



RIC 2007

PRA Models Methods and Tools

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Human Reliability Analysis (HRA) State-of-the-Art

- HRA is viewed by practitioners as an important contributor to PRA uncertainties. Issues associated with these uncertainties include:
 - Accuracy of the HRA process
 - Capability of an HRA method to appropriately model and quantify human failure events
 - Scope—existing methods focus on internal event analysis for the reactor at full power
- Other approaches (e.g., sensitivity analyses and engineering judgment) are sometimes used to compensate for limitations of HRA when the estimated human error probabilities play a role in the decision
- Therefore, there is a need to address these limitations in order to improve the reliability of HRA results and the credibility of the use of HRA in risk-informed regulatory applications

HRA State-of-the-Art (cont)

- The HRA technology over the years dealt primarily with modeling and quantification of human failure events
- The importance of the **HRA process** as part of a PRA has not been recognized as an equally important aspect of a “good” PRA/HRA
 - IPE review/insights and the PRA standards identified the importance of this issue
 - NUREG-1792, HRA Good Practices, addresses it to a certain extent
 - Development of HRA standards will further support standardization of the HRA process
- There are many HRA methods available; consideration needs to be given to selection of the method and whether it is capable of analyzing the issue
 - Choosing the right method for the right regulatory application is another important issue
 - NUREG-1842, Evaluation of HRA Methods Against the Good Practices, identified this issue and developed a framework for addressing it
 - Recognition of this issue by the larger PRA/HRA community and establishment of more detailed guidance, would further improve the quality of HRA in regulatory applications

HRA State-of-the-Art (cont)

- HRA technology even for at-full-power/internal event analysis is still evolving
 - The various HRA methods/quantification tools have differences in their underlying assumptions and data
 - NUREG-1842 illustrated how different the methods are and the need to understand to what extent these differences impact the results and, therefore, the decision
 - There is evidence of method-to-method and analyst-to-analyst variability
 - There is evidence of inappropriate implementation of the methods
- HRA did not have the benefit of testing and validation thru data and experimentation
- The larger PRA/HRA community recognizes the need for such efforts
- The NRC has initiated collaborative efforts for both simulator experiments for HRA and the systematic collection of information (“data”) related to human performance in NPP and other similar settings

HRA needs for risk-informed decision-making

- Benchmarking of HRA methods against simulator data, initiated in the Fall of 2006, is an international collaborative effort using the Halden Reactor Project simulators, to understand and address many HRA issues
- The study will do method-to-data and method-to-method comparisons in order to develop insights with regard to:
 - How methods are applied on the basis of their underlying assumptions
 - Methods' predictive ability
 - Methods' strengths and weaknesses
 - When and to what extent a detailed analysis is needed vs a more crude analysis
- The results of this study will support
 - Improvement of existing method—clarify method capabilities
 - Potentially steer direction towards the use of “a method” or few methods—achieve “harmonization”

HRA needs for risk-informed decision-making (cont)

- Collection of human events in a systematic fashion such as the NRC's Human Event Repository and Analysis (HERA) will further improve HRA by incorporating actual/simulator experience in HRA
 - Will help reduce the use of subjective judgment
 - Address important questions on performance shaping factors (PSFs)
 - What are the important PSFs?
 - How are they interacting?
 - Should we consider them “all” at “all times?”
 - Potentially use data to directly estimate probabilities