



**Advisory Committee
on Reactor Safeguards**

Fukushima Event and Issues

April 7, 2011

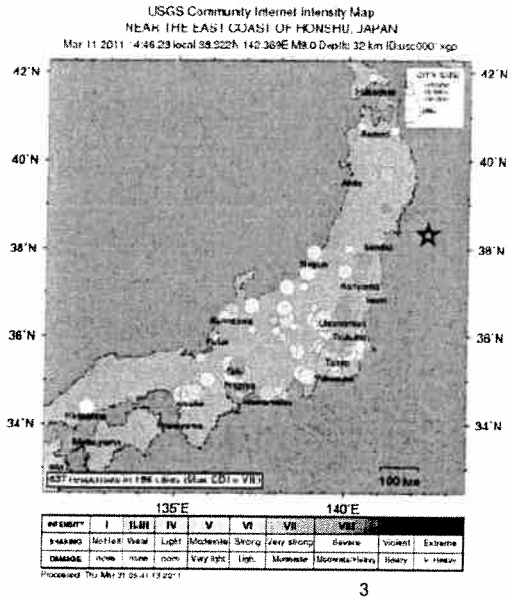


Agenda

- Introduction – Bill Ruland (5 min)
- Sequence of Events – John Thorp (10 min)
- Information Notice – Eric Bowman (5 min)
- Industry Actions and Temporary Instruction – Tim Kobetz (5 min)
- Near Term Task Force – Barry Westreich (10 min)
- Seismic Attributes – Syed Ali (5 min)
- Station Blackout – George Wilson (10 min)
- NRC Incident Response – Brian McDermott (10 min)
- Emergency Preparedness – Randy Sullivan (10 min)

Tohoku Pacific Earthquake

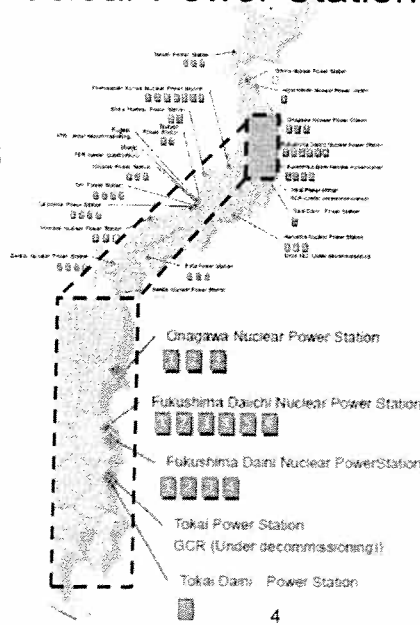
- 14:46 (Local) March 11, 2011
- Magnitude 9.0 Earthquake
 - 4th largest in the world since 1900 (USGS)
 - Largest in Japan since modern instrument recordings began 130 years ago (USGS)
- Resulted in a Tsunami that is estimated to have exceeded 32 feet in height (NISA)



Affected Nuclear Power Stations

- **Onagawa NPS**
 - All 3 units scrammed
- **Fukushima Dai-ichi (I) NPS**
 - Units 1, 2, 3 scrammed
 - Units 4, 5, 6 already shutdown
- **Fukushima Dai-ni (II) NPS**
 - All 4 units scrammed
- **Tokai**
 - Scrammed (single unit site)

Source: NISA



Extended SBO at Fukushima Dai-ichi

- Earthquake
 - Reactor Units 1, 2, and 3 scram
 - Loss of offsite power to all 6 units
- Tsunami
 - Loss of emergency AC power
- Extended Station Blackout



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Accident Sequence

- Reactor coolant flow after SBO
 - Reactor isolation makeup water system
- Loss of coolant flow
 - Utility established seawater injection
- Elevated primary containment pressure
- Explosions
 - Damaged reactor buildings for Units 1, 3 and 4
 - Unit 2 explosion in primary Containment- reactor building not damaged, possible torus damage

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5 April Status: Units 1,2 and 3

