

POLICY ISSUE **(Information)**

November 7, 2013

SECY-13-0118

FOR: The Commissioners

FROM: Brian W. Sheron, Director
Office of Nuclear Regulatory Research

SUBJECT: ANNUAL UPDATE OF THE RISK-INFORMED ACTIVITIES PUBLIC
WEB SITE

PURPOSE:

This paper provides the Commission with an annual update on activities contained in the Risk-Informed Activities public Web site, including a summary of recent accomplishments and accomplishments anticipated in the near term. This paper does not address any new commitments or associated resource implications.

BACKGROUND:

On June 1, 2006, the Commission issued a staff requirements memorandum (SRM) (Agencywide Documents Access and Management System (ADAMS) Accession No. ML061520304) that directed the U.S. Nuclear Regulatory Commission (NRC) staff to improve on the Risk-Informed Regulation Implementation Plan (RIRIP) by developing an integrated master plan for activities designed to help the NRC achieve its goal of a holistic, risk-informed, and performance-based regulatory structure. The Commission also directed the staff to seek ways to communicate more transparently to the public and stakeholders on the purpose and use of Probabilistic Risk Assessment (PRA) in the agency's reactor, materials, and waste regulatory programs. SECY-07-0074, "Update on the Improvements to the Risk-Informed Regulation Implementation Plan," dated April 26, 2007 (ADAMS Accession No. ML070890396), conveyed that plan, which the staff retitled as the "Risk-Informed and Performance-Based Plan."

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To meet the Commission's expectations for both a risk-informed and a performance-based regulatory structure, [Enclosure 1](#) to SECY-07-0074 included explicit criteria for the staff's review and consideration of performance-based approaches to determine which initiatives should be both risk-informed and performance based. SECY-07-0191, "Implementation and Update of the Risk-Informed and Performance-Based Plan (RPP)," dated October 31, 2007 (ADAMS Accession No. ML072700587), discussed the staff's progress in implementing the RPP and included an updated set of objectives, bases, and goals for the reactor, materials, and waste regulatory arenas. In November 2007, the staff completed its commitment to make all aspects of the RPP available to the general public through the agency's public Web site. The most recent version of the public Web site list of risk-informed activities changed the format from the previous plan and was provided as SECY-12-0149, "Annual Update of the Risk-Informed and Performance-Based Plan," dated October 31, 2012 (ADAMS Accession No. ML12270A313).

DISCUSSION:

This Commission paper contains summary information on risk-informed and performance-based activities in the Reactor Safety arena. More comprehensive and detailed information appears on the NRC's public Web site at <http://www.nrc.gov/about-nrc/regulatory/risk-informed/rpp.html>, for the Reactor Safety, Materials Safety and Waste Management arenas. The Web site provides a readily accessible overview and current status of the agency's risk-informed and performance-based regulatory activities, updated at least annually coincident with this paper.

The following regulatory initiatives are highlighted here, with more details in the [enclosure](#):

- A. Workshop on Probabilistic Flood Hazard –
A recent workshop was held with federal agency partners to share information on probabilistic flood-hazard assessments for extreme events such as: flood-induced dam and levee failures; tsunami flooding; riverine flooding, local intense precipitation flooding and storm surges. NUREG/CP-0302 documented the proceedings including recommendations that will be considered during the development of a NRC research plan on flooding.
- B. Enhance Regulatory Framework for Extended Storage and Transportation of Spent Nuclear Fuel –
Staff will use risk information and performance-based approaches in the gap assessments to identify technical and regulatory needs to expand the basis for regulating the extended storage and transportation of spent nuclear fuel.
- C. Publish the Glossary of Risk-Related Terms –
A glossary of risk-related terms has been completed and provides a single source to reduce ambiguity and facilitate communication on risk-informed activities.
- D. Develop Methods, Tools and Guidance for Including Digital Systems in Nuclear Plant PRAs –
Staff continues to develop methods and analytical tools for including models of digital systems in nuclear plant PRAs. Recent efforts have focused on performing statistical testing of a pilot digital I&C system and development of a network model for estimating software reliability.

- E. Apply Risk Assessment Methodology for Reprocessing Facilities –
Staff will identify changes to existing regulatory requirements that are necessary to license a reprocessing facility using risk insights for the variety of chemical-radiological operations associated with the radiological risks for fission product and actinide separations.
- F. Assess Debris Accumulation on PWR Sump Performance, Generic Issue (GI)-191 –
The generic issues program and 10CFR50.46c rulemaking is considering debris accumulation on the Emergency Core Cooling (ECC) sump screen that might restrict water flow to the pumps, following a LOCA. Licensees calculate the portions of core damage frequency and large early release frequency attributable to debris and compare them to the risk acceptance guidelines in Regulatory Guide 1.174.
- G. Emergency Core-Cooling System Redefined Loss Of Coolant Accident (LOCA) Large Break Size –
Proposed Rulemaking is designed to redefine the large-break loss-of coolant accident requirements to provide a risk-informed alternative maximum break size. In April of 2012, the staff requested withdrawal of the final rule from Commission consideration so that the staff could review the rule and ensure its compatibility with the ongoing regulatory framework activities under Recommendation 1 of the Fukushima Near-Term Task Force (NTTF) report.
- H. Apply Level 3 PRA Consequence Analysis Methods to Emergency Preparedness Oversight and SPAR Models to Emergency Action Levels –
Staff quantified the protection provided by Emergency Planning using SPAR models for the Emergency Action Levels (EALs). Conditional core-damage probability used as the risk metric showed that the current EAL schemes appropriately reflect plant risk increases as the severity of the emergency classification increases.
- I. Develop Standardized Plant Analysis Risk (SPAR) Models –
The staff will maintain and improve models that cover accident progression from systems, components and operator actions to assess risk of events and degraded conditions.
- J. Improve Human Reliability Analysis (HRA) Methods and Practices –
HRA efforts address the suitability of methods for NRC applications, striving to improve consistency among practitioners by providing improved methods and guidance for quantifying human reliability.
- K. Develop Improvements to Standard Technical Specifications (TS) –
Three initiatives to risk-inform TS are: to allow hot shutdown repairs, modify technical specification completion times, and add actions to preclude entry into Limiting Condition for Operation (LCO) 3.0.3, (times to shutdown modes when LCO and associated actions are not met).

