

***Revised***  
***PJM Generator Interconnection***  
***Facility Study Report***

***Related to:***  
***PJM Generation Interconnection Request***  
***Queue Position AD2-213***  
***“East Flemington-Lebanon 34.5 kV”***

**April 2021**

## Table of Contents

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<b>Preface</b> .....	3
A. Transmission Owner Facilities Study Summary.....	3
1. Description of Project .....	3
2. Amendments to the System Impact Study or System Impact Study Results .....	3
3. Revisions to December 2020 Facilities Study Report.....	3
4. Interconnection Customer’s Milestone Schedule .....	3
5. Customer’s Scope of Work.....	4
6. Description of Facilities Included in the Facilities Study .....	4
7. Total Cost of Transmission Owner Facilities Included in the Facilities Study.....	5
8. Summary of the Schedule for Completion of Work for the Facilities Study.....	5
B. Transmission Owner Facilities Study Results.....	5
1. Transmission Lines –New .....	5
2. Transmission Lines – Upgrade .....	6
3. Substation/Switchyard Facility Upgrades .....	7
4. Telecommunications Facilities – Upgrades.....	7
5. Metering & Communications .....	7
6. Environmental, Real Estate and Permitting.....	7
7. Summary of Results of Study.....	8
9. Schedules and Assumptions .....	10
Attachment A: Protection Scope.....	12
Attachment B: Single Line Diagram .....	15
Attachment C: TO Single Line Diagram .....	16
Attachment C: Proposed Project Location.....	17
Attachment D: Generation Connection Requirements .....	19

## ***Preface***

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The intent of the Facility 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: 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, an Interconnection Customer 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 Facility Study estimates attempt to identify the estimated 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.

## **A. Transmission Owner Facilities Study Summary**

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### ***1. Description of Project***

Ftera Energy APD Flemington LLC, (hereinafter referred to as IC) has proposed the addition of a new battery storage generating facility for AD2-213 which will have a total capability of 20 MW with 0 MW of this output being recognized by PJM as capacity.

This project is located at 79 Junction Road, Flemington, New Jersey, 08822. The generation facility will interconnect with Jersey Central Power & Light (JCPL) a FirstEnergy Company (FE) hereinafter referred to as "Transmission Owner" (TO), by tapping the Flemington-Lebanon 34.5 kV line at a point located approximately 0.53 miles from the Lebanon substation and 0.76 miles from East Flemington substation.

### ***2. Amendments to the System Impact Study or System Impact Study Results***

The System Impact Study indicated that the GSU must have a grounded wye connection on the high (utility) side and a delta connection on the low (generator) side. The protection requirements have been revised and require a delta or ungrounded wye connection on the high (utility) side.

### ***3. Revisions to December 2020 Facilities Study Report***

The Facilities Study has been revised to reflect the updated milestone schedule as shown in Section 4.

### ***4. Interconnection Customer's Milestone Schedule***

The planned in-service date, as requested by the IC is August 30, 2022. The planned initial back-feed date is June 15, 2022.

**Transmission Owner's Assumed Milestone Schedule:**

06/15/2022	Initial Back-feed through Project Substation Date
08/30/2022	Project Commercial Operation Date

**5. Customer's Scope of Work**

Developer will construct photovoltaic facilities, generation step-up (GSU) transformer(s), 34.5 kV generator Lead Line, and connect to the Point of Interconnection.

**Point of Interconnection (POI):** The point where Developer's 34.5 kV generator Lead Line terminates on the IC's newly installed 34.5 kV pole. (Ref: Figure 2).

Developer is required to own, install, and maintain a fully-rated, fault-interrupting circuit breaker on the high-side of the GSU transformer with revenue metering equipment between the collector bus and the incoming generator lead line. Transmission side (34.5kV) of the connecting transformer shall be either Delta connected, or ungrounded Wye connected winding. The protective relaying and metering design must comply with First Energy's applicable standards as well as compliant with PJM requirements. There should be two independent protection schemes on separate current transformers. At least one set of current transformers should be on the Utility side of the circuit breaker.

Developer will also purchase and install the minimum required FirstEnergy generation interconnection relaying and control facilities. This includes over/under voltage protection, over/under frequency protection, and zero sequence voltage protection relays. They will also purchase and install supervisory control and data acquisition (SCADA) equipment to provide information in a compatible format to the FirstEnergy Transmission System Control Center. Developer will provide for establishment of dedicated communication circuits for SCADA report to the FirstEnergy Transmission System Control Center.

**Assumptions / Notes:**

- Developer will coordinate design and alignment of proposed 34.5 kV generator lead line with the Transmission Owner for review of any clearance, right-of-way or right-of-way encroachment issues with TO owned facilities.
- For the proposed 34.5 kV Lead Line, the Developer shall provide TO with plan & profile or PLS-CADD drawings file prior to construction and as-built drawings, confirmed by as-built survey data post-construction for sag and tension of conductor.
- Additional costs will be incurred by the Developer, if final alignment or tension of 34.5 kV Lead Line causes encroachments, changes, or modifications to any existing TO facilities.
- Developer is responsible to make all arrangements for electric distribution service (if required) for its generation station. No costs or schedule included herein.

