTF	Y2-044	4.67
LTF	Y2-049	3.08
LTF	Y2-056	1.31
LTF	Y2-068	7.17
LTF	Y2-082	4.68
914351	Y2-087 C	2.81
914352	Y2-087 E	18.79

Appendix 3

Bus Number	Bus Name	Full Contribution
200812	ALY HYDR	.02
235567	ARMSTRONG 1	3.87
235569	ARMSTRONG 2	3.85
200857	LAURHILL	4.13
293301	N-039 E	3.76
293802	O-038 E	2.35
294515	P-022 E	.94
290086	Q-036 E	2.36
315446	Q-065	-10.03
296914	R-092 C	.91
296915	R-092 E	3.65
200715	SHAWVL 1	9.11
200722	SHAWVL 2	9.35
200665	SHAWVL 3	13.98
889061	U2-055 C	1.08
889062	U2-055 E	7.3
LTF	V3-012	.89
904761	V4-077 C	.02
904762	V4-077 E	1.36
200852	WARR RDG	.02
907461	X1-109 C	19.12
LTF	X2-042	1.75
LTF	X3-021	3.76
LTF	X3-050	2.89
LTF	X3-096	1.01
LTF	X3-097	1.43
LTF	X3-098	1.35
LTF	X4-041	1.34
LTF	Y1-002	1.78
LTF	Y1-004	.94
LTF	Y2-007	1.35
LTF	Y2-008	1.47
LTF	Y2-040	3.76
LTF	Y2-044	4.67
LTF	Y2-049	3.08
LTF	Y2-056	1.31
LTF	Y2-068	7.17
LTF	Y2-082	4.68
914351	Y2-087 C	2.81
914352	Y2-087 E	18.79

Appendix 4

Bus Number	Bus Name	Full Contribution
200812	ALY HYDR	.05
200887	ARMNA MT P47	.03
235567	ARMSTRONG 1	10.56
235569	ARMSTRONG 2	10.5
203261	BLOSSBCT	.03
200503	C.SLOPE	.33
200805	COLVER13	.23
202158	CON.GEN1	.
202160	CON.GEN2	.
200835	DSGENWIN	.02
200828	HNSMLK 1	.08
200829	HNSMLK 2	.08
200830	HNSMLK 3	.08
200831	HNSMLK 4	.08
200832	HNSMLK 5	.08
200837	HOMER C1	.96
200838	HOMER C2	.97
200839	HOMER C3	1.02
290890	I-012	.04
200636	IUP CO-G	.02
200864	K-013	.01
292340	K-022	.
292350	K-023	.01
200856	L-013 C	.01
200849	LAKVU GN	.01
203283	MANOR	.
293270	N-036 C	.82
293300	N-039 C	.06
293602	O-018 C	.03
293801	O-038 C	.04
293901	O-048 C	.01
293942	O-052 C	.86
294271	P-001 C	1.75
294512	P-022 C	.02
294902	P-060 C	.02
200649	PENNTECH	.16
200608	PINEY #1	.04
200657	PINEY CK	.05
290081	Q-034 C	1.31
290085	Q-036 C	.04
295247	Q-046	.04
200882	Q-053 C	.02

290113	Q-063 C	.04
296322	R-032 C	.03
293431	R-040 C	.
296914	R-092 C	2.58
200846	RINGGOLD	1.16
291409	S-029B	.01
884780	S-058 C	11.57
884781	S-058 E	38.15
291011	S-103	.12
200662	SCRUB GR	.13
200642	SENECA#1	.55
200643	SENECA#2	.51
200644	SENECA#3	.08
200833	SEWRDB34	.97
200715	SHAWVL 1	25.86
200722	SHAWVL 2	26.53
200665	SHAWVL 3	39.77
200666	SHAWVL 4	39.92
200809	SITHE	.06
200834	SOMERWIN	.02
292274	T-085	.01
886091	T-121 C	1.29
292548	T-155	.01
204656	TITUS 1G	-4.05
204657	TITUS 2G	-4.05
204658	TITUS 3G	-4.05
889061	U2-055 C	3.09
LTF	V3-012	11.2
894651	V3-030 C	.01
894731	V3-042 C	.55
904751	V4-076 C	.
904761	V4-077 C	.06
901131	W1-045 C	.59
901181	W1-064	.
902201	W2-018	.01
903641	W3-099 C OP1	.8
200852	WARR RDG	.05
203102	WEST TAN	.06
907461	X1-109 C	41.9
909051	X2-021 C OP1	1.23
909111	X2-031 C	.62
LTF	X2-042	12.54
LTF	X3-020	3.44
LTF	X3-021	16.87

