



GTEN 2021 Virtual Symposium

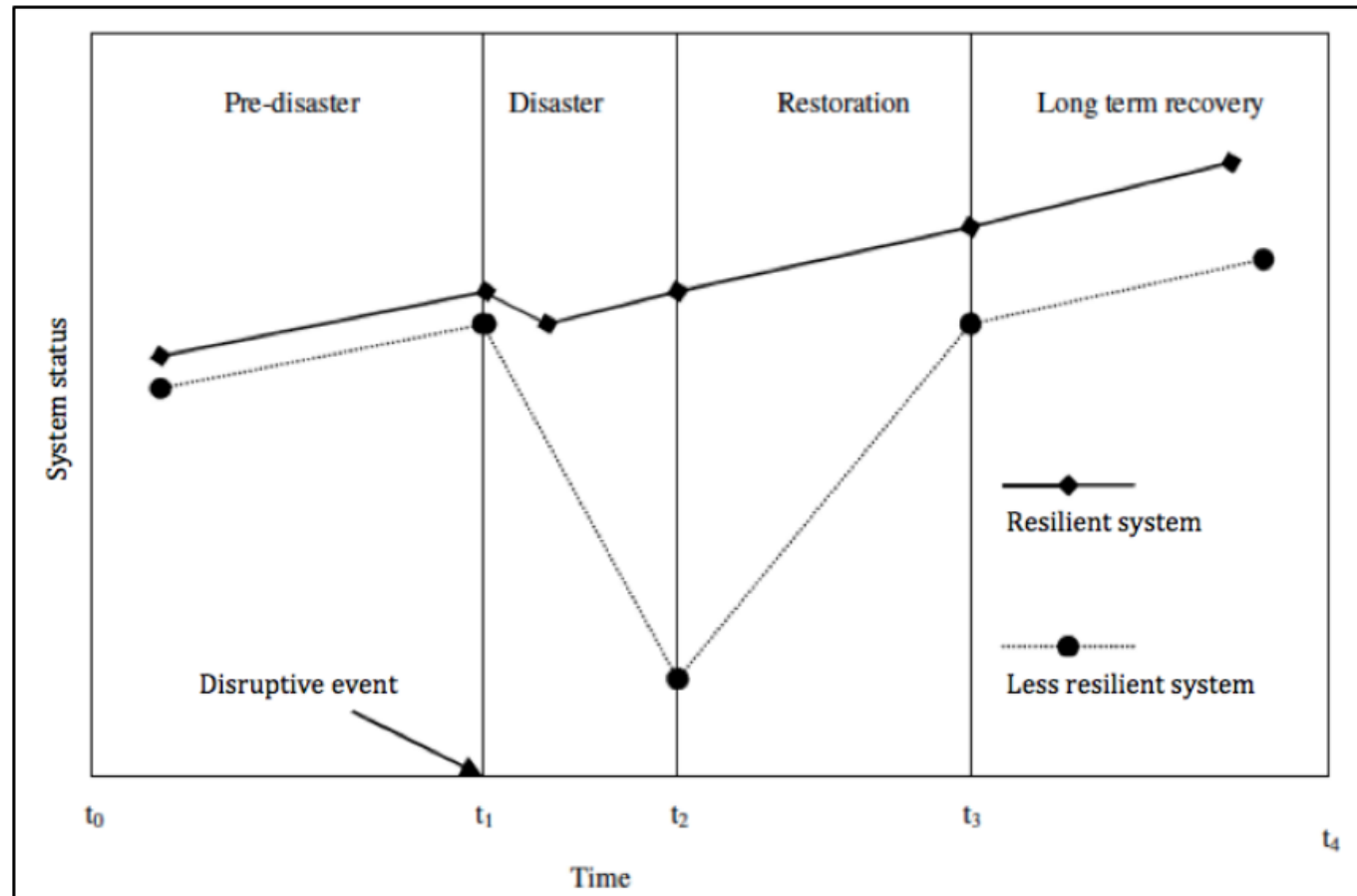
October 18th & 19th, 2021

DESIGNING FOR RESILIENCY IN AERODERIVATIVE TURBINE PEAKING FACILITIES

Ammar Moosa
PROENERGY

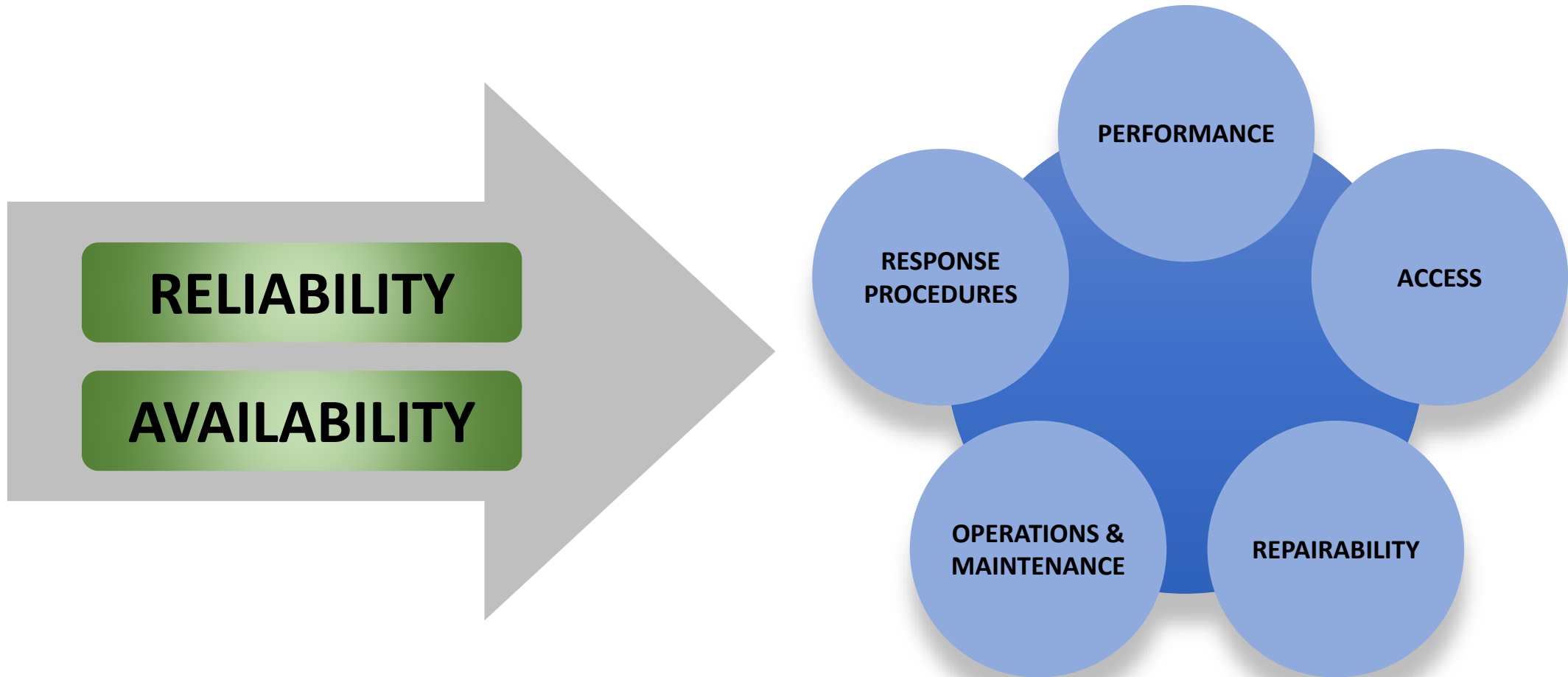
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Resilience: How Fast Can You Get Back Up?





Thinking Beyond Reliability and Availability



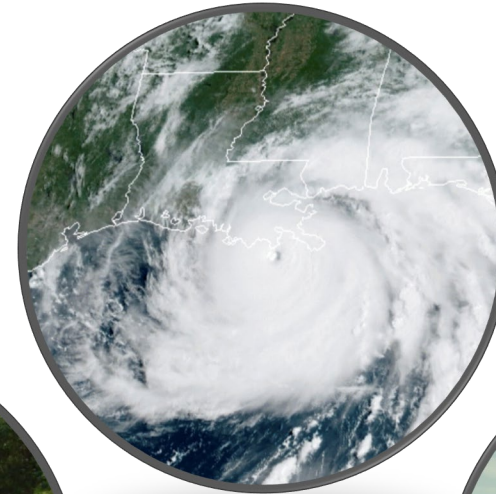


Applying Resilience to Peaking Facilities

- Power Infrastructure
 - Generation facility, fuel supply, transmission, people, networks
- CAPEX Sensitivity
 - Risk in overdesigning
- Traditional vs. Current Peaker Philosophy
 - Renewables increase base-load volatility
 - Aging base-load increases peaker capacity factors (>1,500 hr/year)



