



# Black Start in PJM

Vince Stefanowicz  
Sr. Lead Engineer, Generation, PJM  
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- **What is black start?**

- If power is lost throughout the entire or large portion of the PJM area, black start units are the designated resources that are able to restore electricity to the grid without using an outside electrical supply.
- Black start units are the first units to start and provide the foundation upon which the grid is restored.
- Black start generation is required by NERC Standard EOP-005-3 for system restoration.

## Local Area Blackout (e.g. storm event)

- Typically localized (sub-state)
- Often can be anticipated
- Restoration priorities well established
- Crews and repair work evident; external crews typically mobilized to expedite repairs
- Typically does not require black start if adequate external power available from the grid

## Wide Area Blackout (Rare event)

- Everyone out (multi-state)
- Cause may not be apparent
- Restoration times not available
- Usually without warning or time to prepare (e.g. gas scheduling, customer notification, utility/crew mobilization)
- Black start is required to start the grid

- **Black Start units**
  - Ability to self start / close to a de-energized bus within 3 hours
  - Provide power to serve Critical Loads
  
- **PJM Critical Load Criteria:**
  - Critical Load Units (units with a hot start time of 4 hours or less)
  - Nuclear safe shutdown loads
  - Critical gas infrastructure (electric-powered gas compressor stations)

- **Critical Load**
  - In the context of black start, critical load is defined as generators in strategic locations that can then help to bring up pockets of load that can then be connected together to restore the entire system.
  - Other categories include nuclear plants (to ensure safe shutdown) and electric powered natural gas compressor stations.
- **Priority Load**
  - Retail load locations (hospitals, military facilities etc.) on the distribution system which have restoration priority through Transmission Owner restoration plans.

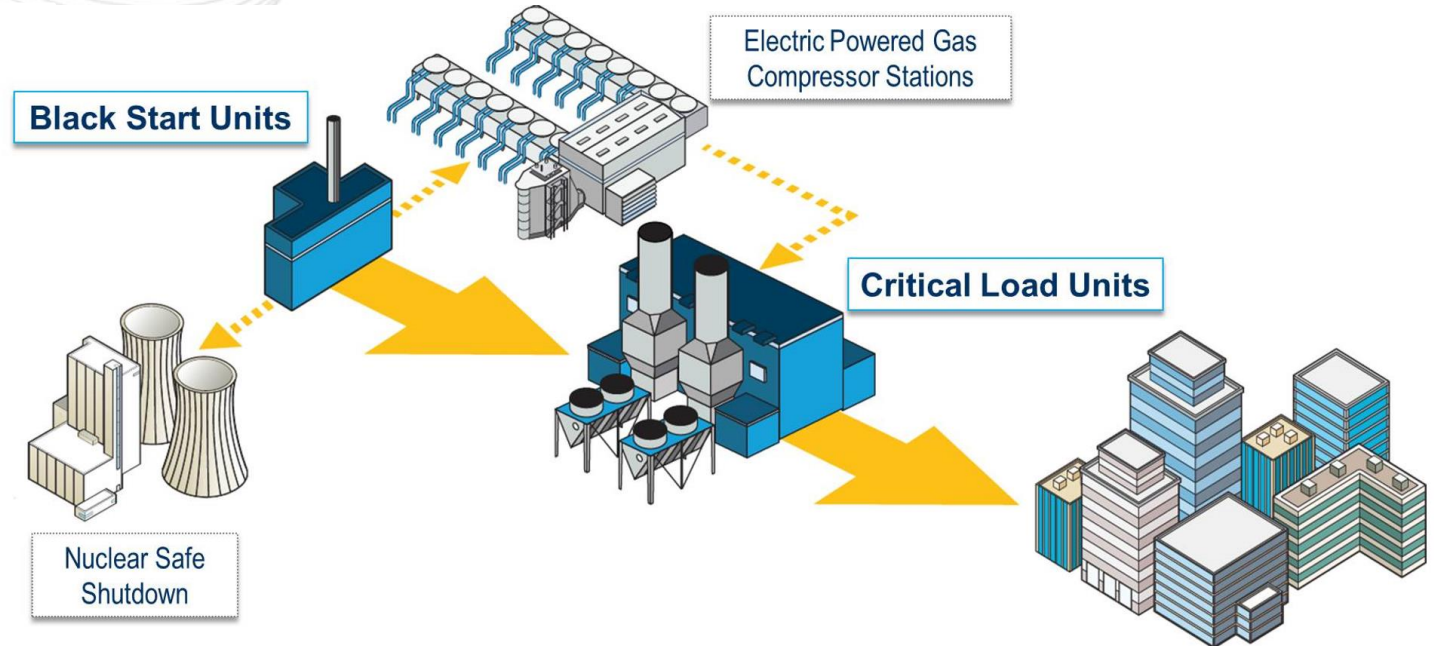
- **PJM** as Transmission Operator (TOP) Balancing Authority (BA) and Reliability Coordinator (RC)
  - Role is limited during initial phases of system restoration following a total system blackout
  - May have limited analysis capability depending on extent of blackout
  - Will NOT be calculating LMP or dispatching units
  - Helps Transmission Owners (TOs) identify opportunities to reconnect to Eastern Interconnection (if any) or other islands created by other TOs

- **Transmission Owners (TOs)**
  - Have the lead role in system restoration
  - Must completely assess status TO footprint prior to beginning restoration process
  - Communicates directly with Black Start Resources (BSR), Critical Load units and other Generation Resources in TO zone
  - Performs or directs switching to establish Cranking Paths from BSR to CL
  - Instructs units to come online and load as necessary to balance load and generation in each island
  - Controls voltage and frequency within each island

- **Black Start Resources (BSR) Owners**
  - Receives instructions directly from local TO – NOT PJM
  - Starts BSR when directed by TO
  - Ensures that BSR is operated to quickly respond to changes in frequency and voltage
  - Coordinates loading of BSR directly with TO
  - Immediately reports to TO any concerns with operation of BSR



- Assess system
- Start black start units to form islands
- Build cranking paths
- Restore critical loads
- Synchronize islands\*
- Connect to neighbors\*
- Return to normal operations\*



\*At one of these steps PJM will assume control of the area(s) being restored, if/once it is able, from the TO(s)

## Cross Zonal Black Start

- Serving critical load in a TO zone from a black start resource in an adjacent TO zone

## Testing

- Successful annual test within past 13 months

## Procurement

- RTO Wide 5 year RFP process
- Incremental (Replacement) RFP
- Reliability Backstop RFP

## Cost Recovery

- Capital Cost Recovery
- Formula Rate
- FERC Approved Rate

Presenter:  
Vince Stefanowicz  
[Vincent.Stefanowicz@pjm.com](mailto:Vincent.Stefanowicz@pjm.com)

Facilitator:  
Janell Fabiano  
[Janell.Fabiano@pjm.com](mailto:Janell.Fabiano@pjm.com)

Secretary:  
Nicole Militello  
[Nicole.Militello@pjm.com](mailto:Nicole.Militello@pjm.com)

## Fuel Requirements for Black Start Resources



### Member Hotline

(610) 666 – 8980

(866) 400 – 8980

[custsvc@pjm.com](mailto:custsvc@pjm.com)