# *Generation Interconnection Combined Feasibility/Impact Study Report*

***For***

# *PJM Generation Interconnection Request Queue Position W3-093*

# *Lyon Station Project*

June, 2011

## Introduction

This Feasibility/Impact Study report provides the documentation of a system assessment performed by PJM Interconnection LLC and FirstEnergy (FE) in response to a request made by East Penn Mfg Co for the connection of a battery storage power project with a total capability of 3 MW to the Met-Ed Transmission network. This 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 East Penn Mfg Co by conducting 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 and the "FE Requirements for Transmission Connected Facilities" documents to assure that the assessment performed incorporates study assumptions, follows the documented system performance procedures, considers alternative connection and reinforcement plans, and jointly coordinates the study recommendations.

## Connection Facilities

In compliance with the Regional Transmission Expansion Planning (RTEP) protocol, East Penn Mfg Co has submitted a "Form of Generation Interconnection Feasibility Study Agreement" (Attachment N) to PJM that identifies its plan to construct a Deka Road (W3-093) Generation Project comprised of batteries and inverters on a plot of land near Deka Road, Fleetwood, Pennsylvania. The installed facilities will have a total capability of 3 MW with 0 MW of this output being recognized by PJM as capacity. This means the entire 3 MW will be curtailable should a system reliability constraint be declared by either PJM or FE. The maximum charging current will be 3.6 MW. The proposed in-service date for this Deka Road (W3-093) Project is October 1, 2011.

As defined by the East Penn Mfg Co and shown on Attachment 2, the Deka Road (W3-093) Project will be located about 0.35 miles south of the Lyons 230/69 kV substation. It will connect behind the meter of the existing East Penn South Main substation 69 kV connection. Attachment 3 shows a conceptual one-line diagram of the Deka Road (W3-093) Project. As indicated, it will be studied as both a 3 MW injection into the Met-Ed 69 kV system at East Penn South Main substation and a 3.6 MW load at the same. Because this project will connect behind the meter, no new Met-Ed Direct Connection Facilities will be required.

## PJM Report on the Transmission System

This portion of the report addresses the impacts on and the required reinforcements to the transmission system under direct PJM jurisdiction.

### Network Impacts

Queue project W3-093 was studied as a 3.0 MW (0.0 MW of which was Capacity) injection into ME's system at the Lyons 69.0 kV substation. Project W3-093 was evaluated for compliance with reliability criteria for summer peak conditions in 2014.

Potential transmission network impacts are as follows:

### Generator Deliverability

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

No violations identified.

### Multiple Facility Contingency

*(Double Circuit Tower Line contingencies only with full energy output. Stuck Breaker and Bus Fault contingencies will be applied during the Impact Study)*

No violations identified.

### 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 violations 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 required.

### 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 required.

**Short Circuit**
*(Report over-dutied breakers.)*

None required.

**Energy Portion of Interconnection Request**
PJM also studied the delivery of the energy portion of the surrounding generation. Any potential 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 Transmission Interconnection request.
*Note*: *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 analyzes all overload conditions associated with the overloaded element(s) identified. As a result of the aggregate energy resources in the area, the following violations were identified*.

No violations identified.

## FirstEnergy Feasibility Analysis Report

This portion of this Combined Feasibility/Impact Study Report has been prepared for PJM queue project W3-093 by FirstEnergy. It addresses the impacts on and required reinforcements to that portion of the network at the distribution level, including the attachment and direct connection facilities.

## Power Flow Analysis

A Power Flow study was conducted to determine the reliability impact of the proposed Deka Road (W3-093) Project on the FE Transmission System. This study was completed using a 2015 summer peak load power flow that contains a detailed representation of the Met-Ed transmission networks in the area of the proposed Deka Road (W3-093) Project. The findings and the recommendations from this analysis are based on a contingency review that was performed to identify the facility loadings and/or voltage conditions that violate the ReliabilityFirst, PJM or FE Planning Criteria and are attributable to this project.

The results of the FE analysis show that there are no network upgrades required for the deliverability of the Deka Road (W3-093) Project generation to the Met-Ed and PJM transmission systems. There also are no reinforcements defined for previous projects for which this project will have an impact.

