

POLICY ISSUE

(Information)

September 13, 2012

SECY-12-0123

FOR: The Commissioners

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

SUBJECT: UPDATE ON STAFF PLANS TO APPLY THE FULL-SCOPE SITE
LEVEL 3 PRA PROJECT RESULTS TO THE NRC'S REGULATORY
FRAMEWORK

PURPOSE

In response to the Commission direction in the staff requirements memorandum (SRM) (Agencywide Documents and Management System [ADAMS] Accession No. ML112640419) resulting from SECY-11-0089, "Options for Proceeding with Future Level 3 Probabilistic Risk Assessment (PRA) Activities" (ADAMS Accession No. ML11090A039), this paper updates the Commission on the plans to apply the full-scope site Level 3 PRA project results to the U.S. Nuclear Regulatory Commission's (NRC's) regulatory framework.

BACKGROUND

The last Level 3 PRA study sponsored by the NRC was completed in 1990 (NUREG-1150¹). Since that time, there have been numerous technical advances in PRA and related fields, as well as plant modifications, that are not reflected in the NUREG-1150 PRA models. In addition, Level 3 PRAs for nuclear power plants have been conducted in the U.S.² and other

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¹ NUREG-1150, "Severe Accident Risk: An Assessment for Five U.S. Nuclear Power Plants," December 1990 (ADAMS Accession No. ML040140729).

² For example, Seabrook Station has a Level 3 PRA (ADAMS Accession No ML062770173).

countries.³ In SECY-11-0089 (ADAMS Accession No. ML11090A041), the staff proposed three options for proceeding with Level 3 PRA activities. In the SRM related to SECY-11-0089, the Commission approved a modified version of Option 3, to conduct a full-scope site Level 3 PRA for an operating plant.

The full-scope site Level 3 PRA project, as described in SECY-11-0089, will develop a Level 3 PRA, generally based on current state-of-practice methods, tools, and data,⁴ to meet the following objectives:

- Reflect technical advances since completion of the NUREG-1150 studies, and address scope considerations that were not previously considered (e.g., low power and shutdown,⁵ multi-unit risk, and spent fuel storage).
- Extract new risk insights to enhance regulatory decision making and help focus limited agency resources on issues most directly related to the agency's mission to protect public health and safety.
- Enhance NRC staff's PRA capability and expertise and improve documentation practices to make PRA information more accessible, retrievable, and understandable.
- Obtain insight into the technical feasibility and cost of developing new Level 3 PRAs.

SRM-SECY-11-0089 states:

"A necessary outgrowth of this effort should be the development, early in the project, of a clear articulation of how the results of the analysis can be applied consistent with the NRC's Principles of Good Regulation. A paper updating the Commission regarding the staff's plans to apply the Level 3 PRA results to the NRC's regulatory framework should be provided to the Commission for information 12 months after the issuance of the staff requirements memorandum (SRM) resulting from SECY-11-0089."

This paper provides the requested update.

As stated in the initial Level 3 PRA project plan (ADAMS Accession No. ML120370031⁶), Southern Nuclear Operating Company's Vogtle Electric Generating Plant, Units 1 and 2,⁷ was selected as the volunteer site for the Level 3 PRA study. While the Level 3 PRA study is for a single multi-unit site, and many of the insights obtained may not be applicable to other plant designs, other multi-unit sites, and all technical issues, the NRC staff anticipates that some insights obtained will be applicable to similar plants, and may be used to inform or enhance regulatory decision making.

³ Nuclear Energy Agency, Committee on the Safety of Nuclear Installations, "Use and Development of Probabilistic Safety Assessment," NEA/CSNI/R(2007)12, November 14, 2007.

⁴ "State-of-practice" methods, tools, and data refer to those that are routinely used by the NRC and licensees or have acceptance in the PRA technical community.