**6. Description of Facilities Included in the Facilities Study****Attachment facilities**

Transmission Owner will tap the East Flemington-Lebanon 34.5 kV Line and install a single span of 34.5 kV line (approximately 100 feet) for the battery storage facility (AD2-213). The tap will be made using 336.4 kcmil 18/1 ACSR on the tap line to point of interconnection at a new IC owned pole and shielded with 3#6 Alumoweld shield wire

**Direct Connection**

None

**Non-Direct Connection****East Flemington-Lebanon 34.5 kV line**

Existing double circuit pole #164 will be retired and replaced with a new single circuit wood 3-way tap structure. Two (2) new single circuit wood monopole switch structures on either side of the new 3-way tap structure #164.

**East Flemington – Glen Gardner 34.5kV line**

To accommodate the tap structure, two (2) tangent structures will be installed to carry the East-Flemington-Glen Gardner 34.5kV line that currently shares double circuit poles with the East Flemington-Lebanon 34.5 kV line.

**East Flemington Substation**

Modify existing relay settings

**Lebanon Substation**

Modify existing relay settings

***7. Total Cost of Transmission Owner Facilities Included in the Facilities Study***

The following table summarizes the total estimated costs according to FERC criteria. The estimated costs are in 2020 dollars. This cost excludes a Federal Income Tax Gross Up charges (CIAC (Contribution in Aid of Construction)). This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 88-129. If at a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

<i>Item</i>	<i>Total Cost</i>
Substation Attachment Facilities	\$ 206,000
Non-Direct Connect Facilities	\$ 1,250,700
<b>Total Cost</b>	<b>\$ 1,456,700</b>

***8. Summary of the Schedule for Completion of Work for the Facilities Study***

<i>Attachment Facility</i>	<i>Timeframe</i>
Engineering, Procurement, and Construction	12 months

**B. Transmission Owner Facilities Study Results**

This section describes facilities identified to be installed (attachment facilities), replaced, and/or upgraded (upgrade facilities) by First Energy to accommodate the project. During detailed design and analysis other components may be

identified for installation or replacement due to this interconnection.

## 1. Transmission Lines –New

None

## 2. Transmission Lines – Upgrade

### Non-Direct Connection

#### **East Flemington-Lebanon 34.5kV Line**

The proposed tap is to be located at the following GPS coordinates:

40.515422°, -74.845721°

- Construct a line tap to the customer POI on the F734 East Flemington-Lebanon 34.5kV line (see Figure 2).
- The existing line is constructed on double circuit wood H-frame structures, shared with the T748 East Flemington-Glen Gardner 34.5kV line. Per drawing F-734, existing conductor is 336.4 kcmil 18/1 ACSR and existing shield wire is 5/16" CUWD.
- The line tap location is assumed to be structure 164.
- The line tap requires the installation of:
  - Existing 336.4 kcmil 18/1 ACSR conductor and 5/16" CUWD shield wire will be transferred to new switch structures and to the 3-way tap structure.
  - Replace existing double circuit tangent structure #164 with (1) new single circuit wood 3-way tap structure.
  - (2) new single circuit wood monopole switch structures
    - (1) per span ahead and back of new 3-way tap structure #164.
    - Switches are assumed to be 1200A switches with SCADA, MOABSs and high-speed whips.
- Conductor on the line tap is assumed to be 336.4 kcmil 18/1 ACSR and shield wire is assumed to be a single 3#6 Alumoweld, approximately 100' to a customer owned pole.
- Siting/Licensing
  - Assume no local opposition to the project.
  - Assume minimal social and ecological impacts.
- Assumptions
  - Assume OPGW is not required.
  - An aerial LiDAR survey of the project area will be required.
  - Assume existing structures 163 and 165 are in good condition and have adequate capacity for any revised loading arrangements. An engineering analysis will be required to confirm.

#### **East Flemington-Glen Gardner 34.5kV Line**

- To accommodate constructing a line tap to the customer POI of the F734 East Flemington-Lebanon 34.5kV line, install (2) single circuit tangent structures on the T748 East Flemington-Glen Gardner 34.5kV line.
- The existing line is constructed on double circuit wood H-frame structures, shared with the F734 East Flemington-Lebanon 34.5kV line. Per drawing F-734, existing conductor is 336.4 kcmil 18/1 ACSR and existing shield wire is 5/16" CUWD.
- The line reroute requires the installation of:
  - (2) new single circuit wood tangent structures

- Existing 336.4 kcmil 18/1 ACSR conductor and 5/16" CUWD shield wire will be transferred to new tangent structures.

### **New Substation/Switchyard Facilities**

None

### **3. Substation/Switchyard Facility Upgrades**

#### **East Flemington Substation**

Revise relay settings on the Lebanon line terminal

#### **Lebanon Substation**

Revise relay settings on the East Flemington line terminal

#### **AD2-213 Generation Sub**

Create nameplates, one line, and revise HVCD drawing.

