Special MIC Meeting – DER

Small DER Aggregation Example

April 10th, 2017

Presented by:
  Drew Adams
  A.F.Mensah, Inc.
Outline

• Example Overview
• System Design
• Operations – Backup Power Mode
• Meter Description
• EDC Ownership Demarcation Line
• Interconnection Process Overview
• PJM Aggregation Considerations
• Future Considerations
<table>
<thead>
<tr>
<th>Example Overview</th>
<th></th>
</tr>
</thead>
</table>
| **Site Overview** | • Front of Meter Generator  
                   | • Retail Load  
                   | • Retail Solar PV – Net Energy Metering  |
| **FERC Jurisdiction Determination** | • Non-FERC Jurisdictional  |
| **ISA or WMPA?** | • WMPA  |
| **PJM Classification – Resource Type** | • Generation Resource – Energy Only  |
| **PJM Interconnection Application** | • Attachment BB  |
| **PJM Applications** | • Frequency Regulation Market  
                       | • Energy Market  |
| **Other Applications** | • Backup Power (solar-storage)  |
SYSTEM DESIGN - FRONT OF METER GENERATOR

EDC Meter - GEN

M2

EDC Meter - LOAD

M1

Main Electrical Load Panel

Auto Transfer Switch

Auto Transfer Switch

Non-EDC Resiliency Meter

Non-EDC PJM Meter

Battery Inverter(s)

Battery Pack

Sub Electrical Load Panel

SREC Meter

Solar Inverter(s)

Solar Panels

Electric Distribution Grid

AC Electricity - Energized

AC Electricity – De - Energized

DC Electricity - Energized

SYSTEM DESIGN - FRONT OF METER GENERATOR

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EDC Meter - LOAD

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A.F.Mensah
## METER DESCRIPTION

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>PJM Purpose</th>
<th>EDC Purpose</th>
<th>Owner</th>
<th>Cost</th>
<th>New or Existing</th>
<th>PJM Compliant</th>
<th>Comms Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>EDC Retail Meter Load</td>
<td>N/A</td>
<td>Retail Settlement LOAD (NEM)</td>
<td>EDC</td>
<td>EDC</td>
<td>Existing</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>M2</td>
<td>EDC Retail Meter GEN Only</td>
<td>Hourly Energy Confirmation</td>
<td>Retail Settlement GEN</td>
<td>EDC</td>
<td>GEN Owner</td>
<td>New</td>
<td>Y¹</td>
<td>Y</td>
</tr>
<tr>
<td>M3</td>
<td>Non-EDC Meter GEN Only</td>
<td>Real Time Data; Hourly Energy</td>
<td>N/A</td>
<td>GEN Owner</td>
<td>GEN Owner</td>
<td>New</td>
<td>Y¹</td>
<td>Y²</td>
</tr>
<tr>
<td>M4</td>
<td>Non-EDC Meter Resiliency Only</td>
<td>N/A</td>
<td>Retail Resiliency</td>
<td>GEN Owner</td>
<td>GEN Owner</td>
<td>New</td>
<td>N/A</td>
<td>TBD</td>
</tr>
<tr>
<td>M5</td>
<td>Sub Meter Solar (SREC)</td>
<td>N/A</td>
<td>N/A</td>
<td>GEN Owner</td>
<td>Solar Owner</td>
<td>Either</td>
<td>N/A</td>
<td>Y/N</td>
</tr>
</tbody>
</table>

¹ Compliant with proper internet connection and if meets PJM accuracy requirements
² Real time secure data link to PJM SCADA Network
EDC OWNERSHIP DEMARCATION LINE

OVERHEAD SERVICE

UNDERGROUND SERVICE

EDC Ownership Demarcation Line

EDC Owned Line

Customer Owned Line

EDC Meter – LOAD (existing)

EDC Meter – GEN (new)
# INTERCONNECTION PROCESS (State Jurisdictional)

## PJM – Interconnection Application

| Attachment BB Application | Eligible Size: Up to 10 kW  
Application Fee: $500 / Site  
Equivalent to $50 / kW or $50,000 / MW |
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>FERC Jurisdiction Determination</td>
<td>Non-FERC Jurisdictional</td>
</tr>
<tr>
<td>Wholesale Market Participation Agreement (WMPA)</td>
<td>Individual WMPA per Site</td>
</tr>
</tbody>
</table>

## EDC - Dedicated Service Line Request

<table>
<thead>
<tr>
<th>Dedicated Service Line Application</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Site Survey</td>
<td>~ PJM Combined Feasibility/Impact Study</td>
</tr>
<tr>
<td>Metering &amp; Installation Site Survey</td>
<td>~ PJM Facilities Study</td>
</tr>
<tr>
<td>EDC Work Order Creation &amp; Scheduling</td>
<td>~ PJM Construction Services Agreement</td>
</tr>
<tr>
<td>Cost Considerations</td>
<td>EDC Cost + Contractor Cost to Install</td>
</tr>
</tbody>
</table>

## EDC - State Level Interconnection

| Level 1 or 3 Interconnection Application | Administrative Exercise w/ Study Completed Above |
## PJM AGGREGATION CONSIDERATIONS

### Project Overview

<table>
<thead>
<tr>
<th># of Generators</th>
<th>20 – Battery Storage Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generator Size per Site</td>
<td>5 kW</td>
</tr>
<tr>
<td>Aggregated Size</td>
<td>100 kW (0.1 MW) (20 x 5 kW)</td>
</tr>
<tr>
<td>PJM Classification</td>
<td>Generation Resource – Energy Only</td>
</tr>
</tbody>
</table>

### Interconnection Aggregation

<table>
<thead>
<tr>
<th>Attachment BB Application</th>
<th>20 – separate applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>WMPA</td>
<td>20 – separate agreements</td>
</tr>
<tr>
<td>PJM Model Points</td>
<td>1 – single point as aggregate</td>
</tr>
</tbody>
</table>

### Market Registration & Telemetry Aggregation

| PJM Telemetry Requirements | 1 – Fleet (0.1 MW)  
1 – Market Resource (0.1 MW) |
<table>
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<tbody>
<tr>
<td>Frequency Regulation Market</td>
<td>1 – Market Resource</td>
</tr>
<tr>
<td>Energy Market</td>
<td>1 – Market Resource (single pricing node)</td>
</tr>
<tr>
<td>Capacity Market</td>
<td>N/A</td>
</tr>
</tbody>
</table>
FUTURE CONSIDERATIONS

• Interconnection Process
  • Project Design & Market Rules to Accommodate Behind the Meter Resources
  • Aggregated PJM Interconnection Application for Small DERs
  • Mixed FERC and Non-FERC Projects As Aggregations

• Metering Requirement
  • Coordination Between PJM and EDC to Avoid Duplicate Metering
  • Data Sharing Between PJM, EDC, and GEN Owner

• Aggregation
  • Consistent Aggregation Rules Across All Markets
  • Mix of GEN, DR, DER?
  • Adding / Removing Resources to Existing Aggregation
Thank You!

A.F.Mensah, Inc.
1 North Johnston Ave
Suite 208
Hamilton, NJ 08609

Drew Adams
drew.adams@afmensah.com
BEHIND THE METER GENERATOR – GRID OUTAGE

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