U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

ACRS MEETING WITH THE U.S. NUCLEAR REGULATORY COMMISSION

March 7, 2014

Overview

John W. Stetkar

Accomplishments

- **Since our last meeting with the Commission on July 11, 2013, we issued 17 Reports**
- **Topics:**
  - **Draft Commission Paper, "NRC Staff Recommendation for the Disposition of Recommendation 1 of the Near-Term Task Force Report"**

- **Topics (cont.):**
  - **Spent Fuel Pool Study**
  - **Staff Evaluation and Recommendation for Japan Lessons-Learned Tier 3 Issue on Expedited Transfer of Spent Fuel**
  - **Interim Staff Guidance JLD-ISG-2013-02, "Compliance With Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions"**

- **Topics (cont.):**
  - **Revisions to Low-Level Radioactive Waste Disposal Requirements in 10 CFR Part 61 (2 letter reports)**
  - **Chapters 6 and 7 of the Safety Evaluation Report with Open Items for Certification of the US-APWR Design and Related Long-Term Core Cooling Issues**
  - **Safety Evaluation of US-APWR Topical Report MUAP-07001 Revision 5, "The Advanced Accumulator"**

- **Topics (cont.):**
  - **Chapters 2, 6, and 7 of the Safety Evaluation Report with Open Items for the Comanche Peak Nuclear Power Plant, Units 3 and 4, US-APWR Reference Combined License Application**
  - **Chapters 2, 3, 9, 13, and 14 of the Safety Evaluation Report with Open Items Associated with the Calvert Cliffs Nuclear Power Plant, Unit 3, Combined License Application**

- **Topics (cont.):**
  - **Gerald R. Ford Class Aircraft Carrier Nuclear Propulsion Plant Design**
  - **Interim ACRS Review of Watts Bar Nuclear Unit 2 Operating License Application**
  - **Monticello Nuclear Generating Plant Extended Power Uprate License Amendment Request**
  - **Monticello Nuclear Generating Plant Maximum Extended Load Line Limit Analysis Plus License Amendment Request**

- **Topics (cont.):**
  - **ACRS Assessment of the Quality of Selected NRC Research Projects – FY 2013**
  - **Draft Commission Paper, "Recommendations for Risk Informing the Reactor Oversight Process for New Reactors"**

- **Topics (cont.):**
  - **Regulatory Guide 1.79, "Preoperational Testing of Emergency Core Cooling Systems for Pressurized-Water Reactors," Revision 2, and Regulatory Guide 1.79.1, "Initial Test Program of Emergency Core Cooling Systems for New Boiling-Water Reactors," Revision 0**

Ongoing/Future Reviews

New Plants:

- Design Certification Applications and SERs Associated with the EPR and US-APWR designs
- Adequacy of Long-Term Core Cooling Approach for the EPR and US-APWR
- Reference COLAs for ABWR, ESBWR, US-APWR, and EPR
- Subsequent COLAs for AP1000

Ongoing/Future Reviews

License Renewal

- Callaway Unit 1
- Sequoyah Units 1 & 2

Subsequent License Renewal

Extended Power Uprates

- Peach Bottom 2 & 3

Ongoing/Future Reviews

Other:

- Fukushima Long-Term Efforts
  - Station Blackout
  - Onsite Emergency Response Capabilities
  - Filtering Strategies
- Risk-Informed Regulatory Framework
  - Fukushima Near-Term Task Force Recommendation 1
  - Risk Management Task Force Recommendations

Ongoing/Future Reviews

Other:

- Watts Bar Unit 2
- PSEG early site permit application
- DSRS for Small Modular Reactors
- Transitions to Risk-Informed Fire Protection Programs
- NRC Safety Research Program
- Level 3 PRA
- Human Reliability Analysis Methods

Recommendation 1 of the Near-Term Task Force Report

Stephen P. Schultz

Background

- **Near-Term Task Force Recommendation 1 included:**
  - **Draft a Commission Policy Statement that Articulates a Framework that Includes Extended Design-basis Requirements**
  - **Initiate Rulemaking to Implement**
  - **Modify the Regulatory Analysis Guidelines**
  - **Evaluate the IPE and IPEEE Efforts**

Background (cont.)

Commission Directed that:

- **Recommendation 1 be pursued independently of the other recommendations**
- **Provide a separate notation vote paper providing options and a staff recommendation to disposition Recommendation 1**

Background (cont.)