### **4. Telecommunications Facilities – Upgrades**

1. SCADA connections for two (2) new line switches
2. Installation of two (2) 700MHz radio systems to support SCADA switch installations

### **5. Metering & Communications**

FirstEnergy shall, at the Connecting Party's expense, provide, own, operate, test and maintain the revenue metering equipment at the generation facility's step-up substation.

Transmission Owner's Revenue Metering Requirements may be found in the *Requirements for Transmission Connected Facilities* document located at the following links:

[www.firstenergycorp.com/feconnect](http://www.firstenergycorp.com/feconnect)

[www.pjm.com/planning/design-engineering/to-tech-standards.aspx](http://www.pjm.com/planning/design-engineering/to-tech-standards.aspx)

These requirements are in addition to any metering required by PJM.

Transmission Owner will obtain real-time, site-specific, generation data from PJM, via the required communication link from Developer to PJM. Transmission Owner will work with PJM and Developer to ensure the generation data provided to PJM meets Transmission Owner's requirements.

### **6. Environmental, Real Estate and Permitting**

The following are possible environmental, real estate and permitting issues:

- Environmental permitting, Real Estate acquisition, and New Jersey Board of Public Utilities (NJBPU) notifications vary, some up to twelve (12) months after preliminary engineering is completed to secure the required approvals.
- Assumed Developer is to provide all access rights, easements, ROW and permits necessary to complete the Project to the satisfaction of Transmission Owner. Environmental permitting shall encompass all federal, state and local requirements, consultations and agency coordination. If any

of these elements are not included in the final agreement between Transmission Owner and Developer, twelve (12)-to-eighteen (18)- months should be added to the Project Schedule to secure necessary permits, and additional costs would apply.

- Developer is responsible for all property acquisition (including easements/rights-of-way (ROW)) for transmission, distribution and communication facilities needed for the generator interconnection.
- All work occurs within an existing transmission line right-of-way or on Developer's property with access to all existing structures possible via that property and the right-of- way following established access routes that do not cross wetlands or streams.
- Developer will develop, and secure regulatory approval for, all necessary Erosion and Sediment Control (E&SC) plans and National Pollutant Discharge Elimination System (NPDES) permits.
- Developer will obtain all necessary permits.
- Developer will conduct all necessary wetlands and waterways studies and permits.
- Developer will conduct all necessary historical and archaeological studies.
- If the Developer plans to cross the transmission line right of way with facilities or access roads, please refer to the Transmission Rights-of-Way Restrictions information located at: <https://www.firstenergycorp.com/help/safety/real-estate-power-lines/transmission-right-of-way.html#ROWform>

## 7. Summary of Results of Study

Description	Total Cost (w/o Tax)	Tax (if applicable)	Total Cost (w/Tax)
F734 Fleming-Lebanon 34.5kV Line Tap: Construct a line tap to the customer POI on the F734 East Flemington- Lebanon 34.5kV line. (PJM Network Upgrade Number n5853)	\$ 206,000	\$ 36,400	\$ 242,400
<b>Total Attachment Facilities (AF) Costs</b>	<b>\$ 206,000</b>	<b>\$ 36,400</b>	<b>\$ 242,400</b>
F734 Fleming- Lebanon 34.5kV Line Switches: Replace existing double circuit pole with three way tap pole, Install two (2) switch structures. (PJM Network Upgrade Number n5856)	\$ 755,200	\$ 133,300	\$ 888,500
T748 Fleming-Glen Gardner 34.5kV Reconfigure for F734 Tap: Install (2) single circuit tangent structures on the T748 Fleming-Glen Gardner 34.5kV line to accommodate a new line tap to a customer POI on the F734 East Flemington-Lebanon 34.5kV line. (PJM Network Upgrade Number n6912)	\$ 130,500	\$ 23,100	\$ 153,600



SCADA Communication: SCADA work at East Flemington & Lebanon substations to support updated relay settings. Installation of (2) 700 MHz radio systems to support SCADA switch installations. <i>(PJM Network Upgrade Number n5854 for East Flemington and n5855 for Lebanon)</i>	\$146,200	\$ 25,900	\$ 172,100
Project Management and Environmental. <i>(PJM Network Upgrade Number n5856)</i>	\$142,800	\$ 25,300	\$ 168,100
East Flemington Substation: Revise Relay Settings. <i>(PJM Network Upgrade Number n5854)</i>	\$12,100	\$ 2,200	\$ 14,300
Lebanon Substation: Revise Relay Settings. <i>(PJM Network Upgrade Number n5855)</i>	\$ 12,100	\$ 2,200	\$ 14,300
AD2-213 Customer Substation: Nameplates and review of customer drawings. <i>(PJM Network Upgrade Number n5856)</i>	\$ 51,800	\$ 9,200	\$ 61,000
<b>Total Non Direct Connect (NDC) Costs</b>	<b>\$ 1,250,700</b>	<b>\$ 221,200</b>	<b>\$ 1,471,900</b>
<b>Total AF +DC + NDC Costs</b>	<b>\$ 1,456,700</b>	<b>\$ 257,600</b>	<b>\$ 1,714,300</b>

Generation projects meeting IRS "Safe Harbor" provisions generally do not incur "CIAC" (Contribution in Aid to Construction), a tax collected by the utility for the state or federal government. First Energy does not expect to collect CIAC for this project. If for any reason, "CIAC" would be required for this project, it would be the responsibility of the party owning the generator to pay this cost.

