

**POLICY ISSUE
NOTATION VOTE**

February 18, 2011

SECY-11-0024

FOR: The Commissioners

FROM: R. W. Borchardt
Executive Director for Operations

SUBJECT: USE OF RISK INSIGHTS TO ENHANCE THE SAFETY FOCUS OF
SMALL MODULAR REACTOR REVIEWS

PURPOSE:

This paper responds to Staff Requirements Memorandum (SRM)-COMGBJ-10-0004/COMGEA-10-0001, "Use of Risk Insights to Enhance Safety Focus of Small Modular Reactor Reviews," dated August 31, 2010 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML102510405). This paper:

- (1) Requests Commission approval of the U.S. Nuclear Regulatory Commission (NRC) staff's recommended risk-informed and integrated review framework for the near-term efforts pertaining to integral pressurized-water reactor (iPWR) designs.
- (2) Requests Commission approval of the staff's plans for developing, over the longer term, a new risk-informed and performance-based regulatory structure for the licensing of advanced reactor designs (e.g., high-temperature gas-cooled reactors (HTGRs) and liquid metal reactors (LMRs)).
- (3) Informs the Commission of the staff's plans to resolve policy considerations for small modular reactor (SMR) licensing addressed in SECY-10-0034, "Potential Policy, Licensing, and Key Technical Issues for Small Modular Nuclear Reactor Designs," dated March 28, 2010 (ADAMS Accession No. ML093290268).

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- (4) Informs the Commission of staff resources needed to support the aforementioned activities.
- (5) Informs the Commission of the staff's activities and plans to engage SMR vendors and other external stakeholders in the development and implementation of these initiatives.

This paper doesn't address any new commitments.

SUMMARY:

The staff has developed a more risk-informed and more integrated review framework for pre-application and application review activities pertaining to iPWR designs in response to paragraphs a–c of SRM-COMGBJ-10-0004/COMGEA-10-0001. The proposed iPWR review framework is consistent with current regulatory requirements and Commission policy statements and builds on the staff's current application review process. In addition, the framework retains the current processes the staff uses to determine both safety class (i.e., safety-related or non-safety-related) and risk-significance. The framework is more risk-informed in that it provides a graded approach for the review of structures, systems, and components (SSCs) with the most detailed, in-depth review (analogous to the current review process) conducted for SSCs determined to be both safety-related and risk-significant, and a progressively less detailed review applied to SSCs determined to be non-safety-related or not risk-significant. The framework enhances the efficiency of the SSC review process by improving the integration of performance-based program requirements into the SSC review process. This integration is possible for most SSCs because of the correlation between certain review acceptance criteria (i.e., those criteria which are performance-oriented) and certain program requirements (i.e., those which are performance-based). The staff anticipates that implementation of the proposed iPWR review framework could result in efficiencies that would be incorporated into future budgets and application schedules.

This paper discusses the framework and NUREG-0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," "Introduction," Draft Revision 3 (ADAMS Accession No. ML110110701) (enclosed), describes the framework in detail. If the Commission approves, the staff would further refine and document the framework and prepare design-specific review plans derived from the framework for the anticipated near-term iPWR design applications. To support the development of the framework, the staff provided a preliminary briefing to the Advisory Committee on Reactor Safeguards (ACRS) Future Plant Designs Subcommittee on February 9, 2011, and plans to brief the full ACRS Committee in March 2011.

The staff has developed an approach for creating, over the longer term, a new risk-informed and performance-based regulatory structure for licensing advanced reactor designs (e.g., HTGRs and LMRs) in response to paragraph d of SRM-COMGBJ-10-0004/COMGEA-10-0001. The staff plans to refine and implement this approach and to subsequently recommend a proposed regulatory structure to the Commission. The staff's activities related to this initiative will be coordinated with and possibly integrated into or subsumed by the Task Force for Assessment of Options for More Holistic Risk-Informed, Performance-Based Regulatory Approach chartered by the Chairman's tasking memorandum to the Executive Director for Operations (EDO) and the General Counsel (OGC), dated February 11, 2011.

In response to paragraphs e–h of SRM-COMGBJ-10-0004/COMGEA-10-0001, this paper addresses staff activities pertaining to issues identified in SECY-10-0034; staff resources needed to support the aforementioned activities; and the staff's interactions with vendors, industry, and external stakeholders.