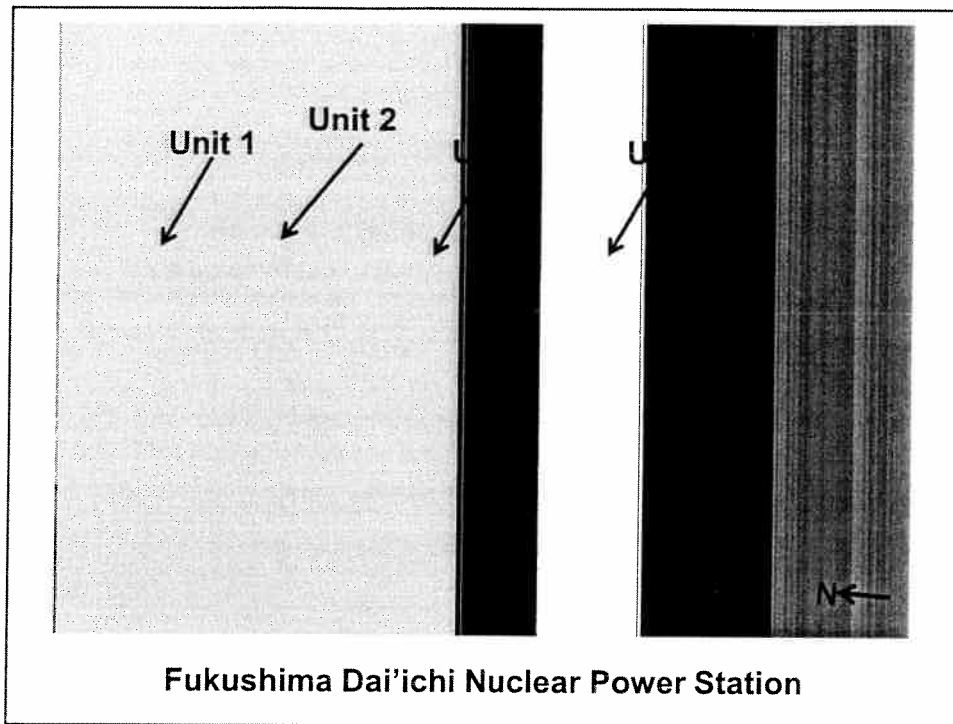
- Cores reported to be damaged
 - Extent unknown
 - Salt buildup from seawater injection
- All units have offsite AC power available
 - Equipment verification in progress
- Freshwater injection via:
 - Feedwater line
 - Low pressure coolant injection
- High radiation levels in containment and site

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Status: Units 4, 5, and 6

- Unit 4
 - Core offloaded to spent fuel pool (SFP)
 - An explosion caused significant damage to Unit 4 reactor building
 - SFP cooling system not functional
 - SFP being cooled periodically by injection of fresh water from a concrete truck pump
- Units 5 and 6
 - On external AC power with core cooling functional
 - SFP cooling is functional on both units

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Information Notice 2011-05

- Purpose: to provide high level discussion of earthquake effects at Fukushima Daiichi and allow licensee review and consideration of actions to avoid similar problems.
- Background discussion of pertinent regulatory requirements
 - General Design Criteria 2 (or similar)
 - “B.5.b Requirements” for beyond design basis events
 - Interim Compensatory Measures Order EA-02-026, Section B.5.b
 - License Conditions
 - 10 CFR 50.54(hh)(2)
 - Station Blackout Rule, 10 CFR 50.63

Industry Initiatives

- An industry-wide assessment to verify and validate each plant site's readiness to manage extreme events
- Initiatives include licensee verification of:
 - Each plant's capability to manage major challenges, and losses of large areas of the plant due to natural events, fires or explosions
 - Each plant's capability to manage a total loss of off-site power
 - Verifying the capability to mitigate flooding and the impact of floods
 - Performing walk-downs and inspection of important equipment needed to respond successfully to extreme events like fires and flood including identification of any potential that equipment functions could be lost during seismic events appropriate for the site, and development of strategies to mitigate any potential vulnerabilities.

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NRC Inspection Activities

- Temporary Instruction 2515/183, "Followup to the Fukushima Daiichi Nuclear Station Fuel Damage Event"
- Inspection uses a combination of assessment of licensee actions and independent inspections
- The inspection is for fact/data gathering to help evaluate whether future regulatory actions may be necessary.