Peaking Resilience is a Function of Climactic Stress





Climactic Stress Has No Geographic Boundary



2021 Winter Storm Uri
— South Texas



Designing for Resiliency is Critical From Every Viewpoint

- Public Safety
 - Protecting life; more than 200 dead in Uri
 - Powering hospitals, water, and other critical infrastructure
- Regional Economic Value
- Business Value
 - Earning peak returns
 - Avoiding costly penalties
 - Maintaining business resilience



Resiliency in the Field: HO Clarke Power Station

- 6x LM6000PC Standardized PowerFLX™ Facility
- Vertical Integration, including turbine, EPC, O&M

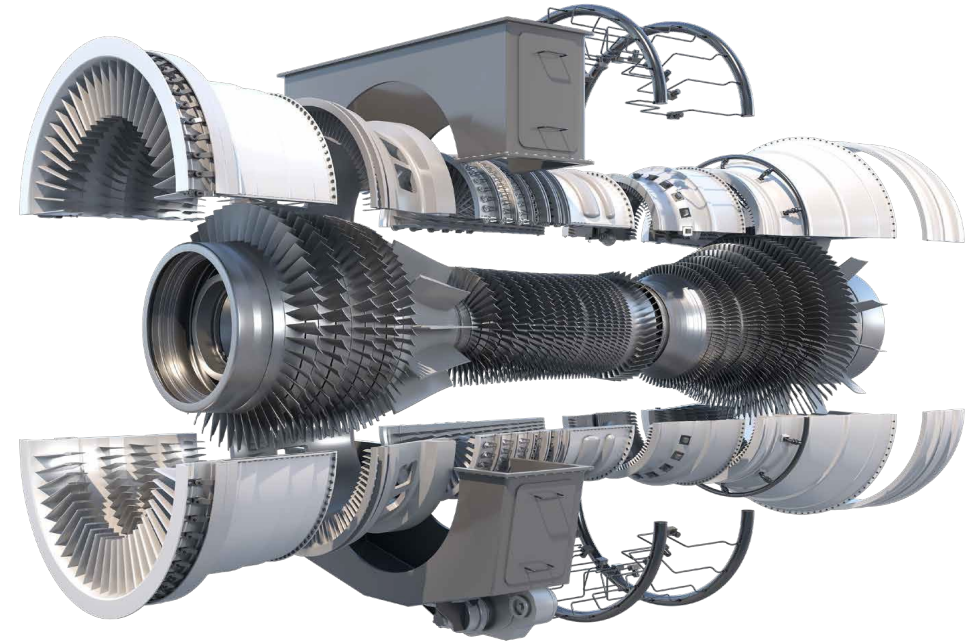




Resiliency in the Field: 5 Key Areas

1. Gas Turbine Technology

- Ancillary services improves economic viability
- Fuel Flexibility (future H2 Operation)
- Aeroderivative (LM6000PC) vs. industrial frame
 - Low Turnkey \$/kW
 - Fast Start <10min
 - Rapid Ramp Rates, Low Turndown
 - No maintenance penalty for frequent starts
 - 50MW “Blocks”, N+1 Redundancy





Resiliency in the Field: 5 Key Areas (continued)

2. Balance of Plant

- Gas supply
 - Heating, compression
- Water storage
 - Tankage vs. treatment capacity
- Dual-fuel capability
 - Storage





Resiliency in the Field: 5 Key Areas (continued)

2. Balance of Plant

- Civil / seismic / wind
 - Top of concrete
- Electrical design
 - GSU and switchyard configuration
- Critical and emergency systems
 - Black start, UPS, HVAC

