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Blackstart in the Variable Generation Era

DOE Electricity Advisory Committee Meeting

Robert W. Cummings 20 October 2021

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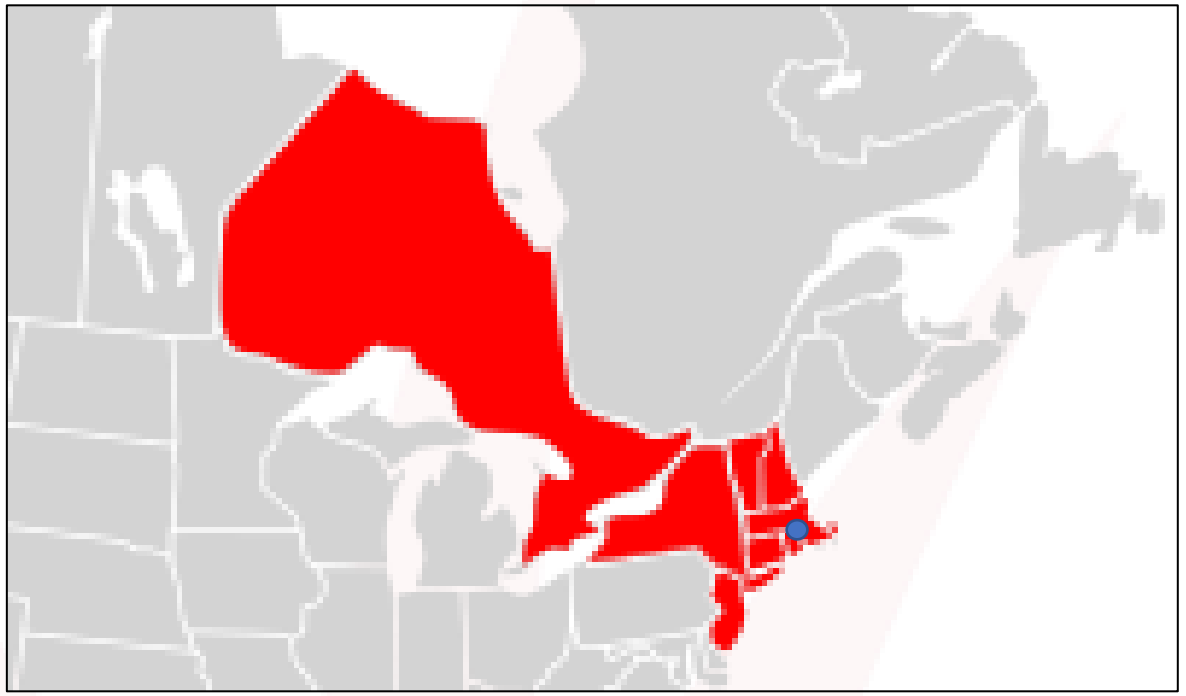
Types of Blackstart and Restoration

- Blackout of the Interconnection – where connection to another energized system is not possible – bootstrap start
- Reconnecting to parts of the Interconnection that are still energized
- Reconnecting an islanded portion of the network that is still energized to the rest of the Interconnection – this would include reconnecting micro-grids to the system
- Reconnecting a de-energized portion of the system to the energized part of the system.
- Radial system reconnection to the energized part of the system.
- Networked system reconnection to the energized part of the system.

November 9, 1965 – Northeast Blackout



A long way to other energized systems

Fall River Electric Light Company
Hathaway Street Steam Plant

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Know the Objectives of the Restoration

- Off-site power restoration to nuclear plants
- Cranking power to restart conventional generation
- Reference voltage to restart inverter-based resources
- Hospitals and emergency services
- Water and sewer treatment facilities and control centers
- Electric system control centers
- Communications infrastructure
- Gas system control centers
- Flood control – pumps
- Government facilities
- Military bases

Establish “Cranking Paths” to meet Priorities

- Have some grid-forming inverters or backup diesel generators to provide a system voltage reference to give the main IBR fleet something to follow
- Know where the system is likely to come apart and where it can be reconnected
  - Prepare several optional paths – don’t be afraid to restart on different paths
  - Plan reconnection points – Voltage and phase angle control there is essential to successful closing of lines
  - Have switchable shunt reactors and capacitors at reconnection points to coarsely control voltage
  - Have controllable resources at reconnection points to adjust phase angle differences
- Isolate lines and facilities along the path – sectionalize the system into manageable pieces
- Assess potential damage to facilities along the path
- Use load and dedicated power electronic systems to stabilize voltage along the path
  - Have grid-forming inverter-based storage (dedicated to providing stability) along path

Disclaimer and Credits

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- The opinions expressed in this presentation are those of Robert W. Cummings from 45 years of experience in the electric power industry.

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Questions?

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