⁵ While NUREG-1150 only addressed reactor operation at-power, the NRC subsequently sponsored two studies that addressed reactor risk for some low power and shutdown modes of operation (NUREG/CR-6143, "Evaluation of potential severe accidents during low power and shutdown operations at Grand Gulf, Unit 1," July 1995 [ADAMS Accession No. ML070530630], and NUREG/CR-6144, "Evaluation of potential severe accidents during low power and shutdown operations at Surry, Unit 1," October 1995 [ADAMS Accession No. ML070570112]).

⁶ A publicly available version of this plan is available at ADAMS Accession No. ML121320310.

⁷ Southern Nuclear Operating Company has received a combined license for two additional nuclear reactors at the Vogtle site. The two new reactors are not within the scope of this study.

The NRC's recently completed state-of-the-art reactor consequence analyses (SOARCA) project addressed a few of the same issues that the Level 3 PRA project intends to address. However, while the Level 3 PRA and SOARCA projects share some technical elements and have complementary roles, they do not directly overlap in purpose and use to the NRC. The SOARCA project involved a severe accident consequence study and examined in detail several accident sequences considered to be most significant to plant risk. The Level 3 PRA project, on the other hand, will examine a much broader spectrum of accident sequences, including those involving multiple units, spent fuel pools, and dry cask storage, and determine their relative risk significance, leveraging the insights and results from the SOARCA project. The NRC staff will then further evaluate the most risk-significant sequences to determine which should be further refined or would benefit from updated methods or data (e.g., determining if the risk contribution of the sequences is largely driven by conservative assumptions). One outcome of this approach is that the level of detail may vary in different areas of the PRA, based on the relative contribution to plant or site risk (e.g., accident sequence timing may be more rigorously evaluated for risk-dominant sequences).

DISCUSSION

The Commission's 1995 PRA Policy Statement⁸ states that the use of PRA should be encouraged and expanded in all nuclear regulatory matters to the extent supported by current methods and data. Per the PRA policy statement, PRAs and associated analyses (e.g., sensitivity studies, uncertainty analyses, and importance measures) are intended to be used in regulatory matters where practical, and within the bounds of the state-of-the-practice, to reduce unnecessary conservatism associated with current regulatory requirements, regulatory guides, license commitments, and staff practices, or, where appropriate, to support additional regulatory requirements. This Level 3 PRA project intends to further implement the goals of the PRA policy statement and allow for enhanced use of PRA for regulatory decisions. In addition, for new reactors, there are additional regulatory requirements associated with PRA. As stated in 10 CFR 50.71(h), each holder of a combined license under subpart C of 10 CFR part 52 is required to develop and maintain a Level 1 and Level 2 PRA (though 10 CFR 50.71(h) does not require the PRA to be extended to Level 3).

Potential uses of the Level 3 PRA can be categorized as follows: enhancing the technical basis for the use of risk information, improving the PRA state-of-practice, identifying safety and regulatory improvements, and supporting knowledge management. The following describes some of the principal uses of the Level 3 PRA in each of these categories. Enclosure 1 provides a more complete and detailed list of the potential uses of the Level 3 PRA project.

Enhancing the Technical Basis for the Use of Risk Information

- *Obtain updated and enhanced understanding of plant risk.* As mentioned previously, it has been more than two decades since the NRC last sponsored a Level 3 probabilistic risk assessment (PRA) study (NUREG-1150). Since that time, there have been numerous technical advances in PRA and related fields, as well as changes in plant operational performance and safety. As such, a new Level 3 PRA study should provide

⁸ 60 FR 42622, "Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities; Final Policy Statement," August 16, 1995.

new insights into plant risk contributors based on these technical advances and plant changes.

