



**U.S. NRC**

UNITED STATES NUCLEAR REGULATORY COMMISSION

*Protecting People and the Environment*

**Korea Hydro & Nuclear Power Co.  
APR1400 Design Certification  
Fukushima Lessons Learned**

**Rocky Foster  
Licensing Branch 2  
NRO/DNRL/LB2**

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# US Fukushima Recommendations

- Near Term Task Force Fukushima Recommendations (<http://pbadupws.nrc.gov/docs/ML1118/ML111861807.pdf>)
- SECY 11-0137 prioritized and expanded upon the Near Term Task Force (NTTF) recommendations
  - Tier 1 – start without delay, enabled by sufficient resource and availability of critical skill sets
  - Tier 2 – delayed due to need for further technical assessment, dependence on Tier 1, unavailability of critical skills sets
  - Tier 3 – require further study, dependent on resolution of shorter-term actions, or dependent on resolution of Recommendation 1
- Orders and information requests issued to all licensees and construction permit holders



# U.S.NRC Tier 1 Recommendations

- 2.1 - Seismic and flood hazard reevaluations (Request for Information (RFI))\*
- 2.3 - Seismic and flood walk-downs (RFI)
- 4.1 - Station blackout regulatory actions (Rulemaking)
- 4.2 - Mitigating strategies for beyond design basis events (Order)\*
- 5.1 - Reliable hardened vents for Mark I and Mark II containments
- 7.1 - Spent fuel pool instrumentation (Order)\*
- 8 - Strengthening and integration of emergency operating procedures, severe accident management guidelines, and extensive damage mitigation guidelines (Rulemaking)\*
- 9.3 - Emergency preparedness regulatory actions (RFI -staffing and communications)\*

\* Applicable to new reactors



## Tier 2 Recommendations

- 7.2, 7.3, 7.4, and 7.5 - Spent fuel pool makeup capability
  - 7.2 – Safety-related AC power for SFP makeup
  - 7.3 – Tech Spec to require one train of onsite emergency power for SFP makeup and SFP instrumentation all modes when irradiated fuel in SFP
  - 7.4 – Seismically qualified means to spray water into SFPs, including easily accessible connection to supply water
  - 7.5 – Rulemaking for 7.1~7.5
  - Latest NRC actions: 7.2 ~ 7.5 consolidated with Recommendation 4.1 SBO rulemaking – Tier 1 action)
- 9.3 - Emergency preparedness regulatory actions
  - Activities associated with periodic training and exercises and EP equipment and facilities for multiunit and prolonged SBO will be addressed in Recommendations 4.1 and 4.2 (Tier 1 Actions)
  - Multiunit dose assessment capability would be made generically applicable through the subsequent rulemaking for Recommendations 9.1 and 9.2 EP items under Tier 3 Actions.
- Additional Issue - Other External Hazards Reevaluation, tornados, hurricanes, drought, etc. (SECY 12-0025 - RFI)



## Tier 3 Recommendations

Require further staff study and will be addressed after completion of Tier 1 and Tier 2 activities. Tier 3 Recommendations include:

- 2.2 10 yr. confirmation of seismic and flooding hazards (dependent on 2.1)
- 3 Potential enhancements to capability to prevent or mitigate seismically induced fires and floods (long-term evaluation)
- 5.2 Reliable hardened vents for other containment designs (LT eval.)
- 6 H<sub>2</sub> control and mitigation inside containment or in other bldgs. (LT eval.)
- 9.1/9.2 Emergency Preparedness (EP) enhancements for multiunit events and prolonged SBO events
- 9.3 Emergency Response Data System (ERDS) capability (related to LT eval. Recommendation 10)
- 10 Additional EP topics for prolonged SBO and multiunit events (LT eval.)
- 11 EP topics for decision-making, radiation monitoring, and public education (LT eval.)
- 12.1 Reactor Oversight Process modifications to reflect new defense-in-depth framework (dependent on Rec 1)
- 12.2 Staff training on severe accidents, resident inspector training on SAMGs (dependent on Rec 8)



# **NTTF Recommendations Applicable to APR1400**

## Chapter 20 DC FSAR Fukushima Topics

- 2.1 - Seismic and Flood Hazard
- 4.2 - Mitigating Strategies for an Extended Loss of AC Power (ELAP)
- 7.1 - Spent Fuel Pool Instrumentation
- 9.3 - Emergency Preparedness  
Regulatory Actions



## 2.1 Seismic and Flooding

- Fukushima did not add requirements for DC applicants, however, be aware the COL applicant will receive Fukushima RAIs for seismic and flooding considerations
- COL information item confirming that site-specific seismic response is bounded by the APR1400 design basis parameters
- COL information item confirming that site-specific flooding considerations are bounded by the APR1400 design basis flood values or are otherwise demonstrated to be acceptable



## 4.2 Mitigating Strategies

- Phase 1 (Initial): requires the use of installed equipment and resources to maintain or restore core cooling, containment and spent fuel pool (SFP) cooling capabilities
- Phase 2 (Transition): requires providing sufficient, portable, onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from off site.
- Phase 3 (Final): requires obtaining sufficient offsite resources to sustain those functions indefinitely