- L. Review and Implement Fire Protection Standard 805 –
Staff is reviewing 18 licensee applications to change their licensing basis to National Fire Protection Association (NFPA) 805, a risk informed, performance based standard endorsed via 10CFR50.48(c), to use Probabilistic Risk Assessment (PRA) to transition from existing deterministic fire protection programs. Fire PRA is an integral part of the new licensing basis, and includes both quantitative evaluations of base risk and changes to base risk in accordance with RG 1.174.
- M. Revise the Fuel Cycle Oversight Process (RFCOP) –
The RFCOP Project Plan will develop an approach to use risk information in making risk significance determinations in oversight of fuel cycle facilities.
- N. Develop a Full-Scope Site Level 3 Probabilistic Risk Assessment (PRA) –
Staff is conducting a full-scope site level 3 PRA that addresses all internal and external hazards; all plant operating modes; and all reactor units, spent fuel pools, and dry cask storage. In May of 2013, the staff completed a preliminary version of the Level 1, at-power, internal events and internal flood model.
- O. Develop Approach for Special Treatment Requirements Categorizing Structures, Systems and Components (SSCs) According to Safety Significance –
Under a Vogtle pilot license amendment, while implementing 10 CFR 50.69, safety significance of SSCs will be used to revise industry guidance, Regulatory Guide (RG) 1.201, and inspection procedures. During the pilot application review, the staff expects to continue to work with the industry and pilot licensees to modify the inspection procedure to reflect lessons learned.
- P. Risk Informed Regulatory Framework for New Reactors –
The staff will give additional consideration to relative risk metrics, or other options that would provide a more risk-informed approach to the significance of inspection findings. A recent series of public meetings have been held in addition to briefing of the ACRS in preparation to respond to the Commission on risk metrics for new reactor inspection findings.

Two activities from the Generic Issues program: Generic Issue (GI)-199, "Implications of Updated Probabilistic Seismic Hazards Estimates in Central and Eastern US on Existing Plants" and GI-204, "Flooding of Nuclear Power Plant Sites Following Upstream Dam Failure", have been subsumed into the Fukushima Lessons Learned activities, Recommendation 2.1, Flooding and Seismic Reassessment.

Two additional risk-informed performance-based staff activities are noted here without further elaboration because they have been and will be more extensively described elsewhere. In SRM-SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," dated August 19, 2011 (ADAMS Accession No. ML112310021), the staff plans to provide the Commission a notation vote paper in December 2013 on Near-Term Task Force (NTTF) Recommendation 1, "Establish a Logical, Systematic, and Coherent Regulatory Framework for Adequate Protection That Appropriately Balances Defense-in-Depth and Risk Considerations". Second, as directed by the Chairman's Memorandum, "Evaluating Options Proposed for a More Holistic Risk-Informed, Performance-Based Regulatory Approach," dated June 14, 2012 (ADAMS Accession No. ML121660102), the staff is developing a response to the recommendations in NUREG-2150, "A Proposed Risk Management Regulatory Framework".

Both these activities are being closely coordinated as will be described in the forthcoming NTTF Recommendation 1 notation vote paper.

COORDINATION:

The Office of the General Counsel has reviewed this paper and has no legal objection.

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Enclosure:
Recent Accomplishments and Near-Term
Anticipated Accomplishments—2013

Recent Accomplishments and Near-Term Anticipated Accomplishments—2013

This summary highlights the major risk-informed and performance-based initiatives that the staff of the U.S. Nuclear Regulatory Commission (NRC) is currently working on or has recently completed in 2013.

A. Workshop on Probabilistic Flood Hazard Assessment

The U.S. Nuclear Regulatory Commission's (NRC's) Offices of Nuclear Regulatory Research (RES), Nuclear Reactor Regulation (NRR) and New Reactors (NRO) organized a Workshop on Probabilistic Flood Hazard Assessment (PFHA). The workshop was held January 29–31, 2013 at the NRC headquarters auditorium, 11545 Rockville Pike, Rockville, MD. The workshop was coordinated with Federal agency partners: the U.S. Department of Energy (DOE), U.S. Department of the Interior's Bureau of Reclamation (BoR) and U.S. Geological Survey (USGS), U.S. Army Corps of Engineers (USACE), and Federal Energy Regulatory Commission (FERC). The research workshop was devoted to the sharing of information on probabilistic flood-hazard assessments for extreme events (i.e., annual exceedance probabilities much less than $2.0E-3$ per year) from the Federal community. The topics included: federal agencies' interests and needs in PFHA; state of the practice in identifying extreme flood hazards; extreme precipitation events; flood-induced dam and levee failures; tsunami flooding; riverine flooding; extreme storm surges for coastal areas; and combined events flooding. The workshop objectives included to: (1) assess, discuss, and inform workshop participants on the state of the practice for extreme flood assessments within a risk context, (2) facilitate the sharing of information between both federal agencies and other interested parties to bridge the current state of knowledge between extreme flood assessments and risk assessments of critical infrastructures, (3) seek ideas and insights on possible ways to develop a PFHA for use in probabilistic risk assessments, (4) identify potential components of flood-causing mechanisms that lend themselves to probabilistic analysis and warrant collaborative study, and (5) establish realistic plans for coordination of PFHA research studies. Observations and insights provided during session presentations and subsequent panel discussions that followed were documented by the panel reporters and are included in NUREG/CP-0302. Significant recommendations included:

- Develop a systematic process of expert elicitation for flood hazard assessment (EEFHA). The EEFHA would address information gaps in flood event scenarios. It would assist in estimating probabilistic flood hazard magnitudes, durations, and frequencies. The EEFHA process should include uncertainty assessments of the flood scenarios, past histories of floods including paleofloods and regional storm events, and related storm-event parameters.
- Support ongoing development of the USACE's Storm Catalogue for analyzing floods in the U.S. The catalogue relates extreme storms to flood events, and includes both point measurements and radar data for spatial and temporal distribution of the precipitation. This information will support both the expert elicitation process, and site-specific stochastic modeling of extreme floods (e.g., Stochastic Event Flood Model).
- Develop a structured evaluation process for dam and levee failures to examine comprehensive uncertainties in data and modeling of potential failure mode scenarios.

Enclosure

- Further develop and apply the USACE's joint probability method for storm and hurricane surge analyses along the Gulf and Atlantic coasts with possible application to the Great Lakes.
- Integrate risk analysis into the state-of-the-practice of watershed and coastal-storm surge modeling as presented by the Bureau of Reclamation and USACE.
- Support ongoing interagency committee activities such as the Subcommittee on Hydrology's working groups on Hydrologic Frequency Analysis and Extreme Storm Events.

Following the workshop, NRC staff briefed the ACRS on the insights and recommendations from the PFHA Workshop; discussed with them on how this information is being used in development of a RES research plan on flooding; and conducted a bilateral technical exchange with the French regulatory authority on probabilistic flood hazard assessments and flood protection.

B. Enhance Regulatory Framework for Extended Storage and Transportation of Spent Nuclear Fuel

In SECY-11-0029, "Plan for the Long-Term Update to the Waste Confidence Rule and Integration with the Extended Storage and Transportation Initiative," dated February 28, 2011 (ADAMS Accession No. ML110260244), the staff provided the Commission with a plan to update the waste confidence decision and rule and to enhance the technical and regulatory basis of the existing regulatory framework for the regulation of spent nuclear fuel for extended periods. This plan incorporates work initiated under SRM-COMSECY-10-0007, "Project Plan for Regulatory Program Review to Support Extended Storage and Transportation of Spent Nuclear Fuel," dated December 6, 2010 (ADAMS Accession No. ML103400287), which directs the staff to (1) continue efforts to enhance the process for licensing and inspection of spent fuel storage, (2) continue current research activities that support long-term storage, and (3) complete the extended storage and transportation gap assessments identified as Phase 1 of the project. The Commission established a separate path for the Waste Confidence rulemaking effort in SRM-COMSECY-12-0016, "Approach for Addressing Policy Issues Resulting from Court Decision to Vacate Waste Confidence Decision and Rule," dated September 6, 2012 (ADAMS Accession No. ML12250A032). The technical work on extended storage and transportation continues to be coordinated between NMSS and RES. The efforts to enhance the technical and regulatory basis of the existing regulatory framework for the regulation of spent nuclear fuel for extended periods will include the use of risk information and performance-based approaches in the regulatory bases. These efforts include an assessment of technical information needs, directed research on significant technical issues, and incorporation of this approach in future revisions to guidance and possible changes in regulations. The draft Technical Information Needs Report was published for comment in May 2012 and is now being finalized. Progress on the extended storage and transportation project was reported to the Commission in SECY-13-0057, "Annual Status Report: Activities Related to Extended Storage and Transportation," dated May 31, 2013 (ADAMS Accession No. ML13130A148).

As discussed in the 2013 Annual Status Report paper, future plans for extended storage and transportation involve continued assessment and completion of technical information needs,

using results of work done by NRC, industry, and other parties (e.g., the Department of Energy). The staff will use the technical information and the associated risk insights to inform decisions on potential revisions to guidance and regulations.

C. Publish the Glossary of Risk-Related Terms

A glossary of risk-related terms has been developed that identifies and defines terms used in risk-informed activities related to commercial nuclear power plants. By providing a single source where the terms can be found, the glossary is intended to reduce ambiguity and facilitate communication on risk-informed activities. In June 2012, a preliminary draft of the glossary was made publically available in a draft version of NUREG-2122 (ADAMS Accession No. ML121570620). The final glossary has been submitted to Publications and is expected to be published by the end of October 2013. This activity is complete, although staff will consider updating the glossary as the need arises.

D. Develop Methods, Tools, and Guidance for Including Digital Systems in Nuclear Power Plant PRAs

Digital Instrumentation and Control (I&C) systems have unique characteristics compared with analog I&C systems, such as using software, and may have different failure causes and/or modes; hence, incorporating them in nuclear power plants (NPP) PRAs entails special challenges. Since digital I&C systems are expected to play an increasingly important safety role at NPPs, the NRC established a plan for digital system research defining a coherent set of projects to support regulatory needs (ADAMS Accession No. ML100541484). One of the projects included in this research plan addresses risk assessment methods and data for digital systems (described in Section 3.1.6 of the plan). The objective of the NRC's digital system risk research is to identify and develop methods, analytical tools, and regulatory guidance for (1) including models of digital systems in NPP PRAs, and (2) incorporating digital systems in the NRC's risk-informed licensing and oversight activities.