BACKGROUND:

As discussed in SECY-10-0034 and in other communications with the Commission, nuclear reactor vendors are developing SMR designs using several technologies. Potential applicants have notified the NRC that they may submit applications as early as fiscal year (FY) 2012. In SECY-10-0034, the staff identifies major policy considerations and technical issues pertaining to the design certification and licensing of these reactors.

In SRM-COMGBJ-10-0004/COMGEA-10-0001, the Commission directed the staff on the preparation for, and review of, applications with near-term focus on iPWR designs. The Commission directed the staff to more fully integrate the use of risk insights into pre-application activities and the review of applications and, consistent with regulatory requirements and Commission policy statements, to align the review focus and resources to risk-significant SSCs and other aspects of the design that contribute most to safety in order to enhance the efficiency of the review process. The Commission directed the staff to develop a design-specific, risk-informed review plan for each iPWR to address pre-application and application review activities. Over the longer term, the Commission directed the staff to develop a new risk-informed regulatory structure, building on insights from iPWR reviews, next generation nuclear plant (NGNP) review activities, and NUREG-1860, "Feasibility Study for a Risk-Informed and Performance-Based Regulatory Structure for Future Plant Licensing," issued December 2007. In addition, the Commission directed the staff to address resolution strategies for the policy considerations discussed in SECY-10-0034; to address staff resources involving this SRM; and to discuss staff interactions and outreach with SMR vendors, industry, and external stakeholders about this SRM.

DISCUSSION:

Risk-Informed Framework for the Licensing Review of Integral Pressurized-Water Reactors (Paragraphs a and b)

The staff has developed a more risk-informed and integrated review framework for pre-application and application review activities pertaining to iPWR designs in response to paragraphs a and b of SRM-COMGBJ-10-0004/COMGEA-10-0001. The following paragraphs discuss the framework, and the draft revised SRP (enclosed) describes the framework in detail.

The staff intends this review framework to be consistent with current regulatory requirements and Commission policy statements. It would provide guidance to the staff on the review of risk-significant SSCs and other aspects of the design that contribute most to safety in order to enhance the efficiency of the review process. This review framework builds on the current review process to result in a more risk-informed and integrated process for the review of iPWR designs. The processes described in the framework could result in efficiencies that would be incorporated into future budgets and application schedules.

The review framework addresses the level of detail in the staff's review of selected acceptance criteria, as defined in the staff's review guidance. It should be noted that this initiative does not change any regulatory requirements or Commission policy and makes no change to the current processes the staff uses to determine both safety class (i.e., safety-related or non-safety-related) and risk-significance of SSCs. The framework incorporates a more risk-informed approach to the staff's review by considering both the safety-importance and risk-significance of each SSC to help determine the appropriate level of review for each SSC. In this regard, the framework is similar to 10 CFR 50.69, "Risk-informed categorization and treatment of structures, systems, and components for nuclear power reactors." Risk-significance may be determined using a process similar to that used in identifying those SSCs included in the reliability assurance program (DC/COL-ISG-018, "Interim Staff Guidance on NUREG-0800 Standard Review Plan Section 17.4, 'Reliability Assurance Program'") and the results of that determination are used to guide the remainder of the review process. It should be noted the risk-significance determinations use not only risk insights from probabilistic risk assessments but also rely on deterministic approaches and defense-in-depth concepts. The framework provides a graded approach in which the staff would conduct the most detailed, in-depth review (analogous to the current review process) for SSCs determined to be both safety-related and risk-significant, and a progressively less detailed review would be applied to SSCs determined to be non-safety-related or not risk-significant. SSCs determined to be neither safety-related nor risk-significant would receive the least detailed review under this framework.

The review framework derives from the current review process, to include current reviewer guidance and SSC-specific acceptance criteria contained in the SRP, but it enhances the efficiency of the SSC review process by improving the integration of performance-based program requirements into the SSC review process. This integration is possible because of the correlation between certain acceptance criteria (i.e., those criteria which are performance-oriented) and certain program requirements (i.e., those which are performance-based). For most SSCs, specific acceptance criteria contained in the SRP may be characterized as either design-related criteria or performance-oriented criteria. The design-related criteria address SSC functions and adequacy of the design. The performance-oriented criteria address aspects of performance (e.g., the capability, availability, reliability, or maintainability) of the SSC. In addition to the SRP specific acceptance criteria, most SSCs are subject to programmatic requirements (e.g., technical specifications, availability controls for SSCs subject to the regulatory treatment of non-safety systems, the maintenance rule, reliability assurance program, initial test program) which also address aspects of performance. It is observed that, for most SSCs, a number of the performance-based measures identified in the programmatic requirements correlate with the performance-oriented acceptance criteria identified in the respective SRP sections. The staff's review of SSCs, under both the current review process and the proposed review framework, involves review against all of the SSC-specific acceptance criteria (i.e., both design-related and performance-oriented acceptance criteria), and, additionally, the applicable programmatic requirements. It should be noted that the proposed review framework makes no change to the current review process regarding review against the SSC-specific design-related acceptance criteria. However, the proposed review framework revises the current review process by providing for integration of the review of the performance-oriented acceptance criteria and the programmatic requirements.

