

***PJM Generator Interconnection
W1-054 So. Akron – Prince 11.4 MW
Feasibility / Impact Study***

May 2010
Docs # 593368

General

Queue W1-054 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 W1-054 has proposed an in-service date of December 31, 2011. **This study does not imply a PPL EU commitment to this in-service date.**

Direct Connection Requirements

Queue W1-054 generation can be connected to the existing Dart Corporation facilities connected to the So. Akron – Prince #2 (Normal) and #1 (Alternate) 138 kV lines as shown on the one line diagram below in Figure 1 and described in the text that follows.

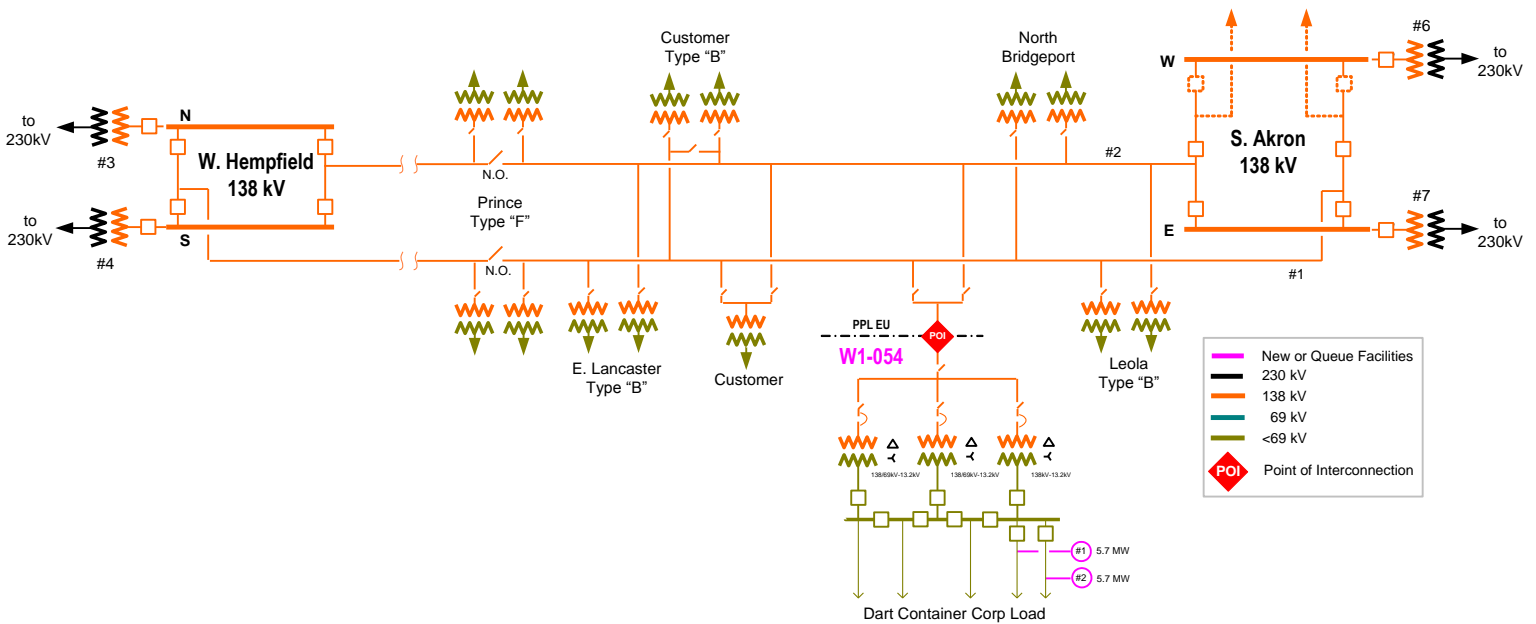


Figure 1

Interconnection Customer (Dart Container) Scope of Direct Connection Work

The Queue W1-054 Interconnection Customer will be responsible for the design and construction of facilities on the W1-054 side of the POI (Point of Interconnection) shown in Figure 1 above and as described below.

Protection equipment --

Queue W1-054 is responsible to design and construct modifications to their existing substation facilities as follows:

The Interconnection Customer will need to install suitable protection and control equipment based on PPL EU parallel generation requirements. This includes both Intertie Protective Relaying (IPR) and Point of Contact (POC) relaying. Please refer to the PPL EU web site for the IPR and POC requirements. The website addresses are shown below.

IPR Requirements:

<http://www.pplelectric.com/Business+Partners/Tools+and+Reference+Center/Customer-Owned+Generation/>

POC Requirements:

http://www.pplelectric.com/NR/rdonlyres/B0937C7E-B6E9-40AD-AE8C-ED3C9558E528/0/point_of_contact.pdf

DTT Relaying Requirements:

Matching radio based DTT (Direct Transfer Trip) equipment is required. Per preliminary field test results, PPL EU is assuming that radio is a viable communication path between W1-054 Interconnection and PPL EU's South Akron 230/138/69 kV Substation.

