POLICY ISSUE
INFORMATION

October 28, 2010 SECY-10-0143

FOR: The Commissioners

FROM: Brian W. Sheron, Director
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SUBJECT: ANNUAL UPDATE OF THE RISK-INFORMED AND PERFORMANCE-BASED PLAN

PURPOSE:

To provide the Commission with an annual update on activities contained in the Risk-Informed and Performance-Based Plan (RPP) including a summary of the significant accomplishments achieved over the past year and anticipated for the next year. This paper does not address any new commitments or associated resource implications.

SUMMARY:

The breadth and depth of programs across the agency demonstrate the staff's commitment to the Commission's goals for risk-informed and performance-based regulation. Since the Commission promulgated the Probabilistic Risk Assessment Policy Statement (60 FR 42622) in 1995, the staff has continued to expand the application of risk-informed technology to regulatory initiatives. Many NRC risk-informed programs, such as the Reactor Oversight Program, are mature elements in the regulatory structure and are not discussed in this paper. These mature programs continuously improve as the state-of-the-art continues to advance. Other programs, such as most of those discussed in this paper, are in a developmental stage and are being integrated into the regulatory process of the agency. The staff continues to engage stakeholders as appropriate to improve our regulatory programs.

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BACKGROUND:

On June 1, 2006, the Commission issued a staff requirements memorandum (SRM) (available in the Agencywide Documents Access and Management System [ADAMS] under Accession No. ML061520304) that directed the U.S. Nuclear Regulatory Commission (NRC) staff to improve upon the Risk-Informed Regulation Implementation Plan (RIRIP) by developing an integrated master plan for activities designed to help 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 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 [ML070890396], conveyed that plan, which the staff retitled as the "Risk-Informed and Performance-Based Plan."

To help meet the Commission's expectations for both a risk-informed and a performance-based regulatory structure, Enclosure 1 of SECY-07-0074 included explicit criteria for the staff's review and consideration of performance-based approaches to help 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," dated October 31, 2007 [ML072700587], discusses the staff's progress in implementing the RPP and includes 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 via the agency's public Web site. The most recent version of the plan was provided as SECY-09-0159 dated October 27, 2009 [ML092680231].

DISCUSSION:

Most of the information on risk-informed and performance-based programs is in Enclosure 1 with the detailed information located on NRC's public Web site http://www.nrc.gov/about-nrc/regulatory/risk-informed/rpp.html. The Web site provides a readily accessible overview and current status of the agency's risk-informed and performance-based regulatory activities.

This paper continues to report on the following regulatory initiatives in the reactor area:

- Fire Protection for Nuclear Power Plants.
- Risk-Informed Technical Specifications.
- Risk-Informed Approach to Special Treatment Requirements.
- Initiative to Enhance Risk Tools for Oversight.
- Risk-Informed Rulemaking.
- Infrastructure for a Risk-Informed and Performance-Based Environment for New Light-Water Reactors.
- Human Reliability Analysis.
- Human Reliability Analysis Development for Fire PRA.
- Analytical Tools for Risk Applications.
- SPAR Model Development Program.
- Reactor Performance Data Collection/Industry Trends.

In addition, the staff has added the following initiatives in the reactor area:

- Risk-Informed Security. NSIR has requested RES to explore the feasibility of using available methods to risk-inform the regulatory approach to security. Currently, this effort is underway. Its deliverable would include a report that evaluates those candidate risk management strategies that are potentially applicable and identifies the informational and analytical gaps that would need to be closed to use those strategies. This work is reported as a reactor initiative, but may also be applicable to non-reactor facilities.

- Risk-Informed Emergency Action Levels. NSIR has requested RES to explore the feasibility of risk-informing the relation between emergency action levels (EALs) and protective actions taken. This work is intended to verify that current EALs are consistent with risk insights. This work is continuing and its status will be updated in the next annual Commission paper.

- Use of Risk Insights to Enhance Safety Focus of Small Modular Reactor Reviews. As directed in the SRM dated August 31, 2010, "Use of Risk Insights to Enhance Safety Focus of Small Modular Reactor Reviews," the staff is developing a plan for a framework and design specific review plans for the integral pressurized water reactor (iPWR) class of SMRs. Further, the staff's plan will include developing enhanced approaches for applying risk insights into the design or licensing reviews for SMRs. The staff is working with industry and will provide their plan to the Commission in mid-February as directed in the SRM.

This paper continues to report on the following regulatory initiatives in the materials and waste area:

- Developing Significance Determination Process (SDP) Tools for the Fuel Cycle Oversight Process (FCOP) Revision.
- Depleted Uranium Rulemaking.

In addition, the staff has added the following initiatives in the materials and waste area:

- Extended Storage and Transportation of Spent Nuclear Fuel. Staff has developed plans to review regulatory programs for spent fuel storage and transportation to evaluate their adequacy for ensuring safe and secure storage and transportation of spent nuclear fuel for periods considered beyond 120 years. A project plan has been proposed by the staff for Commission approval in COMSECY-10-0007, "Project Plan for the Regulatory Program Review to Support Extended Storage and Transportation of Spent Nuclear Fuel," dated June 15, 2010 [ML101390216] that includes gap assessments, technical reviews, and additional research implementation. Detailed plans will be developed based on the results of the gap assessments.

Finally, several initiatives in the materials and waste areas not listed here are provided on the RPP website.

