



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
WASHINGTON, DC 20555 - 0001**

January 2, 2013

Mr. R. W. Borchardt  
Executive Director for Operations  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

**SUBJECT:** DRAFT NUREG-1855, REVISION 1, "GUIDANCE ON THE TREATMENT OF UNCERTAINTIES ASSOCIATED WITH PRAs IN RISK-INFORMED DECISIONMAKING"

Dear Mr. Borchardt:

During the 600th meeting of the Advisory Committee on Reactor Safeguards, December 6-8, 2012, we completed our review of the draft report NUREG-1855, Revision 1, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decisionmaking." Our Subcommittee on Reliability and Probabilistic Risk Assessment (PRA) also reviewed this matter during its meetings on June 19, 2012 and October 19, 2012. During these meetings, we had the benefit of discussions with representatives of the NRC staff, the Electric Power Research Institute (EPRI), and their contractors. We also had the benefit of the documents referenced.

**CONCLUSIONS AND RECOMMENDATIONS**

1. NUREG-1855, Revision 1, provides valuable guidance for the treatment of uncertainties in risk information used for decision making. It should be issued for public comments.
2. Prior to issuing the final report, the staff should consider revising the guidance to note that assessment and review of uncertainties for all proposed risk-informed applications, even when the point-estimate results are well below the nominal acceptance criteria, can provide important information about the degree of confidence in the available margins to the acceptance criteria.
3. The guidance in NUREG-1855, Revision 1, provides an appropriate framework for the identification and quantification of uncertainties. The examples provided in the EPRI reports that are referenced in the NUREG do not clearly demonstrate the appropriate application of this guidance.
4. The staff should initiate efforts to ensure that the principles of uncertainty analysis in NUREG-1855 are applied more consistently throughout the NRC.

## DISCUSSION

Revision 1 of NUREG-1855 incorporates refinements to the guidance that benefit from public workshops, performance of a test case, and practical experience from the implementation of risk-informed licensing activities that have transpired since the original report was issued.

The types of uncertainties that are addressed in NUREG-1855, Revision 1, and the technical content of the guidance remain largely unchanged from the previous version of the report. The scope has been expanded to include general guidance for the treatment of uncertainties in analyses of internal events and external hazards during all modes of plant operation. This extension reinforces the importance of applying the same uncertainty assessment methods for the full spectrum of risk-informed applications.

The most significant change in this revision is a reorganization of the guidance in response to comments received during public workshops and from users of the earlier guidance. The revised organization better addresses practical needs of analysts who will use the guidance to evaluate uncertainties in risk-informed applications and NRC staff who will review those applications. The guidance now follows more closely the sequence of activities that are performed during the preparation of a risk-informed licensing application. It contains explicit references to the level of analyses that are needed to meet the technical capability requirements for uncertainty assessments, as specified in the ASME/ANS Standard on PRA. The report also clarifies guidance and expectations for NRC staff reviews of the treatment of completeness, parameter, and model uncertainties in a risk-informed application. These changes provide improved clarity and will enhance consistency in practical applications of the guidance. Draft NUREG-1855, Revision 1, should be issued for public comments.

The guidance in NUREG-1855, Revision 1, emphasizes the need for enhanced attention to the evaluation and review of uncertainties in risk-informed applications when the point-estimate results are close to challenging or exceeding the regulatory acceptance guidelines. NUREG-1855, Revision 1, indicates that a comprehensive assessment of uncertainties is less important when the results are further below the acceptance criteria. Experience has shown that a systematic evaluation of uncertainties can identify sources of optimism in the point-estimate results from probabilistic and deterministic models. A balanced assessment of the underlying uncertainties in a proposed option also provides important information about the degree of confidence in the available margins to the acceptance criteria. The confidence in those margins strengthens conclusions about an option's nominal acceptability on a point-estimate basis and can affect decisions to implement one option in preference to another. Information about the confidence in the available margins can also affect regulatory decisions that compare various options which nominally achieve the same goal. For these reasons, assessment and documentation of the uncertainties in each proposed application would provide useful information to support the risk-informed decision, beyond a comparison of point-estimate results. Prior to issuing NUREG-1855, Revision 1, in final form, the staff should consider revising the guidance to note that all proposed risk-informed applications should include an assessment of uncertainties, even when the point-estimate results are well below the nominal acceptance criteria.

