PJM Generator Interconnection
U2-085 So. Akron – Prince 11.4 MW
Feasibility / Impact Study Re-study

February 2009

DMS # 525984

February 2009 Updates

Re-study changes to the "October 2008" U2-085 So. Akron – Prince 11.4 MW Feasibility / Impact Study include:

In addition to substation work required at three PPL EU regional substations (Leola, East Lancaster and Prince) similar work will be required at a PPL EU customer-owned type "B" substation. The cost for this additional work is estimated to be $130,000. This work can be done concurrently with other work required for Queue U2-085.

The new total Direct connection work cost estimate is **$580,000**.

General

Queue U2-085 is a Dart Container Corporation request to interconnect an 11.4 MW Capacity Resource (net to the system) consisting of two 5.7 MW Landfill Gas fueled turbine generators. Queue U2-085 has proposed an in-service date of December 1, 2009. PPL will not be able to make this in-service date due to engineering and construction window constraints. PPL proposes March 31st, 2010 as the revised in-service date.

Direct Connection Requirements

Queue U2-085 can be connected to the existing Dart Corporation facilities connected to the So. Akron – Prince #1 (alternate feed) and #2 (primary feed) 138 kV lines as shown on the one line diagram below and described in the text that follows.

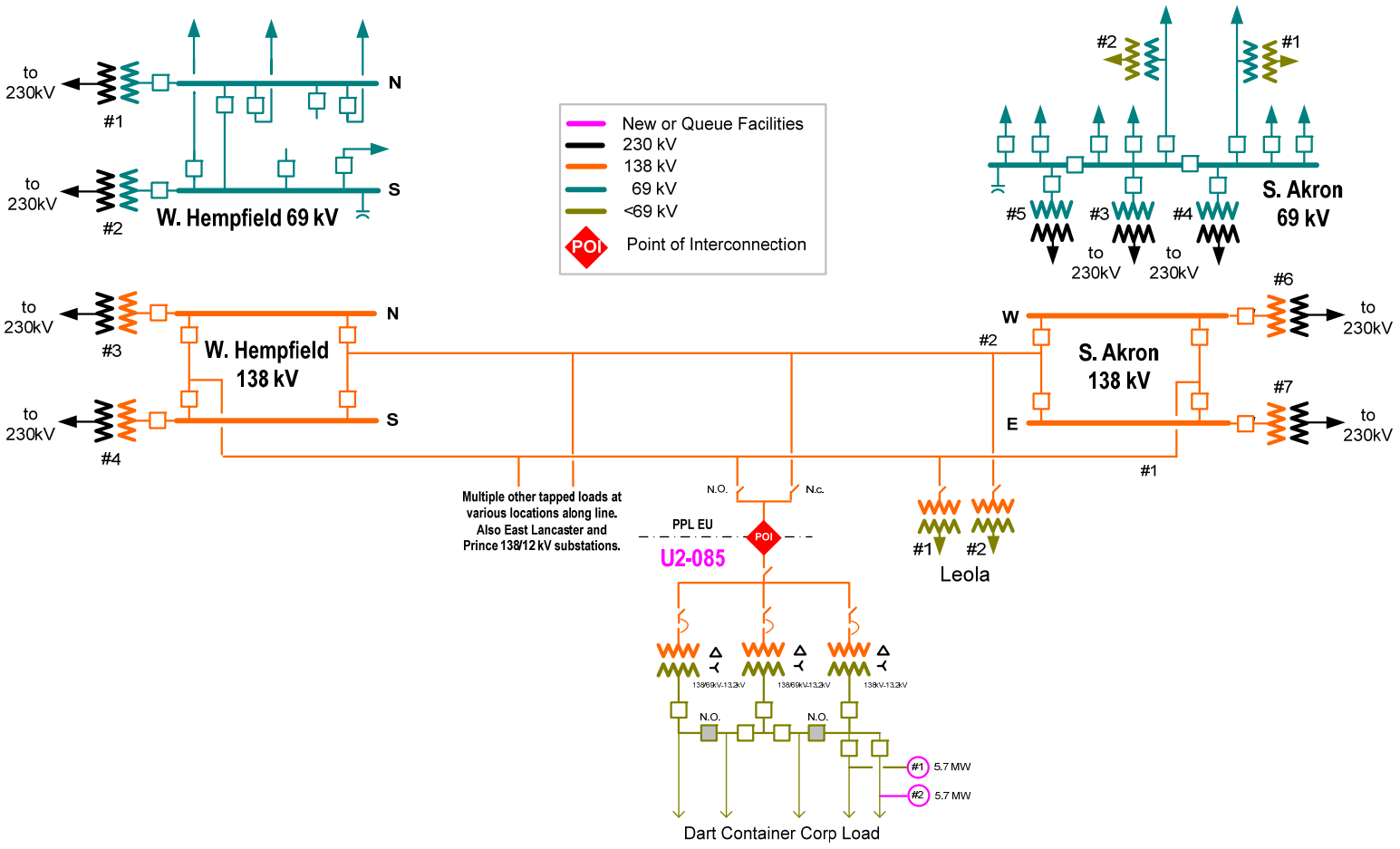
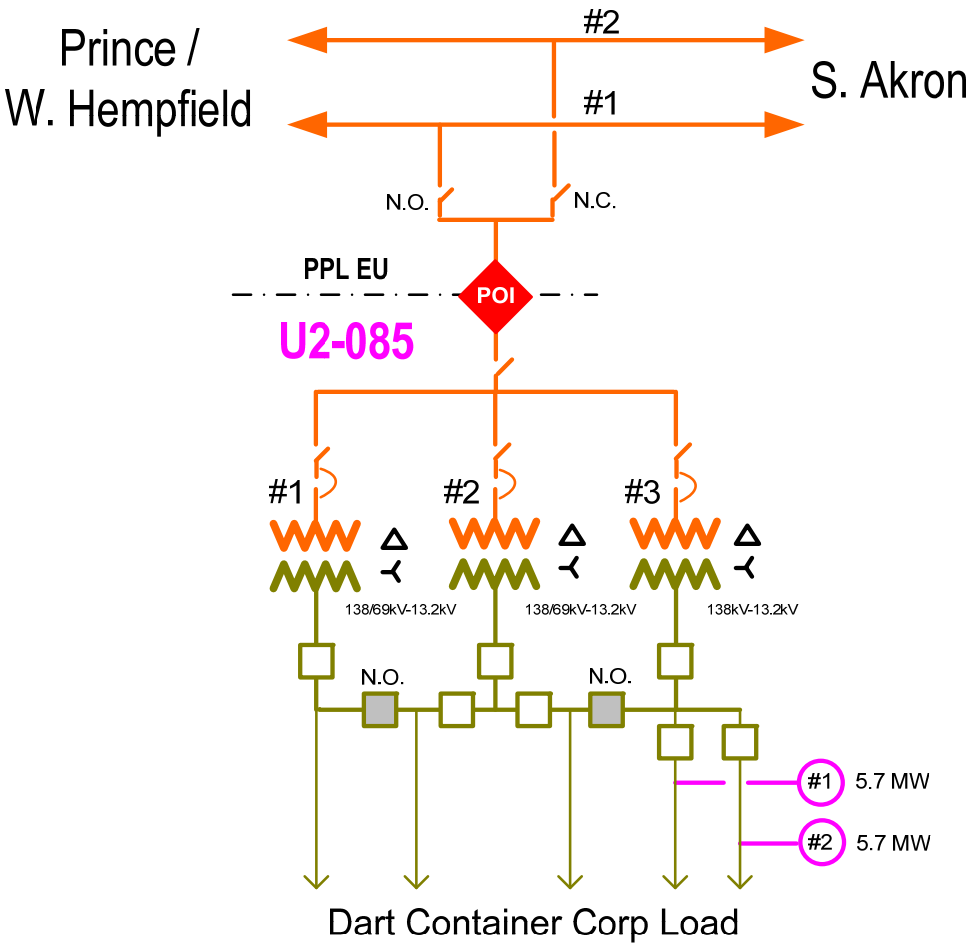


Figure 1

The new generating facilities will be interconnected to the existing Dart Container customer facilities which are normally interconnected to the South Akron – Prince #2 138 kV circuit. The facility is supplied with a double tap, single feed and may also be interconnected to the South Akron – Prince #1 138 kV line during abnormal emergency switching conditions or line maintenance. The Dart Container point-of-interconnection is near grid 43086S27207. South Akron 230/138 kV Substation supplies the South Akron – Prince #1 and #2 lines. At the Dart Container facilities, the two new generating units will be installed on existing Transformer #3 12.47 kV bus, which is currently connected to customer load. See Figure #2 below.



