Background
Regulatory Guide (RG) 1.200 endorses the ASME consensus standard for nuclear power plant probabilistic risk assessments (PRAs). The standard includes a set of minimal requirements for modeling internal events, internal flooding, fires, seismic events and external hazards PRAs. Models developed for each of these hazard groups can be used to evaluate core damage frequency and large early-release frequency in support of risk-informed applications.

For new reactors, Title 10 Code of Federal Regulations (CFR) Part 50.71(h)(1) requires that each holder of a combined operating license develops a Level 1 and a Level 2 PRA no later than the scheduled date for initial loading of fuel. The PRA must cover those initiating events and modes for which consensus standards on PRA models endorsed by the U.S. Nuclear Regulatory Commission (NRC) exist one year prior to the scheduled date for initial loading of fuel.

Westinghouse is currently developing a full-scope PRA for the AP1000® plants being constructed in the United States. The internal events and internal flood hazard portions of this effort have been completed, and have undergone an independent peer review in accordance with the PRA Standard. Work is continuing on the remaining hazard groups in support of initial fuel load.

Description
Westinghouse has the expertise and capability to perform full-scope PRAs for advanced plants at various stages during the design process that meet the requirements of the ASME/American Nuclear Society (ANS) PRA Standard and that address the NRC’s positions in Regulatory Guide 1.200, Revision 2. PRAs developed during the design and pre-operational stages for advanced plants can be used to support design certification, application for a combined operating license, and development of risk-informed applications prior to initial fuel load. In order to meet the requirements of the PRA Standard, advanced plant PRAs need to consider and account for several unique characteristics, including the following:
• Advanced plant designs include unique features, such as passive safety systems, that require new approaches to the identification of initiating events and quantification of frequencies.
• The plant response to initiators relative to existing plants is different and needs to be critically evaluated during the development of accident sequences.
• Design refinements must be monitored, evaluated for PRA impact, and incorporated into system models as necessary so that the PRA reflects the as-designed, as-to-be-built condition.
• Development of emergency operating procedures and other procedures must also be monitored and accounted for so that the human reliability analysis reflects the as-to-be-operated condition.
• Failure data for new features, such as digital instrumentation and control systems, are not available in generic databases, and other methods, such as reliability prediction techniques and expert judgment, are required to address such gaps.
• Supporting requirements in the PRA Standard for plant walkdowns, in order to confirm design features, need to address the use of other means, such as three-dimensional models and plant layout, and arrangement drawings.
• Uncertainties, and sources of model uncertainty related to the unique design features associated with advanced plants, need to be carefully identified and characterized.

Benefits

Development of a full-scope PRA during the design process for advanced plants provides many long-term benefits. PRA insights, which provide improved risk profiles as well as operational improvements, can be evaluated and implemented early in the design cycle. The PRA can also be used to support design certification, applications for combined operating licenses and development of risk-informed applications. Westinghouse has the experience and expertise to fully realize these benefits.

Experience

Westinghouse has developed a full-scope internal events and internal flood PRA for the AP1000 plants currently being constructed in the United States that was recently peer reviewed relative to the supporting requirements of the ASME/ANS PRA Standard. In addition, Westinghouse is continuing the effort to complete PRA models for the fire, seismic events and external events hazard groups in support of initial fuel. This experience and expertise is readily transferable to development of PRAs for new advanced plant designs as well as to risk assessment of other applications.

Westinghouse offers a team-oriented and complete implementation through which it provides an integrated, plant-specific model and stand-alone associated documentation that can support various utility applications.

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