



RIC 2010

Developing an Empirical Basis for Human Reliability Analysis

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March 10, 2010



The Need for an Empirical Basis for HRA

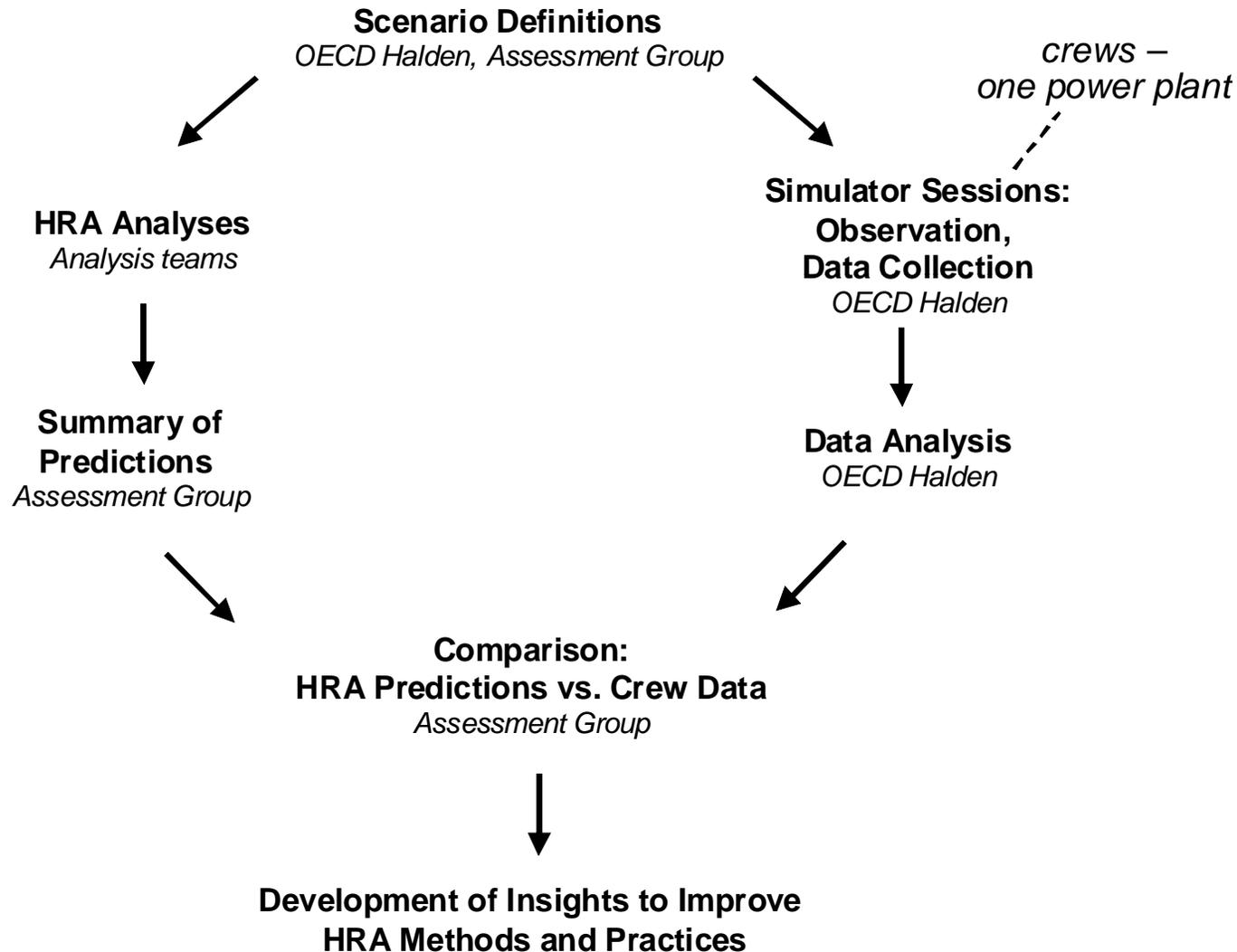
- NRC's risk-informed regulatory framework
- HRA is part of PRA--human performance is frequently an important contributor to risk
- Many HRA methods are available
 - evidence of method-to-method and analyst-to-analyst variability
- Commission direction to address variability
 - SRM-M061020 – 11/06: Develop either a single HRA model or guidelines for models to use in specific circumstances
 - SRM-M090204B – 2/09: Continue to test U.S. nuclear plant operating crews' performance in a variety of situations and keep the Commission informed
- Most HRA methods have had a limited empirical basis
 - Developing/benchmarking methods
 - Use of data in estimating human error probabilities – THERP!
- Recent activities indicate that establishing an empirical basis is an important step forward



Recent Empirical HRA Studies

- The International HRA Empirical Study using the Halden simulators and real crews—NUREG/IA-0216
 - Method-to-data and (to a certain extent) method-to-method comparison
 - Characterize the methods, identify strengths and weaknesses
 - Provide the technical basis for improving HRA methods and applications
 - Support addressing Commission direction on HRA
 - Landmark Study: 13 organizations, 14 HRA teams, and 5 research organizations directly supporting the study
 - 14 crews, 2 steam generator tube rupture and 2 loss of feedwater scenarios, 15 human actions analyzed
 - The Pilot was published, NUREG/IA-0126, Vol 1. Nov. 2009
 - The study is to be completed in 2010

Tasks of the HRA Empirical Study





Sample Insights from the Empirical HRA Study

- The first major effort to compare HRA predictions to simulator performance
- Accounts for the dynamic nature of crew-system interactions
 - significant crew-to-crew variability was observed
- Identified improvements for all methods/analyses submitted
- The need for clear guidance for qualitative analysis is a clear theme from the study
 - most methods focus on quantification
 - the larger part of HRA deals with the development of an understanding of what is required to perform and accomplish a safety function in the context of a specific scenario
 - often not clearly addressed by methods



Sample Insights from the Empirical Study (cont)

- Even methods that do require a more formal qualitative analysis do not necessarily provide strong guidance on how to perform it
 - How to recognize and model cognitive tasks, e.g., interpretation of cues, interpretation of procedures, and monitoring relevant plant parameters
- An important example
 - A typical assumption in some HRA methods is that, after the initial diagnosis of an event, crews performing procedure-driven actions are not performing cognitive tasks
 - This study provides evidence that such an approach does not realistically reflect crew performance -- crews are continually performing cognitive tasks
- Methods and HRA guidance documents need to be revised to provide better treatment of procedure-driven human actions



Additional HRA Empirical Studies

- A U.S. facility is collaborating with the NRC to perform a limited scope empirical study to further validate the results of the International study
 - Address analyst-to-analyst variability
 - Confirm that the findings from international activities are applicable to U.S. applications
 - For example, differences in the conduct of operations in Europe and the U.S.
- NRC's Human Event Repository and Analysis (HERA) project
 - Effort to populate with both historical and simulator events
 - Structure of the database continually evolving—quality and efficiency of data importing issues are being addressed
- OECD/NEA/CSNI HRA data exchange task



The Need for Empirical Data for HRA

- Basis for improving HRA practices
 - HRA method improvement and implementation
- Develop evidence of the ways in which crews are dealing with different situations
 - Procedure-driven actions
 - Recovery of wrong path
 - Complexity and how it is handled by different crews
 - Differences in crew dynamics and interactions
- Actual historical events should complement simulator experience
 - Support HRA reviews—basis to ask what-if questions
- Use empirical basis for estimating human error probabilities
 - Bayesian methods
 - Anchor values
- Creating an Empirical Basis for HRA should (and hopefully will) be the main focus of HRA for the next few years
 - More simulator studies
 - Improved databases