The review framework, for review areas in which a correlation exists between specific performance-oriented acceptance criteria and performance-based program requirements, provides for identifying those program requirements as part of the SSC review. The framework

would use tests or inspections to either augment or replace, as appropriate, technical analysis and evaluation techniques that the staff currently applies. For SSCs determined to be both safety-related and risk-significant, the review would be detailed and in-depth (analogous to current review process), including independent technical analysis and evaluation, and the identification of correlated program requirements would augment the review. For SSCs determined to be non-safety-related and/or not risk-significant, the framework relies increasingly on specific elements (e.g., tests or inspections) of programmatic requirements to satisfy performance-oriented acceptance criteria for such SSCs. For example, the requisite monitoring and analyses of an SSC's performance that are associated with its inclusion within an applicant's reliability assurance program and maintenance rule program may be sufficient to satisfy performance-oriented acceptance criteria pertaining to the reliability, availability, and maintainability of the SSC.

The staff held a preliminary briefing to describe this framework to the ACRS Future Plant Designs Subcommittee on February 9, 2011. The staff plans to brief the full ACRS Committee in March 2011.

Risk-Informed, Design-Specific Review Plans for Licensing Integral Pressurized-Water Reactors (Paragraph c)

In response to paragraph c of SRM-COMGBJ-10-0004/COMGEA-10-0001, the staff plans to implement the aforementioned risk-informed and integrated review framework for each iPWR design application. The staff, with contract support from national laboratories, intends to prepare "design-specific review plans"—a unique plan for each iPWR design—that it will develop and initially implement during pre-application activities, update and modify as appropriate, and implement throughout the application review process.

A design-specific review plan would implement the risk-informed and integrated review framework for the specific iPWR design. The plan would be developed during the pre-application activities consistent with the schedule for application submittal. The plan would identify the specific pre-application and application review activities and the schedule for the activities. It would also provide guidance to support (1) the staff's review activities by incorporating provisions to tailor the SRP guidance (including key references such as regulatory guides) to the specific design (e.g., SRP sections added, deleted, or modified appropriate to specific design features and SSCs); and (2) the documentation of the staff's review by incorporating provisions to tailor the standard template for the safety evaluation report to correlate with specific SRP sections. The development of the design specific review plans may lead to the actual incorporation of some changes into the SRP (NUREG-0800) or regulatory guides but such changes would be coordinated with ongoing programs related to the maintenance of regulatory guidance documents and would, therefore, have minimal impact on activities such as the Regulatory Guide Update Program. To the extent that an iPWR design proposes an innovative means to accomplish a safety function, the staff will generally seek to conduct a more detailed, in-depth evaluation of the involved SSCs during the pre-application review. The plan would provide for ongoing communications and interactions between the staff, applicant, and other stakeholders to support the early identification and resolution of both technical and regulatory issues and to address the scope and scheduling of activities.

The staff expects the implementation of the review framework to result in a more efficient review process. The staff intends to focus initial efforts on implementing the framework and on

familiarizing reviewers with the revised review process. To this end, the staff is exploring use of a “review team” concept as the means for implementing the framework for iPWR design reviews. Under one option for this concept, a multidisciplinary team of staff within the Office of New Reactors (NRO), supported as needed by staff from the Office of Nuclear Regulatory Research, other program offices, and contractors, would be tasked with supporting the initial iPWR design review and providing guidance and training to other NRC reviewers. Other options are being evaluated as the staff seeks to implement lessons learned from the large light water reactor reviews.

In addition to implementing the review framework, the staff plans to review the scope, procedures, and schedules related to pre-application and post-application activities for possible efficiency enhancements to the overall review process. Based on experiences from recently completed and current application reviews, the staff expects to expand the scope of pre-application activities. For example, the staff anticipates conducting audits of preliminary vendor design information and probabilistic risk assessments early in the pre-application process.