- **In June 2012 the NRC Chairman issued a tasking memorandum directing the staff to also consider in this work the regulatory framework recommendations for power reactors in the Risk Management Task Force report**
- **Staff anticipates issuing Commission paper that includes:**
  - **Preliminary draft policy statement**
  - **Integrated plan on potential implementation of any Commission directed recommendations**

Discussion

- **NTTF Recommended Establishing a Regulatory Framework for Adequate Protection that, "Appropriately Balances Defense-in-depth and Risk Considerations."**
- **Does Not Imply that those Concepts are Separable and Must be Considered in Counterpoint Fashion**
- **Question of Integration**

Staff Recommendations

Activity 1 - establish a design basis extension category of events and associated regulatory requirements

Activity 2 - establish Commission expectations for defense in depth

Activity 3 - clarify the role of voluntary initiatives in the NRC regulatory process

ACRS Conclusions and Recommendations

Overall:

- **Staff's proposed approach will provide limited improvement to the current regulatory structure**

Activity 1:

- **Rulemaking is not needed to establish a new design-basis extension category**

ACRS Conclusions and Recommendations (cont.)

Activity 1:

- **Developing guidance to assure consistency in the regulatory treatment of issues assigned to the design-basis extension category has merit**

ACRS Conclusions and Recommendations (cont.)

Activity 2:

- **Establishing the Commission's expectations for defense in depth through a Commission Policy Statement is valuable only if there also is clear direction to move forward with a regulatory framework which includes development of a risk-informed, performance-based, defense-in-depth concept**

ACRS Conclusions and Recommendations (cont.)

Activity 3:

- **Enhanced monitoring and documentation of future industry initiatives is a necessary process improvement**
- **Regulatory inspection requirements should be designed carefully to optimize valuable inspection resources**

ACRS Conclusions and Recommendations (cont.)

General:

- **Characterizations presented on the costs and value of PRA appeared to bias toward limited application of PRA in Improvement Activities 1 & 2**
- **This may inappropriately marginalize and inadvertently prejudge the value of proceeding toward a risk management regulatory framework**

Upcoming ACRS Meetings

- **Risk Management Regulatory Framework**
- **SBO Mitigating Strategies**

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Japan Lessons Learned

Tier 3 Issue: Expedited Transfer of Spent Fuel to Dry Cask Storage

Sam Armijo

Background

- **Events at Fukushima following the March 2011 earthquake and tsunami raised early concerns that the spent fuel pools (SFPs) had suffered significant damage, draining of coolant, fuel failure, and uncontained release of radionuclides.**
- **Although none of the SFPs at Fukushima nor the fuel therein suffered such damage, concerns remained.**

Background (cont.)

- **NRC Actions**
  - **Orders EA-12-049 and EA-12-051**
  - **"Consequence Study of a Beyond-Design-Basis Earthquake Affecting the Spent Fuel Pool for a U.S. Mark I Boiling Water Reactor" (Spent Fuel Pool Study or SFPS)**
  - **"Staff Evaluation and Recommendation For Japan Lessons-Learned Tier 3 Issue on Expedited Transfer of Spent Fuel"**

Staff Evaluation and Recommendation for Japan Lessons-Learned Tier 3 Issue on Expedited Transfer of Spent Fuel

- Conservative, generic analysis addressing all U.S. Plants in central and eastern U.S
- Plants in western U.S. will be addressed upon completion of NTTF Recommendation 2.1 (seismic reevaluation)
- Builds on the plant specific SFPS and plant specific regulatory analysis, prior NRC studies, and other considerations

Expedited Transfer of Spent Fuel (cont.)

Other Considerations:

- Domestic and international operating experience and practices
- Demonstrated structural and liner integrity at twenty Japanese SFPs following the severe seismic events at Kashiwazaki in 2007 and at Fukushima in 2011
- Orders EA-12-051 and EA-12-049
- Inputs from stakeholders and the public

Expedited Transfer of Spent Fuel (cont.)

- **Phase 1 uses the NRC's normal regulatory analysis process as a screening analysis to determine:**
  - **whether a substantial increase in public health and safety will result from expedited transfer of spent fuel from pools to dry casks, and**
  - **whether more detailed analysis is merited**
- **Phase 1 includes a Safety Goal Screening analysis and a Cost/Benefit Analysis**

Expedited Transfer of Spent Fuel (cont.)

- **Grouped plants with similar features, used conservative inputs and assumptions to:**
  - **determine whether the NRC safety goals are met with sufficient margin in the event of a severe SFP accident**
  - **evaluate the costs and benefits of safety enhancements**

Expedited Transfer of Spent Fuel (cont.)

- **Evaluated two SFP loading alternatives**
  - **current high-density loading, (1X4)**
  - **low-density loading following transfer by 2019 of all fuel with > 5 years cooling**
- **Evaluated two severe seismic hazards (0.7g PGA and 1.2g PGA)**

Expedited Transfer of Spent Fuel (cont.)

