

Uncertainty Working Group Proposed Problem Statement

Issue Description

Over the past decade as regulatory decisions have increasingly focused on hazards such as internal fires, seismic events, and external floods, decision-makers have increasingly been confronted with the need to appropriately consider the uncertainties associated with probabilistic estimates. The risk-informed decision-making process outlined in RG 1.174 acknowledges that risk-informed approaches must address these uncertainties both in the interpretation of risk results and in decision-making related to the adequacy of defense-in-depth and safety margins. Unfortunately, there is currently limited practical guidance for such decision-making. This has led to the application of various approaches, including the incorporation of conservatism into PRA models that ultimately will confound good decision-making. The industry and NRC have both identified decision-making in light of uncertainties as an area where additional guidance would be beneficial in improving the predictability of the risk-informed integrated decision-making process.

Major Objectives

The application of risk-informed decision-making can be hindered by: a) the use of conservatism as a method to "address" uncertainties, b) relying on different approaches to address large uncertainties which cannot be reduced, and c) tendencies to over rely strictly on mathematically combined results.

Enhancing the method for making risk-informed decisions is the fundamental objective. This includes the use of risk metrics for various hazards and plant states in a manner that considers the differences in uncertainties between internal events, fire and external events PRAs that are developed using different methodologies of varying maturity and data quality.

In establishing the numerical acceptance guidelines related to the evaluation of risk implications for changes to the licensing basis for RG 1.174, the NRC stated that *'these guidelines are intended for comparison with a full scope (including internal and external hazards, at power, low power, and shutdown) assessment of the change in risk metric and, when necessary as discussed below, the baseline value of the risk metric (CDF or LERF).'* This necessitates the consideration of the integrated (or aggregate) implications of risk contributors with varying degrees of uncertainty.

The following statements in RG 1.174 concerning uncertainty are applicable to this issue:

"Appropriate consideration of uncertainty is given in analyses and interpretation of findings, including using a program of monitoring, feedback, and corrective action to address significant uncertainties."

"One of the strengths of the PRA framework is its ability to characterize the impact of uncertainty in the analysis, and it is essential that these uncertainties be recognized when assessing whether the principles are being met."

"The development of the PRA model is supported by the use of models for specific events or phenomena. In many cases, the industry's state of knowledge is incomplete, and there may be different opinions on how the models should be formulated."

Of significant concern is that the combination of PRA results for various hazards and plant states by simple addition can propagate conservative biases such that comparison with the safety goals (i.e.,

surrogate quantitative measures) would be overly influenced by the mathematical treatment of uncertainty rather than the risk insights. It is a given that there will be contributors that have large, irreducible uncertainties that will require special care in the decision-making process. The concern is that during the decision-making process the widely varying approaches to addressing uncertainties, e.g., introduction of conservatism, will obscure the real risk insights. In this situation decision-makers need to understand what is driving the results and address these drivers via the integrated decision-making process by including an appropriate consideration of defense in depth and safety margin, and where feasible, performance monitoring. Truly risk-informed decision-making requires a deeper understanding of the insights drawn from the PRA in terms of the challenges to acceptance rather than an over reliance on the numerical results. The challenges may be real and irrefutable, but they may also result from our inability to reliably represent reality.

In order to pursue enhancement of the decision-making process in these areas, the industry has identified three specific objectives:

Evaluate current approaches to addressing uncertainties in risk-informed decision-making and identify any gaps that need to be resolved

In order to identify the best path forward, there is a need to characterize the underlying causes of the different types of uncertainties influencing decision-making and assess the existing approaches to their characterization and the overall guidance on the propagation and representation of uncertainty in the estimates of risk metrics in order to determine the key gaps. A number of relevant resources already exist including RG 1.174, NUREG-1855, NRR Office Instruction LIC-504, and various EPRI documents, including EPRI 1026511. The goal is to identify the key areas where additional guidance and/or training may be beneficial in order to focus the near-term efforts.

Propose a framework for regulatory treatment of uncertainty in the context of risk-informed decision-making

Enhancements to the risk-informed decision-making in light of uncertainty are likely to require an improved “framework”. This “framework” may take the form of new guidance on how to address the different types of uncertainty (e.g., very large irreducible uncertainties) or coordinated enhancements to existing guidance, but in either case the approach needs to be consistent and rooted in the same principles for good decision-making.

Identify potential training and education mechanisms, for both PRA practitioners and broader audiences

One known obstacle in this area involves the level of understanding of risk-informed decision-making by PRA practitioners, non-practitioners, and management/decision-makers. A natural extension of the framework definition would be the development and administration of additional training on all of these fronts.

Work Product/Goal

The initial work product will be a scoping document/white paper on treatment of uncertainty in risk-informed decision-making that will evaluate the current situation and outline framework enhancements. Following development of solutions to the issues identified above, the working group will develop industry/NRC guidance (e.g., NEI guidance or EPRI guidance to be reviewed and endorsed by NRC, and/or NRC guidance (ISG, RG 1.174)).