The Commission approved the staff plan for a phased approach to stabilize PRA quality in the SRM dated October 6, 2004 [ML042800369] to SECY-04-0118, "Plan for the Implementation of the Commission's Phased Approach to Probabilistic Risk Assessment Quality," dated July 13, 2004 [ML041470505]. More detailed information is provided in Enclosure 2 on the evolution of our approach to PRA quality, which supports many of the agency's programs. The staff continues to work on efforts associated with PRA quality:

- Stabilizing the PRA Quality Expectations. The staff has had several ongoing efforts in stabilizing expectations for PRA quality. These efforts have been part of the Phased Approach Plan to PRA Quality, SECY-04-0118. The plan involves a three-phased approach that defines the Commission's expectations for PRA quality for current or anticipated applications and the process for achieving that quality while allowing risk-informed decisions to be made using currently available methods until the necessary guidance documents defining quality were developed and implemented. Phase 1 allowed licensee submittals (e.g. licensee amendment applications) without NRC-endorsed PRA standards, while Phase 3 relied on NRC-endorsed PRA standards for defining PRA quality. The Commission stated in the SRM to SECY-04-0118: "…once Phase 3 guidance is in place, Phase 1 applications would no longer be acceptable."

  Central to the plan was (1) the development of national consensus PRA standards by Standard Development Organizations (SDOs) and associated industry peer review guidance and (2) staff endorsement in Regulatory Guide (RG) 1.200. Revision 2 to RG 1.200 was issued in March 2009 and endorsed the ASME/ANS standard for an at-power, Level 1/Limited Level 2 (large early release) PRA addressing both internal and external hazards. Publication of Revision 2 to RG 1.200 completed Phase 3 of the staff plan for operating reactors. Licensee's PRAs in support of the application under consideration are expected to meet the ASME/ANS PRA standard as endorsed in RG 1.200, Revision 2, where appropriate. Non-conforming applications would be returned. See Enclosure 2 for a more detailed discussion of the Phased Approach Plan.

  At the time the plan was developed, it did not address new reactor licensing. Further, though Phase 3 has been completed, the staff is continuing to work with the SDOs in revising the current standard to address emerging issues for operating reactors, to address a PRA standard for low-power and shutdown conditions and developing new standards to support new reactor licensing and advanced non-light-water reactors. In addition, other staff activities involve development of peer review guidance and technical methodology guidance (e.g., treatment of uncertainties, seismic, human reliability analysis). The staff will continue to work closely with industry in these efforts.

COORDINATION:

The Office of the General Counsel has reviewed this paper and has no legal objection. The Office of the Chief Financial Officer has reviewed this paper for resource implications and has no objections.

/RA/

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Enclosures:
1. Recent Accomplishments and Near-Term Anticipated Accomplishments
2. Stabilizing Probabilistic Risk Assessment (PRA) Quality Expectations

Recent Accomplishments and Near-Term Anticipated Accomplishments-2010

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 2010.

1. Fire Protection for Nuclear Power Plants

In 2004, the Commission approved a voluntary risk-informed and performance-based fire protection rule for existing NPPs. The rule endorsed a 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 Nuclear Energy Institute (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, that the staff endorsed in Regulatory Guide (RG) 1.205, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants," issued May 2006. NEI 04-02 was revised (Revision 2) in April 2008 and the staff revised RG 1.205 (Revision 1) in December 2009. To date, 50 operating nuclear power units, including the pilots, have committed to transition to NFPA 805 as their licensing basis.

The Oconee and Shearon Harris plants were the pilot plants for 50.48(c). The Shearon Harris NFPA 805 application was approved via a safety evaluation in June 2010. The Oconee NFPA 805 pilot application is expected to be completed in December 2010.

The staff has developed Standard Review Plan Section 9.5.1.2, "Risk-Informed, Performance-Based Fire Protection" to provide staff guidance for the review of licensee applications to transition to NFPA 805. Additionally, a Frequently Asked Question (FAQ) process has been developed to review and establish a preliminary staff position on implementation issues. These staff activities and schedules are discussed in more detail in a plan addressing fire protection issues that was originally issued in SECY-08-0171 on November 5, 2009, and since updated every 6 months. The next update is scheduled to be issued in November 2010.

2. Risk-Informed Technical Specifications

The staff continues to work on the risk-informed technical specifications initiatives to add a risk-informed component to the standard technical specifications (STS). The following summaries highlight the major accomplishments in this area:

- 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), and Babcock & Wilcox (B&W) plants have been approved, and revisions to the BWR and CE STS have been made available. The Westinghouse topical report submitted in September 2005 was approved in March 2010 while revisions to the B&W STS are expected to be made available in January 2011.

- 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 Title 10, Section 50.65(a)(4), of the *Code of Federal Regulations*. As reported previously in SECY-07-0191, “Implementation and Update of the Risk-Informed and Performance-Based Plan,” dated October 31, 2007, the staff issued the license amendment for the first pilot plant, South Texas Project, in July 2007. The industry has expressed significant interest in implementing this change over the next 5 years, with more than 40 submittals identified as being planned. Vogtle has submitted a letter of intent and a fee waiver request. The fee waiver request is currently under Agency review.