900404	X3-028 C	55.09
910661	X3-039	5.59
LTF	X3-050	7.37
LTF	X3-096	8.28
LTF	X3-097	11.74
LTF	X3-098	11.13
LTF	X4-029D	3.11
LTF	X4-041	11.
LTF	Y1-002	11.75
LTF	Y1-004	13.22
LTF	Y1-007	9.18
913081	Y1-012	.01
913231	Y1-032 C	1.11
913241	Y1-033 C OP1	.37
LTF	Y1-041	3.11
913471	Y1-071	.46
LTF	Y2-004	5.59
LTF	Y2-005	5.59
LTF	Y2-006	5.67
LTF	Y2-007	11.17
LTF	Y2-008	11.32
LTF	Y2-030	3.08
LTF	Y2-031	3.08
LTF	Y2-032	3.08
LTF	Y2-033	6.28
LTF	Y2-034	5.06
LTF	Y2-040	16.87
LTF	Y2-044	11.93
LTF	Y2-049	13.85
LTF	Y2-056	9.34
LTF	Y2-068	58.93
LTF	Y2-069	4.03
LTF	Y2-070	4.03
LTF	Y2-071	4.03
LTF	Y2-072	4.03
LTF	Y2-082	26.38
914351	Y2-087 C	8.12

Appendix 5

Bus Number	Bus Name	Full Contribution
235134	ALL L&D 6	.01
200812	ALY HYDR	.05
200887	ARMNA MT P47	.03
235567	ARMSTRONG 1	11.35
235569	ARMSTRONG 2	11.29
203261	BLOSSBCT	.03
200503	C.SLOPE	.34
200805	COLVER13	.24
202158	CON.GEN1	.
202160	CON.GEN2	.
200835	DSGENWIN	.02
200828	HNSMLK 1	.08
200829	HNSMLK 2	.08
200830	HNSMLK 3	.08
200831	HNSMLK 4	.08
200832	HNSMLK 5	.08
200837	HOMER C1	1.03
200838	HOMER C2	1.02
200839	HOMER C3	1.08
290890	I-012	.04
200636	IUP CO-G	.02
200864	K-013	.01
292340	K-022	.
292350	K-023	.01
200856	L-013 C	.01
200849	LAKVU GN	.01
203283	MANOR	.
293270	N-036 C	.83
293300	N-039 C	.06
293602	O-018 C	.03
293801	O-038 C	.04
293901	O-048 C	.01
293942	O-052 C	.88
294271	P-001 C	1.78
294512	P-022 C	.02
294902	P-060 C	.02
200649	PENNTECH	.16
200608	PINEY #1	.05
200657	PINEY CK	.05
290081	Q-034 C	1.38
290085	Q-036 C	.04
295247	Q-046	.04

