




**UNITED STATES  
NUCLEAR REGULATORY COMMISSION**  
WASHINGTON, D.C. 20555-0001

March 8, 2022

MEMORANDUM TO: Michael Franovich, Director  
Division of Risk Assessment  
Office of Nuclear Reactor Regulation

FROM: Mark Thaggard, Director  Signed by Thaggard, Mark  
Division of Risk Analysis on 03/08/22  
Office of Nuclear Regulatory Research

SUBJECT: REVIEW OF DRAFT NUREG-2199, Vol. 3, "TESTING THE  
INTEGRATED HUMAN EVENT ANALYSIS SYSTEM FOR  
NUCLEAR POWER PLANT INTERNAL EVENTS AT-POWER  
(IDHEAS AT-POWER)"

The Human Factors Reliability Branch (HFRB) in the Division of Risk Analysis is forwarding the Draft NUREG, "Testing the Integrated Human Event Analysis System for Nuclear Power Plant Internal Events At-Power (IDHEAS AT-POWER)," for your review. This report documents collaborative work with the U.S. Nuclear Regulatory Commission (NRC), the Electric Power Research Institute (EPRI), and Sandia National Laboratories, to perform a holistic test of the human reliability analysis (HRA) method developed by the NRC and EPRI, the Integrated Human Event Analysis System for nuclear power plant internal events at-power, hereafter referred to as IDHEAS AT-POWER.

The study documented in the draft NUREG was part of a larger project to improve HRA in support of staff requirements memorandum (SRM)-061020. In a letter to the Chairman, dated May 14, 2014, the Advisory Committee on Reactor Safeguards (ACRS) noted that the staff had made substantial progress toward meeting the objectives of SRM-M061020, and recommended formal pilot testing of the IDHEAS AT-POWER method (ML14134A328). Experience from the development of other complex methods, such as those used for the modeling and analysis of plant fires, has demonstrated the value and the need for comprehensive piloting of the methods before deployment.

The primary objective of the study documented in the draft NUREG was to evaluate whether the IDHEAS AT-POWER guidance could be practically applied to produce consistent HRA results. The testing study was conducted with five teams of HRA analysts (two industry teams, two NRC teams, and a fifth team consisting of the authors of the testing study report). NRC staff participated in the study as indicated in the acknowledgements of the report.

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The HRA analyst teams received training on the IDHEAS AT-POWER method, and then used the method to analyze five human failure events (HFEs) within three scenarios in a pressurized water reactor (PWR). Scenario 1 described a standard steam generator tube rupture (SGTR), and Scenario 2 described a total loss of feedwater with a misleading indicator of flow to the steam generators. Scenario 3 was adapted from an actual event in a nuclear power plant and described an electrical fire that caused a reactor trip and subsequent loss of reactor coolant pump (RCP) seal injection and cooling.

The IDHEAS AT-POWER method was evaluated against five criteria: validity, inter-analyst consistency, traceability, usability, and utility. The draft report provides a detailed analysis of the HRA analyst teams' use of the IDHEAS AT-POWER method, and discusses recommendations with respect to training, method guidance improvement, and future method development.

Overall, this study's results indicated that IDHEAS AT-POWER provides a structured analysis framework and highly traceable quantification approach to HRA. The traceability of the analysis process leads to a more defensible basis for assessing scenario-specific performance issues and influencing factors. The structured qualitative analysis framework encouraged a detailed assessment of timelines, procedures, and plant conditions. The documentation also enabled a third-party review to identify sources of inter-analyst variability, assess whether the rationale underlying the analysis was reasonable, and evaluate the impact of the assumptions made in the analysis. Moreover, the level of detail in the analysis increased the utility of the method by identifying areas for operator performance improvement.

Not surprisingly considering the uncertainties in HRA and the results of past benchmark studies, this study found variability in the results between analyst teams, particularly in the assessment of execution tasks and credit for recovery. Conversely, there were also multiple examples of inter-analyst consistency. This points to evidence that IDHEAS AT-POWER provides an analysis framework that can enhance inter-analyst consistency, but some methodological and guidance limitations can make it difficult to achieve inter-analyst consistency throughout the analysis process.

This study also found that the detailed analysis process can be resource-intensive. The analysts reported a significant learning curve when it came to assessing crew failure modes and performance influencing factors. This highlights the importance of adequate training and practice for analysts to efficiently apply the method. It should be recognized that the benefits of the detailed analysis may outweigh the additional resource costs for complex, cognitively demanding scenarios where traceability and utility are critically important. Moreover, the resource requirements can likely be reduced with a computerized tool and elimination of redundant documentation.

Staff in HFRB used lessons-learned from the testing to inform the development of the IDHEAS General Methodology (IDHEAS-G, NUREG-2198). HFRB staff have also developed a simplified version of IDHEAS, called IDHEAS for Event and Condition Assessment (IDHEAS-ECA) to improve the usability of the method. IDHEAS-ECA is based on the IDHEAS-G framework and can be used by NRC staff for all nuclear-related applications.

The development of IDHEAS AT-POWER is documented in volume 1 of NUREG-2199 (ML17073A041). The enclosed draft NUREG is intended to be published as volume 3 of NUREG-2199.

We request that you provide us any comments on this draft NUREG by April 15, 2022. Consistent with this request, we provided your staff an electronic copy of this report on December 9, 2021. Please feel free to contact Stephanie Morrow ([stephanie.morrow@nrc.gov](mailto:stephanie.morrow@nrc.gov)) or Sean Peters ([sean.peters@nrc.gov](mailto:sean.peters@nrc.gov)) if you have any questions or cannot accommodate this schedule.

Enclosure:

Draft NUREG, "Testing the Integrated  
Human Event Analysis System for  
Nuclear Power Plant Internal  
Events At-Power (IDHEAS AT-POWER)"

Memo to Michael Franovich NUREG 2199 IDHEAS AT-POWER Volume 3 DATE March 8, 2022

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