



EARTH EX[®] III/19

Emergency All-Sector Response to a Transnational Hazard Exercise



EARTH EX 2019 Training Series



Electric System Restoration and Black Start *Training Webinar*

13 February 2019

EARTH)EX[®] III/19



Electric System Restoration and Black Start Presented by

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Electricity Infrastructure Security (EIS) Council

Mission

- EIS Council hosts national and international collaboration on resilience and whole community restoration and response planning, addressing severe, national and global scale hazards to lifeline infrastructures

Summary of Activities

- Annual EIS International Summit (next: Washington, DC, June 24-25)
- EARTH EX II/18 (Aug 22, almost 10,000 participants worldwide!)
- EPRO Handbooks/CUSEC Critical Infrastructure Resilience Project
- Electricity Sub Sector Meetings (next: Washington, DC, March 25-26)

Black Sky Hazards

Natural

- High Magnitude Earthquakes
- Hurricanes and other Extreme Terrestrial Weather
- Extreme GMD

Man-made

- EMP
- IEMI
- Cyber Terrorism
- Coordinated Physical Attack

Contrast: Gray Sky vs. Black Sky

Current scenario

1. Regional Damage:
Minimal, other than weather-related to distribution system
 2. Resource, Service Supply Chain Issues:
Minimal
- Anticipated Outage Duration:
Short. Hours to one or two days for most of system

Think: Hurricane Sandy

Black Sky Scenario

1. Regional Damage:
Catastrophic, including heuristic damage to generation assets and transmission system
 2. Resource, Service Supply Chain Issues:
Extreme. Assured availability only for prearranged, Black Sky-capable resource and service suppliers and tools
- Anticipated Outage Duration:
Long (weeks, at best, presuming Black Sky preparations have been made)

Think: Puerto Rico

Black Sky Event Impacts

- Long term (days or weeks or longer) electrical outages with equipment damage
- Loss of other critical infrastructures
 - Water/wastewater
 - Oil and Natural Gas
 - Food Distribution
 - Mass Care

= Potential for Significant Loss of Human Life



Existing Utility Preparedness

- NERC Standard EOP-005
 - Strategies for system restoration
 - Off site to nuclear power plants
 - Restoring interconnection with adjacent systems
 - Black start resources
 - Cranking paths