First Energy reserves the right to charge the Interconnection Customer operation and maintenance expenses to maintain the Interconnection Customer attachment facilities, including metering facilities, owned by First Energy.

## 9. Schedules and Assumptions

A proposed **twelve (12) month** schedule is estimated to complete the engineering, construction and the associated activities, from the date of a fully executed Interconnection Construction Service Agreement and Construction Kick-Off Meeting. This schedule assumes that all issues covered by the “Environmental, Real Estate and Permitting Issues” section of this document are resolved, and outages (typically not granted from June through September) will occur as planned. Construction cannot begin until after all applicable permits and/or easements have been obtained.

**12 month Schedule**

<b>Activity</b>	<b>Start Month</b>	<b>End Month</b>
Preliminary Engineering	1	3
Detailed Engineering	3	6
Equipment Delivery	8	9
Above Grade Construction	9	11
Testing & Commissioning	12	12

# **ATTACHMENTS & FIGURES**

## Attachment A: Protection Scope

### PROTECTION SCOPE

#### A. Short Circuit Results

(At proposedtappoint-Pole NJ164RTHF734)-

34.5kV Positive Seq. Impedance =  $0.38504 +$

$j1.57390$  Ohms Zero Seq. Impedance =  $0.78748$

$+ j3.11922$  Ohms Single Line to Ground Fault

Current = 9253.36 Amps Three Phase Fault

Current = 12293.2 Amps

1. Faults values above are obtained based on the current system condition on the East Flemington – Lebanon 34.5kV F734 Line without the proposed generation project and extension of the F734 Line to the Point of Interconnection (POI).
2. The faults provided are bolted, symmetrical values for normal system conditions at the location of Pole NJ164RTHF734 and should be similar values at the POI with the extension of the F734 line.
3. The Connecting Party must be aware of future changes in fault currents are possible and it is the Connecting Party's responsibility to upgrade their equipment and/or protective equipment coordination when necessary at its expense.

#### B. General Connection Requirement

All Connecting Party proposed generation POI and load-serving delivery points must comply with the technical requirements detailed in the FirstEnergy "Requirements for Transmission Connected Facilities" document.

#### C. AD2-213 Generation Solar Protection Requirements

1. It is the responsibility of the Connecting Party to assure protection, coordination and equipment adequacy within their facility for conditions including but not limited to:
  - a) Single phasing of supply
  - b) System faults
  - c) Equipment failures
  - d) Deviations from nominal voltage or frequency
  - e) Lightning and switching surges
  - f) Harmonic voltages
  - g) Negative sequence voltages
  - h) Separation from FE supply
  - i) Synchronizing generation
  - j) Synchronizing facilities between independent transmission system and FE

k) Transmission System

2. Transformer Requirements for AD2-213: Transmission side (34.5kV) of the connecting transformer shall be either Delta connected, or ungrounded Wye connected winding

3. There should be two levels of anti-island protection:
  - a) Anti-islanding Direct Transfer Trip. If the inverters meet the testing requirements of IEEE-1547.1 OR comply with IEEE-1547 and are UL1741 certified, Anti-islanding Direct Transfer Trip will not be required since the inverters themselves have one level of anti-island protection.
  - b) The second level of anti-island protection is the intertie relay which can be SEL-351-7 and should provide just the intertie functionality (over and under voltage, over and under frequency and ground overvoltage - see Figure 3 of "Requirement for Transmission Connected Facilities" document). The intertie functionality of the SEL-351-7's that are used for fault protection can also be enabled for the second level of anti-island protection. The intertie relay shall be either directly or through a dedicated, self-resetting, high speed auxiliary relay (94), inhibit automatic reclosing and trip the breaker at the point of interconnection.
4. The Connecting Party is to design their protective system to clear any faults within their zones of protection with one or more of their local circuit breakers. Each zone of protection covering the 34.5kV portion of the interconnection system, including the transformer(s), is to be protected by two independent relay schemes that each provide high speed fault clearing. The terminal breaker at the interconnect end of the direct connection line is to be included in at least one of the 34.5kV over-lapping zones of protection. The CTs used for the zones of protection covering the 34.5kV portion of the system shall use C800 or C400 relay accuracy CTs and the CTs should not saturate for the maximum through-fault current that can be experienced by the relay system for the tap ratio in use.
5. All Connecting Party's relays, relay schemes, and relay settings that involve 34.5 kV system voltages or currents or trip any 34.5 kV circuit breakers shall be reviewed and approved by FirstEnergy.
6. FirstEnergy will complete detailed relay coordination studies to identify off-site relay setting changes (at East Flemington and Lebanon) required due to this generation interconnection. This may result in additional individual relay replacements being required and shall be done at the Connecting Party's expense.