- For each plant group, staff determined:
  - frequency and magnitude of initiating seismic event
  - AC power fragility, liner fragility
  - adequacy of air cooling
  - fuel heat-up
  - effectiveness of mitigation
  - radionuclide release and dispersion
  - health and economic consequences

Expedited Transfer of Spent Fuel (cont.)

- For each design and operational variable a base case, low estimate, and high estimate value was selected.
- For some variables values were known or could be calculated with reasonable confidence.
- For other variables, conservative or bounding values were selected.

Safety Goal Screening Analysis

- **The safety goal screening analysis is designed to determine when a regulatory requirement should not be imposed generically because the residual risk is already acceptably low.**
- **Further analysis not required if safety goals are met.**

Safety Goal Screening Analysis (cont.)

- **Evaluated against two Quantitative Health Objectives (QHOs). In the event of a nuclear plant accident:**
  - **Prompt fatality QHO – risk to an individual within 1 mile of the plant boundary should not exceed 0.1% of the total prompt fatality risk from all other causes.**
  - **Latent cancer fatality QHO – risk should not exceed 0.1% of the total latent cancer risk from all causes to population near the plant.**

Safety Goal Screening Analysis (cont.)

- **Findings for a densely loaded spent fuel pool accident which releases large quantities of radionuclides:**
  - **No prompt fatalities expected.**
  - **Latent cancer fatality risk is two orders of magnitude lower than QHO.**
  - **SFP accidents are a small contributor to overall risk to public health and safety (less than 1% of the QHOs).**
  - **Further reduction in risk from low-density loading will have marginal safety benefit.**

Cost/Benefit Analyses

- **Base case analysis generally used conservative assumptions for key parameters:**
- **Attributes assessed included:**
  - **Public health, Occupational health**
  - **Offsite and Onsite property**
  - **Industry implementation**
  - **NRC implementation**
- **Expected values for each cost and benefit is the product of the probability of the cost or benefit occurring and the consequences.**

Cost/Benefit Analyses (cont.)

- **Findings**
  - **For all base cases and all groups, costs of expedited transfer significantly exceeded benefits.**
  - **For several high cases and sensitivity studies, benefits could exceed costs by large amounts.**

ACRS Observations

- **Liner Fragility**
  - **Our finding that carbon steel, rather than stainless steel, properties were used in the SFPS and Tier 3 analyses indicates that actual liner seismic capacities are higher than those used in the analyses.**
- **Mitigation Effectiveness**
  - **Assumption that mitigation is effective only for low-density loading reduces release frequency by factor of 19.**
  - **Since operability of mitigation equipment is not dependent on pool loading density, and implementation time is not strongly affected, this assumption is unjustified.**

ACRS Conclusions

- **The staff's safety goal screening analysis has:**
  - **adequately evaluated the safety benefits of expedited transfer from spent fuel pools to dry cask storage systems.**
  - **demonstrated that the NRC Safety Goal Policy and Quantitative Health Objectives are met with orders of magnitude margin for both current high-density SFP loadings and proposed low-density fuel loadings.**
- **There is insufficient safety benefit to justify expedited transfer of spent fuel from U.S. pools to DCSSs.**

ACRS Conclusions

- **The staff's base case regulatory analysis has demonstrated that the benefits of expedited transfer are far less than the costs of implementation.**
- **The base cases are adequately conservative to support the staff's recommendation that more detailed evaluations of the benefits of expedited transfer need not be pursued.**
- **The cumulative effects of conservatisms and assumptions used in the high estimates, and in sensitivity studies of the regulatory analyses, result in exaggerated frequencies of fuel damage and exaggerated benefits of expedited transfer.**

Containment Hardened Vents Interim Staff Guidance JLD-ISG-2013-02

Michael Corradini

NRC Orders on Mark I and Mark II BWRs Containment Venting Systems

- **Order EA-12-050, requires licensees to install reliable hardened vents capable of removing heat and lowering pressure within containment.**
- **A new order, EA-13-109, included additional requirements to ensure that venting functions be available during severe accident conditions.**

NRC Orders on Mark I and Mark II BWRs Containment Venting Systems (cont.)