- *Inform agency activities regarding emergency preparedness.* It is expected that insights from the current Level 3 PRA study could inform the process for evaluating the potential impact that a multi-unit accident (or an accident involving spent fuel) may have on the efficacy of the emergency planning zone (EPZ) in protecting public health and safety.⁹

Improving the PRA State-of-Practice

- *Demonstrate new methods for site risk assessments.* Some previous risk studies have been performed for spent fuel pools (e.g., NUREG-1738¹⁰) and dry cask storage (e.g., NUREG-1864¹¹). However, due to the specific objectives of these previous studies, the methods used may need to be enhanced for use in the Level 3 PRA (e.g., in the areas of success criteria determination, human reliability analysis, accident phenomena, and source term analysis). In addition, the Level 3 PRA project includes risk assessment of areas for which no established methods currently exist, such as addressing multi-unit risk. This project will help develop new risk assessment technology and apply risk assessment technology in areas where it has not been broadly applied, thus improving our PRA state of knowledge.
- *Support development of PRA screening processes.* Screening analyses are performed throughout PRAs (e.g., screening of initiating events; structures, systems, and components; human failure events; and hazards) to determine the necessary scope and level of detail required in developing the various models that support the overall PRA model. Currently, there is no consensus within the PRA community on a consistent set of screening criteria for determining the needed scope and level of detail. This study should provide insights regarding technically acceptable screening processes.

Identifying Safety and Regulatory Improvements

- *Identify potential safety improvements that may be voluntarily implemented by licensees.* This study has the potential to identify accident prevention, accident mitigation, and emergency planning safety improvements for the reactor, the spent fuel pool, and dry cask storage that the licensee may choose to voluntarily implement. For example, the Level 3 PRA study should provide insights regarding the overall integrated risk of all major site radiological sources,¹² which could be used by the licensee to prioritize accident management strategies for responding to accidents involving more than one of these sources. Also, NUREG-1150 and the individual plant examination studies identified plant features that provided safety improvements and that could be applied to other plants (e.g., for flooding scenarios, designing door swing-out directions based on

⁹ Insights gained from the Level 3 PRA study are expected to include radiological source term characterization to support determination as to whether the EPZ size and response timing remains protective of public health and safety in response to severe accidents.

¹⁰ NUREG-1738, "Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants," February 2001.

¹¹ NUREG-1864, "A Pilot Probabilistic Risk Assessment of a Dry Cask Storage System at a Nuclear Power Plant," March 2007.

¹² Including all reactor cores, spent fuel pools, and dry storage casks on site, but excluding fresh nuclear fuel, radiological waste, and minor radiological sources (e.g., calibration devices).

which side of the door the flood water will likely be encroaching from and whether it is more beneficial to have the water flow out of the room of interest or remain contained within it). The Level 3 PRA study may also identify safety improvements that may be voluntarily implemented at other plants.

- *Identify potential safety improvements that may lead to regulatory improvements.* As stated above, this study has the potential to identify accident prevention, accident mitigation, and emergency planning safety improvements for the reactor, the spent fuel pool, and dry cask storage. Some of these safety improvements could have generic implications, not limited to the subject site, and may warrant further evaluation by the NRC and possible inclusion in the Generic Issues Program or other regulatory action.

Supporting Knowledge Management

- *Develop in-house PRA technical capabilities and support PRA knowledge management and risk communication activities.* As this project progresses, the NRC staff's understanding of PRA will be enhanced, particularly in areas where current experience is limited (e.g., calculating dry cask and spent fuel pool risk). Improving the staff's PRA skills will increase the NRC's ability to support risk assessment in-house. Familiarity with PRA methods and approaches will be needed if the staff begins to exercise a new risk informed framework for future reactor designs (e.g., NUREG-1860¹³). Additionally, the Level 3 PRA model will be a maintainable PRA tool that can continue to support future PRA training, research, and other regulatory applications (e.g., evaluating emerging technical issues).
- *Enhance PRA documentation practices.* A key aspect of any PRA is the adequacy of the supporting documentation. The documentation provides the basis for the technical acceptability of the study. The Level 3 PRA project will examine ways to more effectively and efficiently meet PRA documentation needs. In addition, the project should provide insights into how to perform the documentation in a consistent manner, compatible with the documentation guidance in Regulatory Guide 1.200,¹⁴ which would improve the efficiency of NRC and industry PRA reviews.

