



ACRS MEETING WITH THE U.S. NUCLEAR REGULATORY COMMISSION

November 29, 2011



Overview

Said Abdel-Khalik

Accomplishments

- **Since our last meeting with the Commission on June 6, 2011, we issued 16 Reports.**
- **Topics:**
 - **Initial ACRS Review of: (1) the NRC Near-Term Task Force Report on Fukushima and (2) Staff's Recommended Actions to be Taken Without Delay**

- **Topics (cont.):**
 - **ACRS Review of Staff's Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned (SECY-11-0137)**
 - **Proposed Rulemaking to Introduce a Site-Specific Performance Assessment and Human Intrusion Analysis Requirement to 10 CFR Part 61**

- **Topics (cont.):**
 - **Draft SECY Paper, “Options for Proceeding with Future Level 3 Probabilistic Risk Assessment Activities”**
 - **Selected Chapters of the Safety Evaluation Report (SER) with Open Items for Certification of the U.S. APWR Design**
 - **Nine Mile Point Nuclear Station, Unit 2, Extended Power Uprate Application**

- **Topics (cont.):**

- **Final SER Associated with the License Renewal Application for Hope Creek Generating Station**
- **General Electric Topical Report NEDC-33173P, Supplement 2, Parts 1, 2, and 3, “Analysis of Gamma Scan Data and Removal of Safety Limit Minimum Critical Power Ratio (SLMCPR) Margin”**

- **Topics (cont.):**
 - **Assessment of the Quality of Selected NRC Research Projects**
 - **Draft Final Revision 6 of Standard Review Plan Branch Technical Position 7-19, “Guidance for Evaluation of Diversity and Defense-in-Depth in Digital Computer-Based Instrumentation and Control Systems”**
 - **Enhancing the Fuel Cycle Oversight Process**

- **Topics (cont.):**

- **Response to EDO Regarding RG 1.152, “Criteria for Use of Computers in Safety Systems of Nuclear Power Plants”**
- **Regulatory Guide 1.115, “Protection Against Turbine Missiles”**
- **Draft Final Regulatory Guide (RG) 1.82, “Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident,” Revision 4**

- **Topics (cont.):**

- **Draft Regulatory Guides in Support of Proposed 10 CFR 50.46(c) Rule, “Requirements for Emergency Core Cooling Systems for LWRs” :**
 - **DG 1261, Conducting Periodic Testing for Breakaway Oxidation Behavior**
 - **DG 1262, Testing for Postquench Ductility**
 - **DG 1263, Establishing Analytical Limits for Zirconium-Based Alloy Cladding**

- **Topics (cont.):**

- **Revision 19 to the AP1000 Design Control Document (DCD) and the AP1000 Final Safety Evaluation**

- **In December 2010, we concluded that the AP1000 DCA maintains the robustness of the previously certified design**

- Rev. 19 to AP1000 DCD (cont.)**
 - Conclusion relied in part on commitments provided by WEC during our meetings which were not yet included in the DCA application**
 - Revision 19 of the DCD was submitted in June 2011 and staff FSER issued in August 2011**

– Rev. 19 to AP1000 DCD (cont.)

▪ DCD Revision 19 Changes

- ✓ Additional finite element analyses of Passive Cooling System Tank**
- ✓ Additional analyses of seismic and thermal load combinations of the Enhanced Shield Building (ESB)**
- ✓ Additional Tier 2* information describing steel modules of the ESB wall**
- ✓ Updated containment accident pressure analysis**

- **Rev. 19 to AP1000 DCD (cont.)**
 - **The changes proposed in the AP1000 DCD amendment, including those made in Revision 19, maintain the robustness of the previous certified design.**
 - **There is reasonable assurance that the revised design can be built and operated without undue risk to the health and safety of the public.**

New Plant Activities

- **Reviewing:**
 - **DC applications and SERs associated with the U.S. EPR and US-APWR designs**
 - **Adequacy of Long-Term Core Cooling Approach for the ABWR and US-APWR**
 - **Reference COLAs for ABWR, ESBWR, US-APWR, and U.S. EPR**
 - **Subsequent COLAs for AP1000**
- **Continuing to complete reviews of available material promptly**

License Renewal

- **Interim and final reviews to be performed for Columbia, Davis Besse, Seabrook, and South Texas**

Power Upgrades

- **Will review the Grand Gulf, Turkey Point, St. Lucie, Monticello, Fort Calhoun, Peach Bottom, and Prairie Island Extended Power Upgrade Applications**
- **Will review GE Topical Report NEDC-33436P, “BWR Vessel Internals Project, Methodology for Demonstrating Steam Dryer Integrity for Power Upgrade”**

