U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

ACRS MEETING WITH THE U.S. NUCLEAR REGULATORY COMMISSION

December 6, 2012

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Overview

J. Sam Armijo

Accomplishments

- **Since our last meeting with the Commission on June 7, 2012, we issued 19 Reports.**

- **Topics**
  - **SECY-12-0064, Recommendations for Policy and Technical Direction to Revise Radiation Protection Regulations and Guidance**

- **Topics (cont.)**
  - **ACRS Review of Staff's Draft SECY Paper on Consideration of Additional Requirements for Containment Venting Systems for Boiling Water Reactors with Mark I and Mark II Containment Designs**
  - **NRC Staff's Draft Plans and Status Summaries for Tier 3 Japan Lessons Learned Recommendations**

- **Topics (cont.)**
  - **Draft Interim Staff Guidance Documents in Support of Tier 1 Orders**
  - **Response to the August 15, 2012 EDO Letter Regarding ACRS Recommendations in Letter dated July 17, 2012 on the Draft Interim Staff Guidance Documents in Support of Tier 1 Orders**

- **Topics (cont.)**
  - **SECY-12-0110, "Consideration of Economic Consequences within the U.S. Nuclear Regulatory Commission's Regulatory Framework"**
  - **Chapters 5, 8, 10, 11 and 12 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**

- **Topics (cont.)**
  - **Chapter 9 of the Safety Evaluation Report with Open Items for the US-APWR Design Certification Application**
  - **Long-Term Core Cooling for the South Texas Project Advanced Boiling Water Reactor Combined License Application**

- **Topics (cont.)**
  - **SECY-12-0081, "Risk-Informed Regulatory Framework for New Reactors"**
  - **Draft Final NUREG-1934 (EPRI 1023259), "Nuclear Power Plant Fire Modeling Analysis Guidelines (NPP FIRE MAG)"**
  - **Grand Gulf Nuclear Station, Unit 1, Extended Power Uprate License Amendment Request**

- **Topics (cont.)**
  - **Final Safety Evaluation Report Associated with the Florida Power and Light St. Lucie, Unit 1, License Amendment Request for an Extended Power Uprate**
  - **Final Safety Evaluation Report Associated with the Florida Power and Light St. Lucie, Unit 2, License Amendment Request for an Extended Power Uprate**

- **Topics (cont.)**
  - **Draft Safety Evaluation of WCAP-16793-NP, Revision 2, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous and Chemical Debris in the Recirculating Fluid"**
  - **Technical Information Needs Affecting Potential Regulation of Extended Storage and Transportation of Spent Nuclear Fuel**

- **Topics (cont.)**
  - **Interim Staff Guidance 8, Revision 3, "Burnup Credit in the Criticality Safety Analyses of PWR Spent Fuel in Transportation and Storage Casks"**
  - **Draft Regulatory Guide DG-1290 (Proposed Revision of Regulatory Guide 1.59), "Design-Basis Floods for Nuclear Power Plants"**

- **Topics (cont.)**
  - **Proposed Revision 1 to Regulatory Guide 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code"**

New Plant Activities

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

Future License Renewal Activities

- Interim and final reviews to be performed for Grand Gulf, South Texas Project, Limerick, Davis Besse, and Callaway

Future Power Uprate Activities

- Will review the Crystal River 3; Browns Ferry 1, 2, & 3; Monticello; and Peach Bottom 2 & 3 Extended Power Uprate Applications

Other Ongoing/Future Activities

- Fukushima Longer-Term Efforts (e.g., Recommendation 1, Station Blackout Rule, Tier 3 recommendations)
- Uncertainties in SOARCA Analysis
- Watts Bar 2
- Fire Modeling Applications
- Naval Reactors: Gerald Ford Class
- Small Modular Reactors: Design Specific Review Standards
- Other Emerging Technical Issues

SECY-12-0064

Proposed Revisions to NRC Radiation Protection Requirements and Guidance

Michael T. Ryan

Background

SRM-SECY-08-0197

- **Directed the staff to proceed with stakeholder interactions and data analysis to make NRC radiation protection requirements and guidance more consistent with ICRP Publication 103 (2007) recommendations**

SECY-12-0064

- **Presents results of staff efforts and analysis**
- **Requests guidance from Commission on several issues namely,**

SECY-12-0064

Staff Recommendations

- **Updating Methodologies and Terminologies in Dose Assessments**
- **Revising the Limits for Occupational Total Effective Dose Equivalent**
- **Revising the Dose Limit for the Lens of the Eye**
- **Revising the Dose Limit for Exposure to the Embryo/Fetus**

Staff Recommendations (cont.)

