Nuclear Power and Electric Grid Resilience: Today and Tomorrow

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Grid Resilience – My context…

Generic System Resilience:
“the ability of a system to withstand a change or a disruptive event by reducing the initial negative impacts (absorptive capability), by adapting itself to them (adaptive capability) and by recovering from them (restorative capability)”

Electric Grid Resilience:
“the system’s ability to minimize interruptions of electricity flow to customers given a specific load prioritization hierarchy”
Grid resilience is about more than my electricity bill

- Societal Resilience and Critical Infrastructure Resilience are hostage to Grid Resilience
- Need to distinguish between “Tactical Resilience” and “Strategic” or “Very Bad Day Resilience”
- Electricity currently treated as a commodity – rather than a strategic national resource
- Current realities vs. future possibilities:
  - Technologies & Markets
  - Hazards & Threats
- Distinction between Fuel Security and Resilience Value
Current Nuclear Power Plants (NPPs) provide unique Grid resilience benefits

- NPPs have unique fuel security - up to 2 yrs
- Current NPPs have demonstrated resilience value of fuel security
  - 2011 Jan-Feb Southwestern Severe Cold Weather Event (NMPRC, 2011)
  - 2014 Jan Polar Vortex (NERC, 2014)
- But, current NPPs are intolerant of Grid interface anomalies
Future resilient Nuclear Power Plants (rNPPs) can anchor resilient Grid

- Enable the electric Grid to **absorb** and **adapt** to a broad spectrum of Grid anomalies and disruptions.

- Enhance the Grid’s ability to quickly **recover** from upsets, and to **restore** electric service in a manner consistent with the system operator’s load prioritization hierarchy.

### Six rNPP Functional Capabilities

1. Robust real/reactive load-following capability
2. Immunity to damage from external events
3. Tolerate Grid anomalies
4. Operate in Island Mode
5. Unlimited independent safe shutdown cooling
6. Independent self-cranking black start capability

### Enable New Applications

- Flexible Operations
- Hybrid Nuclear Energy Systems
- Grid Black Start Resources
- Resilient Critical Infrastructure Islands (RCIIs)
Nuclear Power – Grid Resilience
Publications By S. R. Greene

Dr. Sherrell R. Greene is the President of Advanced Technology Insights, LLC (ATI). Dr. Greene has 40 years experience in the nuclear energy arena, with specialized expertise in applied engineering research, advanced reactor concept development (for both terrestrial and space-based nuclear power systems), technology maturity assessment, systems analysis, nuclear systems licensing support, and U.S. nuclear technology export control compliance. He is an internationally recognized expert in the field of commercial nuclear power safety, in high-stakes technical and programmatic messaging and communications, and in the emerging field of electric Grid and Critical Infrastructure resilience assessment.

Dr. Greene founded Advanced Technology Insights, LLC in 2012, after a 33-yr career at Oak Ridge National Laboratory (ORNL). During his last seven years at ORNL, Dr. Greene served as Director of Nuclear Technology Programs and Director of Research Reactor Development Programs. In those roles, he was responsible for development and leadership of ~ $120M/yr of basic and applied nuclear technology and nuclear energy research for the U.S. Department of Energy (DOE), U.S. National Nuclear Security Administration (NNSA), the U.S. Nuclear Regulatory Commission (NRC), and the U.S. National Aeronautics and Space Administration (NASA) – as well as a host of international and domestic partnerships and collaborations in the governmental and private sectors.

Dr. Greene has worked with numerous scientific and technical organizations throughout North America, Europe, and Asia. His views and perspectives on complex technical issues have been sought by a variety of public media outlets, including National Public Radio, The Economist, Popular Science, Wired Magazine, and Japan’s HNK television network.

Dr. Greene holds a B.S. and M.S. in Nuclear Engineering, and a PhD in Energy Science and Engineering from the University of Tennessee.