- Initiative 5b, “Risk-Informed Surveillance Frequencies,” relocates surveillance test intervals to a licensee-controlled document and provides a risk-informed method to change the intervals. The staff approved the industry’s guidance document (Revision 0 of NEI 04-10, “Risk-Informed Technical Specifications Initiative 5B, Risk-Informed Method for Control of Surveillance Frequencies”) in September 2006 along with the license amendment for the pilot plant, Limerick Generating Station. Revision 1 of NEI 04-10, which relocates staggered testing requirements and makes other administrative changes, was approved in September 2007. The associated Technical Specification Task Force guidance (TSTF-425) to revise the STS was made available in July 2009. The industry has expressed significant interest in implementing this change over the next 5 years, with 50 submittals identified as being planned. Four sites with eight units have received approval via safety evaluations under Initiative 5b. The Agency is nearing completion on safety evaluations for an additional 7 sites with 11 units. Finally, applications for an additional 10 sites with 19 units are under review.

- Initiative 6, “Modification of Selected TS for Conditions Leading to Exigent Plant Shutdown,” revises the completion times for loss-of-function conditions to allow up to 24 hours for corrective actions. A revised CE topical report was submitted for staff review in December 2007, and was approved in May 2010. Other vendor topical reports are anticipated along with STS changes to implement the approved CE topical report.

3. Develop an Alternative Risk-Informed Approach to Special Treatment Requirements

The Commission decided in 1998 to consider promulgating new regulations that would provide an alternative risk-informed approach for special treatment requirements in the current regulations for power reactors. The final rule (10 CFR 50.69, “Risk-informed categorization and treatment of structures, systems and components [SSCs] for nuclear power reactors”), with some modifications, was approved by the Commission on October 7, 2004 and was published 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, on April 28, 2006.

On September 25, 2006, the Nuclear Energy Institute submitted Westinghouse Topical Report WCAP-16308-NP (Revision 0, July 2006), “Pressurized Water Reactor Owners Groups 10 CFR 50.69 Pilot Program – Categorization Process – Wolf Creek Generating Station,” for NRC review. The staff found the categorization process described in the topical report to be

acceptable, but did not approve nor endorse any specific treatment process. Treatment programs being implemented under 10 CFR 50.69 do not require prior approval from the NRC as part of the license amendment review process. At this time no licensee has submitted an application requesting to implement 10 CFR 50.69, though at least one licensee has recently indicated an interest in submitting a pilot application. 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 staff plans to develop guidance for sample inspections to be conducted at plants voluntarily choosing to implement 10 CFR 50.69. The staff plans to issue draft guidance to obtain stakeholder input and issue final guidance by the summer 2011. Inspection efforts will be focused 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 lower safety significant function SSCs (such as those 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. Inspection guidance developed with industry stakeholder input is viewed as an efficient vehicle for reaching a common understanding of what constitutes an acceptable treatment program for SSCs since specific treatment plans are not reviewed as part of a licensee's application to implement 10 CFR 50.69.

4. Initiative to Enhance Risks Tools for Oversight

The NRC staff uses a suite of risk tools to support oversight of nuclear reactors such as risk assessment software, Standardized Plant Analysis Risk (SPAR) models, databases, guidance for the Significance Determination Process (SDP), and associated training. The Risk Tool Enhancement (RTE) Project represents a structured assessment involving internal stakeholders in NRR, RES and each Region to define, prioritize, and implement enhancements to risk tools used by risk analysts, inspectors and their management. In February 2010, the staff issued a RTE Project Plan, which organized input received from internal stakeholders on enhancements for maintaining the quality, for improving the efficient use, and for advancing the state of the art of NRC's risk tools.

There are currently 73 tasks managed under the RTE Project that address the enhancement or maintenance of NRC risk tools, procedures, or training. Technical leads for each task were identified and the tasks were prioritized in terms of benefit to the agency and resources needed. Also, the agency established the RTE Oversight Team, consisting of managers from NRR, RES, and each Region. The purpose of this team is to oversee the RTE Project schedule and work products. The desired outcome of the RTE Project is to assure availability of high quality NRC risk analysis tools that are technically sound and to assure adequate training for staff to use the risk tools. Of the 73 tasks, approximately 10 tasks were completed in FY2010 and another 10-12 are scheduled to be completed in FY2011.

5. Risk-Informed Rulemaking and Related Activities Currently in Progress

The staff continues to work on several risk-informed rulemaking initiatives. The following summary highlights major accomplishments.

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 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, the 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, which provided a plan (including resource and schedule estimates) for responding to the ACRS recommendation and related comments. Then, in an SRM related to SECY-07-0082 dated August 10, 2007, the Commission agreed with the staff's recommendation that completing the rulemaking should be assigned a medium priority. Nonetheless, the SRM also directed that the staff continue to make progress on the 10 CFR 50.46a rulemaking and to apply resources to the effort in 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, 74 FR 40765, August 13, 2009 (Performance-Based Emergency Core Cooling System Acceptance Criteria) for public comment. The public comment period ended in January 2010. After reviewing public comments, and making any changes based on those comments, a final rulemaking package is expected to be provided to the Commission for approval in December 2010.

On October 3, 2007, the staff published a proposed rulemaking on "Alternate Fracture Toughness Requirements for Protection against Pressurized Thermal Shock Events." This rulemaking was finalized with the publication of 10 CFR 50.61a [**Federal Register** /Vol. 75, No. 1 /Monday, January 4, 2010, pp. 13-29]. This rule provides new requirements that a pressurized-water reactor licensee could voluntarily use as an alternative to complying with the existing requirements set forth in 10 CFR 50.61.