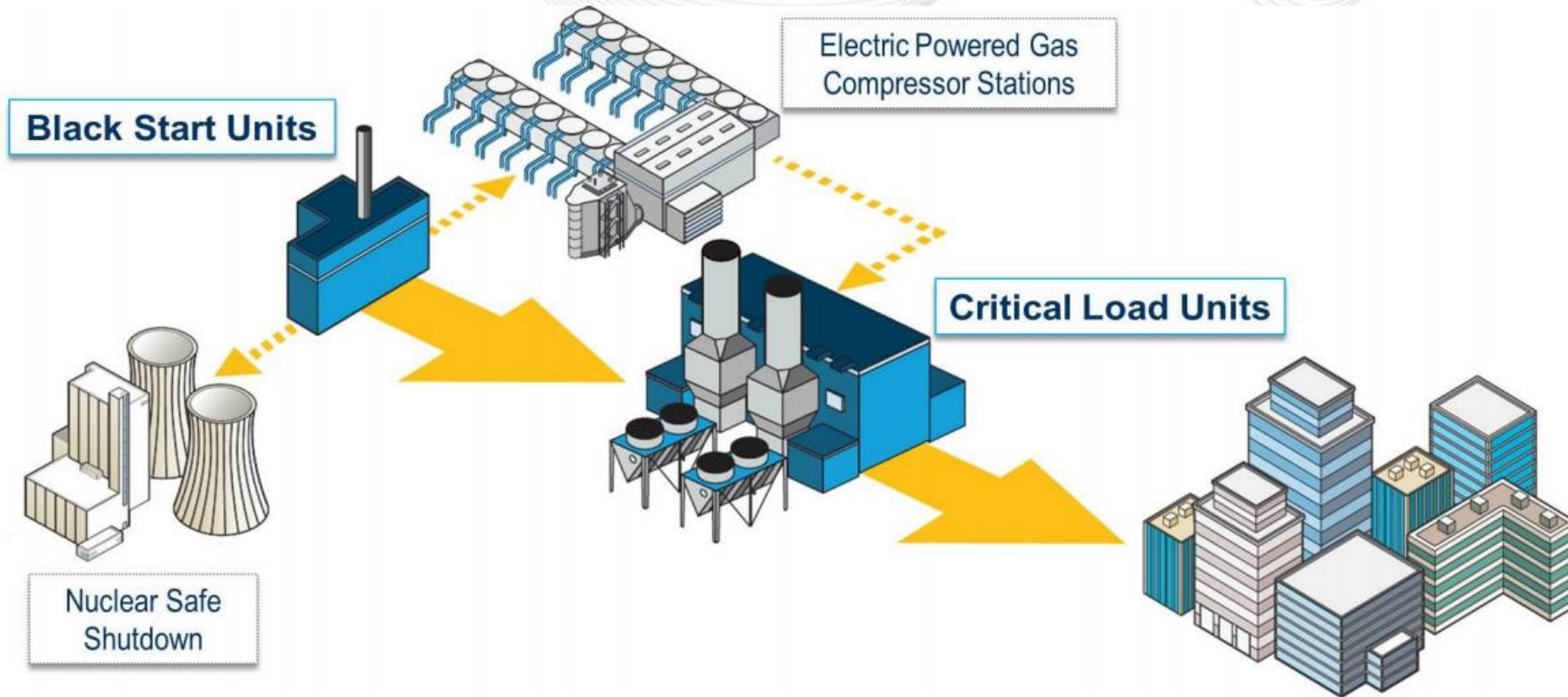
Black Start Generators

- Generation resources that can be started (from black) without any external power
 - Examples: Hydro, oil, gas
- Usually small, with a close to equal amount of local load to provide for the creation of a balanced island
- Cranking paths are the electrical route (transmission and distribution) to connect a black start generator to adjacent generators and islands
- Black start generators are required to test their capability to provide black start service