The DTT scheme will provide a trip signal to the Interconnection Customer for any line fault, or any other condition that will cause the source South Akron 138 kV line breaker to trip. The DTT scheme provides a block-closing signal to the breakers at PPL EU source switchyard/substation from W1-054. Automatic reclosing of the PPL EU line breaker will be blocked whenever the breaker connecting the Interconnection Customer's generation is closed and their generation is on-line.

SCADA Requirements—

PPL EU will require the installation of PPL EU approved SCADA equipment that will connect to its existing SCADA system. This connection will be a 4-wire dedicated FDDA-type phone line. PPL EU will provide detailed specifications and design drawings for this equipment.

Telephone Circuit Requirements--

PPL EU will require a communication path for SCADA and voice. PPL EU anticipates that telephone circuits will be required to establish these paths.

The Interconnection Customer will be responsible to procure the following:

- a) A 4-wire dedicated FDDA-type phone line for SCADA.
- b) A normal dialup telephone line for voice communication. This may be an extension telephone.

Phone lines tend to be long lead-time items and must be in place and operational for equipment testing. The Interconnection Customer should investigate with the local phone company the possibility of obtaining this type of service at the Dart Leola facility.

All installation, maintenance, and monthly lease or billing charges for communications facilities are the responsibility of the Interconnection Customer.

Metering Equipment Installation at the Point of Interconnection--

Installation of revenue grade Metering Equipment will be required at the Queue W1-054 Point of Interconnection (POI). PPL EU will design and supply the required metering equipment but all the installation cost would be borne by the developer. All metering equipment must meet applicable PPL EU tariff requirements as well as being compliant with all applicable requirements of the PJM agreements. The equipment should be housed in a control cabinet or similar enclosure and must be accessible to PPL EU metering personnel.

Metering / Telemetry for PJM--

Interconnection Customer is also required to provide revenue metering and real-time telemetry data to PJM in compliance with the requirements listed in PJM Manuals M-01 and M-14.

Synchronizing Breaker Requirement --

The W1-054 units must have their own synchronizing breaker.

Transmission Owner (PPL EU) Scope of Direct Connection Work

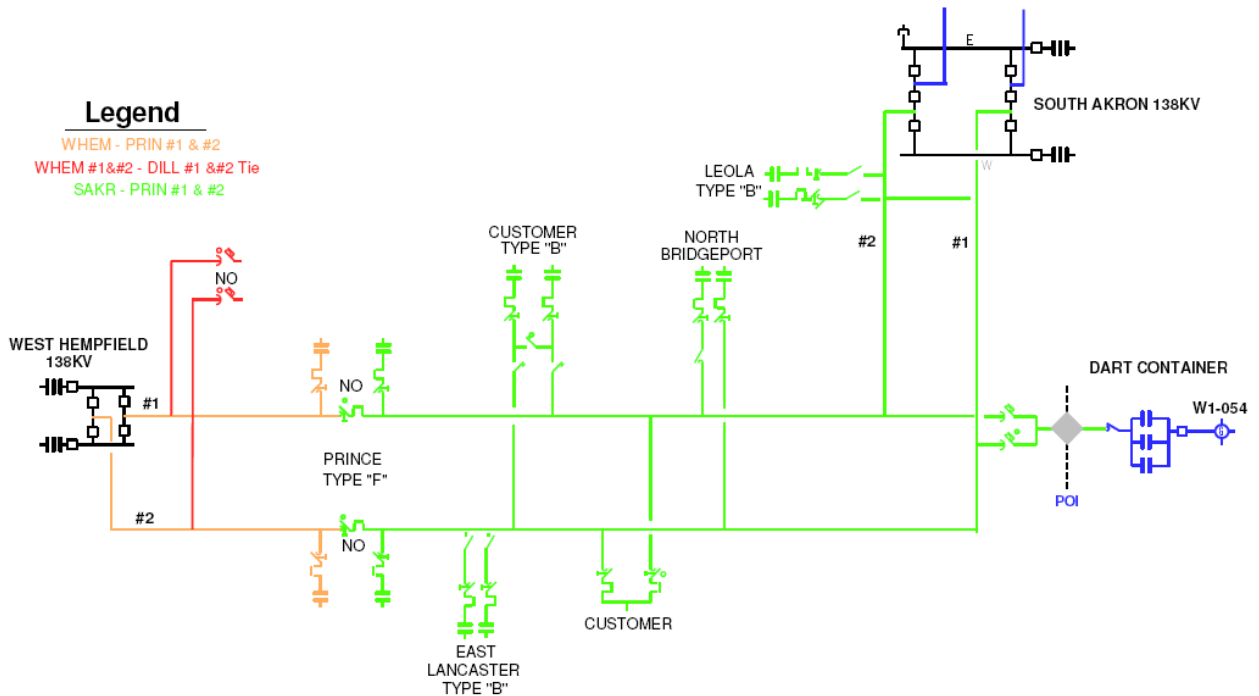


Figure 2

W1-054 generation will be interconnected to the existing Dart Container customer facilities which are normally supplied from the South Akron – Prince #2 138 kV circuit. The facility is designed in a double tap, single feed arrangement and may also be interconnected to the South Akron – Prince #1 138 kV line during abnormal or emergency switching conditions or because of 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 normally.