New Risk-Informed Regulatory Structure (Paragraph d)

In response to paragraph d of SRM-COMGBJ-10-0004/COMGEA-10-0001, the staff has devised an approach for the development, over the longer term, of a new risk-informed and performance-based regulatory structure for licensing advanced reactor designs (e.g., HTGRs and LMRs). The staff’s approach is a multistep process that would extend over several years and would include several pilot studies in which the principles of a technology-neutral regulatory framework are considered for an iPWR design application, the NGNP pre-application and application activities, and the pre-application activities for LMR designs. The staff plans to refine and implement this approach, periodically update the Commission, and subsequently provide the Commission with its recommendation on a new regulatory structure.

SECY-09-0056, “Staff Approach Regarding a Risk-Informed and Performance-Based Revision to Part 50 of Title 10 of the *Code of Federal Regulations* and Developing a Policy Statement on Defense-in-Depth for Future Reactors,” dated April 7, 2009, describes current NRC activities related to the development of a risk-informed regulatory structure. The staff’s plans involve continuation of pre-application activities pertaining to the NGNP program and the testing of a more risk-informed regulatory structure in parallel with the review of the NGNP application. As described below, the existing plans have been updated and several activities (e.g., items described in SECY-09-0056 and COMSECY-08-0018, “Report to Congress on Next Generation Nuclear Plant (NGNP) Licensing Strategy,” dated June 16, 2008) have been consolidated into an updated plan.

The first step of the approach would be to acquire insights pertaining to iPWR designs. The staff would conduct a pilot study of an iPWR design application by applying the principles of a technology-neutral regulatory framework (e.g., NUREG-1860) for review of the application. This pilot study is distinct from the licensing review described in the previous sections. The staff would conduct the pilot study in parallel with review of the iPWR design application. The staff would determine the scope and depth of the pilot study during the iPWR pre-application activities (using preliminary results from PRAs) and would begin the pilot study following the submittal of the application. The staff intends to conduct this study in cooperation with the applicant and in a manner to minimize burden on the applicant. The staff may need to make assumptions or otherwise compensate for limitations on interactions with designers and the

possible lack of information beyond that needed for the actual licensing review. The staff would develop and document insights that it acquires from the pilot study. The staff plans to conduct the study in FY 2013.

To acquire insights pertaining to HTGR designs, the staff would continue ongoing and planned NGNP pre-application interactions and review activities (e.g., review of white papers and participation in topical public meetings) and compare and contrast the proposed NGNP regulatory approach with the principles of a technology-neutral regulatory framework (e.g., NUREG-1860). Depending on the relative timing of the NGNP and iPWR application submittals, this study might be informed by the pilot study for iPWRs. Following the submittal of the NGNP design application, the staff plans to conduct a limited comparison study of the application, applying the principles of a technology-neutral regulatory framework (e.g., NUREG-1860), in parallel with its review of the NGNP design application. The staff would conduct the comparison study in cooperation with the applicant and in a manner to minimize burden on the applicant. The staff would develop and document insights that it acquires. Based on the current schedule, the staff plans to conduct the comparison study in FY 2014-2015.

To acquire insights pertaining to LMR designs, the staff would continue its limited pre-application interactions with potential LMR applicants (e.g., the PRISM and 4S reactor designs); would review American Nuclear Society 54.1, "Nuclear Safety Criteria and Design Process for Sodium Cooled Nuclear Power Plants," which is currently under development; and would participate, consistent with resource availability, in international forums on fast reactors. The staff would compare and contrast the information acquired in these interactions and activities to the principles of a technology-neutral regulatory framework (e.g., NUREG-1860). The staff plans to develop and document any insights related to LMRs.

The staff intends to consolidate the insights acquired from the aforementioned activities; the insights would collectively form the bases for a recommendation to the Commission that addresses a new risk-informed and performance-based regulatory structure. The staff's activities related to this initiative will be coordinated with and possibly integrated into or subsumed by the Task Force for Assessment of Options for More Holistic Risk-Informed, Performance-Based Regulatory Approach chartered by the Chairman's tasking memorandum to the EDO and OGC, dated February 11, 2011.