How Black Start Units are Used—PJM Example



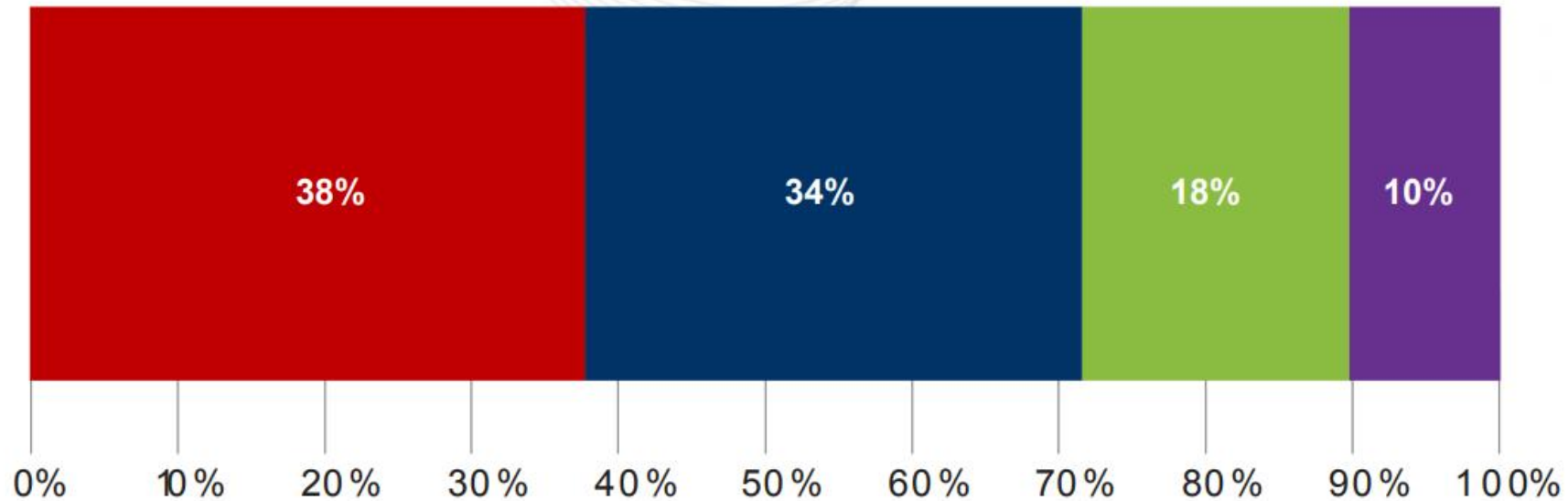
How Black Start Units are Used



Fuel Source of Black Start Units—PJM Example



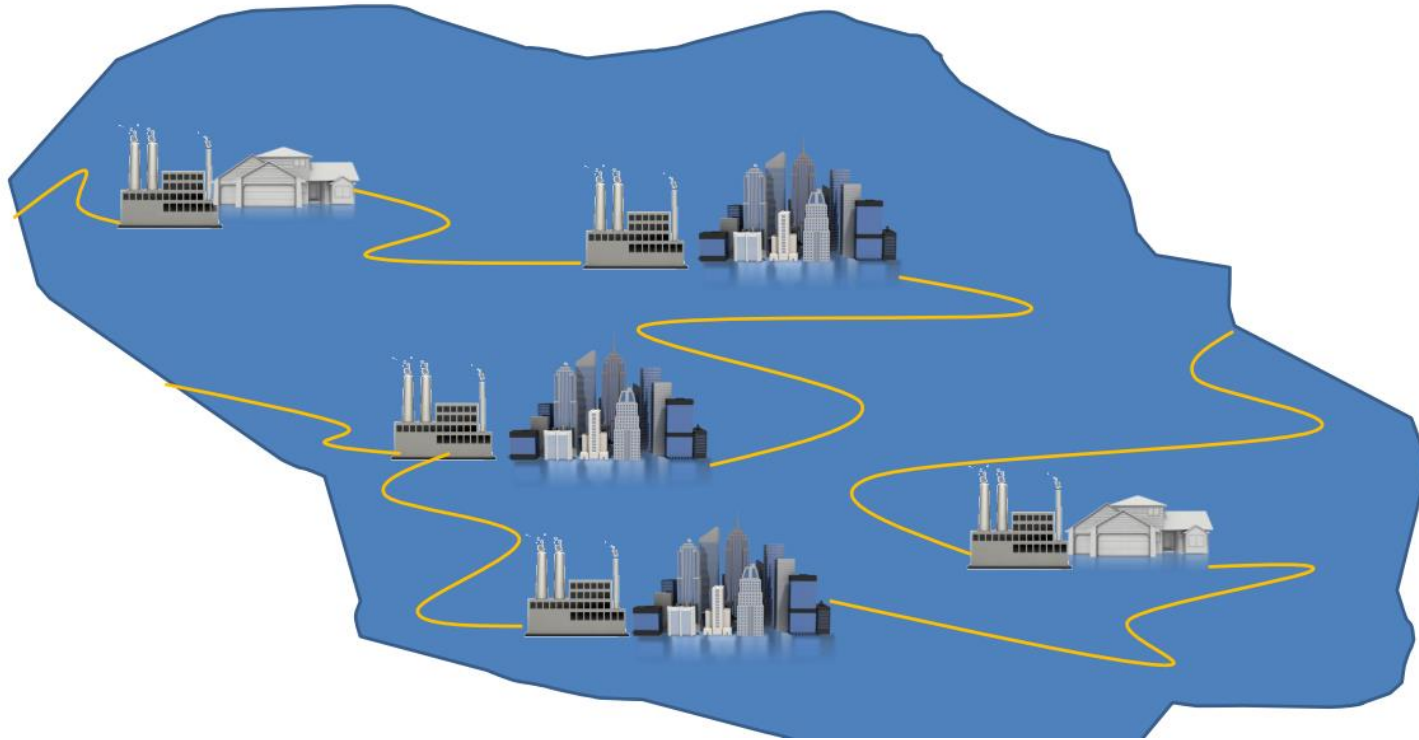
Black Start Resources Fuel Breakdown



Black Start (% by Capability)

- Natural Gas, Single Fuel
- Natural Gas, Dual Fuel (Natural Gas, Oil)
- Hydro
- Oil, Single Fuel

Bottom Up Restoration



- Start black start generators and create stable, balanced islands
- Connect the islands together to create a network of islands
- Add more generation and load to build out the restoration and go back to normal dispatching

So What's the Problem?