A draft of the original version of NUREG-1855 incorporated an Appendix A, which contained examples for the treatment of modeling uncertainties. The examples relied too heavily on sensitivity analyses, rather than the characterization and quantification of the sources of uncertainty. In our letter report of February 23, 2009 we recommended that Appendix A to the draft NUREG be withheld from publication until more comprehensive examples for practical application of the guidance were developed. The original version of NUREG-1855 was subsequently issued for use in March 2009, without the material in Appendix A.

In lieu of an integral appendix that contains examples of methods to identify and quantify sources of parametric and modeling uncertainties, NUREG-1855, Revision 1, refers to two EPRI reports that provide specific examples in the context of a risk-informed licensing submittal. The reports are EPRI-1016737, "Treatment of Parameter and Model Uncertainty for Probabilistic Risk Assessments", published in December 2008, and EPRI-1026511, "Practical Guidance on the Use of PRA in Risk-Informed Applications with a Focus on the Treatment of Uncertainty," a draft version of which was issued for comments in August 2012.

We were briefed on the content of the EPRI reports. The examples in these reports have been extracted primarily from the material in the original draft Appendix A to NUREG-1855. The screening and sensitivity examples presuppose conservatism in the point estimate values. The sensitivity analyses are not organized to inform a complete uncertainty evaluation.

The guidance in NUREG-1855, Revision 1, provides an appropriate framework for the identification and quantification of uncertainties. The examples that are currently provided in the EPRI reports do not clearly demonstrate the appropriate application of this guidance. The comments and recommendations in our February 23, 2009 letter report continue to apply for any narratives and examples that are intended to illustrate how uncertainties may be evaluated to support risk-informed decisions.

NUREG-1855, Revision 1, is focused primarily on licensee preparation and staff reviews of risk-informed licensing applications. However, the report describes general principles of uncertainty assessment that apply to probabilistic and deterministic analyses which are performed routinely by NRC staff to support regulatory decisions and reactor oversight functions. These principles are not applied by all branches of the NRC.

Decisions about proposed regulatory practices and enforcement options would benefit from a deeper understanding of the underlying uncertainties and the degree of confidence in the available safety margins that are afforded by each alternative. The staff should initiate efforts to ensure that the principles of uncertainty analysis in NUREG-1855 are applied more completely and more consistently throughout the NRC to support the agency's internal decisions.

Sincerely,

*/RA/*

J. Sam Armijo  
Chairman

## REFERENCES

1. Draft NUREG-1855, Revision 1, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decisionmaking", NRC-RES, August 2012 (ML12286A262).
2. ACRS Letter Report, 'Draft Final NUREG-1855, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-informed Decisionmaking" and Draft Appendix A, "Example Implementation of the Process for the Treatment of PRA Uncertainty in a Risk-Informed Regulatory Application"', February 23, 2009 (ML090490652).
3. EPRI Report, "Treatment of Parameter and Model Uncertainty for Probabilistic Risk Assessments", EPRI-1016737, December 2008.
4. EPRI Report, "Practical Guidance on the Use of PRA in Risk-Informed Applications with a Focus on the Treatment of Uncertainty," EPRI-1026511, Draft Report, August 2012.
5. ASME / American Nuclear Society, "Standard for Level 1 / Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," ASME/ANS RA-Sa-2009, March 2009.

**REFERENCES**

1. Draft NUREG-1855, Revision 1, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decisionmaking", NRC-RES, August 2012 (ML12286A262).
2. ACRS Letter Report, 'Draft Final NUREG-1855, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-informed Decisionmaking" and Draft Appendix A, "Example Implementation of the Process for the Treatment of PRA Uncertainty in a Risk-Informed Regulatory Application"', February 23, 2009 (ML090490652).
3. EPRI Report, "Treatment of Parameter and Model Uncertainty for Probabilistic Risk Assessments", EPRI-1016737, December 2008.
4. EPRI Report, "Practical Guidance on the Use of PRA in Risk-Informed Applications with a Focus on the Treatment of Uncertainty," EPRI-1026511, Draft Report, August 2012.
5. ASME / American Nuclear Society, "Standard for Level 1 / Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," ASME/ANS RA-Sa-2009, March 2009.

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