6. Infrastructure for Risk-Informed and Performance-Based Environment for New Light Water Reactors

During FY 2010, the staff prepared a draft Commission paper and held a public meeting regarding the development of risk-informed regulatory guidance for new LWRs. The staff also provided a briefing to the full ACRS on the subject matter. The discussions in these forums address the regulatory framework as applied to currently operating reactors and highlight potential implementation issues if and when applied to new reactor designs. In a letter to the Commission dated July 27, 2010 (ML102000422), ACRS agreed with the staff's position on the proposed framework as described in Option 2 of the draft Commission paper. The staff

reviewed the ACRS letter and responded on August 25, 2010 (ML102210553). The final Commission paper, SECY-10-0121, was issued on September 14, 2010 (ML102430197).

In FY 2011, the Agency will continue to develop the infrastructure and programs to foster a risk-informed and performance-based environment. These activities will include:

- Continued development of requirements specific to new and advanced LWRs in consensus probabilistic risk assessment (PRA) standards.

- If directed by the Commission is response to SECY-10-0121, continued discussions with internal and external stakeholders regarding the development of risk-informed regulatory guidance for new LWRs, including public meetings and briefings before the ACRS, as necessary.

7. Human Reliability Analysis

The staff is addressing issues associated with the differences in the many HRA methods available for quantifying human failure events in a PRA. In addition to supporting the agency's plan to stabilize and enhance PRA quality, the staff also is following up on a Commission staff requirements memorandum (M061020).

The Commission directed the Advisory Committee on Reactor Safeguards (ACRS) in staff requirements memorandum (SRM) (M061020) to "work with the staff and external stakeholders to evaluate the different human reliability models in an effort to propose a single model for the agency to use or guidance on which model(s) should be used in specific circumstances." Consequently, the staff will be interacting with the ACRS on a frequent basis to incorporate its input on all facets of the work, including the technical approach, its development, its implementation and its deployment process. Moreover, the staff has initiated efforts to address SRM-M090204B to collect data and test HRA methods using U.S. nuclear plant operating crews.

The staff supports and participates in the International HRA Empirical Study, an experimental study performed collaboratively by about a dozen regulatory and industry organizations and members of the Halden Reactor Project. This study involves 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 pilot phase of the study was published as NUREG/IA-0216 Vol. 1. The staff expects the study will be completed by December 2010 and published as NUREG/IA, Vol. 1, 2, and 3 by September 2011.

Utilizing the results from the international HRA study as well as previous HRA method evaluations, the staff is performing technical work to address SRM-M061020. The approach aims to address the issue of variability in HRA through the adoption of a formalization process guiding the identification of potential human failures, the utilization of an explicit human performance framework for establishing causal relationships of human failures to underlying failure mechanisms, and the utilization of the current understanding of cognitive psychology as a technical basis for postulating failure events, failure mechanisms and underlying performance drivers. It also aims to use a mathematical formulation consistent with the overall PRA

framework in estimating failure probabilities. The staff believes that this approach will result in a single architecture for HRA that ensures consistency and adequacy for all HRA applications. This work is being performed collaboratively with EPRI under a Memorandum of Understanding (MOU) to address the issue of variability in HRA. The staff expects to complete the work in September 2012.

As part of SRM-M090204B to collect data and test HRA methods using U.S. nuclear plant operating crews, the staff has established an MOU with a US utility and has initiated a new study with the objective 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 US nuclear power plant. The results will be used to determine potential limitations of data collected in non-US simulators when used to evaluate US applications and to improve the insights developed from the International HRA Empirical Study. The staff expects to complete the work in September 2012.

On HRA data collection, the Human Event Repository and Analysis (HERA) system includes a data taxonomy (NUREG/CR-6903, Vol. 2) and tool to collect human performance information to support HRA. A world-wide-web based database tool has been implemented to provide analysts convenient access to the database. Current data efforts are on enhancing current data taxonomy to more effectively support the estimates of human error probabilities to address parts of the SRM-M061020 and SRM-M090204B. The enhancements focus on broadening the data sources, developing a method for aggregative use of data of different types, and increasing terminology rigor. Currently the HERA main data source is the event reports. The staff is exploring data sources from operator licensing exams, licensees' simulator training programs, and potentially available databases from other industries. The staff is also closely monitoring and participating in the project of addressing SRM-M061020 (work described above this paragraph) to incorporate any data identified in the project into the data collection scope. The data taxonomy is expected to be mature by the end of 2011. Tool enhancements and data collection are planned to be started when the taxonomy is mature.

8. HRA Development for Fire PRA

Under a joint MOU, NRC's Office of Nuclear Regulatory Research (RES) and EPRI have embarked on a cooperative program to improve the state-of-the-art in fire risk studies. This program produced a joint document, EPRI 1011989 & NUREG/CR-6850, entitled "Fire PRA Methodology for Nuclear Power Facilities" (ML052580075, ML052580118) that addresses fire risk for at-power operations. Because this joint NRC/EPRI report does not describe a methodology for developing best-estimate human failure probabilities, a new effort is underway to develop such a methodology and associated guidance, including peer review and testing. The results of this HRA methodology development effort is expected to support the NFPA 805 transition initiative and possible resolution of other regulatory issues, such as multiple spurious operation and operator manual actions.