The staff has previously completed substantial work in modeling digital system hardware within a PRA context. Current research activities are focused on the quantification of software reliability. The staff recently catalogued potential quantitative software reliability methods to identify a set of methods with desirable characteristics suitable for quantifying software failure rates and per-demand failure probabilities of digital systems in PRAs. Based on this evaluation, the staff selected the Bayesian Belief Network (BBN) approach and statistical testing method (STM) to be applied to an example software-based protection system to demonstrate their feasibility, practicality, and usefulness for use in NPP PRAs. RES is currently performing proof-of-concept studies applying the BBN and STM approaches to a protection function of the Loop Operating Control System of the Idaho National Laboratory Advanced Test Reactor. In FY2014 and beyond, the staff plans to continue to support digital I&C PRA research consistent with the agency's digital I&C research plan.

E. Apply Risk Assessment Methodology for Reprocessing Facilities

In SRM-SECY-07-0081, "Regulatory Options for Licensing Facilities Associated with the Global Nuclear Energy Partnership," dated June 28, 2007 (ADAMS Accession No. ML071800084), the Commission directed the NRC staff to proceed with a regulatory gap analysis and to identify

changes in the regulatory requirements necessary to license a potential reprocessing facility. As part of the regulatory gap analysis, the staff identified the need to develop quantitative risk insights for the variety of chemical-radiological operations that might occur at potential spent nuclear fuel reprocessing and advanced fuel cycle facilities. Staff from RES and the Office of Nuclear Material Safety and Safeguards (NMSS) collaborated to develop analytical tools that can account for potential hazards at reprocessing and advanced fuel cycle facilities, as well as provide quantitative insights on the radiological risks associated with fission product and actinide separations. The staff described its approach to using risk information in SECY-11-0163, "Reprocessing Rulemaking: Draft Regulatory Basis and Path Forward," dated November 18, 2011 (ADAMS Accession No. ML113202350). In SRM-SECY-11-0163, which has the same title and is dated August 30, 2012 (ADAMS Accession No. ML122430189), the Commission directed the staff to provide, within one year, a notation vote paper providing the staff's assessment of the current state of activity (and U.S. Department of Energy and industry plans) regarding reprocessing, its recommendations regarding the need for continued effort to develop a rule, and the anticipated schedule and resources requires to complete the rule, as well as an appropriate range of options. In SECY-13-0093, "Reprocessing Regulatory Framework – Status and Next Steps," (ADAMS Accession No. ML13178A243) dated July 1, 2013, the staff responded to SRM-SECY-11-0163. Also in SECY-13-0093, staff recommended that the Commission approve a new regulation (10 CFR Part 7x) for reviewing and updating the regulatory basis for licensing a reprocessing facility. Staff is currently waiting for Commission direction and will proceed accordingly.

F. Assess Debris Accumulation on PWR Sump Performance, GI-191¹

This generic issue (GI) concerns the possibility that, following a loss-of-coolant accident in a PWR, debris accumulating on the emergency core-cooling system's sump screen might result in clogging and restrict water flow to the pumps and to the core. As a result of this generic issue and the related generic letter (GL) 2004-02, (ADAMS Accession No. ML042360586), all PWR licensees increased the size of their containment sump strainers, significantly reducing the risk of strainer clogging. A second issue, which needs to be resolved to close GI-191, is the potential for debris to bypass the sump strainers and enter the reactor core. In 2008, the NRC staff determined that additional industry-sponsored testing was necessary to support resolution of this issue. Some testing was performed and found acceptable to the staff. The testing only justifies low amounts of debris in the core making it useful only for plants that can show that their core debris loads are small. 18 operating units plan to use this testing to close GI-191. Industry has proposed additional testing to reduce the conservatism introduced by performing tests that bound all PWRs. This testing is being completed as allowed by SRM-SECY-12-0093 which is discussed below. 31 units plan to use the new testing to justify closure of GI-191.

In SRM-SECY-10-0113, "Closure Options for Generic Safety Issue - 191, Assessment of Debris Accumulation of Pressurized Water Reactor Sump Performance," dated December 23, 2010 (ADAMS Accession No. ML103570354), the Commission determined that it was prudent to allow the nuclear industry to complete testing on in-vessel effects and zone of influence in 2011,

¹ The NRC identifies Generic Issues (GI) through the assessment of plant operation, involving public health and safety, the common defense and security, or the environment that could affect multiple entities under NRC jurisdiction. These issues are documented and tracked through resolution. These issues were previously identified as Generic Safety Issues (GSI) with the program described in Management Directive 6.4 (Generic Issues Program) and NUREG-0933, (Resolution of Generic Safety Issues).

and to develop a path forward by mid-2012. The SRM directed the staff to evaluate alternative approaches, including risk-informed approaches, for resolving GI-191 and to present them to the Commission by mid-2012. In SECY-12-0093, "Closure Options for Generic Safety Issue - 191, Assessment of Debris Accumulation of Pressurized Water Reactor Sump Performance," dated July 9, 2012 (ADAMS Accession No. ML121310648), the staff recommended options for resolving GI-191. Among the recommended options are a risk-informed approach that is being developed by the South Texas Project (STP) and a risk-informed treatment of in-vessel effects. The Commission endorsed the staff's proposed options for resolving GI-191 in SRM-SECY-12-0093, dated December 14, 2012 (ADAMS Accession No. ML12349A378). As part of the resolution process, licensees seeking additional time to pursue new testing or new approaches (including risk-informed approaches) will implement measures to mitigate the potential for debris blockage of the strainer or reactor core. Industry is performing additional testing to support risk-informed evaluations for GI-191.