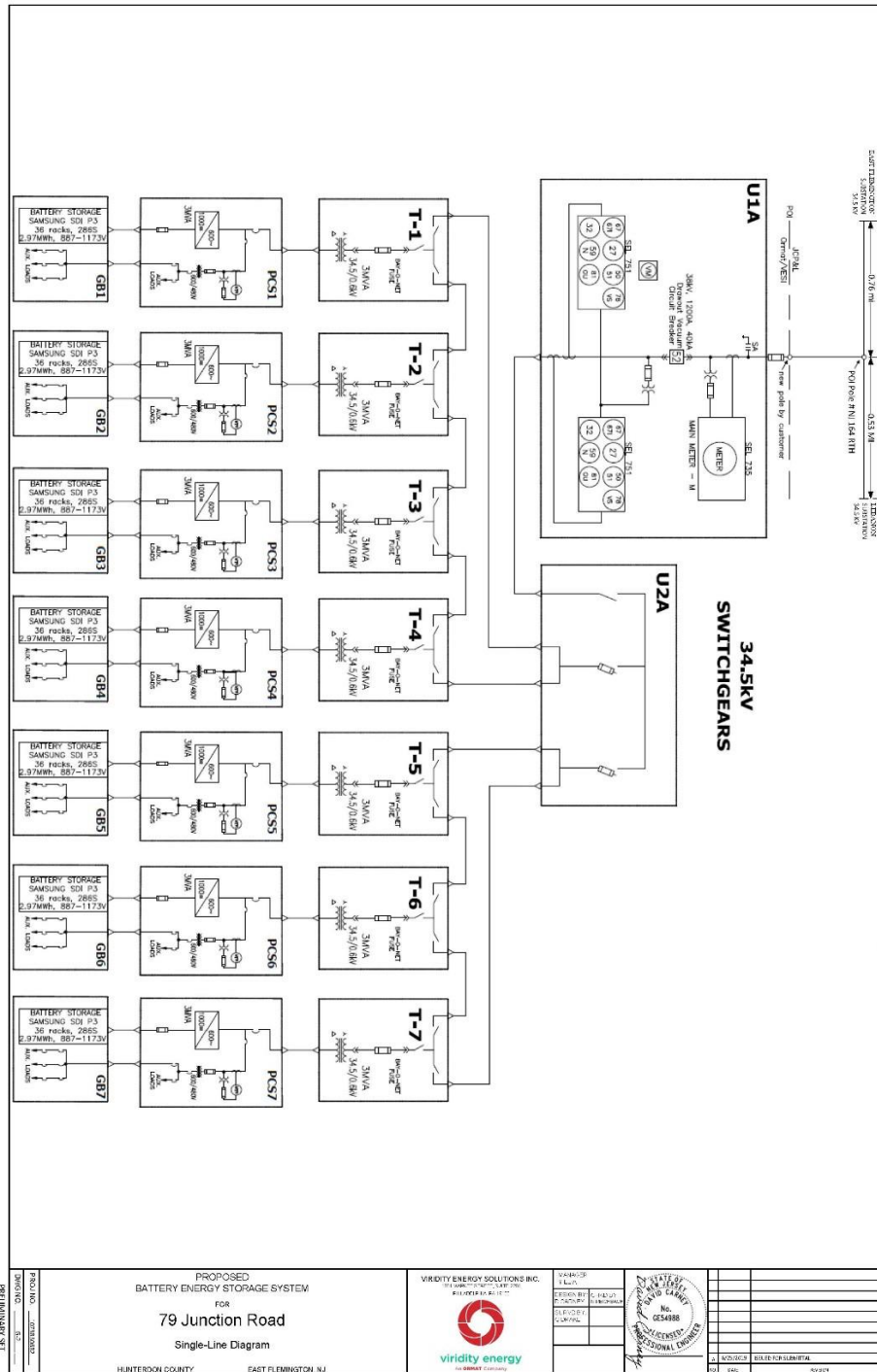
#### **D. First Energy Protection Requirements**

Possible relay Setting changes for 34.5kV F734 Line on East Flemington and Lebanon Line terminals.

The Connecting Party is solely responsible for protecting its own equipment in such a manner that electrical faults or other disturbances on the FE system do not damage its equipment.