## Short Circuit and Dynamics Analysis

In accordance with the RTEP process, a short circuit analysis will not be conducted by PJM since the Deka Road (W3-093) Project connection is to the 69 kV system. Therefore, the FE Protection staff conducted a short circuit review of the project connection. An assumption of this study was that battery storage generation projects will contribute no appreciable fault current to the breakers on the FE transmission system. As defined by EPRI: "Inverters are generally designed to limit fault currents to 130% or less of rated current. Thus they can usually be disregarded when conducting fault studies."[1] Based on this fact, the results of the FE analysis showed that no FE circuit breaker will exceed its interrupting capability with the implementation of the Deka Road (W3-093) Project. Therefore no circuit breaker reinforcements will be required.

Note that stability studies will be conducted by the PJM staff as part of the Impact Study stage of the RTEP process.

[1] EPRI Document TR-111490 "Integration of Distributed Resources in Electric Utility Distribution Systems: Distribution System Behavior Analysis for Suburban Feeder", published November 1998, page 62

## System Protection Analysis

An analysis was conducted to assess the impact of the Deka Road (W3-093) Project on the system protection requirements in the area. The results of this review have identified the following:

Under the assumption that the Deka Road (W3-093) Project generation will not supply fault current to the Jersey Central transmission system, there will be no protection upgrades needed for the Lyons – East Penn Mfg Co (865) 69 kV line. However, the Deka Road (W3-093) Project will be required to implement a directional power relay to eliminate the possibility of the Deka Road (W3-093) Project generating power onto the Met-Ed system, should the load of the East Penn South Main substation ever fall below the generation output of the Deka Road (W3-093) Project. This can be implemented by the East Penn Mfg Co using any of the following three configurations at the East Penn South Main substation:

1) Add a directional overcurrent relay on the 69 kV breaker CT along with three phase 69 KV PTs to provide the directional reference.

2) Add a directional overcurrent relay on the 13.2 breaker CT for Transformer #J as well as having 3 phase 13.2 PT source to the relay for directional reference. and an interlock so that the battery is not operation when the tie between the West and Middle section is closed.
or

3) Add directional overcurrent relays on the 13.2 breaker CTs for each of the three transformers with each having 3 phase 13.2 PT sources for directional reference.

## Metering

Because the Deka Road (W3-093) Project will be a load shaving connection behind the existing East Penn Mfg Co point of interconnection with directional relaying to block reverse power flow, no changes to the existing metering will be required by FirstEnergy. However, the Deka Road (W3-093) Project must comply with any metering requirements imposed by PJM.

## Compliance Issues

Because the proposed Deka Road (W3-093) Project will be connected behind the meter of the existing East Penn Mfg Co point of interconnection, the FirstEnergy "Requirements for Transmission Connected Facilities" will not apply. However, the East Penn Mfg Co must remain in compliance with its existing service contract with the addition of the Deka Road (W3-093) Project.

## FE Facility Upgrades and Costs

The results of the FE analysis shows that no planning criteria violations are attributable to the addition of the Deka Road (W3-093) Project for the conditions studied. Therefore the

conclusion is that no transmission or distribution reinforcements will be required to provide the requested service.

**East Penn Mfg Co Requirements**

1. Any complaints from other customers (e.g. flicker complaints) will have to be corrected by East Penn Mfg Co. Correction may include changing operation, reducing generation, disconnecting the generators from the Met-Ed system, or other measures.

2. A compliance with the inverter standard UL1741 and IEEE 1547, "Standard for Interconnecting Distributed resources with Electrical Power Systems", in addition to the power quality standards defined by ReliabilityFirst and PJM.

3. A compliance with the PJM Manuals and Operating instructions to have a plant operator on call 24/7 to respond within a minute to reduce the output of Deka Road (W3-093) Project if network constraints occur.