On January 31, 2013, STP Nuclear Operating Company (STPNOC) submitted an exemption request for a risk-informed approach to resolve GI-191 for STP Units 1 and 2, and on June 19, 2013, submitted a revised exemption request responding to NRC staff's non-acceptance notification of original submittal. On August 13, 2013, the NRC staff agreed to review the exemption request, although the submittal still did not include sufficiently detailed information in several areas. The NRC staff recognized that the risk-informed approach developed by STPNOC is first-of-a-kind review and therefore decided to invoke the provision of rare circumstances in LIC-109, "Acceptance Review Procedures" (ADAMS Accession No. ML091810088), to accept the application for review. In its acceptance review letter, the NRC staff informed the licensee that failure to provide the required technical information in a reasonable amount of time may result in the NRC terminating its review, in which case the licensee would be expected to resolve GI-191 concerns using a deterministic approach. Tentatively, 14 units propose to implement a full risk-informed resolution to GI-191. Two units plan to risk inform the in-vessel evaluation and use a deterministic evaluation for the ECCS strainer.

NRC staff awarded a contract to Southwest Research Institute/Center for Nuclear Waste Regulatory Analysis to evaluate the development and application of probability distributions for various phenomena associated with LOCAs.

SRM-SECY-12-0034, "Proposed Rulemaking – 10 CFR 50.46c: Emergency Core Cooling System Performance During Loss-of-Coolant Accidents," dated January 7, 2013, (ADAMS Accession No. ML13007A478) directed that the "50.46c proposed rule should contain a provision allowing NRC licensees, on a case-by-case basis, to use risk-informed alternatives without an exemption request." As such, the revised 50.46c proposed rule will include a provision that would allow licensees to use an alternative risk-informed approach to demonstrate the effects of debris on long-term cooling. The revised 50.46c proposed rule is due to the Commission, for a 10-day pre-publication review, on December 20, 2013.

Per SRM-COMSECY-13-006, "10 CFR 50.46c Rulemaking: Request to Defer Draft Guidance and Extension Request for Final Rule and Final Guidance," dated May 9, 2013, the draft guidance related to the GI-191 risk-informed alternative will not be published concurrent with the proposed rule. Rather, that draft guidance will be developed in parallel with the staff's review of the South Texas Project Submittal and published for comment when complete (anticipated

Spring 2015). All final guidance (that related to GI-191 and that related to the embrittlement requirements) will be published with the final rule, which is due to the Commission in February 2016.

G. Emergency Core-Cooling System Redefined Loss Of Coolant Accident (LOCA) Large Break Size – (LOCA)

The staff prepared a proposed rule containing emergency core-cooling system evaluation requirements that could be used as an alternative to the current requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) 50.46, "Acceptance Criteria for Emergency Core Cooling Systems (ECCS) for Light-Water Nuclear Power Reactors." That proposed rulemaking is designed to redefine the large-break loss-of coolant accident requirements to provide a risk-informed alternative maximum break size. In October 2006, the staff produced a draft final rule and briefed the Advisory Committee on Reactor Safeguards (ACRS).

In response, ACRS recommended that the Commission should not issue the proposed rule in its present form. As a result, the staff prepared SECY-07-0082, "Rulemaking To Make Risk-Informed Changes to Loss-of-Coolant Accident Technical Requirements: 10 CFR 50.46a, 'Alternative Acceptance Criteria for Emergency Core Cooling Systems for Light-Water Nuclear Power Reactors,'" dated May 16, 2007 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML070180466), to provide a plan (including resource and schedule estimates) for responding to the ACRS recommendation and related comments.

Then, in SRM-SECY-07-0082, dated August 10, 2007 (ADAMS Accession No. ML072220595), the Commission agreed with the staff's recommendation that completing the rulemaking should be assigned a medium priority. Nonetheless, the SRM also directed the staff to continue to make progress on the 10 CFR 50.46a rulemaking and to apply resources to the effort in fiscal year (FY) 2008. On April 1, 2008, the Executive Director for Operations provided the staff's schedule for completing the final rule to the Commission. Following Commission approval, the NRC published a supplemental proposed rule, "Performance-Based Emergency Core Cooling System Acceptance Criteria" (74 FR 40765, August 13, 2009), for public comment. The public comment period ended in January 2010.

After reviewing public comments and making changes to address these comments (and ACRS comments), the staff submitted a final rulemaking package to the Commission for approval on December 10, 2010, in SECY-10-0161, "Final Rule: Risk-Informed Changes to Loss-of-Coolant Accident Technical Requirements (10 CFR 50.46a) (RIN 3150-AH29)" (ADAMS Accession No. ML102210460). On April 20, 2012, the staff requested withdrawal of the 10 CFR 50.46a final rule from Commission consideration so that the staff could review the rule and ensure its compatibility with the ongoing regulatory framework activities under Recommendation 1 of the Fukushima Near-Term Task Force (NTTF) report. The Commission approved the staff's request in SRM-SECY-10-0161, dated April 26, 2012 (ADAMS Accession No. ML12117A121). The staff does not plan to publish a notice in the *Federal Register* withdrawing the 10 CFR 50.46a final rule. The staff intends to resubmit the draft final rule for Commission consideration after receiving Commission direction in conjunction with NTTF Recommendation 1.

H. Apply Level 3 PRA Consequence Analysis Methods to Emergency Preparedness Oversight and SPAR Models to Emergency Action Levels

The staff received direction in SRM-COMDEK-08-005 to quantify the protection provided by Emergency Planning (EP) and codify it in a transparent, objective, and measurable manner.

The staff published NUREG/CR-7160, Risk Informing Emergency Preparedness Oversight: Proof of Concept; to explore methods to quantify the protection provided by EP programs as well as determining the relative risk significance of program elements. The quantification tool in conjunction with a performance based regulatory structure could enhance oversight of nuclear power plant EP programs and will be detailed in a SECY paper in late 2013.