The substation work at one regional and three area supply substations to accommodate the interconnection of U2-085 is estimated to cost **$450,000** (total).

Note: The costs given above are based on the assumption that Queue U2-085 will use a standard IPR (Interconnection Protective Relaying) cabinet design and that the Queue U2-085 drawings will be in good order.

Transmission Direct Connection Work ($0)

PPL EU transmission facilities (South Akron – Prince #2 normal and South Akron – Prince #1 alternate) are of sufficient capacity to permit the injection of an additional 11.4 MW of generation at Dart Container. No transmission line upgrades are required for this new interconnection.

Under abnormal switching conditions, the Dart Container facility may be supplied from West Hempfield 230/138/69 kV substation. This study assumes that U2-085 will not operate the generation during this abnormal system arrangement. If U2-085 would prefer to operate during this condition, a Direct Transfer Trip (DTT) protection scheme to West Hempfield will need to be pursued. This study assumes that supply from South Akron 138 kV yard ONLY is adequate. U2-085 will be able to operate on the normal supply line South Akron – Prince #2 line and on the alternate supply line South Akron – Prince #1 line. If this assumption is incorrect, U2-085 is asked to inform PPL immediately in order to meet the proposed schedule.

Regional Substation Work ($230,000)

Direct Transfer Trip (DTT) protection to U2-085 is required. The work at South Akron 230/138/69 kV substation yard includes:

- Installation of radio based DTT (Direct Transfer Trip) equipment,
- Installation of line selector switch,
- Installation of associated wiring, cables, conduit, etc.

This work includes installation of radio based DTT equipment and control design modifications at the South Akron 230/138/69 kV substation with a matching set of DTT equipment at the customer's site. The scheme will provide a trip signal to the U2-085 generation for any line fault, or any other condition that will cause the PPL EU breaker at South Akron substation to trip. Preliminary indications are that radio based DTT is a feasible option.

Note: The estimate is based on using radio based equipment. If radio communication is unachievable, fiber or phone technology will need to be implemented which will increase the estimate.

PPL substation facilities (South Akron 138 kV Bay 1 and Bay 2) are of sufficient capability to permit connection of an additional 11.4 MW of generation from Dart Container. Also, the South Akron 138 kV circuit breakers are adequate to clear the fault current for a fault on the South Akron – Prince #1 or #2 lines with the additional generation provided from Dart.

Area Supply Substation Work ($220,000)

Leola, East Lancaster, and Prince 138/12 kV substations (PPL EU-owned) must also be modified by the addition of synchro-check relays on the low-side circuit breaker of each power transformer. The substations are designed with protection controls that assume the 138 kV sources will always be in phase and synchronized with system generation. The

introduction of new independent generation on this transmission circuit invalidates this design. Facilities must be installed to verify that the 138 kV system generation and the new sources (Queue U2-085 generators) are in-phase before the low side breakers are allowed to close.

The work at PPL EU-owned **Leola 138/12 kV** substation includes:

- Modification of controls at this type "B" substation to include synchro-check relaying on the 12 kV breakers
- Synchro-check relay cabinet
- Cables for AC and DC supplies and transformer breaker interlocks
- Cost estimate at Leola = $65,000

The work at PPL EU-owned **East Lancaster 138/12 kV** substation includes:

- Modification of controls at this type "B" substation to include synchro-check relaying on the 12 kV breakers
- Synchro-check relay cabinet
- Cables for AC and DC supplies and transformer breaker interlocks
- Cost estimate at East Lancaster = $65,000

The work at PPL EU-owned **Prince 138/12 kV** substation includes:

- Modification of controls at this type "F" substation to include synchro-check relaying on 12 kV switchgear
- Two synchro-check relay cabinets
- Cables for AC and DC supplies and transformer breaker interlocks
- Cost estimate at Prince = $90,000

SCADA Requirements:

PPL EU will require the installation of a PPL EU approved SCADA equipment that will connect to its existing SCADA system. At this point in time, the only means for making this connection is a 4-wire dedicated FDDA-type phone line. The Interconnection Customer should investigate with the local phone company the possibility of obtaining this type of service at the Leola facility.