Other Ongoing/Future Activities

- **Fukushima Longer-Term Reviews**
- **SOARCA**
- **Watts Bar 2**
- **Digital I&C**
- **10 CFR 50.46(c)**
- **Emergency Planning for Small Modular Reactors**
- **Revision to the Construction Reactor Oversight Process Assessment Program**
- **Blending of Low-Level Radioactive Waste**
- **Safety Culture**
- **Emerging Technical Issues**
- **Extended Dry Cask Storage**



ACRS Review of FUKUSHIMA

Said Abdel-Khalik

ACRS Briefings on Fukushima

- **April 7 – NRC Staff on Initial Response**
- **May 26 – DOE and NEI**
- **June 23 – NRC Staff on Task Force Actions**
- **July 12 – INPO**
- **August 16 & September 8 – Near Term Task Force**
- **October 7 – Fukushima Steering Committee**

ACRS Reports on Fukushima

- **Responses to Commission Tasking via SRM-SECY-11-0093, “Near-Term Report and Recommendations for Agency Actions Following the Events in Japan”**
 - **ACRS Letter Report dated October 13, 2011**
 - **ACRS Letter Report dated November 8, 2011**
- **Additional Letter Reports will be issued as we engage with the staff on action plans related to specific recommendations**

ACRS Letter – October 13, 2011

- **Staff's recommended actions are appropriately focused on lessons learned from what is currently known**
- **Near-term recommendations unlikely to be negated, or rendered inappropriate, by the acquisition of new information**

ACRS Letter – October 13, 2011

- **ACRS review focused on completeness and appropriateness of recommended staff actions**
- **Two categories of recommendations**
 - **Additional immediate actions (21-Day Report)**
 - **Additional actions beyond those specified in the NTTF Report**

ACRS Letter – October 13, 2011

Additional Immediate Actions (21-Day Report)

- **Actions related to NTF Recommendation 2.1 (seismic and flood re-evaluations) should be expanded to include an expedited update of the applicable regulatory guidance, methods, and data for external flooding**
- **Actions related to NTF Recommendation 2.3 (seismic and flood walkdowns) should be expanded to address the integrated effects of severe storms**

ACRS Letter – October 13, 2011

Additional Immediate Actions (21-Day Report)

- **Actions related to NTTF Recommendation 4.1 (SBO regulatory actions) should be expanded to include issuance of an advanced notice of proposed rulemaking and require licensees to provide an assessment of capabilities to cope with an extended SBO**
- **Actions related to NTTF Recommendation 5.1 (reliable hardened vents for Mark I containments) should also be applied to BWRs with Mark II containments**

ACRS Letter – October 13, 2011

Additional Immediate Actions (21-Day Report)

- **Discussions with stakeholders should be initiated regarding near-term actions for additional hydrogen control and mitigation measures in reactor buildings for plants with Mark I and Mark II containments.**
- **Information should be requested from licensees regarding current plant-specific spent fuel pool instrumentation, power supplies, and sources of makeup and cooling water.**

ACRS Letter – October 13, 2011

Additional Immediate Actions (21-Day Report)

- **Actions related to NTTF Recommendation 8 (integration of EOPs/SAMGs/EDMGs) should be expanded to include fire response procedures.**

ACRS Letter – October 13, 2011 **Additional Recommendations to** **NTTF Report**

- **Performance-based criteria to mitigate and manage an extended SBO should be considered as an alternative to the specific coping times proposed in Recommendation 4.1.**

ACRS Letter – October 13, 2011

Additional Recommendations to

NTTF Report

- **Recommendation 6 should be expanded to include:**
 - **a requirement for BWR plants with Mark I and Mark II containments to implement combustible gas control measures in reactor buildings as a near-term defense-in-depth measure.**
 - **an assessment of the vulnerabilities introduced by shared ventilation systems or shared stacks in multi-unit sites.**

ACRS Letter – October 13, 2011 **Additional Recommendations to** **NTTF Report**

- **Selected reactor and containment instrumentation should be enhanced to withstand beyond-design-basis accident conditions.**

ACRS Letter – October 13, 2011

Additional Recommendations to

NTTF Report

- **The NRC should proactively engage in efforts to define and participate in programs to capture and analyze data from the Fukushima event to enhance understanding of severe accident phenomena, including BWR melt progression, seawater addition effects, hydrogen transport and combustion, and safety systems operability.**

ACRS Letter – October 13, 2011

Containment Accident Pressure

- **Licensing actions requiring the granting of containment accident pressure (CAP) credit should be suspended until the implications of post-Fukushima containment pressure control measures are understood.**

ACRS Letter – November 8, 2011

- **Staff's three-tier approach and criteria for prioritization of NTTF recommendations are appropriate subject to the following additional recommendations:**
 - **Rulemaking activities related to strengthening of SBO mitigation capability should be expedited**