## 4.2 Mitigating Strategies

- Initial and Transition Phase Coping (per order EA-12-049 and JLD-ISG-2012-01, Rev. 0)
  - Description of initial and transition phase coping periods
  - Specify the time duration that coping is required
  - Identify installed equipment that is credited for initial phase coping
  - Identify resources (such as water and fuel oil) used during the initial and transition phase
  - Verification that the resources will be available in sufficient quantities to support the requirements



## 4.2 Mitigating Strategies

- Initial and Transition Phase Coping (per order EA-12-049, and JLD-ISG-2012-01, Rev. 0)
  - Strategy for maintaining or restoring core cooling after the beyond design basis event for all modes of operation
  - Cooling system capabilities
  - Required support functions (such as cooling of reactor seals, required ventilation for equipment cooling, and control room habitability)
  - Adequacy of batteries (DC power) for support of credited core cooling equipment, instrumentation and controls
  - Strategy for maintaining containment function after the beyond design basis event for the initial phase coping



## 4.2 Mitigating Strategies

- Initial and Transition Phase Coping (per order EA-12-049, and JLD-ISG-2012-01, Rev. 0)
  - Strategy for providing for adequate spent fuel pool cooling after the beyond design basis event
  - Address maximum decay heat loads and time to boil
  - Makeup water requirements to assure cooling and accessibility to SFP area, if required
  - Strategy for coping with loss of access to ultimate heat sink
  - Containment pressure control/heat removal
  - Control room/remote shutdown room habitability
  - Ventilation of all rooms with equipment credited in the FLEX plan



## 4.2 Mitigating Strategies

- Design provisions for structures used to house equipment required for the mitigating strategies to achieve the required structural feature robustness
- Performance requirement of any safety-related and non-safety-related and portable pumps, valves and dynamic restraints credited for use as part of the mitigation strategies for an ELAP event
- Provisions for design, manufacture, testing, installation, and surveillance to provide assurance of the seismic, environmental, and functional capability of any safety-related and non-safety-related and portable pumps, valves and dynamic restraints to perform their intended functions credited for use as part of the mitigation strategies for an ELAP



## **4.2 Mitigating Strategies**

- Plants' ability to accommodate use of FLEX equipment to support final phase coping. Plant design allows for the physical and electrical connection of the FLEX equipment (Areva NP, Inc. Engineering Information Record 51-9199717, "Regional Response Center Generic and Site-Specific Equipment," Section 6.4, "Standard Connections")
- Discussion on reasonable protection of the systems and equipment credited in mitigating strategies will be achieved
- Identify any deviations from guidance in JLD-ISG-2012-01 and NEI 12-06 applicable to the DC
- Provide COL information Item, if necessary (i.e. development of procedures and guidance to implement strategy)



## 7.1 Spent Fuel Pool Instrumentation

- Per Order EA-2012-051 and JLD-ISG-2012-03, Rev. 0, Provide reliable indication of water level in associated spent fuel storage pools capable of supporting identification of the pool water level conditions by trained personnel

### Design Features

Instrument  
Qualification  
Accuracy

Arrangement  
Independence  
Testing

Mounting  
Power Supply  
Display

### Programmatic Requirements\*

Training

Procedures  
(\*Addressed by COL information item)

Testing/Calibration



## 7.1 Spent Fuel Pool Instrumentation

- Instrument
  - Two permanently installed or portable full range instrument channels to provide reliable indication
- Arrangement
  - Channels to be arranged in manner that provide for missile protection
- Mounting
  - Permanently installed instruments to retain its design configuration during and following the maximum seismic ground motion
- Qualification
  - Instrument channels to be reliable at the expected environmental conditions



## 7.1 Spent Fuel Pool Instrumentation

- Independence
  - Primary and backup channels to be independent from each other
- Power Supply
  - Instrument channels to be provided with separate connections to independent power sources
- Accuracy
  - Instrument channels to retain calibration after switching power sources
- Testing
  - Instrument channel design to provide for routine testing and calibration
- Display
  - On-demand or continuous indication of spent fuel pool water level at appropriate and accessible locations





## **9.3 Emergency Plan (only the staffing and communications equipment portions)**

- Address in DC to enhance design application
- Communication equipment
- Emergency response facility size (to accommodate a multi-unit response)
- COL information item to address any remaining issues



## Fukushima Reference Documentation

- US-APWR DCD, (Rev. 4), Chapter 01, “Introduction and General Description of Plant,” Section 1.9, “Conformance with Regulatory Criteria” (ML13262A462)
- MUAP-13002 (Rev. 1), “US-APWR Evaluation and Design Enhancement to Incorporate Lessons Learned from TEPCO’s Fukushima Dai-ichi Nuclear Power Station Accident,” (ML13280A469)
- U.S. EPR DCD, (Rev. 5), Chapter 19, “Probabilistic Risk Assessment and Severe Accident Evaluation,” Section 19.2.8, “Beyond Design basis Extended Loss of AC Power Assessment,” (ML13220A996)
- ANP-10329 (Rev. 0), “U.S. EPR Mitigation Strategies for Extended Loss of AC Power Event Technical Report,” (ML13126A328)
- South Texas Project COLA FSAR, (Rev. 10), Chapter 01, “Introduction” Appendix 01E, “Response to NRC Post-Fukushima Recommendations” (ML13311B457)
- South Texas Project 3&4 ABWR FLEX Integrated Plan (Rev. 1) (ML14114A194)



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Comments or Questions?