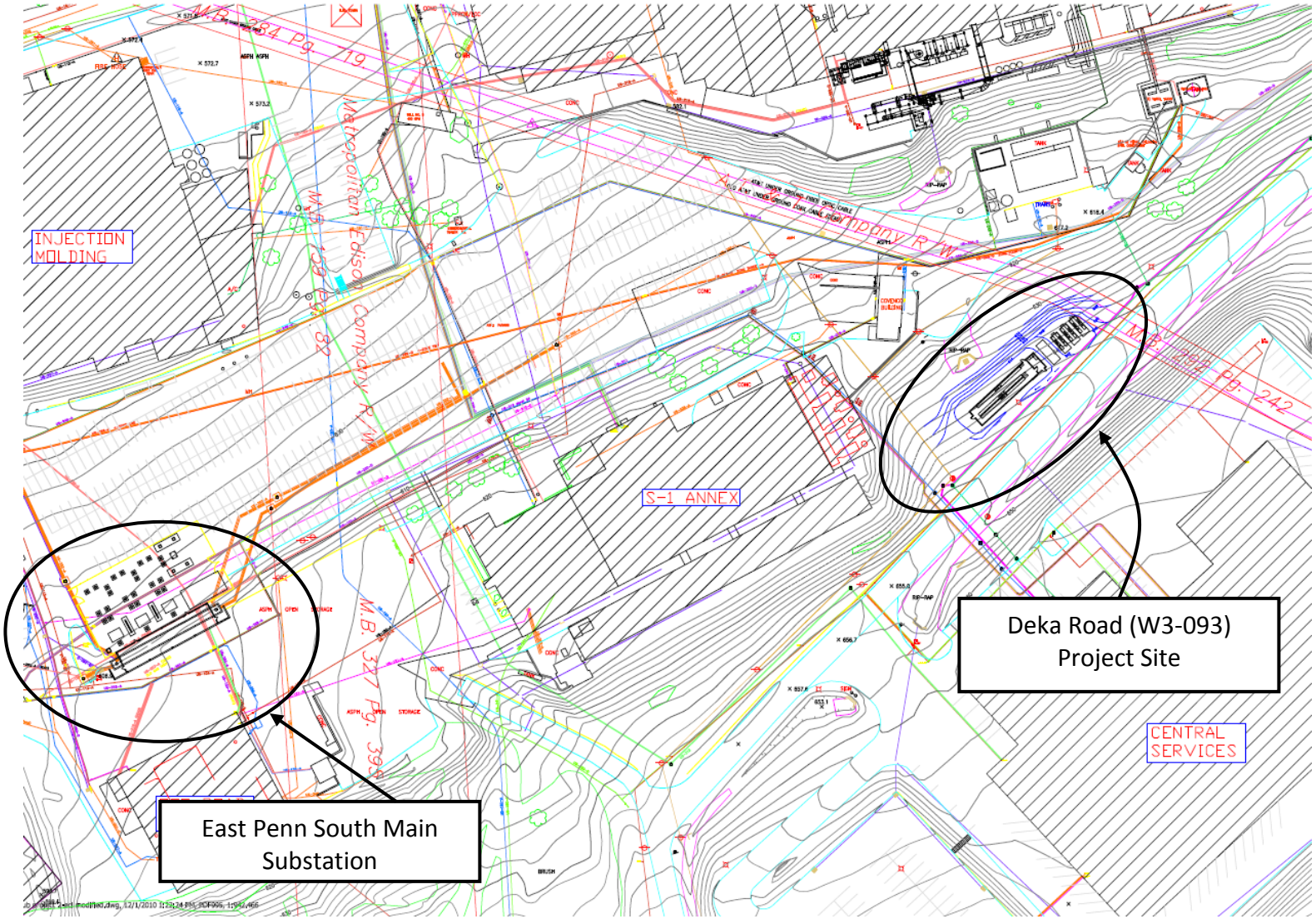
The above requirements are in addition to any metering or other requirements imposed by PJM, including requirements found in PJM manual 14D.

Note that an assumption of this study is that the Deka Road (W3-093) Project generation will automatically be disconnected whenever the local area network is islanded. If this assumption is not correct, a direct transfer trip scheme will need to be implemented for such situations at East Penn Mfg Co's cost.

