Black Start / System Restoration

October 5, 2015
TOA-AC Meeting
Overview

• Background
• Five Year RTO Wide RFP Summary
• Black Start RFP Review and Implementation Process
• Challenges & Solutions
• Remaining Work / Next Steps
• System Restoration Strategy Task Force (SRSTF) assembled to review restoration planning process

• SRSTF Deliverables
  • Critical load definition and Black Start Requirements
  • 5 Year RTO Wide Black Start RFP process
  • Incremental RFP Process
  • Cross-zonal Black Start Solutions
  • Reliability Back Stop
Critical Load Methodology

- Minimum Critical Black Start Requirements for each transmission zone consist of:
  - Cranking power load to units with a “hot” start-up time of 4 hours or less
  - Off-site nuclear unit safe shutdown load
  - Critical gas infrastructure
• Successful implementation of new methodology for critical load requirement
• Sufficient black start megawatts to serve critical load requirements in all transmission owner zones post-2015 retirements
• Cross zonal solutions utilized in some transmission owner zones
• Potential termination of some existing excess black start units where appropriate
### RTO Wide RFP Awards Summary

<table>
<thead>
<tr>
<th>Description</th>
<th>Count</th>
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<tbody>
<tr>
<td>Black Start Sites Awarded</td>
<td>26</td>
</tr>
<tr>
<td>Black Start Units Awarded</td>
<td>36</td>
</tr>
<tr>
<td>Black Start MWs Awarded</td>
<td>3,914</td>
</tr>
<tr>
<td>TO Zones Awarded Black Start</td>
<td>13</td>
</tr>
<tr>
<td>Number of Cross-zonal Solutions</td>
<td>5</td>
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Key Points for Post-2015 State

• Overall less black start megawatts, with fewer black start units, cranking a lower amount of critical load but a higher quantity of critical load units

• Surplus of black start to critical load requirement varies across RTO - driven by:
  • Larger units / multiple units per plant for RFPs
  • Ensuring cranking power for all critical load units
  • Geographic diversity
Black Start RFP Review & Implementation

- **RFP Proposal Review**
  - GO: Reactive Capability, Ramp Rates, Environmental/Operational Limits
  - TO: Cranking Paths, Minimum Gen. Reqmnts.

- **Power Flow & Dynamic Studies**

- **RFP Awards**

- **Implementation**
  - GO: Construction Updates
    - Black Start Test
    - Cost Submittal
  - TO: Restoration Plan Update
  - IMM: Cost Review & Approval

- **Black Start Service**

(EOP-005)
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<tr>
<th>Challenges</th>
<th>Impacts</th>
<th>Solutions</th>
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| Uncertainty of Black Start In-Service Dates    | • Permitting / Construction / Equip. Delivery  
• Black Start Test Date uncertainty  
• Cost Submittals / IMM Review  
• EOP-005 Studies                  | • Regular status updates  
• Multiple scenarios included in EOP-005 studies                                         |
| Coordination of TO Restoration Plan updates    | • PJM restoration plan process  
• TO restoration plan process  
• Nuclear Safe Shutdown definition and NPIR coordination | • Multiple restoration plans versions  
• Increased PJM / TO coordination  
• NGOUG coordination               |
| Unanticipated Black Start Terminations         | • Black Start Shortage  
• Cranking Path Issues                                                     | • Incremental RFP  
• Short Term / Long Term Cross Zonal Solutions                                   |
| Cross Zonal Black Start Solutions              | • Increased complexity of restoration  
• TO/GO communications  
• Additional PJM Manual M36 form submittals                                   | • Effective TO-TO collaboration on cranking path solutions  
• Increased focus on detailed documentation in restoration plans  
• Training on cross zonal during Restoration Drills                           |
• Second Incremental RFP - W. PA / NE Ohio
• Implementation of remaining RFP solutions
• TO System Restoration Plan updates
• Termination of Surplus Black Start
• Planning for next RTO wide RFP
  • Starting process in 2017
  • 2020 implementation