- Existing utility preparedness, while proven from previous blackouts, is based on restoration from power outages without system damage
- Black Sky events will likely be accompanied by substantial system damage and the areas of damage may not be immediately obvious
- Black Sky events will outage other critical infrastructures that are dependent on electricity for operation (water, oil, gas, transportation, etc.)

Another Way to Think About System Restoration

- Existing paradigm—starts at the Black Start generators: Return as many customers to service as soon as possible
- Nothing wrong with that!! BUT, it may not work as well in a Black Sky event in the presence of system damage

Another thought...

- Invert the existing paradigm—start at the most critical loads: Build paths back to multiple generators to give priority to critical load restoration (say **RED** paths)

Example: Starting at the municipal water purification plant, how do we get back to generators can restart the plant and restore water service?



Implementing the RED Path Approach

- Identify the life sustaining critical infrastructure loads, e.g.
 - Water/wastewater treatment
 - Mass care
 - Food distribution
 - Fuel distribution
 - Communications hubs
- Identify redundant RED paths back to multiple generators that have the capacity to restore each critical load (remember: Black Sky events will be accompanied by system damage)



Implementing the RED Path Approach

- System Planning
 - Consider resiliency investments to harden the RED paths and the associated generators
 - Work with the critical asset owners to increase redundancy at the site and make prudent investments to boost resilience
- System Operations
 - Train system operators in the RED path methodology and develop procedures to implement the process in a Black Sky event
 - Practice the process together with the operations staffs of the critical loads to ensure that the communications protocols are in place and work effectively



Don't the Paradigms Conflict?

- YES—they are drawing on limited restoration resources, but remember in a Black Sky event, the focus needs to be on preventing loss of human life! Ask Puerto Rico.
- NO— elements of both paradigms could be implemented simultaneously, depending on the damage assessment. In Black Sky, the traditional system restoration will be facing large challenges.
- MAYBE—both paradigms rely heavily on proper analysis, training, practice, and relationship building with critical asset owners. Neither paradigm will be effective in Black Sky restoration if those elements have not been properly addressed.



Increasing Electric System Resilience

- Build upon existing storm restoration procedures and capabilities
- Assess organizational capabilities and increase capacity as necessary to address a system-wide emergency over a sustained period
- Build relationships with critical infrastructure owners to ensure mutual understanding of interdependencies and alternative responses
- Consider prudent investments to provide additional redundancy or hardening of assets that would increase the probability of continuity of operation in the aftermath of a Black Sky event



What is the EIS Council doing?

- Developing resilience guidance for the electrical industry
- Conducts cross sector exercises to raise awareness
- Sponsoring events for industry and government leaders to share best practices and foster collaboration

More information: www.EIScouncil.org

EARTH EX 2019 New Training Opportunities

Event	Date
Electric & Emergency Management - Black Sky/black start and the Electric Grid	13-Feb
Private Sector Preparedness for Catastrophe Survival	13-Mar
Medical, Health and Long-Term Care - Resilience Measures for Medical, Health and Long-Term Care	10-Apr
Federal Government - Resilience Actions for Contingency, Continuity and Restoration	10-Apr
Water - Water Systems: Black Sky Resilience Measures	8-May
California Resiliency Alliance - EARTH EX 2019 - How to be part of the world's largest cross-sector exercise	22-May
Communications: Priority Communication Assets and Technologies	11-Jun



EARTH EX 2019 Lead Up Exercise Opportunities

Event	Date
Individual and Family Awareness Exercise	14 Feb
Community Leaders and Employees Preparedness Exercise (One Phase)	8-Apr
Team Preparedness and Response Exercise (Two Phases)	6-Jun

Single point for registration – Play at anytime – Replay on demand – No feedback requirements



EARTH EX 2019 Registration

<https://www.eiscouncil.org/earthex.aspx>

Available for Play: 21 August 2019

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E-Mail for Questions and Information

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To make recommendations for the exercise, ask questions or to participate in one of the design team meetings – send an e-mail.

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