In 2008, a peer review was performed and testing on selected plants was completed. In May 2009, feedback from both of these efforts was reviewed and addressed, resulting in a revised draft of the NUREG-1921/EPRI 1019196, "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines." This draft was internally reviewed, and an overview was presented to the ACRS HRA subcommittee in June 2009. Following some additional revisions, the report was issued

as a draft for public comment in December 2009. This work is one input to the work being done under SRM-M061020 and related research.

The public comment period for the draft report closed in March 2010. Comments were received from four reviewers. In addition, feedback was provided by the PWR Owner's Group in a pilot application of the fire HRA guidelines. The joint EPRI/NRC-RES team is currently reviewing these comments and preparing the final report. Also, the joint team developed training materials that will be presented by the team in the first fire HRA module in the Joint EPRI/NRC-RES Fire PRA Training Course (September 27- October 1, 2010 and October 25 - 29, 2010). Publication of the final report is expected in 2011.

9. Analytical Tools for Risk Applications

SAPHIRE Version 8, released in April 2010, includes features and capabilities that are new or improved over Version 7 to address new requirements for risk-informed programs. User interfaces were developed for performing:

- SDP Phase 2 analyses with the SPAR models.
- Condition assessments for SDP Phase 3 and ASP analyses, and MD 8.3 evaluations.
- Initiating event assessments for ASP analyses and MD 8.3 evaluations.
- PRA analyses requiring more significant modeling or data revisions.

Features and capabilities also have been improved for SPAR model development and use. Enhanced SPAR models for internal events during power operations have been developed to use the new SDP Phase 2 analysis interface. A new data input method and code improvements for the SPAR models were developed. New capabilities to model and analyze LERF PRA models have been incorporated. SAPHIRE Version 8 also includes the capability to perform phase mission time analysis that is also useful for modeling within the SPAR-SD models. In addition, SAPHIRE Version 8 has been designed with unique capabilities to use the SPAR models in an integrated manner (i.e., different model types such as internal and external events models combined into one model). Improved PRA methods also have been implemented for common cause failure modeling and for sequence solving. Finally, the software's general functionality has been enhanced, and the interface layout has been made more user-friendly.

SAPHIRE Version 8 was developed closely with the user community. For example, in developing the SDP user interface, pilot training classes were provided to NRC end users. The staff also widely participated in testing beta versions and provided feedback for consideration in its development. Moreover, an NRC internal peer review assessed the software requirements. In addition to these types of quality assurance activities, independent verification and validation and acceptance testing were performed for SAPHIRE Version 8.

10. SPAR Model Development Program

SPAR models are plant-specific PRA models that model accident sequence progression, plant systems and components, and plant operator actions. The standardized models represent the as-built, as-operated plant and, as such, permit the staff to perform risk-informed regulatory

activities by independently assessing the risk of events or degraded conditions at operating NPPs. During FY2010, the staff accomplished the following:

- The staff, with the cooperation of industry experts, completed a peer review of a representative BWR SPAR model and PWR SPAR model in accordance with ASME/ANS RA-S-2002, "Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications," and Regulatory Guide 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities." The peer review teams concluded that, within the constraints of the program, the SPAR models are an appropriate tool to provide an independent check on utility PRAs. The peer review teams also provided additional findings and observations to enhance the SPAR models.

- In FY 2009, the staff developed a detailed shutdown model maker guideline document to provide consistent guidance for the construction of shutdown SPAR (SPAR-SD) models. Two new SPAR-SD models were developed using the modeling guidelines, resulting in a total of seven shutdown SPAR models available to support SDP Phase 3 analyses.

- The staff has performed MELCOR analyses, using input decks developed under the State-of-the-Art Reactor Consequence Analysis Project, to investigate success criteria associated with specific Level-1 PRA sequences. In some cases, these analyses confirm the existing technical basis and in other cases they support modifications that can be made to increase the realism of the agency's SPAR models.

- The 77 SPAR models representing the 104 operating commercial NPPs were revised and augmented to take advantage of the new features and capabilities of SAPHIRE Version 8. In addition to the above model enhancements, the staff completed an evaluation of the potential core damage risk reduction associated with the extensive damage mitigation strategies and guidance required by 10 CFR 50.54(hh) for about two-thirds of the SPAR models. The evaluations of the remaining SPAR models are scheduled to be completed by October 2010.

- The staff also developed new SPAR models for the Advanced Boiling Water Reactor (ABWR) and the AP1000. These models will allow confirmation of PRA results presented in licensing submittals and evaluation of risk-informed applications prior to new plant operation, and assessment of operational findings and events once operation commences. The SPAR model for the AP1000 design was completed in February 2010 and quality assurance activities are being completed for the ABWR model. Enclosure 2 provides a detailed status of SPAR models.

- The staff has executed an addendum to the memorandum of understanding with EPRI to conduct cooperative nuclear safety research for PRA. Several of the initiatives included in the addendum are intended to help resolve technical issues that account for the key differences between NRC SPAR models and licensee PRA models. In support of this effort, the memorandum of understanding addendum on PRA with the Electric Power Research Institute has been extended through 2016. The staff also continues to work with the National Aeronautical and Space Administration to address PRA issues of mutual interest. In addition, the NRC has utilized the cooperative agreement and grant

program to establish collaborative PRA research projects with the University of Maryland and the Massachusetts Institute of Technology.