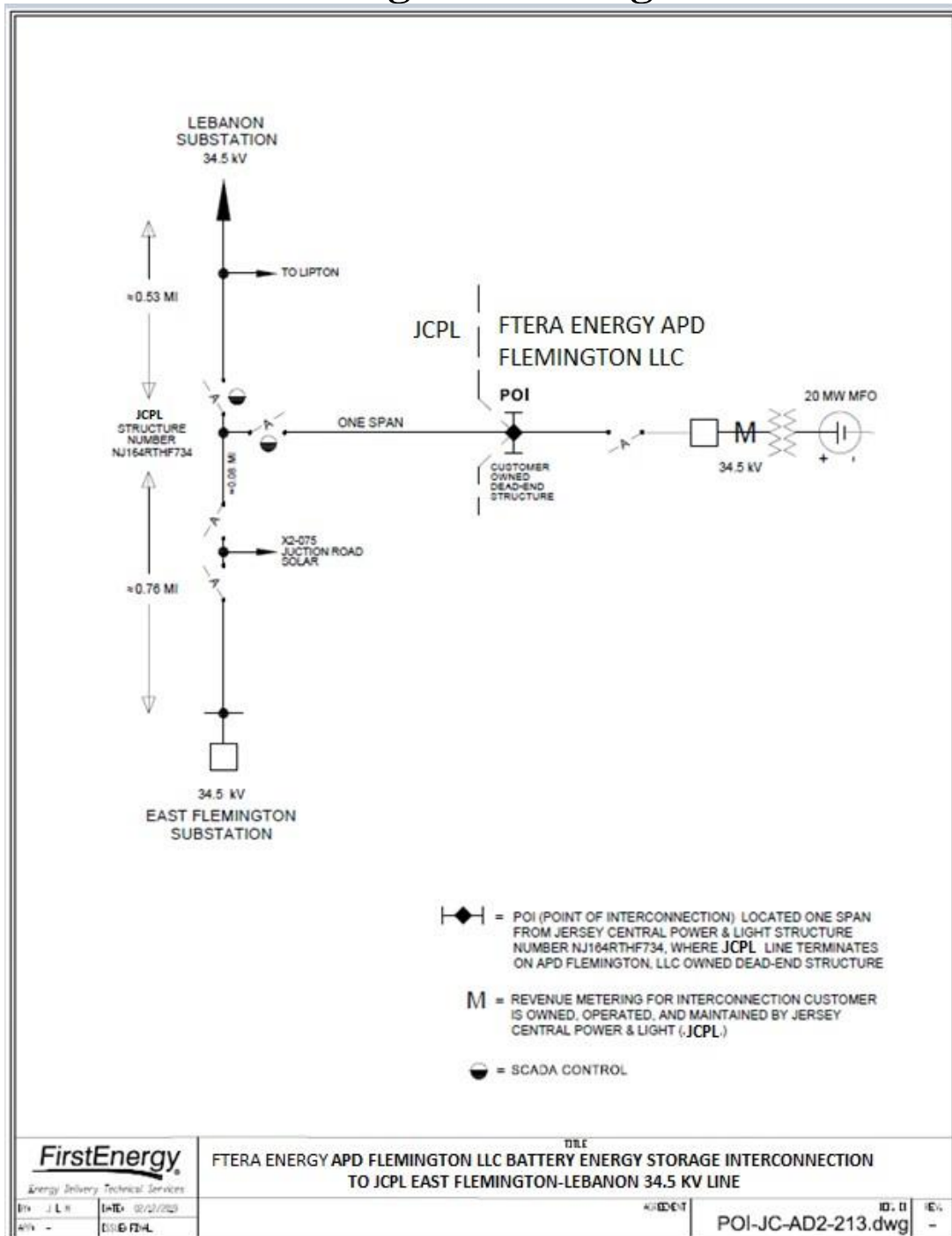
# Attachment B: Single Line Diagram

## Figure 1 Single Line Diagram



## Attachment C: TO Single Line Diagram

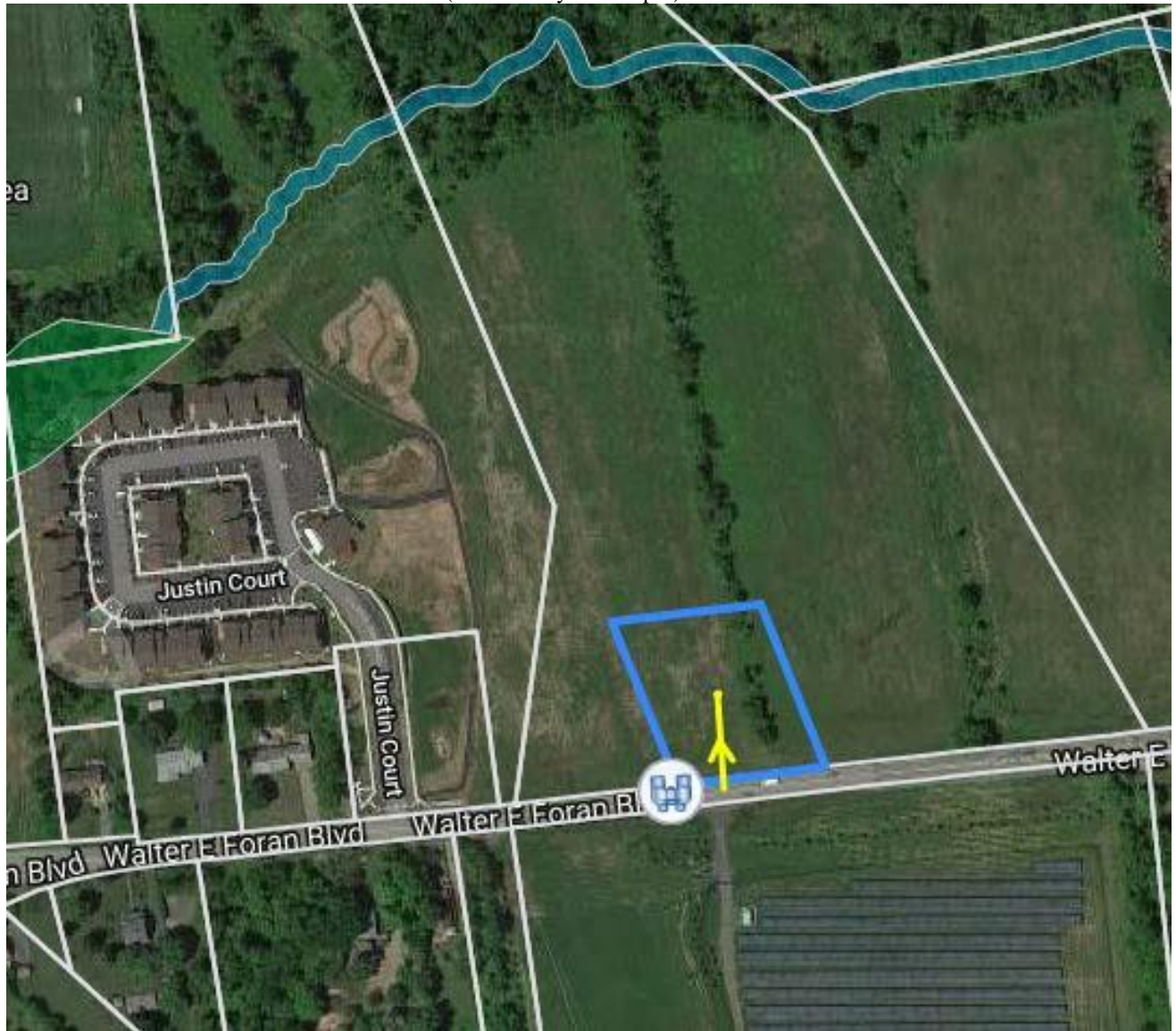
### Figure 2 TO Single Line Diagram

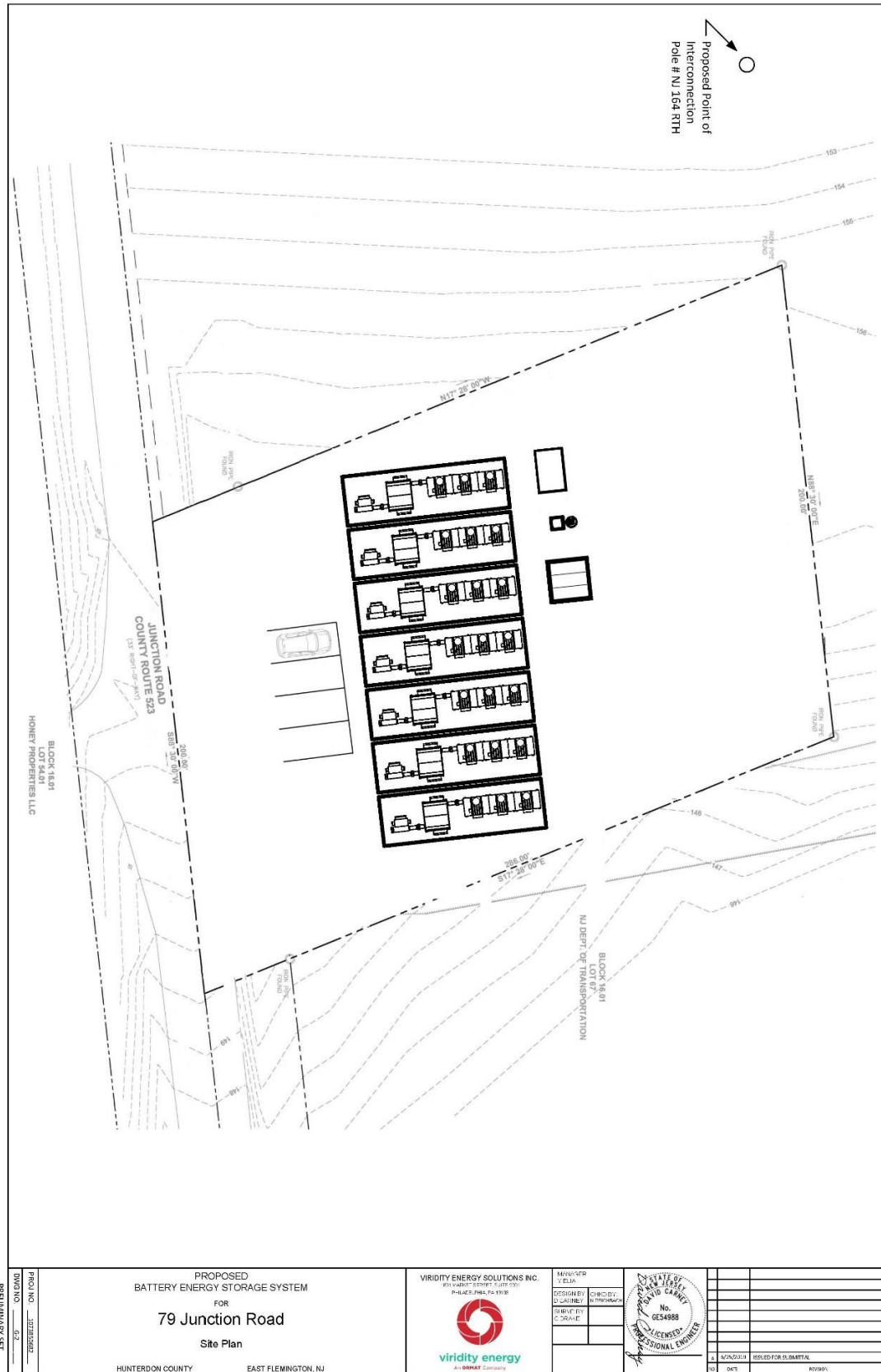




## Attachment C: Proposed Project Location

**Figure 3**  
**Queue #AD2-213**  
**Proposed Project Location**  
(Provided by Developer)





## Attachment D: Generation Connection Requirements

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### Generation Connection Requirements

The proposed interconnection facilities must be designed in accordance with the Transmission Owner's *Requirements for Transmission Connected Facilities* documents located at either of the following links:

[www.firstenergycorp.com/feconnect](http://www.firstenergycorp.com/feconnect)

[www.pjm.com/planning/design-engineering/to-tech-standards.aspx](http://www.pjm.com/planning/design-engineering/to-tech-standards.aspx)

The following is an excerpt taken from Transmission Owner's *Requirements for Transmission Connected Facilities* document:

*For all generation facilities, other than wind-powered and other non-synchronous generating facilities, the minimum requirement shall be the provision of a reactive power capability sufficient to maintain a composite power delivery at continuous rated power output at a power factor as defined in the table below. This requirement will be measured at either the POI or generator terminals as specified in the table below. These reactive requirements apply to both the initial installation as well as to any incremental change in unit MW capability. FE will coordinate with the Connecting Party to identify the optimal generator step-up transformer tap to make such a capability available when demanded.*