Recently, the major telephone company that provides service in the PPL EU electric service territory (Verizon) has changed its rules and procedures for "High Voltage Telephone Service". These changes have resulted in significant, additional minimum lead time for the installation of these phone lines to 3.5 months, or more, and additional costs for the design and engineering of these facilities. The Interconnection Customer should secure the necessary phone line circuits as soon as possible.

Metering Requirements:

U2-085 must indicate whether they plan to sell on the PJM market or to the second party (Dart Container) only. Metering requirements vary depending on the second/third party scenario.

Design and Operating Requirements of the Generation Project:

Design

The Customer Facility would normally need to meet the following PJM Tariff power factor requirements:

> "The Interconnection Customer shall design its Customer Facility with the ability to maintain a power factor of at least **0.95 leading to 0.90 lagging** measured at the Point of Interconnection."

However, due to the poor load power factor of the existing load at Dart Container, nonstandard power factor language will need to be incorporated in the ISA (Interconnection Service Agreement) to excuse Queue U2-085 generation from the obligation to correct load power factor.

Operation

U2-085 has indicated that the two new units will be synchronous generators. **The POI (Point of Interconnection – see Figures #1 and #2) at Dart Container is to operate near unity power factor over all MW output levels.** Under normal operating conditions, U2-085 must maintain a MVAR schedule of zero (neither absorbing nor producing VARs) as measured at the 138 kV interconnection point with a tolerance of plus/minus 2.0 MVAR. In the past, PPL EU has directed U2-085 to hold this constant power factor at all MW output levels.

Based on preliminary analysis of data provided for this study, PPL EU calculations indicate that the new units will need to operate lagging near 0.90 in order to maintain near unity power factor at the point of interconnection. PPL EU will review the voltage regulation requirements again in future studies should U2-085 choose to proceed with this installation.

Preliminary drawings indicate that Dart Container's transformer #3 will have the intertie protection relay package and SCADA RTU. The new generation cannot be tied to any transformer other than transformer #3. Interlocks must be installed to avoid this condition from occurring (including the normally open breaker 108b, the tie switch on pole 318, and the tie switch on pole 447).

Future PPL EU studies will be based on the following data currently on record as provided by U2-085:

(1) Two gas turbine-generators, each 8.125 MVA and 6.30 MW, terminal voltage of 12.47kv, direct axis sub-transient reactance of 18.6%, both

generators sharing the same 12.47kv bus on the low side of the customer's transformer #3.

(2) One interconnection power transformer (existing), 15/20/25MVA, 138/13.2-7.62kv, and an impedance of 8.748% on a 15MVA base.

If the above data is incorrect, U2-085 is asked to provide updated information on this equipment.

Schedule Requirements for the Generation Project

Activity	**Start**	**Finish**
PPL EU Study & Contracts:		
Feasibility/ Impact Study		10/15/2008
Interconnection Agreement Complete		12/31/2008
PPL EU Engineering:		
IPP Provides Design Drawings for PPL EU Review	09/01/2008	12/31/2008
PPL Completes Engineering	1/1/2009	6/30/2009
PPL EU Construction:	09/01/2009	1/31/2010
U2-085 Phone Line In-service:		**9/1/2009**
PPL EU Relay and Control:	1/1/2010	3/31/2010
Meter Install	2/1/2010	2/28/2010
Commercial In-Service Date		3/31/2010
Complete As-Built Drawing Review		04/01/2010

Notes concerning the Schedule:

(1) The PJM three-party ISA (Interconnection Service Agreement) and CSA (Construction Service Agreement) or an Interim ISA Agreement must be signed by Dart Container, PJM, and PPL EU before any PPL EU activities may commence.

(2) The ISA and CSA or an Interim Agreement must be signed by 12/31/08 in order to meet the proposed March 31st, 2008 in-service date.