- In accordance with existing user need requests, the staff will continue to implement enhancements to the SPAR models for full-power operations. Anticipated enhancements include incorporating new models for support-system initiators and revised success criteria based on insights from thermal-hydraulic analyses.

- The staff will use information obtained as part of the National Fire Protection Association Standards 805 pilot application process to create two new SPAR fire models with updated fire scenarios.

- The staff will continue to evaluate the need for additional SPAR model capability (beyond full-power, internal initiators) based on experience gained from SDP, ASP, and MD 8.3 event assessments and respond to any new user need requests.

- The staff has reviewed the SPAR model peer review comments. A project plan is being developed to address peer review comments, where appropriate, and is planned to be completed in 2013. The main objective of this effort is to ensure the SPAR models continue to be of sufficient quality to support the staff's risk-informed activities.

11. Reactor Performance Data Collection/Industry Trends

The staff collects data and information on a continual basis to support studies and risk analyses of nuclear power plant operational experience. The information comes primarily from Licensee Event Reports (LERs); the Institute of Nuclear Power Operations' Equipment Performance and Information Exchange (EPIX) and its processor database, the Nuclear Plant Reliability Data System (NPRDS); and Monthly Operating Reports (MORs). These data collection efforts have been consolidated into a single system at Idaho National Laboratory (INL), the Integrated Data Collection and Coding System (IDCCS).

The Industry Trends Program uses this data to report periodic estimates of industry-wide and plant-specific system and component reliabilities, initiating event frequencies, common-cause failure parameters, and fire event frequencies. IDCCS data is also employed in evaluating and applying the Mitigating System Performance Index used in the Reactor Oversight Process; in developing the Baseline Risk Indicator for Initiating Events; and to update the Standard Plant Analysis Risk (SPAR) models, which are used to help assess inspection findings.

Over the past 12 months, LERSearch, the internet-based, in-house tool, has been enhanced with new search capabilities and now provides access to more risk-related operational data. A public version, containing more limited search options and access, was also rolled out in early 2010. The common cause failure database was also updated in the fall 2009.

In a Staff Requirement Memorandum (ML082110496) dated July 29, 2008 the Commission directed the staff to provide a plan to develop a metric to assess the effectiveness of ongoing improvements to the agency's fire protection regulatory framework. In 2009, IDCCS data was used in the development of the new fire metric. In the summer 2009, the staff began a

comprehensive effort to update the existing fire database. The updated database will reside at INL and be based on proprietary industry-reported data provided to the NRC. The new database will enhance the staff's ability to produce meaningful fire metrics and establish parameters important to fire PRA. The staff has entered into a cooperative agreement with the Electric Power Research Institute to facilitate utility cooperation in obtaining the requisite input and to improve database quality.

The NRC Reactor Operational Experience Results and Databases web page, http://nrcoe.inel.gov/results/index.cfm, provides links to component and systems study reports which were updated in the fall 2009. The following reports provide unreliability estimates, by failure mode, for safety-related systems and components; estimated frequencies for initiating events and fire events; and uncertainty estimates and trend evaluations:

Safety-Grade Component Studies:

- Emergency diesel generators (Enhanced for additional insights)
- Turbine driven pumps (Enhanced for additional insights)
- Motor-operated pumps
- Air-operated valves
- Motor-operated valves

Safety-Grade System Studies:

- Boiling Water Reactor (BWR) Systems
- High Pressure Coolant Injection (HPCI) System
- High Pressure Core Spray (HPCS) System
- Isolation Condenser (IC) System
- Reactor Core Isolation Cooling (RCIC) System
- Pressurized Water Reactor (PWR) Systems
- Auxiliary Feedwater (AFW) System
- High Pressure Safety Injection (HPSI) System
- Common Systems
- Emergency Power System

- These reports will be updated again in the fall of 2010. In addition, in 2010 the staff expects to publish a NUREG report on safety relief and power operated relief valve performance based on data through 2007.

12. Use of Risk Insights to Enhance Safety Focus of Small Modular Reactor Reviews

The staff requirements memorandum (SRM) dated August 31, 2010, "Use of Risk Insights to Enhance Safety Focus of Small Modular Reactor Reviews," instructed the staff to develop a plan to apply risk insights to the licensing of small modular reactors (SMRs) in order to improve the efficiency and safety focus of the NRC review process. As directed in the SRM, the staff is developing a plan for a framework and design-specific review plans for integral pressurized water reactors (iPWRs). The staff's plan will address applying the lessons from the ongoing interactions with the Next Generation Nuclear Plant (NGNP) Program, to the longer term goal of developing a broader risk-informed licensing structure for nuclear power plants. The support activities that the NRC has contracted from the DOE national laboratories to help develop

infrastructure and guidance for SMR licensing have been revised to support developing enhanced approaches for applying risk insights into the design or licensing reviews for SMRs. This topic is also being discussed at the routine generic topics meetings held between the NRC staff and industry working groups related to SMR licensing, which are coordinated by NEI. As discussed in the SRM and SECY-10-0034, "Potential Policy, Licensing, and Key Technical Issues for Small Modular Nuclear Reactor Designs," the staff will continue to provide the Commission periodic updates on this activity via the quarterly report on the status of new reactor licensing activities and reports on specific generic policy issues. The staff's plan for addressing the SRM will be provided to the Commission in mid-February as directed in the SRM.