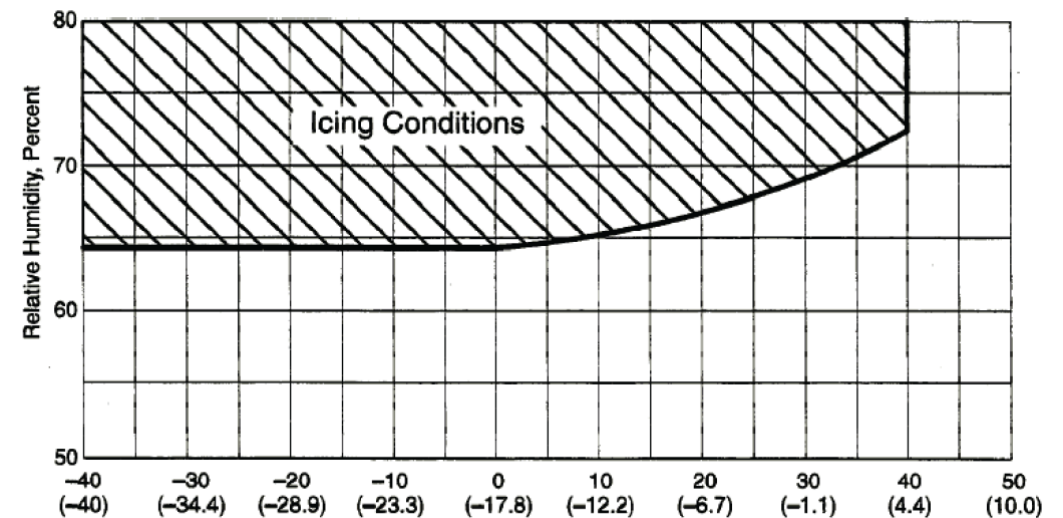
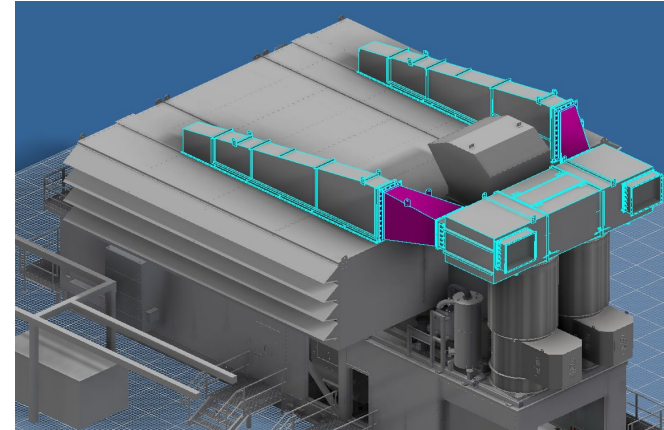




Resiliency in the Field: 5 Key Areas (continued)

3. Winterization

- Ensure operation in cold weather
- Turbine anti-icing system
 - Package Air Recirculation
 - Other Options:
 - CDP Bleed Air Inlet Heating
 - Exhaust Recirculation
 - External Glycol Heating
- Plant heat trace and insulation