The Office of Nuclear Security and Incident Response (NSIR) sent a user need to RES (NSIR-2010-002) in May 2010. In response to the user need, RES staff worked with NSIR staff to explore the feasibility of using a PRA approach to evaluate the consistency of emergency action levels and enhance guidance through risk-related information. This was the first effort to apply PRA methodology to Emergency Action Level (EAL) schemes. Peach Bottom, Surry, and Sequoyah were selected as pilot plants for analysis. EAL threshold conditions, as stated in the plant-specific emergency plan documents, are mapped into scenarios specific to the Standardized Plant Analysis Risk (SPAR) models for these plants. Conditional core-damage probability is used as the risk metric to evaluate each EAL scenario. The results of the study showed that the current EAL schemes, in general, appropriately reflect plant risk increases as the severity of the emergency classification increases. However, the results also identified some inconsistencies. The risk insights from this study, along with deterministic analyses, can be applied to enhance future EAL schemes and regulatory decisions.

The details of this study are documented in NUREG/CR-7154, "Risk Informing Emergency Preparedness Oversight: Evaluation of Emergency Action Levels—A Pilot Study of Peach Bottom, Surry and Sequoyah", Vols. 1 and 2, published in January 2013 (ADAMS Accession Nos. ML13031A500 and ML13031A501 respectively). Additionally, RES performed a Level 2 PRA study to analyze emergency scenarios involving Peach Bottom EALs associated with fission product barriers. This was exploratory in nature, but it demonstrated the capability to apply Level 2 PRA to certain EALs. The insights gained were documented in a white paper titled "Feasibility Study of Risk Informing Emergency Preparedness Using Level 2 PRA: A Pilot Study Using Peach Bottom Level 2 SPAR Models" (ADAMS Accession No. ML13142A387). The user need was completed in February 2013. No new activities are planned.

I. Develop Standardized Plant Analysis Risk (SPAR) Models

SPAR models are plant-specific PRA models that cover accident sequence progression, plant systems and components, and plant operator actions. These standardized models represent the as-built and as-operated plant to the extent needed to support NRC regulatory activities. As such, they permit the staff to perform risk-informed regulatory activities by independently assessing the risk of events or degraded conditions at operating nuclear power plants. In addition, the NRC staff continues to maintain and improve Version 8 of the SAPHIRE software to support risk-informed programs. The staff provided the Commission with an update of these activities in SECY-13-0107, "Status of the Accident Sequence Precursor Program and the Standardized Plant Analysis Risk Models," dated October 4, 2013 (ADAMS Accession

No. ML13232A062). The staff plans to continue the SPAR and SAPHIRE development and maintenance programs consistent with RES and user office needs.

J. Improve Human Reliability Analysis (HRA) Methods and Practices

The staff is addressing issues associated with the differences in human reliability analysis (HRA) methods available for quantifying human failure events in a PRA. This work is being performed as directed in SRM-M061020 where the Commission directed the ACRS to “work with the staff and external stakeholders to evaluate the different human reliability models in an effort to propose either a single model for the agency to use or guidance on which model(s) should to [sic] be used in specific circumstances.” In response, the staff supported and participated in an International HRA Empirical Study. This study involved the collection of reactor operator crew performance observations and comparison with the results of different HRA methods used to evaluate the actions involved in simulated scenarios. The NRC published the results of the study in NUREG/IA-0216, “International HRA Empirical Study-Phase 1 Report,” and NUREG-2127 in 2013 that documents the overall lessons learned from the study. Furthermore, the staff has established an MOU with a U.S. utility and performed a follow-up study to evaluate a specific set of HRA methods used in regulatory applications through a comparison of HRA predictions to crew performance in simulator experiments performed in a U.S. nuclear power plant. The staff completed this work in 2013. The results of this study will be used to determine the potential limitations of data collected in non-U.S. simulators.

The Office of Nuclear Regulatory Research (RES) signed another agreement with the same U.S. utility in March 2011 to collaborate on the collection of human performance information in operator simulator training. The information sources include the licensed-operator simulator training, job performance measures, and emergency drills. To aid in data collection, the staff developed the Scenario Authoring, Characterization, and Debriefing Analysis (SACADA) tool. The staff is currently seeking both U.S. and international collaboration in use of this tool for data collection.

The staff collaborated with the Electric Power Research Institute (EPRI) under an MOU to address HRA variability by developing a new HRA method that integrated the strengths and improved the weak areas in existing methods. The approach aims to use an explicit human performance framework for establishing causal relationships of human failures to underlying failure mechanisms through the use of the current understanding of cognitive psychology as a technical basis for postulating failure events, failure mechanisms, and underlying performance drivers. The method was initially developed in 2013 and will go through further testing in 2014.

K. Develop Improvements to Standard Technical Specifications (TS)

The staff continues to work on the risk-informed technical specifications (RITS) initiatives to add a risk-informed component to the standard technical specifications (STS). The following summaries highlight these activities:

Initiative 1, “Modified End States,” would allow licensees to repair equipment during hot shutdown rather than cold shutdown. The topical reports supporting this initiative for boiling water reactor (BWR), Combustion Engineering (CE), Babcock & Wilcox (B&W), and

Westinghouse plants have been approved, and revisions to the BWR, CE, B&W, and Westinghouse STS are available (ML093570241, ML093570241, ML103360003, ML093570241).

Initiative 4b, "Risk-Informed Completion Times," modifies technical specification completion times to reflect a configuration risk-management approach that is more consistent with the approach described in the Maintenance Rule, as specified in 10 CFR 50.65(a)(4). As reported previously in SECY-07-0191, "Implementation and Update of the Risk-Informed and Performance-Based Plan," dated October 31, 2007 (ADAMS Accession No. ML072690619), the staff issued the license amendment for the first pilot plant, South Texas Project, in July 2007. In July 2010, Southern Nuclear Company submitted a letter of intent for Vogtle (Units 1 and 2) to implement RITS Initiative 4b. The NRC granted the associated fee waiver request and received a pilot application in September 2012. The associated Technical Specification Task Force guidance (TSTF-505) to revise the STS became available in March 2012.