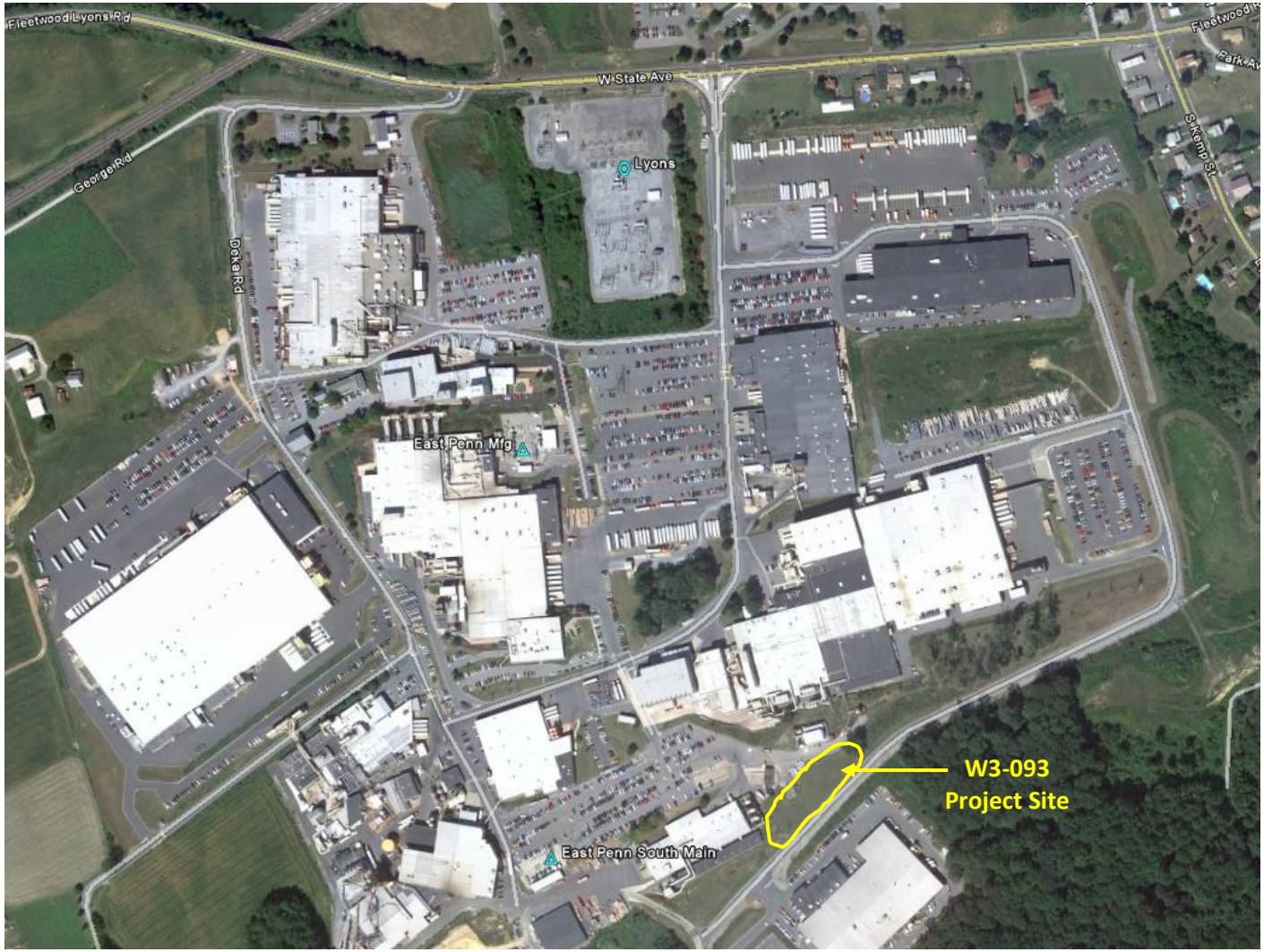
**Summary**

The connection of the Deka Road (W3-093) Project to the FE transmission system will require no network upgrades. Because the proposed Deka Road (W3-093) Project will be connected behind the meter of the existing East Penn Mfg Co point of interconnection, there will be no additional Direct Connection facilities required. Therefore, there will be no cost to connect the Deka Road (W3-093) Project.

# ATTACHMENT 1 - LOCAL SITE PLAN



# ATTACHMENT 2 - DEKA PLANT SITE AND PROJECT SITE



# Attachment 3

## East Penn Mfg Co – Deka Rd (W3-093) RTEP Project