- **Phased approach was recommended to ensure implementation with minimal delays.**
  - **Phase 1 - Wetwell Venting System**
  - **Phase 2 - Drywell Venting System**

NRC Interim Staff Guidance JLD-ISG-2013-02

- **Staff ISG endorsed Industry Guidance NEI 13-02 with exceptions and clarifications to assure that all Phase 1 objectives are met.**
- **ISG provides an integrated set of considerations and requirements for the design and implementation of a severe accident capable HCVS for wetwell venting.**

ACRS on ISG Reviews and Discussion

- **September 18, 2013 - ACRS Fukushima Subcommittee**
- **October 2013 - ACRS Full Committee meeting and letter report**
- **Containment Accident Pressure discussed and industry will develop detail venting procedures**

ACRS on ISG Reviews and Discussion (cont.)

- **A common concern in Phases 1 and 2 is determination whether a temperature of 545 °F is the appropriate value for design of the drywell vent and any common or shared portions of the vent piping.**
- **Phase 2 guidance development key issues are discussed.**

ACRS Conclusion & Recommendations

- **Interim Staff Guidance JLD-ISG-2013-02 was issued in November 2013.**
- **The staff should better define accident scenarios during which drywell venting would be necessary or preferred over wetwell venting.**
- **Additional combustible gas control measures should be given higher priority.**

ACRS Conclusion & Recommendations (cont.)

- **Venting procedures must be developed that do not compromise long term core cooling which depends on containment accident pressure.**
- **Staff agreed with the ACRS recommendations for implementing Phase 2 requirements of the Order.**

ACRS Future Interaction with the Staff

- **The staff is working on Phase 2 in conjunction with the technical basis study for the filtering strategy rulemaking.**
- **We have planned additional interactions with the staff during second half of 2014 and 2015.**

Proposed Revisions to 10 CFR Part 61

Dr. Michael T. Ryan

Background

- **Previous Meetings and Letter Reports:**
  - **570th ACRS Meeting**
    - **Letter Report - March 18, 2010**
  - **585th ACRS Meeting**
    - **Letter Report - September 22, 2011**
  - **606th ACRS Meeting**
    - **Letter Report - July 22, 2013**

Discussion

November 19, 2013, Subcommittee Meeting

- US Department of Energy
  - DOE Order 435.1
  - Requirements for Site-Specific Performance Assessments and Waste Acceptance Criteria
  - Implementation at Nevada National Security and Savannah River Sites

Discussion (cont.)

December 3, 2013, Subcommittee Meeting

- **Agreement State Representatives**
- **Disposal Site Operators**
- **Electric Power Research Institute**
- **Other LLW Disposal Experts**
- **US Department of Energy**

Discussion (cont.)

January 16, 2014, Subcommittee Meeting

- Summary of November 19 and December 3, 2013 Subcommittee Meetings
- NRC Staff on history and reasons for proposed Part 61 revisions

ACRS Conclusions and Recommendations

- **Affirm the conclusions and recommendations in the earlier reports.**
- **The compliance period covering a reasonably foreseeable future should not exceed 1,000 years.**

ACRS Conclusions and Recommendations (cont.)

- **Waste already disposed in accordance with current Part 61 should not be subjected to additional compliance evaluations or new disposal requirements.**

- **Proposed revisions contain excessive implementation detail. These details should be in implementation guidance rather than the rule.**

Abbreviations

ABWR	**Advanced Boiling Water Reactor**
ACRS	**Advisory Committee on Reactor Safeguards**
AC	**alternating current**
ANS	**American Nuclear Society**
APWR	**Advanced Pressurized Water Reactor**
AP1000	**Advanced Passive 1000**
BWR	**boiling water reactor**
CFR	**Code of Federal Regulations**
COLA	**combined license application**
DCSS	**dry cask storage system**
DOE	**U.S. Department of Energy**
DSRS	**design specific review standard**
EA	**enforcement action**
ECCS	**emergency core cooling system**
EPR	**Evolutionary Power Reactor**
ESBWR	**Economic Simplified Boiling Water Reactor**
HCVS	**hardened containment vent system**
ISG	**interim staff guidance**
IPE	**independent plant examination**
IPEEE	**independent plant examination of external events**
JLD	**Japan Lessons Learned Project Directorate**
LLW	**low-level radioactive waste**
MUAP	**Mitsubishi Heavy Industries, Ltd topical** report (**Mitsubishi US-APWR**)
NEI	**Nuclear Energy Institute**
NRC	**Nuclear Regulatory Commission**
NTTF	**Near-Term Task Force**
PGA	**peak ground acceleration**
PRA	**probabilistic risk assessment**
PSEG	**Public Service Enterprise Group Incorporated**
PWR	**pressurized water reactor**
QHO	**quantitative health objective**
SBO	**station blackout**
SER	**safety evaluation report**
SFP	**spent fuel pool**
SFPS	**spent fuel pool study**