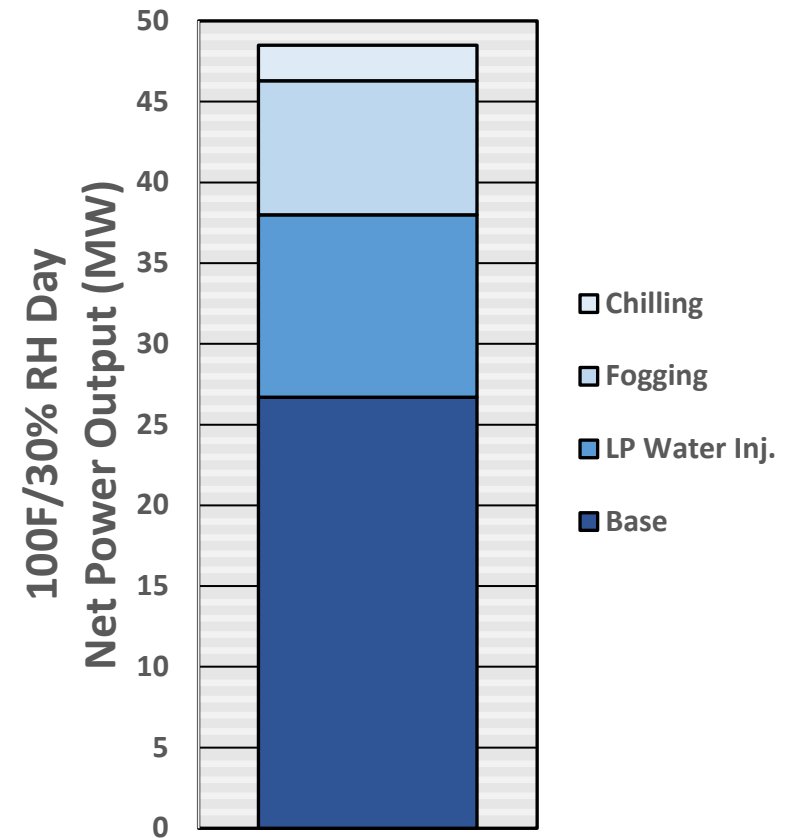




Resiliency in the Field: 5 Key Areas (continued)

4. Performance Augmentation

- Maximize output in hot weather
- Low-pressure water injection
- Inlet fogging, 100% saturation
 - OR Evaporative Cooling
- Inlet chilling

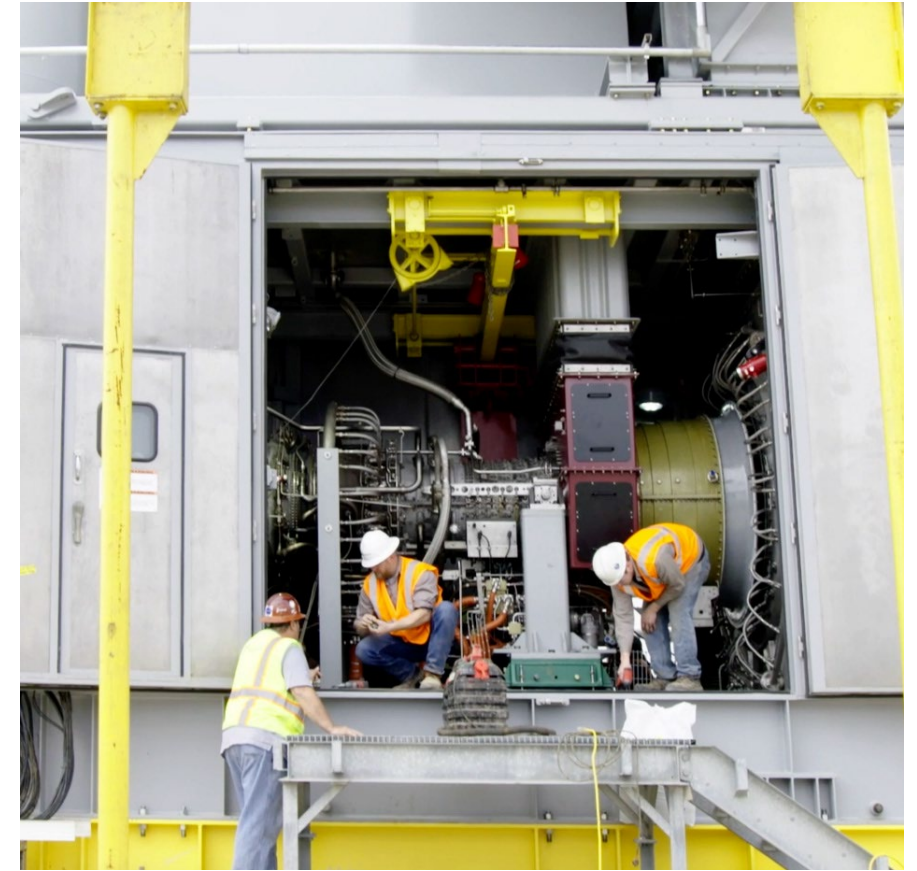




Resiliency in the Field: 5 Key Areas (continued)

5. Operations Strategy

- Operations and asset-management protocols
- Remote operations, monitoring and diagnostics
- Centralized and well-stocked spares pool





The Operational Value of Resiliency

Winter Storm Uri

- HO Clarke was 100% available
 - 141 hours (~6 days) of operation during the storm and subsequent recovery period
 - Over 60% of ERCOT capacity was unavailable
- Delivered power to more than 200,000 homes



Questions & Discussion

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