13. Developing SDP Tools for the Fuel Cycle Oversight Process (FCOP) Revision

In an SRM dated April 3, 2008, the Commission directed NRC staff to "…continue to make the fuel cycle performance review process more transparent and risk-informed." To develop an oversight process that has an improved degree of objectivity, predictability, transparency, and consistency that incorporates risk-informed and performance-based tools, the Executive Director for Operations (EDO) directed the staff to undertake a comprehensive effort to develop a new oversight process for fuel cycle facilities. The Commission provided additional guidance on the desired revisions in the SRM dated February 17, 2009, and in a memorandum dated March 13, 2009, from the Office of Nuclear Materials Safety and Safeguards (NMSS) and Region 2 to the EDO, the staff described its plan for revising the fuel cycle oversight process.

Staff submitted a Notation Paper (SECY 10-0031), dated March 19, 2010, for the Commission's consideration and approval of the plan to revise the Fuel Cycle Oversight Process. The Commission was briefed on the Notation Paper on April 29, 2010. Following the April 29 briefing staff received an SRM requesting a concise comparison of ISA and PRA analysis as they relate to the Oversight Process. The staff will provide ISA-PRA comparison to ACRS by October 29, 2010.

14. Disposal of Significant Quantities of Depleted Uranium

Depleted uranium is considered source material, in accordance with 10 CFR Part 40, "Domestic Licensing of Source Material," and if treated as a waste would fall under the definition of low-level radioactive waste per 10 CFR 61.55(a). The Commission reaffirmed this waste classification in Memorandum and Order CLI-05-20 dated October 19, 2005. Consistent with Commission policy to increase the use of risk assessment technology in all regulatory matters, the NRC staff considered in a risk-informed screening analysis (SECY-08-0147), dated October 7, 2008, whether quantities of depleted uranium at issue in the waste stream from commercial uranium enrichment facilities warrant amending 10 CFR 61.55(a)(6) or 10 CFR 61.55(a) waste classification tables.

The Commission directed the staff in a Staff Requirements Memorandum (SRM-SECY-08-0147), dated March 18, 2009, to pursue a limited rulemaking to specify a requirement for a site-specific analysis and associated technical requirements for unique waste streams including, but not limited to, the disposal of significant quantities of depleted uranium. In pursuing this limited rulemaking, NRC is not proposing to alter the waste classification scheme. However, for unique

waste streams including, but not limited to, significant quantities of depleted uranium, a need may exist to place additional criteria on its disposal at a specific facility or to deny such disposal based on unique site characteristics. Those restrictions would be determined via a site-specific performance assessment analysis, which satisfies the requirements, developed through the rulemaking process.

On June 24, 2009, NRC announced in the *Federal Register*, 74 FR 30175, that it is seeking early public input on major issues associated with potential rulemaking for land disposal of unique waste streams including, but not limited to, significant quantities of depleted uranium in near-surface, low-level radioactive waste facilities. NRC staff conducted public workshops in Rockville, Maryland, on September 2-3, 2009, and in Salt Lake City, Utah, on September 23-24, 2009, to discuss issues associated with rulemaking.

The staff is working on the development of the technical basis for the draft rulemaking. The technical basis will consider the input from the stakeholders at the workshops and the input provided to the docket.

15. Extended Storage and Transportation of Spent Nuclear Fuel

In February 2010, the Commission issued SRM-COMDEK-09-0001 that directed the staff to undertake a thorough review of the regulatory programs for spent fuel storage and transportation to evaluate their adequacy for ensuring safe and secure storage and transportation of spent nuclear fuel for extended periods considered beyond 120 years. The SRM also directed staff to undertake research to bolster the technical bases of NRC's regulatory framework for extended storage periods, identify risk-informed performance-based enhancements that will bring increased predictability to the regulatory processes. In June 2010, the staff provided a project plan for Extended Storage and Transportation (EST) to the Commission for approval in COMSECY-10-0007 (ML101390216). For enhancing the regulatory framework for EST, key objectives include performing regulatory gap assessments and technical reviews; implementing additional research and technical assessments; developing guidance and regulatory bases for EST; and implementing guidance and potential rule changes to support EST. The project plan includes performing a gap assessment of activities and regulatory framework products that may benefit from Risk-Informed and Performance-Based enhancements. Detailed plans will be developed for actual risk-informing implementation activities after the completion of the gap assessment.

The Office of Research is currently implementing research under existing user needs that are integral to EST technical needs. In addition, the Electric Power Research Institute (EPRI), the U.S. Department of Energy (DOE), utilities, international entities, and others will also conduct experiments and collect data to examine the viability of extended storage and transportation. The staff expects to participate independently in external initiatives and share information as appropriate.

Stabilizing Probabilistic Risk Assessment (PRA) Quality Expectations:

The staff has had several ongoing efforts in stabilizing expectations for PRA quality. These efforts have been part of the plan for the Phased Approach to PRA quality (ML041470505). The plan involved a three-phased approach that defined the needed PRA quality for current or anticipated applications and the process for achieving the quality while allowing risk-informed decisions to be made using currently available methods until the necessary guidance documents defining quality were developed and implemented.

