US Nuclear Industry Response to the Fukushima Earthquake/Tsunami

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The Great East Japan Earthquake

**Date/Time**
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**Epicenter**
Offshore Sanriku Coast (approx. 180 km from Fukushima NPSs)

**Seismic Energy**
Magnitude (M) 9.0
*Largest earthquake/tsunami in recorded history of Japan*

**Dead/Missing**
Approx. 19,000
*1st-ever case to set up Gov’t Emergency Disaster Response HQ*

![Map of epicenter](image1)

![Tsunami Height](image2)

![Scene from Minami-soma City](image3)

*Source: Fuji Television Network, Inc.*

Tokyo Electric Power Company
US NRC Response to Fukushima

Mitigation Strategy Order
Enhanced Spent Fuel Pool Inst Order
Severe Accident Capable Vent Order
Emergency Planning Enhancements
Seismic Evaluations
Flooding Evaluations
Industry Response to Fukushima
Industry actions

Goal: *Develop response capability to events in the U.S. that is scalable*

- Industry Self Assessment (INPO)
- Industry Response Framework
- Define equipment, materials, storage locations, and transportation logistics that augment site emergency coping strategies (a.k.a. FLEX)
- Establish drill and inspection programs
What is FLEX?

- Provides a diverse and flexible means to prevent fuel damage while maintaining containment function and spent fuel pool cooling in beyond design basis external event conditions resulting in an:
  - Extended Loss of AC Power, and
  - Loss of Normal Access to the Ultimate Heat Sink

- Objective:
  - Establish an essentially indefinite coping capability by relying upon installed equipment, onsite portable equipment, and pre-staged offsite resources
Three-phase approach

- FLEX employs a three-phase approach:
  - Following the event and prior to the time when portable equipment can be deployed, the plant must be able to maintain the key safety functions using installed equipment (Phase 1)
  - With adequate time and staffing, on-site portable equipment is deployed (Phase 2)
  - After 24 hours, off-site equipment can be deployed to sustain key safety functions indefinitely (Phase 3)
- Diverse and flexible to enable deployment of the strategies for a range of initiating events and plant conditions
Typical Strategies Include

- Portable generators to repower vital instrumentation
- Portable pumps to supply necessary cooling water
- Additional battery/nitrogen supply to operate key valves
- Satellite phones
- Portable lighting
- Dedicated storage buildings to protect equipment from external events
- New procedures to implement
- Training and validation demonstrations
Offsite Staged Equipment Strategy

- List off-site equipment needs
  - Base on realistic natural disasters, such as floods, tornados, etc
  - Leverage current inventories (Phase 2)
  - Standardize interconnections (Phase 2 and 3)
  - Leverage commercial equipment (Phase 3)
- Align with on-site coping strategies
  - Determine required deployment times
  - Determine off-site locations
- Determine logistics, transport, and shipping requirements
- Establish sharing agreements
- Plan for self-sufficiency, but include government
National SAFER Center (NSRC)

- NSRC Support
  - There are two Response Centers capable of delivering equipment to any site
  - Each Center has 5 sets of equipment
    - 4 sets to support nuclear units
    - 1 set out of service for maintenance
  - In addition, each Response Center has any additional equipment specified by a site in their site-specific Response Plan
  - Response Center equipment is redundant to a site’s Phase 2 equipment
Regional Response Center strategy

- RRC Support (continued)
  - Each site will identify staging areas for holding/ prep and delivery of the equipment (off-site/ on-site)
  - The RRC will deliver any specified equipment to the on-site staging area within 24 hours of being notified
  - Delivery to the off-site staging area will be by fixed wing aircraft and/ or ground transport depending on the distance of the site from the RRC and anticipated weather conditions
  - Equipment technicians will accompany the equipment to the site to assist with set up and initial operation
The Pooled Equipment Inventory Company (PEICo) joined forces with AREVA NP Inc. to create the SAFER Team to develop and manage a FLEX regional response center program as part of the PEICo’s existing Pooled Inventory Management (PIM) Program for the U.S. nuclear industry.
Response Center Locations
1000 mile radius / 20 hours by truck
Staging Areas

Staging Area A – the location on site where the equipment will be utilized (deployment location)

Staging Area B – the on-site staging area

Staging Area C – off-site staging area

Staging Area D – alternate to Staging Area C (not a requirement)
Timeline for Emergency Response

- T-0 – Notification
- T-2 – Mobilization
- T-4 – Begin transportation to off-site staging area (SA)
- T-20 – Equipment arrives at SA; begin preparation
- T-22 – Transportation to on-site staging area
- T-24 – First equipment on-site
Response Center Movement Plan

Call from Affected Site
- Notified by licensee

Regional Response Center

Memphis/Phoenix Airport

Local Area Airport

Ground Transport to Site
- Responsibilities
- Coordination with Federal, State and local entities

Local Staging Area
- Location criteria
- Staffing

Unaffected Nuclear Site

Affected Nuclear Site
Transportation

**Contract** with FedEx for ground and fixed wing movement

**Tiered approach to Helicopter availability**

- **1st Level** – Contract with multiple commercial helicopter companies
- **2nd Level** – State National Guard via state emergency management organizations
- **3rd Level** – Coordinate Federal support through FEMA
RRC Capabilities

Generic Equipment

- 4kV Turbine Generators
- 4kV Distribution Panel
- 480V Turbine Generators
- High Pressure Pump (2000 PSI / 60 GPM)
- Low Pressure – Medium Flow Pump (300 PSI / 2500 GPM)
- SG/RPV Makeup Pump (500 PSI / 500 GPM)
- Low Pressure – High Flow Pump (150 PSI / 5000 GPM)
- Diesel Fuel Transfer

- Standard Hoses and Connections (suction, discharge, strainers)
- Standard Generator Connection Cables
- Portable Lighting
- SAFER Team Equipment
  - Communications
  - Material Handling
  - Habitability
- Limited spare parts
RRC Capabilities

Non-Generic Equipment (Site Specific)

- Transformer - 480V to 600V
- Mobile Boration Unit
- Water Treatment
- Extra 4kV Turbine Generators
- Submersible Pump(s)
- Portable Air Compressors
- Water Storage
- Suction Booster Pumps
- Fuel Tanks
- Ventilation Fans
Phoenix Response Center
Phoenix Response Center
Phoenix Response Center
4kV Turbine Generator
4kV Turbine Engine
4kV Distribution Center
4kV Cable
480 V Distribution Center
480V Cable
480V – 600V Transformers
Portable Pump
Hose Deployment Module
Fuel Tank w/internal AC/DC Pump
Portable Fuel Transfer Pump
Portable Air Compressors
Submersible Pump
Nuclear Industry Investment

- $55M investment in equipment
- $16M investment in staffing/ training/ warehousing/ contracting/ plans development
- $320M investment in maintenance and storage
- ~$400M total industry investment
  - $4M per unit