The staff recognizes there have been two recent studies that have examined the regulatory process and provided recommendations for an improved risk-informed regulatory structure, as documented in the Risk Management Task Force report (NUREG-2150, "A Proposed Risk Management Regulatory Framework" [ADAMS Accession No. ML12109A277]) and the Commission paper on Near-Term Task Force recommendations (SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan" [ADAMS Accession No. ML11186A959]). The NRC staff is working on a Commission paper that will provide recommendations on how to disposition these recommendations. It is envisioned that the results from the Level 3 PRA project will provide insights into implementing any revisions to the NRC's regulatory framework that the Commission approves. For example, NUREG-2150 identifies three categories for regulatory classification of events: adequate protection, design enhancement, and residual risk. If the staff were to propose, and the Commission were to

¹³ NUREG-1860, "Feasibility Study for a Risk-Informed and Performance-Based Regulatory Structure for Future Plant Licensing," Volumes 1 and 2, December 2007 (ADAMS Accession Nos. ML080440170 and ML080440215).

¹⁴ Regulatory Guide 1.200, Rev. 2, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," March 2009 (ADAMS Accession No. ML090410014).

approve, this approach, then the Level 3 PRA project could help inform the decision about which category a particular scenario or sequence would best fit. As an example related to SECY-11-0093, it is expected that insights from the current Level 3 PRA study could inform the process for evaluating the potential impact that a multi-unit accident may have on the efficacy of the emergency planning zone in protecting public health and safety.

Moreover, the Level 3 PRA project is aligned with the NRC's Strategic Plan,¹⁵ which identifies the following principles of good regulation: independence, openness, efficiency, clarity, and reliability. The Level 3 PRA project is being performed consistent with these principles, and the NRC intends that the results from the project will be used consistent with these principles. The NRC will develop its own independent full-scope site Level 3 PRA model for Vogtle, Units 1 and 2. However, to gain efficiency, the NRC will leverage (to the extent practical) existing PRA information available from the licensee.

The technical approach, key assumptions, and results have been, and will continue to be, vetted with external stakeholders through open public meetings and a publicly released final report. The potential uses of the insights and results of the Level 3 PRA identified above will improve the efficiency, clarity, and reliability of the regulatory process. For example, this study will increase the quantity and quality of risk information available to support the regulatory process, which will enhance the efficiency of the NRC and its regulations by focusing limited agency resources on issues most directly related to the agency's mission to protect public health and safety. The Level 3 PRA will help to improve the technical basis for assessing the risk of nuclear power plant operation, which should improve stakeholders' confidence in the NRC's ability to protect the public's health and safety. The Level 3 PRA project may provide insights to support potential changes in regulations. However, the NRC's established risk-informed decision-making process provides a stable and reliable foundation for applying these insights to any proposed regulatory changes.

COMMITMENT

This SECY paper contains no new commitments.

CONCLUSION

This Level 3 PRA project intends to further implement the goals of the PRA policy statement and allow for enhanced use of PRA for regulatory decisions. The Level 3 PRA project and results can be used to enhance the technical basis for using risk information, improve the PRA state-of-practice, identify safety and regulatory improvements, and support knowledge management, and the project is being performed consistent with the Principles of Good Regulation identified in the NRC's Strategic Plan. The staff intends that the results from the project will be used consistent with these principles.

¹⁵ NRC Strategic Plan: Fiscal Years 2008–2013, NUREG-1614, Volume 5 (<http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1614/v5/index.html>).

The Commissioners

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COORDINATION

The Office of the General Counsel has reviewed this package and has no legal objection. The Chief Financial Officer reviewed this package and determined that there is no financial impact.

/RA/

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Enclosure:
Potential Uses of the Full-Scope
Site Level 3 PRA Project

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