Reactor Arena
Operating Reactor Sub-arena
Oversight Activity

Activity: **Establish guidance for risk-informed regulation: Development of Human Reliability Analysis (RES/DRA)**

Primary FY 04-09 Strategic Plan Goal: Ensure that NRC actions are effective, efficient, realistic, and timely.

Strategy 2: Improve NRC regulation by adding needed requirements and eliminating unnecessary requirements.

Secondary FY 04-09 Strategic Plan Goal: Ensure protection of public health and safety and the environment.

Strategy 3: Use sound science and state-of-the-art methods to establish risk-informed and, where appropriate, performance-based regulations**.**

Regulatory Guide (RG) 1.200 provides an acceptable approach for determining the technical adequacy of PRA results for risk-informed activities. However, RG 1.200 (including the PRA standards reflected and endorsed by RG 1.200) is a high-level regulatory guide, addressing what to do but not the how to do it. Consequently, there may be several approaches for addressing certain analytical elements, which may meet the RG 1.200 and associated standards but may do so by making different assumptions and approximations and, therefore, may yield different results. This is particularly true for human reliability analyses (HRA) for which many methods are available to model mitigative actions in PRAs. The staff is addressing this issue by developing lower level guidance documents to support the implementation of RG. 1.200.

This work supports the NRC's action plan for stabilizing PRA quality expectations and requirements (described in SECY-04-0118 and SECY-00-0007). It also is responsive to the November 8, 2006, staff requirements memorandum (SRM) (SRM-M061020) in which the Commission, based on ACRS concerns, directed the staff "…to evaluate different human reliability models in an effort to propose a single model for the agency to use or guidance on which model(s) should be used in specific circumstances." The following activities are addressing HRA improvement needs:

(1) HRA Method Benchmarking: Participate in the International HRA Empirical Study in an effort to benchmark HRA methods by comparing HRA predictions to crew performance on a nuclear power plant simulator.

The International HRA Empirical study is a multinational multi-team effort supported by the Organization for Economic Co-Operation and Development (OECD) Halden Reactor Project. The Halden Reactor Project provided facilities, crews, and expertise to collect and analyze simulator crew performance data and HRA analyst teams from multiple organizations used their preferred HRA methods to analyze and predict the performance of these crews. The objective of the study is to develop an empirically-based understanding of the performance, strengths, and weaknesses of the various HRA methods used to model human response to accident

sequences in probabilistic risk assessments (PRAs). The study involves a variety of experts with different roles. Licensed operator crews respond to a series of scenarios in Halden's simulator facility; Halden experimental staff design, collect, and analyze crew performance data; HRA teams apply an HRA method to obtain predictions for the human failure events defined for the study; and a group of independent experts, called the Assessment and Evaluation Group, have the overall responsibility for the study, including its design and implementation process, the comparison of analytical outcomes to simulator outcomes, the evaluation of HRA methods on the basis of the comparison, and the communication and documentation of the results. The NRC, Halden, the Swiss Federal Nuclear Inspectorate, and the Electric Power Research Institute (EPRI) support this group

This study is the first of its kind; no previous HRA benchmarking studies have been performed using crew simulator data. Its first phase, the pilot phase, has been completed and documented in draft NUREG/IA-0216/HWR-844, "International HRA Empirical Study Description of Overall Approach and First Pilot Results from Comparing HRA Methods to Simulator Data," to be issued as a final in November 2008. The study has also produced many scientific papers, presented at the annual Institute of Electrical and Electronics Engineers Conference on Human Factors in August 2007 and at the Ninth International Conference on Probabilistic Safety Assessment and Management in May 2008 and at the American Nuclear Society International Probabilistic Safety Conference 2008 (PSA8) in September 2008.

The "actual" phase of an experimental work typically consists of several iterations of experiments and analysis. However, the scope of this study is limited to the use simulator data collected from two (one easy and one complicated) steam generator tube rupture scenarios (SGTR) and two loss of feedwater scenarios (LOFW), performed by 14-crews in Halden in the Fall 2006. The collection and analysis of the data produced in these simulator runs and their comparison with HRA results is currently pursued. The staff expects to have documented the results related to SGTR in a draft report in September of 2009 and the results related to LOFW, April 2009. These publications will go through peer and public review and will be completed in 2010. However, the Pilot has produced valuable insights which can be used to address the SRM.

