U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Full-Scope Site Level 3 PRA Project

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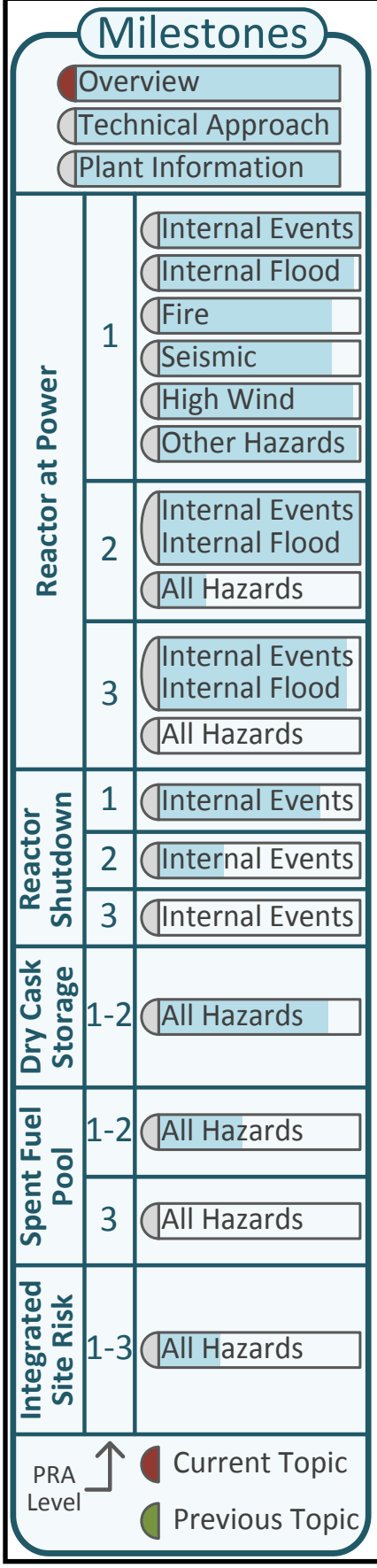
Level 3 PRA Project Overview



Risk and PRA

The risk associated with a facility or operation is the combined set of answers to three questions: "What can go wrong?" "How likely is it?" and "What are the consequences?" Probabilistic risk assessment (PRA) is a systematic analysis tool consisting of specific technical elements that provide both qualitative insights and a quantitative assessment of risk. A PRA can assess consequences in terms of core condition (this is the endpoint of a Level 1 PRA), radioactive material release from the plant (a Level 2 PRA), or offsite effects (a Level 3 PRA), as shown in the figure below. Importantly, only the Level 3 PRA estimates the two high-level quantitative health objectives related to early and latent cancer fatality risks as identified in the 1986 safety goal policy statement.

Motivation

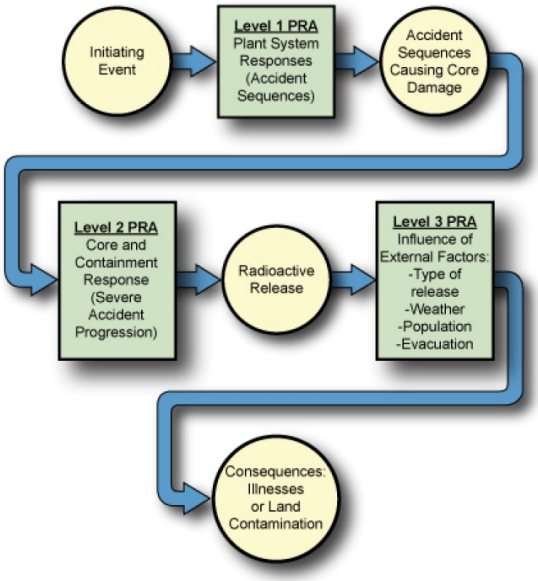
The last NRC-sponsored level 3 PRAs were conducted over two decades ago. The results were published in NUREG-1150, "Severe accident risks: An Assessment for Five U.S. Nuclear Power Plants," in 1990. These results have been used in several regulatory applications, including the establishment of the numerical risk guidelines for the use of core damage frequency and large early release frequency as surrogates for early and latent cancer fatality risks. However, as described in SECY-11-0089 (ADAMS ML11090A041), a new, updated site Level 3 PRA study is warranted because of

