Manual 14-D
Generator Operational Requirements
Revision 50

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Sr. Lead Engineer, Generation
System Operations Subcommittee
September, 5 2019
# Manual 14-D, Generator Operational Requirements

## Committee

<table>
<thead>
<tr>
<th>Rev. 49 Non-Retail Behind the Meter Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOS</td>
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<td>OC</td>
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<tr>
<td>MRC</td>
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<table>
<thead>
<tr>
<th>Rev. 50 Energy Storage Resource Participation</th>
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<tbody>
<tr>
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<thead>
<tr>
<th>Rev. 51 DER Ride-through</th>
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<td>SOS</td>
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<tr>
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<tr>
<td>MRC</td>
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*Initially presented as Rev. 49
M-14D Requirements for Energy Storage Resources

<table>
<thead>
<tr>
<th>Action Required</th>
<th>Deadline</th>
<th>Who May Be Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compliance with new manual requirements as they apply to Energy Storage Resource model participants</td>
<td>12/3/2019</td>
<td>ESR / Generation Owners</td>
</tr>
</tbody>
</table>
Changes specific to Energy Storage Resource (ESR) participation model

• Driven by FERC Order 841 Compliance Filing

Changes unrelated to Energy Storage Resource (ESR)

• Changes for consistency with M-13, Emergency Operations
• Cover to cover review
• Administrative changes
• Clarifying changes
• DRAFT Changes related to Non-Retail Behind the Meter Generation covered separately
Changes specific to Energy Storage Resource (ESR) participation model

• Driven by FERC Order 841 Compliance Filing
M-14D – Changes Specific to ESR Participation Model

New section titled Definitions and Applicability

- including OATT definitions of:
  - Energy Resource
  - Capacity Resource
  - Energy Storage Resource
  - Capacity Storage Resource

- Added language to clarify applicability of M-14D requirements to generation and storage resources
M-14D – Changes Specific to ESR Participation Model

Definitions and Applicability (cont’d)

• Added definition of Generating Facility
  • Definition included in PJM Compliance filing related to FERC Order 845 (not 841), Reform of Generator Interconnection Procedures and Agreements
  • Will become Tariff-defined term if / when accepted by the FERC
Changes Specific to ESR Participation Model

Section 4.1.7: SCADA - Supervisory Control and Data Acquisition

- Updated Exhibit 6 to include telemetry of State of Charge for Energy Storage Resource Model Participants

Section 4.2.3: Metering for Individual Generators

- Added metering requirements specific to Energy Storage Resources
- Metering requirements vary based implementation of ESR
Number and location of measurement devices required will vary depending on how ESR operates.

Energy Storage Resources that are co-located with end use load that is not Station Power shall provide a device for measurement of MWh located directly on the Energy Storage Resource terminals (M3 in diagram at left.)
M-14D – Changes Specific to ESR Participation Model - Metering

Case 1
Utility Grid

Case 2
Utility Grid

POI

N.C. = normally closed switch
N.O. = normally open switch
POI = Point of Interconnection
M = Revenue Quality Meter

On-Site Generation
Energy Storage Resource
Customer Load

On-Site Generation
Energy Storage Resource
Customer Load
Section 7.3: Critical Information and Reporting Requirements

- Added Energy Storage Resource outage reporting requirements
- Charging or lack of charge alone does not require an eDART ticket

Attachment D: PJM Generating Unit Reactive Capability Curve Specification and Reporting Procedures

- Updated to include Energy Storage Resources
- Updated stand-alone document containing “D-curve” examples
- See example on next slide
For inverter-based Energy Storage Resources, the reactive capability should be based on Inverter MVA Capability Curve.

Consistent with NERC Guideline on Reactive Capability for Inverter-based Energy Storage Resources

### Example of an Inverter-based Energy Storage Resource

<table>
<thead>
<tr>
<th>Point</th>
<th>MW</th>
<th>Minimum MVAR</th>
<th>Maximum MVAR</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point 1</td>
<td>-20</td>
<td>-22</td>
<td>22</td>
<td>Maximum Active Power CHARGING (Min MW)</td>
</tr>
<tr>
<td>Point 2</td>
<td>-14</td>
<td>-26</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Point 3</td>
<td>-7</td>
<td>-29</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Point 4</td>
<td>0</td>
<td>-30</td>
<td>30</td>
<td>Inverter MVA Capability Curve Rating</td>
</tr>
<tr>
<td>Point 5</td>
<td>6</td>
<td>-29</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Point 6</td>
<td>12</td>
<td>-27</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Point 7</td>
<td>18</td>
<td>-24</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Point 8</td>
<td>25</td>
<td>-17</td>
<td>17</td>
<td>Maximum Active Power DISCHARGING (Max MW)</td>
</tr>
</tbody>
</table>
• Updated to include Energy Storage Resources
  • Individual generating units and inverter-based Energy Storage Resources with a gross nameplate rating greater than 20 MVA and directly connected to the Bulk Electric System
  • Generating plants/facilities with a gross aggregate nameplate rating greater than 75 MVA including inverter-based Energy Storage Resources, and variable resources such as wind, solar, run of river hydro, etc.
## Testing Requirements Summary

