PRA Model Optimization

Background

Many existing Computer-aided Fault Tree Analysis (CAFTA) and Fault Tree Reliability eXpert (FTREX)-based Probabilistic Risk Assessment (PRA) models have been developed, expanded and updated over several years without a strong focus on the ultimate use of the models. As a result, many of these PRA models have become unwieldy to maintain and can take a significant amount of time to update or quantify. As risk-informed applications become more time-constrained, some even requiring near real-time risk information to support plant decision-making, the need for streamlined models is becoming paramount.

Description

Westinghouse's PRA Model Optimization process provides a means to streamline PRA models to reduce update and/or quantification times and produce direct benefits across multiple hazard models. Our optimization efforts are initially based on internal event models with the downstream quantification impacts extrapolated to the external events and risk monitor models. These improvements allow plants to support the more rigorous, time-constrained risk applications and, as a result, deliver the associated significant operational flexibility and regulatory response capability available through risk-informed applications. Such improvements include control room-based risk quantifications (risk monitor models) that extend allowed outage times (AOTs) and completion times (CTs), and prompt model updates for emergent needs such as Notices of Enforcement Discretion (NOEDs) and Significance Determination Process evaluations (SDPs).

Process Overview

The key steps and objectives of the optimization process are as follows:

- Re-engineer the PRA models with efficient quantification in mind

  - Models can be restructured to maximize the abilities of the quantification engine

- Reduce/condense the volume of a PRA model without impacting the results

  - PRA model fidelity and quality remain consistent with the base model

- Retain existing PRA methodologies or underlying assumptions

  - Existing modeling techniques are applied in a structured and scrutable manner

  - Eliminate the need for additional peer reviews

Optimized PRA models being used to provide timely input to the decision-making process.

Benefits

Two major benefits:

- Streamlined model to support more demanding time-constrained applications

- Potential reduction in model maintenance scope (i.e., resource burden reduction)

Experience

Westinghouse's PRA Model Optimization efforts have been specific to the CAFTA/FTREX suite, but optimization may be extended to other PRA software tools through assessment of targeted quantification processes and functions. To-date, Westinghouse has seen the following benefits from our PRA optimization solution:

- Quantification time improvements ranged widely in completed projects; depending on the beginning state of the models, optimization has yielded reductions of 80 percent or more

- One example model went from one hour quantification (internal events only) to a quantification time of less than two minutes

- Minor changes have resulted in significant reductions in quantification times; one project yielded a 25 percent reduction in quantification times resulting from a relatively simplistic optimization task and further improvement opportunities remained available

  [*]*Reported results are based on Internal Events Models; downstream impacts on external events and risk monitor models quantification times were also realized.*