

Background and History

Baseline risk estimates for most new reactor designs are lower than those for a design similar to that of the current fleet (potentially by an order of magnitude or more) when internally initiated events and externally initiated events that have been quantified are included. The lower risk values raised questions about how to apply acceptance guidelines for changes to the licensing basis and regulatory response in the Reactor Oversight Process (ROP). The staff developed a white paper in February 2009 that identified the issues posed by the lower risk estimates for new reactor designs in risk-informed applications and potential options for implementation (Agencywide Documents Access and Management System (ADAMS) Accession No. ML090160004).¹ The Nuclear Energy Institute developed an additional white paper in March 2009 to discuss these issues and recommended no change to the current risk metrics (ADAMS Accession No. ML090900674). Staff and industry representatives briefed the Advisory Committee on Reactor Safeguards (ACRS) and held public meetings, including one that focused on the potential issues associated with the ROP (ADAMS Accession No. ML092780211).

Based on these interactions, the staff developed a draft Commission paper (ADAMS Accession No. ML101090355) to describe the staff's plans to identify appropriate changes to the risk-informed guidance for new reactors. The staff held another public meeting and an ACRS briefing in June 2010 to review the draft paper and discuss the path forward. In a letter to the Commission dated July 27, 2010 (ADAMS Accession No. ML102000422), ACRS agreed with the staff's position on the proposed framework as described in Option 2 of that draft paper. The staff reviewed the ACRS letter and responded on August 25, 2010 (ADAMS Accession No. ML102210553). The final Commission paper, SECY-10-0121, "Modifying the Risk-Informed Regulatory Guidance for New Reactors," was issued on September 14, 2010 (ADAMS Accession No. ML102430197). The two white papers and the ACRS correspondence were included as enclosures to that paper. A Commission briefing on the topic was held on October 14, 2010.

Subsequently, the Commission issued a staff requirements memorandum (SRM) on March 2, 2011, directing the staff to continue to use the existing risk-informed framework, including current regulatory guidance, for licensing and oversight activities for new plants, pending additional analysis (ADAMS Accession No. ML110610166). In the SRM, the Commission stated that it "reaffirms that the existing safety goals, safety performance expectations, subsidiary risk goals and associated risk guidance (such as the Commission's 2008 Advanced Reactor Policy Statement and Regulatory Guide 1.174), key principles and quantitative metrics for implementing risk-informed decision making, are sufficient for new plants."

The Commission further stated that "new reactors with these enhanced margins and safety features should have greater operational flexibility than current reactors. This flexibility will provide for a more efficient use of U.S. Nuclear Regulatory Commission (NRC) resources and allow a fuller focus on issues of true safety significance." The Commission also directed the staff to engage with external stakeholders in a series of tabletop exercises to test various realistic performance deficiencies, events, modifications, and licensing-bases changes against

current NRC policy, regulations, guidance, and all other requirements (e.g., technical specifications, license conditions, and code requirements) that are or will be relevant to the licensing bases of new reactors. The purpose of the tabletop exercises was to either confirm the adequacy of those regulatory tools (and make the NRC aware of these potential scenarios so that commensurate regulatory oversight can be applied) or identify areas for improvement, such as potential adjustments to the ROP.

In response to the SRM on SECY-10-0121, the staff conducted a series of public workshops and meetings with stakeholders in 2011 and provided a status briefing to the ACRS Subcommittee on Reliability and PRA on September 20, 2011. Based on these interactions, the staff developed a draft Commission paper (ADAMS Accession No. ML12011A191) describing the results of the tabletop exercises, including key observations and conclusions regarding regulatory and programmatic controls that strengthen the various programs and tend to limit the decrease in the enhanced safety margin of the new reactor designs. The staff held another public meeting on February 28, 2012, and briefed the ACRS Subcommittee on Reliability and PRA on March 7, 2012, to review the draft paper and discuss the path forward. A briefing of the full ACRS was held on April 12, 2012. The ACRS provided its conclusions and recommendations to the Commission in letter dated April 26, 2012 (ADAMS Accession No. ML12107A199). The staff provided a response to each of the recommendations in the ACRS letter dated May 30, 2012 (ADAMS Accession No. ML12123A695). The final Commission paper, SECY-12-0081, "Risk-Informed Regulatory Framework for New Reactors," was issued on June 6, 2012 (ADAMS Accession No. ML12117A012).