ACRS Letter – November 8, 2011 **(additional recommendations)**

- Tier 1 recommendations should be expanded to include additional actions identified in our October 13, 2011, report:**
 - guidance for flooding hazards evaluations**
 - integrated walkdowns**
 - station blackout**
 - BWR hardened vents**
 - shared ventilations systems**
 - hydrogen control and mitigation**
 - spent fuel pools**
 - integration of onsite emergency actions**

ACRS Letter – November 8, 2011 **(additional recommendations)**

- NTTF recommendation 10.2 regarding evaluation of the command and control structure and qualifications of decision makers should be initiated in parallel with Tier 1 activities related to integration of onsite emergency actions**

ACRS Letter – November 8, 2011 **(additional recommendations)**

- Tier 2 recommendations should be expanded to include the additional recommendations regarding enhancement of selected reactor and containment instrumentation, and the need to proactively engage in efforts to capture and analyze data from the Fukushima event**

ACRS Letter – November 8, 2011 **(additional recommendations)**

- Tier 1 recommendation 7.1-2, “Develop and issue order to licensees to provide reliable SFP instrumentation,” should be reconsidered. Schedules for SFP instrumentation improvements and other modifications to the SFP should be informed by quantification of the contribution made by SFPs to overall plant risk.**

Summary

- **Staff's recommended actions are appropriately focused on lessons learned from what is currently known**
- **Near-term recommendations unlikely to be negated, or rendered inappropriate, by the acquisition of new information**
- **Looking forward to future engagements with staff to review specific actions related to prioritization efforts.**



**Proposed Rulemaking
to add
Site-Specific Analysis to
Part 61**

Michael T. Ryan

SRM-SECY-08-0147

Directed the staff to:

- **Proceed with rulemaking to add site-specific analysis for disposal of large quantities of depleted Uranium (DU)**

SRM-SECY-10-0043

Directed the staff to:

- **Incorporate large scale blending of low-level waste (LLW) in the rulemaking**

Current Part 61 Performance Objectives

- **§ 61.41 – Principal requirements for protection of members of the public**
- **§ 61.42 - Protection of the inadvertent intruder**
- **§ 61.43 - Protection of individuals during operations**
- **§ 61.44 - Stability of the disposal site after closure**



Proposed Major Rule Changes

§ 61.41

- **Adds Site-Specific Performance Assessment**
- **Adds Period-of-Performance (POP) of 20,000 years**

§ 61.42

- **Adds Site-Specific Intruder Analysis**
- **Adds 500 mrem annual dose for an Intruder**
- **Includes POP of 20,000 years**

Proposed Major Rule Changes

§ 61.13

- **Adds Site-Specific Long-Term Analysis:**
 - **Consider the potential long-term radiological impacts**
 - **Calculate peak dose that would occur 20,000 years or more after site closure**

ACRS Recommendations

- **Part 61 should not be amended as recommended by staff**
- **Assessment methodology should be risk informed and performance based**
- **POP should not be specified in rule; It should be site-specific and risk informed with respect to disposal technology and site characteristics**

Risk-Informed Approach

- **Radionuclide Characteristics**
- **Waste Form**
- **Waste Package**
- **Disposal Technology**
- **Cover Technology**
- **Geohydrological Environment**

POP

- **20,000 years is excessive.**
 - **IAEA Safety Standard (SSR-5) recommends “several hundred years” for short-lived and “several thousand years” for intermediate and high-level waste**
 - **DOE (Order 435.1) uses 1000 years for LLW**
 - **NRC HLW (Part 63) uses 10,000 years**

POP (cont.)

- **ACNW previously (1997 and 2000) recommended two-part approach:**
 - **(1) Site-specific time to address more mobile radionuclides – peak dose for compliance**
 - **(2) Qualitative assessment, without compliance measure, to identify possible deficiencies in long term performance of facility**

POP (cont.)

- **Assessments longer than a few hundred to a thousand years should focus on major failures of a disposal system, rather than a few intruders**
- **Only one commenter out of 15 on draft proposed language specifically supported 20,000 year POP**

Disposal of DU

- **DU can be acceptable waste for disposal in a Part 61 LLW facility, under certain circumstances**
- **DU can be evaluated in a risk informed performance assessment for a LLW facility**
 - **For example – a range of depth of burials could be evaluated to minimize intruder contact with DU waste**

Inadvertent Intruders

- **Original Part 61 - intruder analysis was a simplified bounding calculation to establish concentrations for certain radionuclides**
- **More realistic inadvertent intruder scenarios that consider site-specific factors should be used within a risk-informed approach**
- **Most LLW is decayed away with only a small number of radionuclides present after 300 years**

In Conclusion

- **Greater emphasis on a risk informed approach for LLW management**
- **Focus on radionuclide quantity rather than waste origins or concentrations**
- **Realistic treatment of intruder protection, including probability and consequences of intrusion, and other parameters (depth of burial, performance of intruder barriers)**