- **ALARA Planning**
- **Protection of the Environment**
- **Units of Radiation Exposure and Dose**
- **Reporting of Occupational Exposure**
- **Revisions to 10 CFR Part 50, Appendix I to make them consistent with dose methodology in Part 20**

Compliance

- **Excellent compliance with 5 Rem/yr limit reported for reactor and fuel cycle facility workers**

- **Compliance issues/challenges reported for medical worker categories**

ACRS Recommendations

1. Rulemaking to revise occupational dose limits should not be undertaken

2. Improvements to dose calculation methodologies should be implemented

ACRS Recommendations (cont.)

3. ALARA guidance should be improved for licensees that could benefit

4. Staff should continue work on:
   - Alternative approaches for individual protection at or near the current limit;
   - Dose limits for the lens of the eye and the embryo/fetus
   - Reporting of occupational exposure by industry segments not currently reporting

Basis for Recommendations

- **Reduction in dose limit should be based on clear safety benefit**

- **Current limits plus ALARA providing adequate protection for large majority of workers**

Basis for Recommendations (cont.)

- **Reduction of dose limits could have unintended negative consequences and impede activities with real safety benefits**

- **Effective ALARA programs reduce doses below the current limit and are monitored and inspected**

DRAFT SECY Paper on Consideration of Additional Requirements for Containment Venting Systems for BWR Mark I and Mark II Designs

Stephen P. Schultz

ACRS Reviews

- **Subcommittee meetings on June 20, September 5, October 3, and October 31, 2012**
- **Committee completed review during November 2012 meeting**
- **Letter report issued on November 8, 2012**

Background

SRM to SECY-11-0137: Staff to consider 'Filtration of Containment Vents' together with Tier 1 issue of hardened vents for BWR Mark I and Mark II containments

- **Order EA-12-050 issued on March 12, 2012**
- **SECY paper on filtration of vents to be delivered to the Commission by end of November 2012**

Background (cont.)

Order EA-12-050, "Order Modifying Licenses with Regard to Reliable Hardened Vents"

- **Applicable only to BWR facilities with Mark I or Mark II containment structures**
- **Venting reliability only under design basis accident conditions**

SECY Paper Options

1. Continue with implementation of EA-12-050 (Status Quo)
2. Severe Accident Capable Vents (upgrade/replace Option 1 vents)
3. Filtered Vents (install filtered venting system)
4. Performance-Based Approach (establish performance criteria to be addressed by licensees)

Discussion

- **At Fukushima, failure to operate systems as designed added to release of radioactive materials**
- **Because of relatively small volumes, venting is important to severe accident management for Mark I and II BWRs**
- **Currently filtration is provided by physical processes (suppression pool, drywell sprays)**

Discussion (cont.)

- **Under station blackout conditions, even under B.5.b or FLEX, drywell sprays can lose effectiveness**
- **As suppression pool floods, operators will vent from the drywell**
- **Without drywell sprays, this could lead to an unscrubbed release of radioactive aerosol**

Staff's Position

- **Staff concludes that improved filtering strategy:**
  - **can compensate for loss of containment barrier due to venting (e.g., drywell flooding)**
  - **improves confidence to depressurize containment when addressing other severe accident challenges**
  - **provides substantial improvement in containment performance**

Staff's Position (cont.)

- **Staff concludes that an improved filtering strategy:**
  - **provides defense in depth addressing uncertainties in severe accident prevention, progression, and mitigation and improves effectiveness of emergency planning and evacuation**
- **Staff Recommends the filtering strategy of Option 3, Filtered Vents, in addition to Option 2**

ACRS Considerations

- **Option 3 does not meet quantitative cost benefit based on current NRC guidance**
- **Staff uses several qualitative considerations (including defense in depth) to recommend Option 3**
- **This approach is appropriate given lower margin and high conditional failure probabilities for Mark I and Mark II containment systems**

ACRS Considerations (cont.)