(3) The schedule is completely under the control of Queue U2-085. PPL EU will turn drawings around in a reasonable time-frame, however, PPL cannot start work until the first set of drawings is received.

(4) Queue U2-085 should have their phone line (SCADA circuit and DTT circuit if radio technology is not feasible) in-service by 9/1/2009. Queue U2-085 Interconnection Customer will need to notify PPL by March 2009 if the phone line option cannot be provided by the telephone provider.

Network Impacts

The queue U2-085 project was studied as an 11.4MW (11.4MW capacity) injection at the Dart TP2 138kV substation. Project U2-085 was evaluated for compliance with reliability criteria for summer peak conditions in 2012. Potential network impacts were as follows:

Generator Deliverability
(Normal System and Single, or N-1, contingencies for the Capacity portion only of the interconnection)

No problems identified.

Multiple Facility Contingency
(Double Circuit Tower Line contingencies for the full energy output; Stuck breaker and Bus Fault contingency analysis will be performed for the Impact Study)

No problems identified.

Short Circuit

No problems identified.

Stability Analysis

Not required due to the size and location of the project.

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)

No problems identified.

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

None.

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)

None.

PJM Generator Interconnection
U2-085 So. Akron – Prince 11.4 MW
Feasibility / Impact Study

October 2008

DMS # 509085

General

Queue U2-085 is a Dart Container Corporation request to interconnect an 11.4 MW Capacity Resource (net to the system) consisting of two 5.7 MW Landfill Gas fueled turbine generators. Queue U2-085 has proposed an in-service date of December 1, 2009. PPL will not be able to make this in-service date due to engineering and construction window constraints. PPL proposes March 31st, 2010 as the revised in-service date.

Direct Connection Requirements

Queue U2-085 can be connected to the existing Dart Corporation facilities connected to the So. Akron – Prince #1 (alternate feed) and #2 (primary feed) 138 kV lines as shown on the one line diagram below and described in the text that follows.