(2) Address HRA Model Differences: The staff has initiated work and has established a memorandum of understanding with EPRI to work together to identify areas where HRA has a significant impact on the regulatory decision making and, in coordination with and input from the ACRS, to use both empirical and historical data to address, the Commission direction to either propose a single model for the agency to use or guidance on which model(s) should be used in specific circumstances. The main tasks of this work include:

- Identify current and anticipated regulatory applications in which HRA results could have an impact on the decision
- Address the suitability and adequacy of these methods in the areas in which they are currently applied as well as in future applications.
- Determine whether a single model should be proposed for use by the Agency or guidance on which models should be used in specific circumstances.
- Develop the single method or improve a small set of method(s) as needed
- Test the adequacy of the "single" method or of the improved small set of methods and develop guidance and training material for its/their implementation.
- Document the results, submit to public comment and produce a final NUREG report

The staff believes that these efforts will result in producing a HRA method (or a tool box of methods) that is/are well understood and appropriately characterized for its/their suitability and usefulness in different regulatory applications.

(3) Address HRA Needs Specific to Low Power and Shutdown Event Analysis

Primary Priority: High
Secondary Priority: Medium

Project Considerations: The HRA guidance addresses many issues associated with the use of HRA in decision-making, including the suitability of an individual method to a regulatory application, consistency among HRA practitioners in implementing HRA methods, and the absence of guidance on the rigor needed for quantification of human reliability.

Selected Major Milestones and Schedules				
Major Milestones	**Original Target Date**	**Revised Date**	**Completion Date**	**NRC Responsibility**
Revise experimental design	December 2007		January 2008	RES/DRA
Draft NRC/Halden report on the results of the pilot phase the International HRA Empirical Study (publically available)	February 2008	June 2008	October 2008	RES/DRA
Submit to publication NUREG/IA-0216, on the results of the Plot Phase of the International HRA Empirical Study	October 2008	December 2009		RES/DRA
Brief the ACRS PRA Subcommittee on the International HRA Empirical Study	February 2008		February 2008	RES/DRA
HRA analyst teams submit their analysis all simulated human actions	June 2008	SGTR-October 2008-LOFW-February 2009	SGTR-October 2008 LOFW-February 2009	RES/DRA
Draft NUREG/IA report, The International HRA Empirical Study, Comparing HRA Method Predictions to Simulator Data - - Phase 2, for review by participating organizations	October 2008	April 2009	July 2009	RES/DRA
Convene an international workshop on the International HRA Empirical Study to discuss the SGTR Scenarios	November 2008	March 2009	March 2009	RES/DRA
Brief the ACRS on the SGTR results of the International Empirical Study and NRC/EPRI efforts to address the SRM on HRA model differences	December 2008	March 009	March 2009	RES/DRA
Convene an international workshop on the International HRA Empirical Study to discuss the LOFW scenarios and overall conclusions	December 2009			RES/DRA
Final NUREG/IA report on the International HRA Empirical Study, Comparing HRA Method Predictions to Simulator Data - - Phase 2 to publications	May 2010			RES/DRA

Draft NUREG/IA report, The International HRA Empirical Study Comparing HRA Method Predictions to Simulator Data - - Phase 3, (documenting the LOFW and overall findings) for review by participating organizations	July 2010			RES/DRA
Final NUREG/IA report on the International HRA Empirical Study, Comparing HRA Method Predictions to Simulator Data - - Phase 3 to publication	September 2010			RES/DRA
Address SRM-M061020: Identify current and anticipated regulatory applications in which HRA results could have an impact on the decision	November 2008		November 2009	
Brief the ACRS on approach to address SRM-M061020	February 2009		February 2009	
SRM-M061020: Address the suitability and adequacy of HRA methods determine if a single of a tool box of methods should be used	April 2009		April 2009	
SRM-M061020: Develop the single method or improve a small set of method(s) as needed	February 2010			
SRM-M061020: Test the single method or the new set of methods	September 2010			
SRM-M061020: Document the single method (or the improved set of methods)	March 2011			
SRM-M061020:: NRC/EPRI report final report on HRA model differences/addressing SRM	September 2011			RES/DRA
NUREG/CR-6903, Vol.3 HERA User's Manual	November 2009			RES/DRA
NUREG/CR-6903, Vol.4 HERA Programmer's Manual	November 2009			RES/DRA
NUREG/CR-6903, Vol. 5 HERA Event Insights	November 2009			RES/DRA

Develop MOU with the South Texas Project on simulator data collection	November 2009			RES/DRA