

UCS Views on the NRC's Human Reliability Program Activities and Analyses

May 29, 2014

Dr. Edwin S. Lyman

Senior Scientist

Union of Concerned Scientists

UCS View on Human Reliability Analysis

- **The study of human reliability is an essential component of nuclear safety research**
- **Importance is growing with increasing reliance on manual mitigating actions to comply with post-Fukushima requirements**
- **Research should be aimed at reducing operator errors, improving human-machine interface and enhancing effective crisis response**
- **Studies are most useful in providing qualitative insights; they are far less useful in developing precise and accurate human error probabilities for PRA applications**

Public confidence in PRA

- **NUREG-1842 Executive Summary (September 2006)**
 - **“Given the continuing importance of probabilistic risk assessments in regulatory decision-making, it is crucial that decision-makers have confidence in the PRA results, including associated human reliability analyses.”**
 - **“Through the years, the HRA community has focused more on how to estimate human error probability (HEP), probably because this may be the most difficult and intriguing aspect of HRA.”**
- **This is not an academic exercise, but one with real-world safety implications**

Public Confidence

- **Aspects of PRA that cannot be well-quantified, like HEPs, can damage credibility**
- **A better approach would be for the NRC to acknowledge that some aspects of risk cannot be well-quantified and that those aspects contribute to irreducible uncertainties**

Expert Confidence (or lack thereof)

- **“This approach [SPAR-H] does not guarantee valid HEP estimates.”**
 - **Blackman, Gertman and Boring (2008)**
- **“I believe that there is general consensus that THERP is silly ...”**
 - **John Stetkar, ACRS, January 14, 2014**

Expert Elicitation

- **The continuing reliance on expert elicitation in HRA (e.g. IDHEAS) can be seen as an admission that there is still insufficient data to support accurate HEP estimates**
- **Given the inability of these methods to produce consistent results, perhaps human reliability analysis should be applied to the experts conducting the elicitation!**
 - **Need more results for variability from one group of experts to another using the same method; U.S. HRA empirical study is a good start**
 - **One expert team even misinterpreted the definition of a human failure event under study**

Findings of the U.S. Empirical HRA Study

- **HEP estimates:**
 - **Vary considerably from one method to another**
 - **Vary considerably within the same method (order of magnitude is typical)**
 - **Were validated using sparse data sets with wide error ranges (3 orders of magnitude)**
- **Even when quantitative agreement was good, there were inconsistencies in the underlying qualitative analysis, raising the possibility that the “agreement” was coincidental**

HRA Guidance is Unclear

- **NUREG-0800, Chapter 19.2:**
 - **“Reviewers should verify that ... the modeling of human performance is appropriate.”**
- **NUREG-1792 (2005):**
 - **“The guidance provided in RG 1.200 and associated documents is not sufficient to address HRA quality issues at an adequate level for regulatory decision-making.”**
 - **“This report does not constitute a standard and, hence, it is not intended to provide de facto requirements.”**

Unclear Guidance

- **NUREG-1842 (2006)**
 - “... this report is *not* intended to provide “acceptance criteria” for determining the acceptability of PRA applications ..”
- **Without clear guidance, the problem of inherent subjectivity of expert elicitation-based HRA methods is exacerbated**

Conclusions

- **Large uncertainties persist in quantitative predictions in state-of-the-art HRAs, and have been confirmed by the empirical studies**
- **NRC has not developed clear acceptance criteria for HRA adequacy that could be used to construct a consensus model**
- **HEP uncertainties are a significant contributor to overall PRA uncertainty: another reason why the NRC should increase emphasis on qualitative factors such as defense-in-depth (despite the recent decision on NTTF Recommendation 1)**

Acronyms

- **HEP: Human Error Probability**
- **HFE: Human Failure Event**
- **IDHEAS: Integrated Decision-Tree Human Event Analysis System**
- **PRA: Probabilistic Risk Assessment**
- **THERP: Technique for Human Error Rate Prediction**
- **UCS: Union of Concerned Scientists**