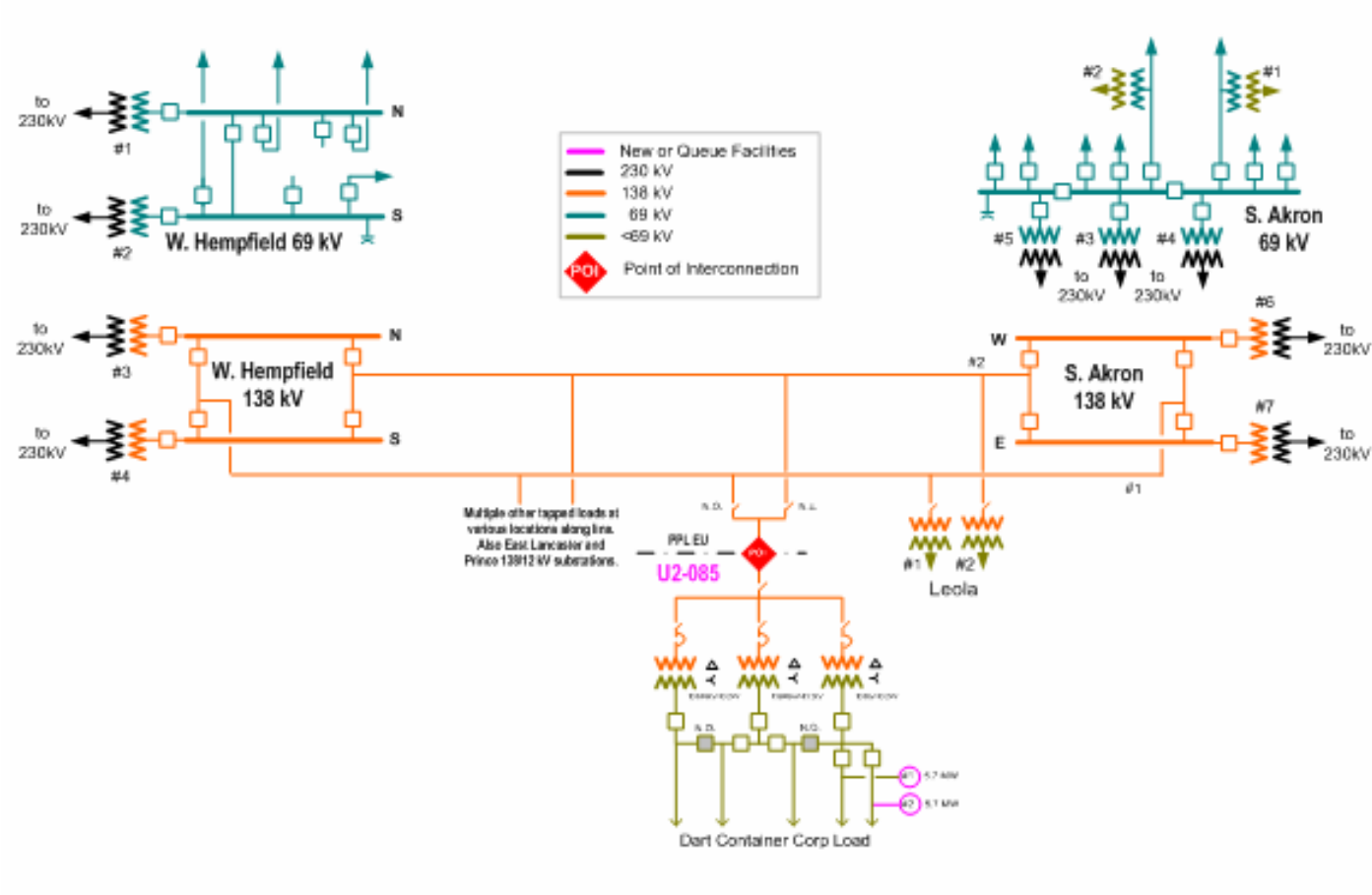
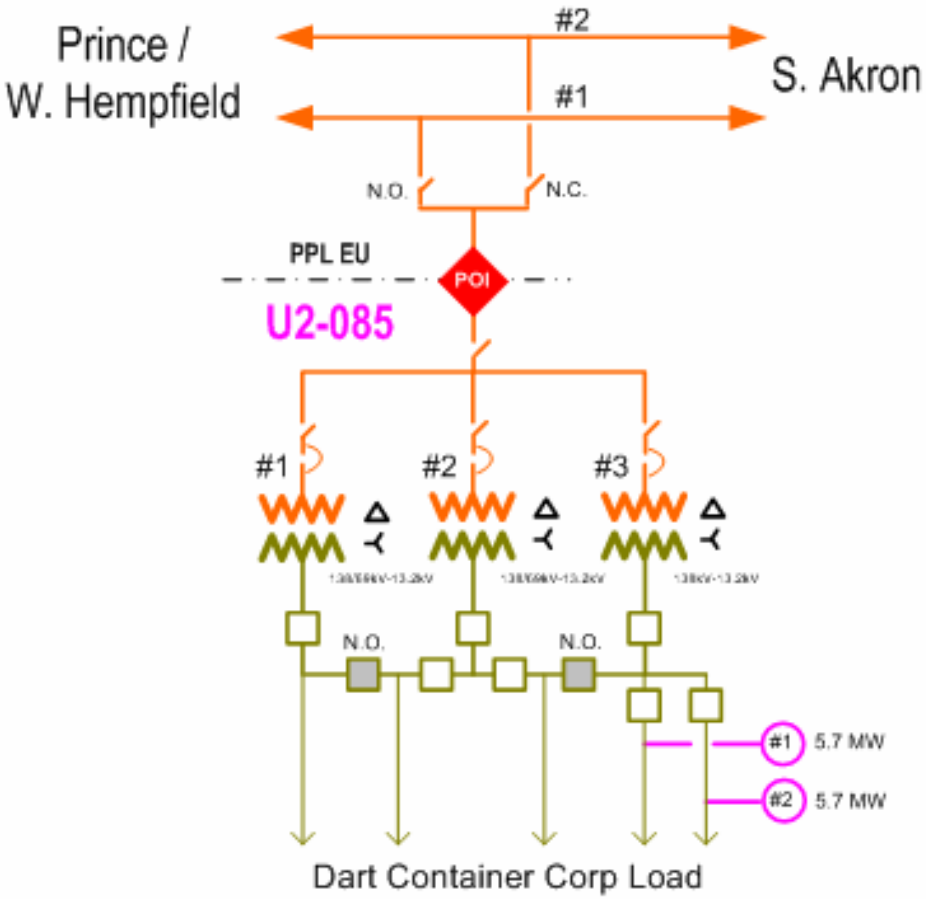


