Safety Corner

What is a PRA?

Probabilistic Risk Assessment (PRA) or Probabilistic Safety Assessment (PSA) is a comprehensive, structured method developed in late 1960s to assess risks in nuclear power systems for the purpose of cost-effectively improving their safety and performance. PRA has since been applied in the chemical processing, aerospace, and transportation industries. And, in the past decade or so, it has been emerging in construction, financing, and project management. One of the key success factors of PRA is its ability to explicitly quantify uncertainties associated with risks. Without formally addressing uncertainties in a risk study, the risk values obtained from the studies may not be meaningful at all.

Large-scale PRA studies integrate reliability and logic modeling tools, such as Fault Tree, Event Sequence Diagram, Event Tree, and Human Reliability Analysis to numerically quantify risks and uncertainties. Briefly, the first step of a PRA is to determine End States or Damage States, such as "loss of life" or "loss of mission," and trace out all accident scenarios that could lead to these States. This is usually conducted through the use of Event Trees, in which the progression of accident scenarios is mapped from the Initiating Events to the End States.

For the Initiating Events and all subsequent Intermediate Events that can affect the outcome of the accidents, Fault Trees are developed to assess their probability of success or failure. At the lowest level, the Basic Events of the Fault Trees are assigned probabilities based on statistical reliability data and/or expert opinion. These probabilities (and uncertainties) are propagated up the logic trees to reach a probability of the Top Event. The total risk of an End State is then the sum of the products of the consequences multiplied by their probabilities for all accident scenarios that lead to that End State.

It has been a general misconception that PRA uses probability to model event but QRA does not, or that a PRA is inferior to a QRA. PRA and QRA essentially use the same analytical tools but most QRA studies apply simplified versions of the detailed tools commonly found in PRA studies. Explicit analyses of uncertainties, common cause failures, data sensitivity, human reliability, etc., are also virtually non-existent in QRA studies. However, due to it relative simplicity, QRA has been found easier to apply, be recognized and accepted by layman.

Future issues of Safety Corner will further discuss the various technical terms mentioned in the above paragraphs.

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