Under abnormal switching conditions, the Dart Container facility may be supplied from West Hempfield 230/138/69 kV substation. This study assumes that W1-054 will not operate the generation during this abnormal system arrangement. If W1-054 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 supply from South Akron 138 kV yard ONLY. W1-054 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, W1-054 is asked to inform PPL immediately in order to meet the proposed schedule.

At the Dart Container facilities, the two new generating units will be installed off the existing Transformer #3 12.47 kV bus, which is currently connected to customer load. See Figure #3 below. The customer has the ability to sectionalize their 12kV low side such that the generation output may be on any of the three existing transformers. Dart

Container has requested PPL EU review the interconnection and proposed protection schemes such that 11.4MW may be injected onto the system through any one of their three 138/12kV transformers.

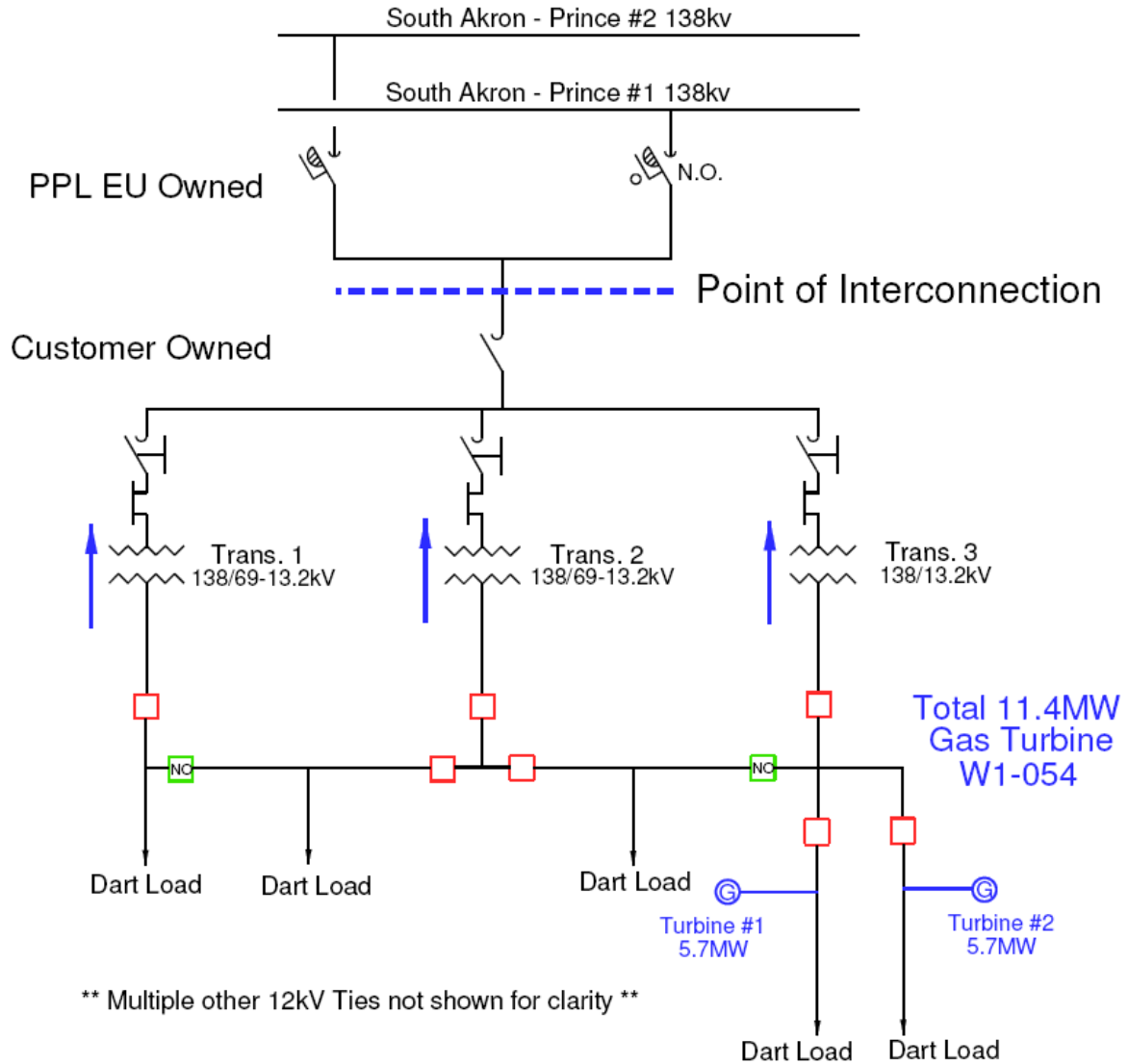


Figure 3

The substation work at one regional supply substation, three PPL EU owned area supply substations, and one customer owned transmission connected substation to accommodate the interconnection of W1-054 is estimated to cost **\$621,500** (total).