Figure 1

The new generating facilities will be interconnected to the existing Dart Container customer facilities which are normally interconnected to the South Akron – Prince #2 138 kV circuit. The facility is supplied with a double tap, single feed and may also be interconnected to the South Akron – Prince #1 138 kV line during abnormal emergency switching conditions or line maintenance. The Dart Container point-of-interconnection is near grid 43086S27207. South Akron 230/138 kV Substation supplies the South Akron – Prince #1 and #2 lines. At the Dart Container facilities, the two new generating units will be installed on existing Transformer #3 12.47 kV bus, which is currently connected to customer load. See Figure #2 below.



The substation work at one regional and three area supply substations to accommodate the interconnection of U2-085 is estimated to cost **$450,000** (total).

Note: The costs given above are based on the assumption that Queue U2-085 will use a standard IPR (Interconnection Protective Relaying) cabinet design and that the Queue U2-085 drawings will be in good order.

Transmission Direct Connection Work ($0)

PPL EU transmission facilities (South Akron – Prince #2 normal and South Akron – Prince #1 alternate) are of sufficient capacity to permit the injection of an additional 11.4 MW of generation at Dart Container. No transmission line upgrades are required for this new interconnection.

Under abnormal switching conditions, the Dart Container facility may be supplied from West Hempfield 230/138/69 kV substation. This study assumes that U2-085 will not operate the generation during this abnormal system arrangement. If U2-085 would prefer to operate during this condition, a Direct Transfer Trip (DTT) protection scheme to West Hempfield will need to be pursued. This study assumes that supply from South Akron 138 kV yard ONLY is adequate. U2-085 will be able to operate on the normal supply line South Akron – Prince #2 line and on the alternate supply line South Akron – Prince #1 line. If this assumption is incorrect, U2-085 is asked to inform PPL immediately in order to meet the proposed schedule.

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- Synchro-check relay cabinet
- Cables for AC and DC supplies and transformer breaker interlocks
- Cost estimate at Leola = $65,000

The work at PPL EU-owned **East Lancaster 138/12 kV** substation includes:

- Modification of controls at this type "B" substation to include synchro-check relaying on the 12 kV breakers
- Synchro-check relay cabinet
- Cables for AC and DC supplies and transformer breaker interlocks
- Cost estimate at East Lancaster = $65,000

The work at PPL EU-owned **Prince 138/12 kV** substation includes:

- Modification of controls at this type "F" substation to include synchro-check relaying on 12 kV switchgear
- Two synchro-check relay cabinets
- Cables for AC and DC supplies and transformer breaker interlocks
- Cost estimate at Prince = $90,000

SCADA Requirements:

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U2-085 Phone Line In-service:		**9/1/2009**
PPL EU Relay and Control:	1/1/2010	3/31/2010
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(2) The ISA and CSA or an Interim Agreement must be signed by 12/31/08 in order to meet the proposed March 31st, 2008 in-service date.

(3) The schedule is completely under the control of Queue U2-085. PPL EU will turn drawings around in a reasonable time-frame, however, PPL cannot start work until the first set of drawings is received.

(4) Queue U2-085 should have their phone line (SCADA circuit and DTT circuit if radio technology is not feasible) in-service by 9/1/2009. Queue U2-085 Interconnection Customer will need to notify PPL by March 2009 if the phone line option cannot be provided by the telephone provider.

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Multiple Facility Contingency
(Double Circuit Tower Line contingencies for the full energy output; Stuck breaker and Bus Fault contingency analysis will be performed for the Impact Study)

No problems identified.

Short Circuit

No problems identified.

Stability Analysis

Not required due to the size and location of the project.

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)

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

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Contribution to Previously Identified System Reinforcements
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None.