On December 18, 2003, the Commission issued Staff Requirements Memorandum (SRM) COMNJD-03-0002, "Stabilizing the PRA Quality Expectations and Requirements" (Agencywide Document Access and Management System (ADAMS) Accession No. ML033520457) in which the Commission approved implementation of a phased approach to achieving an appropriate level of quality for PRAs associated with risk-informed regulatory decisionmaking. The Commission recognized that not all the necessary guidance (e.g., PRA standards) were developed and implemented. The staff submitted the plan to the Commission in SECY-04-0118, "Plan for the Implementation of the Commission's Phased Approach to Probabilistic Risk Assessment Quality," on July 13, 2004 (ADAMS Accession No. ML041470505), and received approval in an SRM dated October 6, 2004 (ADAMS Accession No. ML042800369). The staff's plan involved a three-phased approach:

- Phase 1 represented the situation, where guidance on PRA quality is general, and staff review of the base PRA supporting the activity was performed on a case-by-case basis. In this phase, while all contributions to risk from the different operational modes and internal and external initiating events had to be addressed when making the decision, if the PRA did not include an assessment of some of these contributions, they could have been addressed qualitatively, by bounding methods, by implementing compensatory measures, or by defining the change so that the risk from these missing contributions was not impacted (i.e., did not significantly affect the decision).

- Phase 2 took advantage of the work that had been performed to develop PRA standards. Phase 2 occurred when PRA standards and the associated regulatory guides were in place to address those PRA scope items that are significant to the decision. To be in Phase 2, the licensee's submittal was expected to be in conformance with the published NRC-endorsed standards as they were relevant to the specific application.

- Phase 3 provided a regulatory framework for the development of a PRA that would be of sufficient quality to support current and anticipated applications. Phase 3 was completed by December 31, 2008. It is the staff's intention once Phase 3 was achieved and following a reasonable transition period, to return non-conforming applications (approved in July 13, 2004 SRM to SECY-04-0118).

Central to the plan was the development and staff endorsement of national consensus Level 1 (core damage frequency) and limited Level 2 (large early release frequency) PRA standards and associated industry guidance documents, such as peer review guidance. Regulatory Guide (RG) 1.200 was developed and describes an acceptable approach for determining the technical adequacy of the PRA to support risk-informed regulatory decision. RG 1.200 provides the staff position for one acceptable approach and allows an NRC-endorsed consensus standard in conjunction with a peer review to be used to demonstrate conformance with the staff position.

As such, RG 1.200 endorses the relevant PRA standards and peer review guidance documents. Further, the plan allowed licensees up to 1 year following NRC endorsement (in RG 1.200) to implement the NRC-endorsed PRA standards for the various elements of the PRA (e.g., internal and external hazards, and at-power and low-power and shutdown modes of operation) and to perform the necessary peer review. Following the 1-year implementation period, the NRC expected all risk-informed license amendment submittals to be supported by a PRA that implements the appropriate revision of RG 1.200 for all aspects of the PRA that could impact the outcome of the licensing decision. The staff noted in the plan its intention of working closely with industry in the development of the guidance documents; however, the staff would develop the necessary standards not developed by a Standards Developing Organization.

Revision 2 to RG 1.200 was issued in March 2009 and endorsed the PRA Standard, ASME/ANS RA-Sa-2009. This standard provides requirements[1] for an at-power, Level 1/Limited Level 2 PRA addressing both internal and external hazards. Issuance of Revision 2 to RG 1.200 completed Phase 3 of the staff plan for operating reactors. At the time the plan was developed, peer review and technical guidance documents were recognized as being needed; however, they were not an aspect of completing Phase 3. Further, the plan did not address new reactor licensing.

ASME and ANS currently have efforts underway for development of standards to support new reactor licensing for both new light water reactors (LWRs) and advanced non-LWRs. Peer review guidance has been developed by NEI for addressing internal hazards which is endorsed in RG 1.200. No effort has been initiated at this time by industry for peer review guidance for addressing external hazards or PRA for new LWRs and advanced non-LWRs.

With regard to the development of guidance for technical issues needing resolution, the treatment of uncertainties, seismic and other external hazards, and human performance were identified. In addition, it was noted that as the guidance was implemented, additional technical issues would likely be identified. Work on uncertainties, external events and human performance is ongoing. Since the publication and implementation of Revision 2 to RG 1.200, insights and issues associated with RG 1.200 and the associated standards and peer review guidance have been identified. Some of the issues are associated with aspects of uncertainties, external events and human performance; other issues have been identified, but are also associated with ongoing efforts.

As part of the staff plan, the staff was to develop a “Phase 3 guidance document,” which was to represent “the union of all the documents related to quality for the PRAs addressing contributors to risk that are significant to any of the envisioned applications” for operating reactors. The staff is initiating efforts on the development of such a document. The objective of this document is to identify and link all the documents supporting the identified risk-informed activities for both operating and new reactors. As such, this document will identify where there are potential insufficiencies or gaps in support of PRA technical acceptability for risk-informed activities. For the identified risk-informed activities, the document will identify the risk metrics, the scope and level of detail, and the key technical issues and the nature (significance and complexity) of the issues that need to be addressed. Consequently, the document will identify what remaining standards are needed, and will also identify what methodology guidance is needed along with the specific issues to be addressed. In addition, this document will serve to identify high priority

[1] The standards are written in terms of “requirements.” Therefore, the use of this word is standards language (e.g., in a standard, it states the standards “sets forth requirements”) and is not meant to imply a regulatory requirement.

work and as a communication tool with industry. These activities will involve continuation of standards, peer review and technical guidance, and their status will be documented in future updates to the RPP. The staff will continue to work closely with industry in these efforts.