- **Staff and industry completed studies of severe accident progression and containment performance:**
  - **For certain sequences the addition of filtration systems would reduce radioactive material releases**
  - **For other sequences, existing plant filtration systems operate efficiently and additional filtration would provide little or no added benefits**

ACRS Considerations (cont.)

- Retention of radioactive material in containment is the primary measure for success
- Option 4 allows more latitude and scope for innovation and may result in more effective solutions
- To date the staff has taken limited steps to develop performance measures for retention

ACRS Considerations(cont.)

- Important to consider potential for unintended consequences
- Besides effectiveness of filtering strategies and systems, other characteristics to be considered:
  - Keep containment loads well below design levels
  - Rely primarily on passive components
  - Maintain compatibility with actions to flood drywell and mitigate overfilling the wetwell

ACRS Considerations(cont.)

- **Besides effectiveness of filtering strategies and systems, other characteristics to be considered:**
  - **When relying on suppression pool scrubbing, keep pool temperature below the saturation temperature**
  - **Preserve the integrity of the drywell head seal**
  - **Address hydrogen control**

ACRS Conclusions

- **Additional measures for source-term mitigation are not justified by risk-informed cost-benefit analyses relying on generic PRAs, risk metrics, estimates of averted costs, and uncertainties**
- **Additional defense-in-depth measures should be considered to compensate for uncertainties in quantitative techniques**

ACRS Recommendations

- **Implementation of a performance-based approach, Option 4, should be completed to reduce severe accident radioactive releases**
- **Option 3, installation of external filtered vents, may be one outcome of Option 4**
- **Severe accident capable vents (Option 2) are an essential part of any controlled venting strategy**

SECY-12-0110 Consideration of Economic Consequences within the U.S. NRC's Regulatory Framework

John W. Stetkar

ACRS Reviews

- Joint subcommittee meeting on October 2, 2012 (Regulatory Policies and Practices; Reliability and PRA)
- Committee completed review during November 2012 meeting
- November 13, 2012 report

SECY-12-0110 Options

1. Status Quo – update existing guidance and methods according to current schedule and frequency
2. Enhanced Consistency – increase priorities for integrated updates to existing guidance and methods
3. Explore potential changes to the regulatory framework to "more expressly consider" adverse offsite economic consequences

Staff Recommendation

- **SECY-12-0110 Option 2**
  - **Enhance currency and consistency of the existing framework**
  - **Updates to guidance documents for performing cost-benefit analyses in support of regulatory, backfit, and environmental analysis**

Existing Environmental Reviews

- **Economic consequences are considered in NEPA reviews**
  - **Evaluation of Severe Accident Mitigation Alternatives (SAMAs) for operating plant license renewals**
  - **Evaluation of Severe Accident Mitigation Design Alternatives (SAMDAs) for design certifications and new plant licensing**

Existing Regulatory Decisions

- **Economic consequences are evaluated in regulatory analyses for proposed NRC actions**
- **Economic consequences are evaluated in backfit analyses, but only if it is first concluded that the proposed backfit provides a "substantial increase" in public health and safety**

Evaluation Methods and Tools

- **Staff and public stakeholders have identified shortcomings and inconsistencies in the methods, tools, and data that are currently used for quantitative evaluation of economic consequences**

Public Health Risk

- **Focus of regulations and reactor oversight process is protection of public health and safety**
- **Current risk-informed regulatory framework uses core damage frequency (CDF) and large early release frequency (LERF) as metrics for the evaluation of reactor safety and severe offsite health consequences**

Public Health Risk (cont.)

- Regulatory process has been effective
- Improvements to structures, equipment, procedures, training, and emergency planning
- Reductions in frequency and consequences of accident scenarios that were previously identified as potential threats for severe public health consequences

Economic Consequences Risk

- **Historically received less emphasis in regulatory decision making, in deference to the primary emphasis on public health consequences**
- **Events at Fukushima Daiichi have heightened concerns about the societal impacts from land and water contamination, despite no immediately measurable adverse health consequences**

Economic Consequences Risk (cont.)