Options for Proceeding with Future Level 3 Probabilistic Risk Assessment Activities

John W. Stetkar

SECY-11-0089

- **“Options for Proceeding with Future Level 3 Probabilistic Risk Assessment Activities”**
- **Option 1: Status Quo – Evolutionary development of PRA technology**
- **Option 2: Focused Research – Address identified technology gaps before conducting full-scope PRA**
- **Option 3: Full-scope Level 3 PRA for operating nuclear power plant**

ACRS Reviews

- **Subcommittee meetings in November 2010 and May 2011**
- **Full Committee meeting in June 2011**
- **ACRS recommended modified version of Option 3**
- **SRM for SECY-11-0089 in September 2011 approved modified version of Option 3**

Analytical Advances Since NUREG-1150

- **PRA methods (human reliability, fires, seismic, other external events)**
- **Severe accident phenomena**
- **Risk during shutdown modes**
- **Characterization and quantification of uncertainty**

Industry Advances Since NUREG-1150

- **Plant operations and maintenance**
- **Plant modifications**
- **Risk-informed configuration control**
- **Severe accident mitigation guidance**
- **Emergency planning**

Level 3 PRA

- **Fully integrated assessment**
- **Identification of important linkages and dependencies (physical, functional, human)**
- **Balanced understanding of current risk profile and contributors**

Option 3 vs. Option 2

- **Additional research will be needed to address specific issues**
- **Level 3 PRA provides scenario-based context and focus**
- **Level 3 PRA may identify other important knowledge gaps that require practical solutions**
- **Simplified or bounding assessments can distort understanding of actual risk**

Integrated Level 3 PRA Results

- **Interim results should benefit from integrated assessment of Level 3 risk for specific hazard categories and plant operating states**
 - **Internal events and hazards at full power**
 - **External events at full power**
 - **Multi-unit site risk at full power**
 - **Internal events and hazards at shutdown**
 - **External events at shutdown**
 - **Multi-unit site risk, mixed unit modes**
 - **Other contributors (e.g., fuel pools, ISFSI)**

Available Technical Information

- **Active industry participation and collaborative input**
- **Selection of participating plant site**
- **Benefit from existing SPAR models and plant-specific analyses**
- **Benefit from other NRC initiatives (e.g., SOARCA)**
- **May be prudent to select PWR site, pending understanding of Fukushima Daiichi accident progression**

Quantification of Uncertainty

- **Characterization and quantification of uncertainties is essential for risk understanding and communication**
- **Current methods are adequate, if they are applied in an integrated manner**

Expected Level 3 PRA Benefits

- **Staff knowledge and experience from performance of a modern full-scope Level 3 PRA**
- **Integrated risk perspective**
- **Input to emergency planning**
- **Input to resolution of generic issues**
- **Quantitative framework to address new reactor design and siting issues**

Abbreviations

ABWR	Advanced Boiling Water Reactor	IAEA	International Atomic Energy Agency
ACNW	Advisory Committee on Nuclear Waste	INPO	Institute of Nuclear Power Operations
ACRS	Advisory Committee on Reactor Safeguards	ISFSI	Independent Spent Fuel Storage Installation
APWR	Advanced Pressurized Water Reactor	I&C	Instrumentation & Control
AP1000	Advanced Passive 1000	LLW	Low Level Waste
BWR	Boiling Water Reactor	LWR	Light Water Reactor
CAP	Containment Accident Pressure	mrem	millirem
CFR	Code of Federal Regulations	NEI	Nuclear Energy Institute
COLA	Combined License Application	NRC	Nuclear Regulatory Commission
DC	Design Certification	NTTF	Near-Term Task Force
DCA	Design Certification Amendment	PRA	Probabilistic Risk Assessment
DCD	Design Control Document	POP	Period of Performance
DG	Draft Regulatory Guide	PWR	Pressurized Water Reactor
DOE	U.S. Department of Energy	RG	Regulatory Guide
DU	Depleted Uranium	SAMG	Severe Accident Management Guideline
EDMG	Extreme Damage Mitigation Guideline	SBO	Station Blackout
EDO	Executive Director for Operations	SECY	Secretary of Commission
EOP	Emergency Operating Procedure	SER	Safety Evaluation Report
EPR	Evolutionary Power Reactor	SFP	Spent Fuel Pool
ESB	Enhanced Shield Building	SOARCA	State-of-the-Art Reactor Consequence Analyses
ESBWR	Economic Simplified Boiling Water Reactor	SPAR	Standardized Plant Analysis Risk
FSER	Final Safety Evaluation Report	SRM	Staff Requirements Memorandum/Memoranda
GE	General Electric	WEC	Westinghouse Electric Company
HLW	High Level Waste		