As noted in SECY-12-0081, the ROP tabletops tested various realistic scenarios that are or will be relevant to the licensing bases for new reactors to confirm the adequacy of the current ROP risk-informed processes for regulatory decisionmaking or identify areas for improvement. In preparation for the ROP tabletops, the staff developed a broad cross-section of well-vetted cases from actual greater-than-green significance determination process (SDP) findings, mitigating systems performance index (MSPI) data, and event response (in the risk-informed reactor-safety cornerstones of initiating events, mitigating systems, and barrier integrity) from the current fleet of reactors. For each case study, the staff applied similar situations to the new reactor designs, filling in any gaps with realistic hypothetical situations and reasonable assumptions, and then compared the risk values and resultant regulatory responses from the new reactor scenarios to those derived from the current fleet. A complete summary of the ROP tabletop examples and results was made publicly available (ADAMS Accession No. ML11308A354). In summary, the ROP tabletops demonstrated that current risk thresholds were appropriate for ROP applications; however, a few changes to the ROP might be warranted to implement the existing risk-informed concepts of Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," for new reactors, and the staff presented three options for consideration by the Commission. The staff recommended an option (Option 3B) in which the staff, after working with internal and external stakeholders, would identify appropriate changes to augment the existing risk-informed guidance with deterministic backstops to ensure an appropriate regulatory response for the new reactor designs. Under this recommended option, the staff would:

- (1) Develop deterministic backstops or other qualitative considerations for characterizing the significance of inspection findings in the reactor safety cornerstones to compensate for

shortfalls noted during the tabletop exercises and allow for a transparent and predictable process for determining the appropriate regulatory response to address performance issues.

- (2) Modify the contribution of existing deterministic criteria or develop new deterministic criteria for initiating a reactive inspection for events or degraded conditions at new reactor facilities, to provide a transparent and predictable process for determining the appropriate regulatory response to plant events.
- (3) For active new reactor designs, develop a risk-informed alternative to MSPI (new performance indicators (PIs) or risk-informed inspection) or augment the existing MSPI guidance to place more emphasis on the performance limit (backstop) or revise the performance limit (backstop); also, for passive new reactor designs, increase inspection of passive mitigating systems as necessary to supplement insights that will not be afforded with MSPI.

Additionally, as noted in SECY-12-0081, several current regulatory and programmatic controls exist, and can be leveraged as necessary, to help inform and ensure appropriate response and oversight: (1) the ROP self-assessment process would be used to evaluate and potentially adjust the ROP for new reactors in the future as a result of additional experience and lessons learned; (2) all inspection findings (including those characterized as having very low safety significance) would be entered in the licensee's corrective-action program, would receive attention by licensees and the NRC, and would also be considered for cross-cutting aspects in accordance with the current process; and (3) deviations from the ROP Action Matrix could also be used to adjust the staff's actions to provide for an appropriate regulatory response, if deemed necessary, and then each deviation would be evaluated for potential program improvements.

The staff also acknowledged in SECY-12-0081 that the ACRS recommended that the staff consider a relative risk option for the ROP in their letter dated April 26, 2012. The staff noted its belief that an approach involving relative risk was previously considered but was not pursued for various reasons. In addition, the staff's proposed approach of using deterministic backstops to supplement the risk insights is a simpler approach to achieving the desired outcome while remaining consistent with the existing ROP framework and program goals of being objective, risk-informed, understandable, and predictable. In the February 2009 white paper, the staff considered the merits of a relative risk metric, but impediments to this approach were identified by both internal and external stakeholders. Therefore, the staff did not consider this option further or include it in SECY-10-0121. In its SRM to SECY-10-0121, the Commission did not approve the development of lower numeric thresholds for new reactors in which the ACRS recommendation would effectively result. In addition, the staff's proposed approach is consistent with the existing ROP framework, which provides for deterministic considerations in regulatory decision-making in accordance with RG 1.174; deterministic backstops for new reactors would provide a clear, efficient, and reliable way of ensuring appropriate and predictable regulatory responses within the existing ROP framework, in ways consistent with the principles of good regulation.

In its SRM to SECY-12-0081, "Risk-Informed Regulatory Framework for New Reactors," dated October 22, 2012 (ADAMS Accession No. ML12296A158), the Commission disapproved the staff's recommendation (Option 3B) related to the ROP. Specifically, the Commission directed

the staff to give additional consideration to the use of relative risk metrics, or, if the staff believes that this is not a viable option for new reactor oversight, the Commission directed the staff to provide a technical basis for its conclusions. The SRM further stated that the staff should provide the Commission with a notation vote paper that contains:

- (1) a technical basis for the staff's proposal for the use of deterministic backstops, including examples
- (2) a technical evaluation of the use of relative risk measures, including a reexamination of the pros and cons listed in the staff's 2009 white paper
- (3) a discussion of the appropriateness of the existing performance indicators and the related thresholds for new reactors

The SRM also requested that the staff: (1) provide an information paper to the Commission that reviews the history of the NRC's use and consideration of large release frequency and (2) pursue an independent review of the ROP's objectives and implementation. Those two activities are outside the scope of this paper. SECY-13-0029, "History of the Use and Consideration of the Large Release Frequency Metric by the U.S. Nuclear Regulatory Commission," was issued on March 22, 2013 (ADAMS Accession No. ML13022A207), and the independent review will also be addressed separately.