- **Full-scope PRAs have identified land contamination and economic consequences as important constituents of the complete plant risk profile**
- **Risk (frequency and consequences) depends on specific features of the plant design and the site environment**

Interrelated Issues

- **Fukushima Near-Term Task Force Recommendation 1**
- **Risk Management Task Force NUREG-2150 recommendations**
- **Regulatory treatment of severe accident economic consequences**
- **Guidance for installation of filters in containment hardened venting systems**

Commission Policy Decisions

- **Prominence and degree to which quantitative risk information is used in regulatory decisions**
- **How broad categories of accident consequences are treated in risk-informed decisions**
  - **Public health consequences**
  - **Economic consequences from land and water contamination**
  - **Other consequences**

Commission Policy Decisions (cont.)

- **Options for treatment of economic consequences could affect the regulatory framework**
  - **Risk goal for offsite land and water contamination**
  - **"Design Enhancement Category" of beyond-design-basis accidents**
  - **Existing regulatory framework**
- **Changes would affect how regulations are developed and implemented in practice**

ACRS Recommendation 1

- **ACRS supports SECY-12-0110 Option 3 to explore whether changes to the regulatory framework are needed to further consider economic consequences from severe accidents**
- **Possible changes to the treatment of economic consequences should not be considered in isolation from other on-going initiatives**

ACRS Recommendation 2

- **There is a risk that decisions which address multiple issues related to the treatment of severe accidents and beyond-design-basis events on a topic-by-topic basis could give rise to unintended regulatory inconsistencies**

ACRS Recommendation 2 (cont.)

- **Staff guidance and methods for consideration of the economic consequences from severe accidents should be developed in the context of Commission policy decisions from resolution of Fukushima NTTF Recommendation 1 and the Risk Management Task Force recommendations in NUREG-2150**

ACRS Recommendation 3

- **In support of Recommendation 2, decisions need to be made on how broad categories of severe accident consequences (e.g., risks to public health, land and water contamination, other consequences) will be treated within the NRC's risk-informed regulatory framework**

ACRS Recommendation 4

- **The methodology for evaluating the economic consequences from severe accidents should be improved, even if no changes are made in the regulatory framework**
- **The priorities for those improvements and their required technical attributes will depend on how that information will be used in regulatory decisions**

Abbreviations

ABWR	Advanced Boiling Water Reactor
ACRS	Advisory Committee on Reactor Safeguards
ALARA	As Low As Reasonably Achievable
APWR	Advanced Pressurized Water Reactor
ASME	American Society of Mechanical Engineers
B.5.b	Mitigative strategies specified in Section B.5.b of NRC Order EA-02-026 for enhancing safety and security of nation's nuclear power plants
BWR	Boiling Water Reactor
CDF	Core Damage Frequency
CFR	Code of Federal Regulations
COLA	Combined License Application
DC	Design Certification
DG	Draft Regulatory Guide
EDO	Executive Director for Operations
EPR	Evolutionary Power Reactor
EPRI	Electric Power Research Institute
ESBWR	Economic Simplified Boiling Water Reactor
FLEX	Diverse & Flexible Coping Strategies Guide, NEI 12-06
ICRP	International Commission on Radiological Protection
LERF	Large Early Release Frequency
MAG	Modeling Analysis Guidelines
mrem	millirem
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NPP	Nuclear Power Plant
NRC	Nuclear Regulatory Commission
NTTF	Near-Term Task Force
OM	Operation and Maintenance
PRA	Probabilistic Risk Assessment
PWR	Pressurized Water Reactor
RG	Regulatory Guide
SAMA	Severe Accident Mitigation Alternative
SAMDA	Severe Accident Mitigation Design Alternatives
SECY	Secretary of Commission
SER	Safety Evaluation Report
SOARCA	State-of-the-Art Reactor Consequence Analyses
SRM	Staff Requirements Memorandum/ Memoranda
US-APWR	U.S. Advanced Pressurized Water Reactor
WCAP	Westinghouse Commercial Atomic Power