Initiative 6, "Add Actions to Preclude Entry into LCO 3.0.3," modifies technical specification action statements for conditions that result in a loss of safety function related to a system or component included within the scope of the plant technical specifications. The staff approved the industry's topical report for CE nuclear power plants (Revision 2 to WCAP-16125-NP-A, "Justification for Risk-Informed Modifications to Selected Technical Specifications for Conditions Leading to Exigent Plant Shutdown") in August 2010 (ADAMS Accession No. ML110070500). The associated Technical Specification Task Force guidance (Revision 5 of TSTF-426) to revise the CE STS was submitted for NRC review in November 2011 (ADAMS Accession No. ML113260461). Based on the approved CE topical report, the industry has also submitted requests to revise the B&W STS (Revision 0 of TSTF-538) and the STS for BWRs (Revision 0 of TSTF-540) in March 2012 and May 2012, respectively. The staff is currently reviewing all three of these applications.

L. Review and Implement Fire Protection Standard 805

In 2004, the Commission approved a voluntary risk-informed and performance-based fire protection rule for existing nuclear power plants. The rule endorsed National Fire Protection Association (NFPA) consensus standard NFPA 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants." In addition, the NEI developed NEI 04-02, "Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10 CFR 50.48(c)," dated September 30, 2005 (ADAMS Accession No. ML052590476), that the staff endorsed in Regulatory Guide (RG) 1.205, "Risk-Informed, Performance - Based Fire Protection for Existing Light-Water Nuclear Power Plants," issued in May 2006 (ADAMS Accession No. ML061100174). To date, nearly half of the nuclear power units operating in the United States, including those that participated in the pilot program, have committed to transition to NFPA 805 as their licensing basis. The Oconee and Shearon Harris plants were the pilot plants for 10 CFR 50.48(c). In June 2010, a safety evaluation approved the Shearon Harris NFPA 805 pilot application. A safety evaluation in December 2010 approved the Oconee NFPA 805 pilot application. NEI 04-02 was revised (Revision 2) in April 2008 and the staff revised RG 1.205 (Revision 1) in December 2009 (ADAMS Accession No. ML092730314) to reflect lessons learned from the pilot reviews. The staff developed NUREG-800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Chapter 9, "Auxiliary Systems," Section 9.5.1.2, "Risk-Informed,

Performance-Based Fire Protection Program Review Responsibilities,” issued December 2009, to provide staff guidance for the review of licensee applications to transition to NFPA 805. Additionally, the NRC developed a Frequently Asked Question (FAQ) process to review and establish a preliminary staff position on application, review, and implementation issues. Lessons learned from the pilot applications indicated that the staff and the industry underestimated the complexity and resources necessary to complete the reviews. In SRM-SECY-11-0033, “Proposed NRC Staff Approach to Address Resource Challenges Associated with Review of a Large Number of NFPA 805 License Amendment Requests,” dated April 20, 2011 (ADAMS Accession No. ML111101452), the Commission approved the staff’s recommendation to increase resources to review NFPA 805 applications, develop a staggered review process, and modify the current enforcement policy. The NRC sent the revised enforcement policy to the Commission in SECY-11-0061, “A Request to Revise the Interim Enforcement Policy for Fire Protection Issues on 10 CFR 50.48(c) to Allow Licensees to Submit License Amendment Requests in a Staggered Approach,” dated April 29, 2011 (ADAMS Accession No. ML11117A264) and approved in SRM-SECY-11-0061, dated June 10, 2011 (ADAMS Accession No. ML111610616). To enhance the efficiency and effectiveness of the NFPA 805 application reviews, the industry developed an application template and the staff developed a safety evaluation template. The staff has received 18 applications to date and expects another five by the end of calendar year (CY) 2013.

M. Revise the Fuel Cycle Oversight Process

NMSS is executing a multiyear project plan to revise the fuel cycle oversight program (RFCOP) with the objective of developing an oversight process with an improved degree of transparency, predictability, objectivity, and consistency, using risk-informed and performance-based tools. The staff has engaged the public and industry stakeholders at public meetings and has requested public comment on development activities associated with the RFCOP. Recent achievements in executing this RFCOP Project Plan include:

- Issued a revised NRC Enforcement Policy on January 2013, in the Federal Register (78 FR 5838) that authorizes licensees with Corrective Action Plan (CAP) criteria that meet established standards to receive a non-cited violation (NCV) for a Severity Level IV violation if they manage the corrective actions in accordance with their approved CAP.
- Issued for public comment NUREG-2154, “Acceptability of Corrective Action Programs (CAP) for Fuel Cycle Facilities”. Based on a public comment, this NUREG has been converted to a regulatory guide, and will soon be issued for public comment in that form.
- Developed a draft CAP Inspection Procedure, that is in internal concurrence.
- As directed in SRM-SECY-11-0140, “Enhancements to the Fuel Cycle Oversight Process” (ADAMS Accession No. ML120050322), staff engaged with stakeholders on a definition of “performance deficiency,” including issues associated with licensees failing to meet “self-imposed standards.” In general, the industry representatives seemed to be in agreement with the position paper’s recommendation.

Staff will move forward with the enhancements to the Fuel Cycle Oversight Process as directed in the SRM-SECY-11-0140 consistent with current budget priorities.