*For all wind-powered or other non-synchronous generating facilities the minimum requirement shall be the provision of a reactive power capability sufficient to maintain a composite power delivery at a power factor as defined in the table. This requirement will be measured at either the POI or generator's terminals as specified in the table below. These reactive requirements apply to both the initial installation as well as to any incremental change in unit MW capability. FE will coordinate with the Connecting Party to identify the optimal generator step-up transformer tap to make such a capability available when needed.*

*For projects that entered PJM's New Service Queue after November 1, 2016, the power factor requirement will be as follows:*

Generation Type	New / Increase	Size	Power Factor Requirement	Measurement Location
Synchronous	New	> 20 MW	0.95 leading to 0.90 lagging	Generator's Terminals

Synchronous	New	$\leq 20$ MW	0.95 leading to 0.90 lagging	Point of Interconnection
Wind or Non-Synchronous	New	All	0.95 leading to 0.95 lagging	High Side of the Facility Substation Transformers
Synchronous	Increase	$> 20$ MW	1.0 (unity) to 0.90 lagging	Generator's Terminals
Synchronous	Increase	$\leq 20$ MW	1.0 (unity) to 0.90 lagging	Point of Interconnection
Wind or Non-Synchronous	Increase	All	0.95 leading to 0.95 lagging	High Side of the Facility Substation Transformers

*Any different reactive power requirements that FE and/or PJM determines to be appropriate for wind-powered or other non-synchronous generation facilities will be stated in the applicable interconnection agreement(s).*

*Induction generators and other generators with no inherent VAR (reactive power) control capability, or those that have a restricted VAR capability less than the defined requirements, must provide dynamic supplementary reactive support located at the generation facility with electrical characteristics equivalent to that provided by a similar-sized synchronous generator.*