200882	Q-053 C	.02
290113	Q-063 C	.04
296322	R-032 C	.04
293431	R-040 C	.
296914	R-092 C	2.59
200846	RINGGOLD	1.22
291409	S-029B	.01
884780	S-058 C	14.11
884781	S-058 E	46.53
291011	S-103	.13
200662	SCRUB GR	.14
200642	SENECA#1	.56
200643	SENECA#2	.52
200644	SENECA#3	.08
200833	SEWRDB34	1.01
200715	SHAWVL 1	25.87
200722	SHAWVL 2	26.54
200665	SHAWVL 3	39.71
200666	SHAWVL 4	39.87
200809	SITHE	.06
200834	SOMERWIN	.02
292274	T-085	.01
886091	T-121 C	1.31
292548	T-155	.01
204656	TITUS 1G	-4.71
204657	TITUS 2G	-4.71
204658	TITUS 3G	-4.71
889061	U2-055 C	3.08
LTF	V3-012	13.78
894651	V3-030 C	.01
904751	V4-076 C	.
904761	V4-077 C	.06
209019	VIKI IPP	-.83
901131	W1-045 C	.57
901181	W1-064	.
902201	W2-018	.01
903641	W3-099 C OP1	.84
200852	WARR RDG	.05
203102	WEST TAN	.06
907461	X1-109 C	39.67
909051	X2-021 C OP1	1.29
909111	X2-031 C	.64
LTF	X2-042	15.37
LTF	X3-020	4.22

LTF	X3-021	19.86
900404	X3-028 C	67.62
910661	X3-039	5.95
LTF	X3-050	7.47
LTF	X3-096	10.15
LTF	X3-097	14.39
LTF	X3-098	13.64
LTF	X4-029D	3.8
LTF	X4-041	13.48
LTF	Y1-002	14.32
LTF	Y1-004	16.29
LTF	Y1-007	11.31
913081	Y1-012	.01
913231	Y1-032 C	1.13
913241	Y1-033 C OP1	.39
LTF	Y1-041	3.8
913471	Y1-071	.49
LTF	Y2-004	6.84
LTF	Y2-005	6.84
LTF	Y2-006	6.96
LTF	Y2-007	13.69
LTF	Y2-008	13.88
LTF	Y2-030	3.79
LTF	Y2-031	3.79
LTF	Y2-032	3.79
LTF	Y2-033	7.75
LTF	Y2-034	6.3
LTF	Y2-040	19.86
LTF	Y2-044	12.09
LTF	Y2-049	16.31
LTF	Y2-056	11.39
LTF	Y2-068	72.22
LTF	Y2-069	4.77
LTF	Y2-070	4.77
LTF	Y2-071	4.77
LTF	Y2-072	4.77
LTF	Y2-082	31.79
914351	Y2-087 C	8.07
200813	YOUGH	.01

Appendix 6

Bus Number	Bus Name	Full Contribution
200812	ALY HYDR	.02
235567	ARMSTRONG 1	3.89
235569	ARMSTRONG 2	3.87
200857	LAURHILL	4.14
293301	N-039 E	3.76
293802	O-038 E	2.35
294515	P-022 E	.94
290086	Q-036 E	2.37
315446	Q-065	-10.09
296914	R-092 C	.91
296915	R-092 E	3.65
884780	S-058 C	1.76
884781	S-058 E	5.79
200715	SHAWVL 1	9.12
200722	SHAWVL 2	9.36
200665	SHAWVL 3	14.
889061	U2-055 C	1.08
889062	U2-055 E	7.31
LTF	V3-012	.91
904761	V4-077 C	.02
904762	V4-077 E	1.36
200852	WARR RDG	.02
907461	X1-109 C	19.2
LTF	X2-042	1.78
LTF	X3-021	3.8
LTF	X3-050	2.9
LTF	X3-096	1.03
LTF	X3-097	1.45
LTF	X3-098	1.38
LTF	X4-041	1.36
LTF	Y1-002	1.81
LTF	Y1-004	.97
LTF	Y2-007	1.38
LTF	Y2-008	1.49
LTF	Y2-040	3.8
LTF	Y2-044	4.69
LTF	Y2-049	3.12
LTF	Y2-056	1.33
LTF	Y2-068	7.3
LTF	Y2-082	4.74
914351	Y2-087 C	2.81
914352	Y2-087 E	18.8