SECY-10-0034 Policy Considerations (Paragraph e)

In response to paragraph e of SRM-COMGBJ-10-0004/COMGEA-10-0001 and committed to previously in SECY-10-0034, the staff will update the Commission periodically on its development and implementation of issue resolution plans related to advanced reactors. The staff provides the Commission with an updated status of its activities quarterly; "Quarterly Report on the Status of New Reactor Licensing Activities, October 1, 2010–December 31, 2010" (ADAMS Accession No. ML103470716) is the most recent update of the staff's activities.

Staff Resources (Paragraph f)

In response to paragraph f of SRM-COMGBJ-10-0004/COMGEA-10-0001, the staff has evaluated the resource needs to support these Commission-directed activities. The Resources section below discusses these needs.

Interactions with Small Modular Reactor Vendors and External Stakeholders (Paragraphs g and h)

The staff has initiated a series of public regulatory workshops focused on topics of interest to SMR vendors and other external stakeholders with SMR-related interests (e.g., the issues addressed in SECY-10-0034). These public workshops are part of the staff's overall interactions with industry and preparations for potential SMR applications. The staff began the workshops in July 2010; they take place approximately every 6 weeks and will continue at least throughout 2011. To date, the workshops have been well attended and include participants from SMR vendors and external stakeholder entities. Representatives from the Nuclear Energy Institute attended the meetings and presented industry positions on several issues addressed in SECY-10-0034.

In response to paragraphs g and h of SRM-COMGBJ-10-0004/COMGEA-10-0001, the staff included a discussion of this SRM at the public workshops. For example, at the workshop conducted in September 2010, the staff discussed the content of the SRM, presented its initial outline of the risk-informed and integrated review framework for iPWRs, discussed the planned approach for developing a new risk-informed regulatory structure for advanced reactors, and solicited stakeholder feedback. At the workshops conducted in November 2010 and January 2011, the staff presented an update of the information provided at the September 2010 workshop and engaged attendees in question and answer sessions. Vendors, industry representatives, and external stakeholders expressed general support for the review framework for iPWRs. Vendors and industry representatives reiterated their interest in an overall reduction in review costs and schedule. The staff plans to provide updates at future workshops and to continue to engage vendors and external stakeholders on the activities associated with this SRM and other SMR topics of interest. In addition, the staff has conducted site visits at the facilities of potential applicant's in support of pre-application activities.

RECOMMENDATIONS:

The staff recommends that the Commission approve the use of the risk-informed and integrated review framework for staff pre-application and application review activities pertaining to iPWR design applications. In addition, the staff recommends that the Commission approve consolidation of staff activities currently underway regarding a risk-informed regulatory structure (i.e., WITS 200700304, 200700305, and 200800305) into the staff's plan discussed in this paper for the longer term development of a recommendation related to a new risk-informed regulatory structure. The staff notes that activities related to this plan will be coordinated with and possibly integrated into or subsumed by the Task Force for Assessment of Options for More Holistic Risk-Informed, Performance-Based Regulatory Approach chartered by the Chairman's tasking memorandum to the EDO and OGC, dated February 11, 2011.

RESOURCES:

The staff estimates that the total resources needed to support the activities described in this paper that are included in the FY 2011 President's Budget are 4.0 full time equivalent (FTE) and \$500,000. The 4 FTE includes 3 FTE to support the near-term iPWR-related activities and 1 FTE to support the longer-term non-iPWR activities. The resources requested in the FY 2012 budget needed to support these activities are 4 FTE and \$250,000. The 4 FTE includes 2 FTE for the near-term iPWR-related activities and 2 FTE for the longer-term non-iPWR activities. For both years, the staff estimates about 1.0 FTE of the total will be needed from the Office of Nuclear Regulatory Research (RES). For FY 2013 and beyond, the staff estimates that the resources needed to support the near-term iPWR-related activities will decrease to approximately 1 FTE and \$250,000 as the risk-informed and integrated review framework is implemented for iPWR reviews; however, the resources needed to support non-iPWR activities will increase for both NRO and RES as the effort expands to develop a new risk-informed, performance-based regulatory structure. The FY 2013 and beyond resources will be requested through the planning, budgeting, and performance management process. The staff will further clarify resource needs as the schedules for application submittals become more certain and as pre-application activities proceed.

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 by Martin J. Virgilio for/

R. W. Borchardt
Executive Director
for Operations

Enclosure:

NUREG-0800, "Standard Review Plan
for the Review of Safety Analysis Reports
for Nuclear Power Plants," Introduction,
Draft Revision

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COORDINATION:

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Enclosure:

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SECY-012

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