## Design Requirements

Developer is responsible for specifying appropriate equipment and facilities such that the parallel generation is compatible with Transmission Owner's Transmission System. Developer is also responsible for meeting any applicable federal, state, and local codes.

## Transmission Design Requirements

### Design Criteria

Facilities owned and operated by Transmission Owner shall comply with the applicable Transmission Owner technical requirements and standards posted on the PJM website per the PJM Tariff, and the following criteria. Where there are different requirements for the same criterion, the more restrictive shall apply. Developer must abide by any PJM, RFC or NERC criteria imposed that is more restrictive than those of Transmission Owner.

### General Design Requirements

- System phasing (counter clockwise) X-Y-Z
- System frequency: 60 hertz
- Elevation, AMSL: Less than 1000 meters
- Isokeraunic level: 40
- Maximum ambient temperature: 40 degrees C
- Minimum ambient temperature: -40 degrees C

• Maximum conductor operating temperature:	Contact Owner	Transmission
• Wind Loading (round shapes):	Per ASCE 7-98, per Fig. 6-1 depending on location	
• Ice loading – Substations (no wind):	25 mm	
• Seismic zone:	Per ASCE 7-98, per Fig. 9.4.1.1(a) and (b). Equipment qualification per IEEE 693-97	

### **Voltage and Current Ratings**

• Nominal phase-to-phase:	34.5 kV
• Maximum phase-to-phase:	38 kV
• Basic impulse level (BIL):	200 kV
• Maximum continuous current carrying capacity:	2000 A
• Design fault current:	40 kA
• Single Contingency (breaker failure) clearing time:	60 cycles