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Near-Term Task Force

- Commission Direction for Near-Term Review
 - Conduct a methodical and systematic review of relevant NRC regulatory requirements, programs, and processes, and their implementation, to recommend whether the agency should make near-term improvements to our regulatory system
 - Recommendations for the content, structure, and estimated resource impact for the longer-term review
 - Independent from industry efforts
 - Milestones
 - 30-day Commission meeting (5/12/11)
 - 60-day Commission meeting (6/16/11)
 - 90-day final report, SECY, and Commission meeting (7/19/11)

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Longer-Term Review

- Commission Direction for Longer-Term Review
 - Specific information on sequence of events and equipment status
 - Evaluate policy issues
 - Potential interagency issues
 - Lessons learned for facilities other than operating reactors
 - Receive input and interact with all key stakeholders
 - Report within six months after beginning of long-term effort
 - ACRS to review final long-term report (as issued in its final form), and provide letter report to the Commission

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Tōhoku Earthquake and Tsunami

- Earthquake Data*
 - Magnitude 9.0
 - Epicenter: ~109 miles from Fukushima site
 - Peak Ground Acceleration
 - 1.0g up to 2.75g at 80 miles from epicenter
 - ~0.30g to 0.58g in Fukushima Prefecture

*California Coastal Commission. "The Tōhoku Earthquake of March 11, 2011: A preliminary Report on Implications for Coastal California"

Tōhoku Earthquake and Tsunami

- Tsunami Data*
 - Peak amplitude reports vary
 - Reached shore within ~ one hour after the earthquake
 - Up to six miles of run-up in flat regions

*California Coastal Commission. "The Tōhoku Earthquake of March 11, 2011: A preliminary Report on Implications for Coastal California"

Tōhoku Earthquake and Tsunami

- NPP Foundation Accelerations*

Location	Design Japanese Regulatory Guide g	Observed g
Daiichi Unit 2	.45	.56
Daiichi Unit 6	.46	.45
Daini Unit 1	.44	.23
Daini Unit 2	.44	.20

*TEPCO Press Release April 01, 2011; The record of the earthquake intensity observed at Fukushima Daiichi Nuclear Power Station and the Fukushima Daini Nuclear Power Station (Interim Report).

Station Blackout– Background

- NRC issued SBO Rule (10 CFR 50.63) in 1988
- Each plant must be able to withstand for a specified duration and recover from a SBO
- Regulatory Guide (RG) 1.155, “Station Blackout,” - endorsed NUMARC 87-00 industry guidance for SBO rule
- All 104 plants met the SBO rule requirements at the time of the staff’s review
 - Safety Evaluations
 - Pilot Inspections

Station Blackout - Implementation

- **Coping Duration**
 - Factors affecting Offsite power design
 - Factors affecting Onsite power system
- **Coping Methods**
 - AC independent
 - Alternate AC
- **Procedures**
 - Restoration of AC power
 - Non essential DC loads for stripping
 - Actions for loss of ventilation
 - Grid Interface

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NRC Incident Response

- Response Decisions
- NRC Roles
- Areas of Focus
- Coordination, Support and Outreach
- Current Status of Response

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Emergency Planning Zones

- Two emergency planning zones (EPZ) around each nuclear power plant
 - 10 mile EPZ – plume exposure planning zone
 - Response within hours
 - 50 mile EPZ – ingestion exposure planning zone
 - Response within days
- EPZ size established:
 - Encompasses most accident sequences
 - WASH 1400 Reactor Safety Study
 - Conservative Assumptions
 - Provides a substantial basis for expansion of response beyond the EPZ should it be needed

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PAR for U.S. Citizens in Japan

- Recommendation for 50 mile evacuation
 - Limited and uncertain data available
 - Significant challenges to 3 units and 4 spent fuel pools
 - Potential for large offsite release existed
 - Rapidly modeled aggregate cores to simulate potential release
 - Decision to expand evacuation was prudent given the uncertain conditions

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Questions?