Note: The costs given above are based on the assumption that Queue W1-054 will use a standard IPR (Interconnection Protective Relaying) cabinet design and that the Queue W1-054 drawings will be in good order.

A breakdown of the cost is as follows:

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.

Regional Substation Work (\$246,000)

Direct Transfer Trip (DTT) protection to W1-054 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. The scheme will provide a trip signal to the W1-054 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.

The line selector switch will allow the DTT protection for either the South Akron – Prince #2 (normal) or South Akron – Prince #1 (alternate) 138kV lines depending upon the system arrangement.

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 cost 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 W1-054.

Area Supply Substation Work (\$375,500)

Leola, East Lancaster, and Prince 138/12 kV substations (PPL EU-owned) and one customer owned 138/12kV substation must 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 W1-054 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 = \$72,500

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 = \$72,500

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 = \$97,000

The work at a customer owned **138/12 kV** substation includes:

- Modification of controls at this type “B” substation to include synchro-check relaying on 12 kV switchgear
- Full scope unknown at this time. Will need to contact customer for input.
- Cost estimate at customer facility = \$133,500

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.”

Operation

W1-054 has indicated that the two new units will be synchronous generators. **Typically the power factor is measure at the POI (Point of Interconnection) but due to Dart's parasitic load, the exact power factor metering location will need to be determined.** Under normal operating conditions, W1-054 must maintain a MVAR schedule of zero (neither absorbing nor producing VARs) as measured with a tolerance of plus/minus 2.0 MVAR. The generation should be able to hold this constant power factor at all MW output levels. A MW/MVAR schedule will be provided should the developer choose to proceed.

Future PPL EU studies will be based on the following data currently on record as provided by W1-054:

- (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 transformation.
- (2) Three interconnection power transformer (existing)
 - Transformer #1: 15/20/25MVA, 138/13.2-7.62kv, and an impedance of 9.16% on a 15MVA base.
 - Transformer #2: 15/20/25MVA, 138/13.2-7.62kv, and an impedance of 9.2% on a 15MVA base.
 - Transformer #3: 15/20/25MVA, 138/13.2-7.62kv, and an impedance of 8.748% on a 15MVA base.

If the above data is incorrect, W1-054 is asked to provide updated information on this equipment.

Schedule Requirements for the Generation Project

<u>Activity</u>	<u>Start</u>	<u>Finish</u>
PPL EU Study & Contracts:		
Feasibility/ Impact Study		5/31/2010
Interconnection Agreement Signed		7/31/2010
PPL EU Engineering:		
IPP Provides Design Drawings for PPL Review	07/01/2010	10/30/2010
PPL Substation and Transmission Engineering	Sept 2010	May 2011
Order Long Lead Time Material		Jan 2011
PPL EU Construction:	April 2011	Dec 2011
W1-054 Phone Line In-service:		Feb 2011
Commercial In-Service Date:		Dec 2011
Complete As-Built Drawing Review:		Jan 2012

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.

The ISA and CSA or an Interim Agreement must be signed by 7/31/10 to accommodate the proposed December 31st, 2011 in-service date. **Note, this schedule does not imply a PPL EU commitment to this in-service date. Engineering and construction resource needs will need to be determined and evaluated prior to the development of a finalized project schedule in the ISA/CSA agreements.**

(2) The schedule is completely under the control of Queue W1-054. PPL EU will turn drawings around in a reasonable timeframe, however, PPL cannot start work until the first set of drawings is received.

(3) Queue W1-054 should have their phone line (SCADA circuit and DTT circuit if radio technology is not feasible) in-service by 2/28/2011. Queue W1-054 Interconnection Customer will need to notify PPL by September 2010 if the phone line option cannot be provided by the telephone provider.

Network Impacts

The queue W1-054 project was studied as an 11.4MW (11.4MW capacity) injection at the Dart TP2 138kV substation. Project W1-054 was evaluated for compliance with reliability criteria for summer peak conditions in 2014. Potential network impacts were as follows:

NETWORK IMPACTS

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, Stuck breaker and Bus Fault contingency analysis for the full energy output)

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.

NETWORK UPGRADE REQUIREMENTS

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.