Probabilistic Economic Valuation of Safety Margin Management

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ABSTRACT:

RAVEN is a probability distribution agnostic, code agnostic platform for using Monte Carlo style sampling of stochastic parameters for thermal hydraulics codes for the purposes of a Risk Informed Safety Margin Characterized (RISMC) approach to PRA analysis. RISMC formulation allows for the determination of probabilistic safety margins, defined as the probability that a safety mechanism will be overwhelmed. Standard deterministic safety margins are often characterized as a ratio of the stress on a safety mechanism to its ability to withstand stress. These are most often performed by utilizing a systems thermal hydraulic computer code such as RELAP-7. By integrating RELAP-7 and RAVEN, it has been shown that a large portion of parameter space can be evaluated enabling new, more detailed analysis of transients. In the past, this kind of analysis was prohibitively expensive due to the large computational power needed, but modern high power computational servers have reduced the cost of such computational power to the point that these analyses are cost effective. The proposed project will extend the RISMC approach to the evaluation of the economic costs of plant changes, including design, configuration and operational changes to the cost of the potential consequences of both performing and not performing the changes. Using Probabilistic Risk Assessment (PRA) techniques to evaluate incidents likely to cause economic damage, PRA informed thermal hydraulics modeling can be conducted by applying RAVEN and RELAP-7. This analysis can be used to evaluate the economic viability of various plant upgrades. By combining the analysis of possible system configuration and operational parameters with Level 2 and 3 PRA economic impact data, it will be possible to compare the cost of plant changes with the potential for economic damage from severe accidents both with and without reinforced safety margins. Together these can provide a basis for the economic valuation of safety margins and safety margin upgrades using the RISMC approach.