<table>
<thead>
<tr>
<th>UNIT TYPE</th>
<th>MW OUTPUT</th>
<th>MVAR OUTPUT</th>
<th>TEST DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOSSIL, HYDROELECTRIC &amp; BLACKSTART</td>
<td>MAX</td>
<td>MAX LAG</td>
<td>ONE HOUR WHEN LIMIT REACHED</td>
</tr>
<tr>
<td></td>
<td>MAX</td>
<td>MAX LEAD</td>
<td>WHEN LIMIT REACHED</td>
</tr>
<tr>
<td></td>
<td>MIN</td>
<td>MAX LAG</td>
<td>WHEN LIMIT REACHED</td>
</tr>
<tr>
<td></td>
<td>MIN</td>
<td>MAX LEAD</td>
<td>WHEN LIMIT REACHED</td>
</tr>
<tr>
<td>SYNCHRONOUS CONDENSER or GENERATOR THAT OPERATES IN THE SYNCHRONOUS CONDENSING MODE TO PROVIDE REACTIVE SUPPORT</td>
<td>-</td>
<td>MAX LAG</td>
<td>ONE HOUR WHEN LIMIT REACHED</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>MAX LEAD</td>
<td>WHEN LIMIT REACHED</td>
</tr>
<tr>
<td>NUCLEAR</td>
<td>MAX</td>
<td>MAX LAG</td>
<td>ONE HOUR WHEN LIMIT REACHED</td>
</tr>
<tr>
<td></td>
<td>MAX</td>
<td>MAX LEAD</td>
<td>WHEN LIMIT REACHED</td>
</tr>
<tr>
<td>VARIABLE (E.G. WIND AND SOLAR)</td>
<td>VARIABLE</td>
<td>MAX LAG</td>
<td>WHEN LIMIT REACHED</td>
</tr>
<tr>
<td>(Testing done with at least 90% of turbines or inverters on line)</td>
<td>VARIABLE</td>
<td>MAX LEAD</td>
<td>WHEN LIMIT REACHED</td>
</tr>
<tr>
<td>INVERTER-BASED ENERGY STORAGE RESOURCES</td>
<td>MAX</td>
<td>MAX LAG</td>
<td>WHEN LIMIT REACHED</td>
</tr>
<tr>
<td></td>
<td>MAX</td>
<td>MAX LEAD</td>
<td>WHEN LIMIT REACHED</td>
</tr>
<tr>
<td></td>
<td>ZERO</td>
<td>MAX LAG</td>
<td>WHEN LIMIT REACHED</td>
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Changes unrelated to Energy Storage Resource (ESR)

• Changes for consistency with M-13, Emergency Operations
• Cover to cover review
• Administrative changes
• Clarifying changes
• DRAFT changes related to Non-Retail BtMG covered in separate presentation
Section 7.3.5: Fuel and Emissions Reporting

• Replaced references to Supplementary Status Report (SSR) with references to Resource Limitations page in Markets Gateway
• Added guidance for Resource Limitations consistent with language added to M-13, Emergency Operations
M-14D – Administrative Changes Unrelated to ESR Participation Model

- Performed periodic cover to cover review
- Replaced references to Client Manager with Member Relations throughout
- Corrected typos and capitalized terms where appropriate
  - Generator Owner, generation resource owner, generation owner, generator’s owner/operator replaced with Generation Owner for consistency
- Section 1.2 - Generator Commercial Naming Convention
  - Replaced Performance Compliance with Operations Analysis and Compliance
M-14D – Administrative Changes Unrelated to ESR Participation Model

Section 3.2.4 - Control Center Staffing Requirements
Remove reference to Section 6 as it relates to training and certification requirements

Section 10.2.3 – Implications for Terminating Black Start Units
Updated to cross-reference correct section – Section 9

Attachment N - Cold Weather Preparation Guideline and Checklist
Remove outdated link to Polar Vortex presentation
Manual 14-D, Rev 50 Review / Approval Timeline

SOS
First Read
6/6/19

SOS
Endorsement
9/5/19

MRC
First Read
9/26/19

Effective
Date
12/3/19

OC
First Read
6/11/19

OC
Endorsement
9/10/19

MRC
Endorsement
10/31/19