- significant advances in PRA methods, models, and tools since 1990
- new plant modifications that may affect risk
- useful insights that have been gained from additional research, including the State-of-the-Art Reactor Consequence Study (SOARCA)

Objectives of the Level 3 PRA Project

The objectives of the full-scope site Level 3 PRA project, referred to herein as the L3PRA project (or study) are the following:

- Develop a Level 3 PRA, generally based on current state-of-practice methods, tools, and data that (1) reflects technical advances since completion of the NUREG-1150 studies and (2) addresses scope considerations that were not previously considered.
- Extract new risk insights to enhance regulatory decision-making and to help focus limited agency resources on issues most directly related to the agency's mission to protect public health and safety.



- Enhance PRA staff capability and expertise.
- Obtain insights into the technical feasibility and cost of developing new Level 3 PRAs.

Research Scope

Southern Nuclear Operating Company's Vogtle Electric Generating Plant, Units 1 and 2, is the volunteer site for the L3PRA study. Units 1 and 2 are Westinghouse four-loop pressurized water reactors (PWR) with large, dry containments. The two new units being constructed on the site (Units 3 and 4) are not within the scope of the study.

All major radiological sources, namely, both reactors, both spent fuel pools, and dry cask storage, are analyzed in the study. The scope of the L3PRA project includes the following:

- all modes of reactor operation
- all internal and external hazards (excluding malevolent acts)
- Level 1, 2, and 3 PRA (full consequence analysis)
- integrated site risk

More detailed information about the scope of the project is provided in the milestone graphic shown on page 1. Consistent with the objectives of this project, the L3PRA study is generally based on current state-of-the-practice methods, tools, and data and is only pursuing new research in a few limited cases (e.g., multi-unit risk).

Project Tools and Models

The Level 3 PRA project team is using the following NRC tools and models for performing the Level 3 PRA study:

- Systems Analysis Programs for Hands-on Integrated Reliability Evaluation (SAPHIRE), Version 8
- Vogtle, Units 1 and 2, Standardized Plant Analysis Risk (SPAR) model, Version 8.15
- MELCOR Severe Accident Analysis Code
- MELCOR Accident Consequence Code System, Version 2 (MACCS2)

The Technical Analysis Approach Plan for the Level 3 PRA project (ADAMS ML13296A064) provides more detailed information about the technical approach used in this study.

Quality Assurance Program

A quality assurance program is essential to demonstrating (and documenting) that the PRA model is technically acceptable. One key element of the quality assurance program for the L3PRA study involves multiple levels of technical review, including:

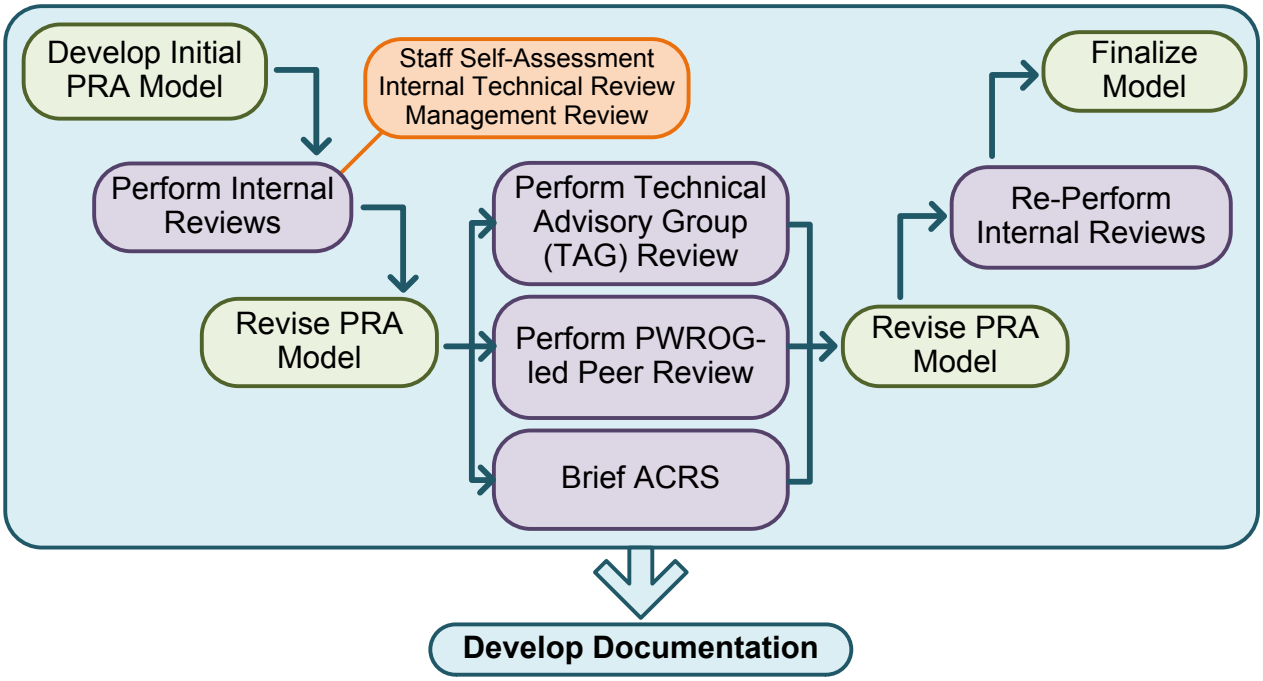
- Internal reviews
- Technical Advisory Group (TAG) reviews. [The TAG is comprised of the NRC's senior level advisors in PRA and related technical areas (e.g., structural analysis and severe accident modeling), and includes two nuclear industry PRA experts.]
- PWR Owners Group reviews against the applicable ASME/ANS PRA standards
- Advisory Committee on Reactor Safeguards briefings and fact-finding meetings

The review process is illustrated on page 3.

Benefits of the Integrated Site Risk Study

The L3PRA study can provide

- better understanding of aggregate risk, including the relative contributions from different hazards (e.g., internal events, flooding, fire, seismic, and high winds) and sources (reactors, spent fuel pools, and dry cask storage), and associated uncertainties
- better understanding of how well the surrogate safety goals of core damage frequency and large early release frequency used for risk informed decision-making (e.g., as used in RG 1.174) relate to the Commission's quantitative health objectives, particularly for cases where aggregate core damage frequency may exceed 10^{-4} per reactor-year
- insights into significant risk drivers and sources of uncertainty for multi-unit and multi-source accidents
- opportunities to greatly enhance the PRA capabilities of the staff in all major NRC offices and regions, significantly increasing staff



L3PRA Project Technical Review Process

effectiveness and efficiency in addressing risk-informed initiatives
- improved realism within the regulatory framework

A comprehensive list of potential benefits is provided in SECY-12-0123 (ADAMS ML12202B171).

A Joint Effort

The L3PRA project benefits from collaborations with—and support from—several other entities at the NRC:

- Office of Nuclear Security and Incident Response
- Office of Nuclear Material Safety and Safeguards
- Office of New Reactors
- Office of Nuclear Reactor Regulation
- Regional support
- Technical Training Center

It also benefits from the support of the following NRC contractor organizations:

- Idaho National Laboratory
- Sandia National Laboratories
- Pacific Northwest National Laboratory
- Brookhaven National Laboratory
- Energy Research, Inc.
- Innovative Engineering & Safety Solutions, LLC
- Applied Research Associates

as well as the external organizations listed below:

- Southern Nuclear Operating Company
- PWR Owners Group
- Westinghouse
- Electric Power Research Institute

For more Information

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