N. Develop a Full-Scope Site Level 3 Probabilistic Risk Assessment

As directed in SRM-SECY-11-0089, "Options for Proceeding with Future Level 3 Probabilistic Risk Assessment (PRA) Activities" (ADAMS Accession No. ML112640419), the staff is conducting a full-scope site Level 3 PRA that addresses all internal and external hazards; all plant operating modes; and all reactor units, spent fuel pools, and dry cask storage. In May 2013, the staff completed a preliminary version of the Level 1, at-power, internal events and internal flood model, and work is continuing in all other technical areas of the study. The staff is currently evaluating the schedule impact of recent reductions in project funding caused by FY 2013 sequestration and diversion of key personnel to higher-priority work.

Although recent project challenges have resulted in an overall project delay of 9-12 months, the staff is continuing to move forward in all technical areas of the project in a manner consistent with the established project Technical Analysis Approach Plan (ML13112A400 and ML13192A171). In FY2014, the staff plans to complete public-health consequence modeling for reactor at-power, internal events and floods and make substantial progress for reactor at-power internal fires and external hazards. In the upcoming year, the staff also expects to progress in estimating the frequency of fuel damage for dry cask and spent fuel pool storage.

O. Develop Approach to Special Treatment Requirements Categorizing Structures, Systems, and Components According to Safety Significance

In 1998, the Commission decided to consider issuing new regulations that would provide an alternative risk-informed approach for special treatment requirements in the current regulations for power reactors. The NRC published the final rule (10 CFR 50.69, "Risk-Informed Categorization and Treatment of Structures, Systems and Components [SSCs] for Nuclear Power Reactors") in the *Federal Register* on November 22, 2004 (69 FR 68008). The NRC staff issued Regulatory Guide (RG) 1.201, "Guidelines for Categorizing Structures, Systems, and Components in Nuclear Power Plants According to Their Safety Significance," Revision 1, in May 2006 (ADAMS Accession No. ML061090627).

The staff completed its review of Westinghouse topical report WCAP-16308-NP (Revision 0, July 2006), "Pressurized Water Reactor Owners Group 10 CFR 50.69 Pilot Program - Categorization Process - Wolf Creek Generating Station" (ADAMS Accession No. ML092430194), and issued its final safety evaluation on March 26, 2009 (ADAMS Accession No. ML090260674). By letter dated December 6, 2010, the Southern Nuclear Company (SNC) informed the NRC of its intent to submit a license amendment request for implementation of 10 CFR 50.69 for Vogtle Units 1 and 2 and requested pilot plant status and a waiver of review fees. By letter dated June 17, 2011, the staff informed SNC that the NRC has granted the fee waiver request for the proposed licensing action in accordance with 10 CFR 170.11(b). SNC submitted the licensing action request on August 31, 2012. Following the initial pilot application, lessons learned from the application review will be used to revise the associated industry guidance and RG 1.201.

In addition, the NRC staff issued draft Inspection Procedure 37060, "10 CFR 50.69 Risk-Informed Categorization and Treatment of Structures, Systems, and Components Inspection," on February 16, 2011. The Nuclear Energy Institute (NEI) and one licensee provided comments on the procedure. The NRC staff addressed the comments and issued the revised inspection procedure in 2011. The NRC will focus its inspection efforts on the most risk-significant aspects related to implementation of 10 CFR 50.69 (i.e., proper categorization of SSCs and treatment of Risk-Informed Safety Class (RISC)-1 and RISC-2 SSCs). Additionally, the inspections are expected to be performance-based, with SSCs of lower safety significance (e.g., classified RISC-3) not receiving a major portion of inspection focus unless adverse performance trends are observed. The staff recognizes the need for an effective, stable, and predictable regulatory climate for the implementation of 10 CFR 50.69. The NRC views inspection guidance developed with industry stakeholder input as an efficient vehicle for reaching a common understanding of what constitutes an acceptable treatment program for SSCs because specific treatment plans are not reviewed as part of a licensee's application to implement 10 CFR 50.69. During the pilot application review, the staff expects to continue to work with the industry and pilot licensees to modify the inspection procedure to reflect lessons learned and information gleaned from the pilot's proposed treatment program.

P. Risk Informed Regulatory Framework for New Reactors

The staff continues to address the issue of risk-informed regulatory guidance for new light-water reactors (LWRs). The staff is working to respond to SRM-SECY-12-0081, "Risk-Informed Regulatory Framework for New Reactors," dated October 22, 2012 (ADAMS Accession No. ML12296A158). Specifically, the notation vote paper being developed by the staff as directed in the SRM addresses the Commission's request to give additional consideration to the use of relative risk metrics, or other options, that would provide a more risk-informed approach to the determination of the significance of inspection findings for new reactors.

Since the issuance of the SRM, the staff conducted a series of public meetings with stakeholders. The first public meeting was on February 5, 2013 (ADAMS Accession No. ML13059A054). Additional public meetings were held on March 25, 2013 (ADAMS Accession No. ML13100A226) and April 15, 2013 (ADAMS Accession No. ML13126A166). The ACRS subcommittee on Reliability and Probabilistic Risk Assessment (PRA) was briefed on July 22, 2013, and a briefing of the full ACRS committee is scheduled for September 5, 2013. The response to SRM-SECY-12-0081 was due to the Commission by October 2013.

In addition, as part of SRM-SECY-12-0081, on March 22, 2013, SECY-13-0029, "History of the Use and Consideration of the Large Release Frequency Metric by the U.S. Nuclear Regulatory Commission" (ADAMS Accession No. ML13022A207), was submitted to the Commission. This SECY is an information paper to the Commission, reviewing the history of the U.S. NRC's use and consideration of large release frequency (LRF). Also, this SECY discusses pros and cons of requiring the use of LRF, possibly in addition to large early release frequency (LERF), for all operating reactors.