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June 28, 2006

Mr. Michael Lesar, Chief
Rules and Directives Branch
Office of Administration
Mail Stop: T6-D59
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Comments Concerning Draft NUREG-1842, *"Evaluation of Human Reliability Analysis Methods Against Good Practices"* (71FR19912, dated April 18, 2006)

Exelon Generation Company, LLC (Exelon) and AmerGen Energy Company, LLC (AmerGen) are submitting this letter in response to a request from the Nuclear Regulatory Commission (NRC) for comments concerning Draft NUREG-1842, *"Evaluation of Human Reliability Analysis Methods Against Good Practices,"* which was published in the Federal Register (i.e., 71FR19912, dated April 18, 2006).

NUREG-1842 evaluates the various human reliability analysis (HRA) methods that are commonly used in regulatory applications, with a particular focus on their capabilities to satisfy the good practices, as well as their respective strengths and limitations regarding their underlying knowledge and databases.

Exelon and AmerGen appreciate the opportunity to comment on NUREG-1842 and offer the attached comments for consideration by the NRC.

If you have any questions or require additional information, please do not hesitate to contact Mr. Richard Gropp at 610-765-5557.

Sincerely,

D. P. Helker

David P. Helker
Manager - Licensing

Attachment

SUNSI Review Complete

E-RIDS = ADM-03
Add = C. Lois (EXL1)

Template = ADM-013

Exelon/AmerGen Comments on Draft NUREG-1842 "Evaluation of Human Reliability Analysis Methods Against Good Practices"

June 28, 2006

The following provides Exelon/AmerGen comments on draft NUREG-1842 for consideration by the NRC.

Draft NUREG-1842 Purpose

The NRC has issued draft NUREG-1842, *"Evaluation of Human Reliability Analysis Methods Against Good Practices"*, whose stated purpose is the following:

> This Human Reliability Analysis (HRA) guidance has been developed in two phases. The first phase focused on developing good practices for implementing HRA, as documented in NUREG-1792, dated April 2005. The second phase, summarized in draft NUREG, evaluated the various HRA methods that are commonly used in regulatory applications, with a particular focus on assessing their capabilities to satisfy the good practices, as well as their respective strengths and limitations regarding their underlying knowledge and data bases. Thus, this second guidance document provides useful information for evaluating the adequacy of an HRA, particularly with respect to the HRA method used (considering its strengths, limitations, and underlying knowledge and data bases).

Comments

Exelon/AmerGen has reviewed draft NUREG-1842, and offers the following comments in an effort to assist the NRC in finalizing this draft Report. The comments are provided in the following three (3) categories:

- General
- Method Specific Comments
- Editorial

GENERAL

1. Premise of Draft NUREG-1842

The HRA method used in a Probabilistic Risk Assessment (PRA) is developed and implemented at the base PRA model development stage. At this stage, there is only a general acknowledgement that a spectrum of PRA applications are to be addressed. Therefore, the base model PRA and its integral HRA method need to be performed with an eye on the spectrum of applications. This is an almost universal truth for the industry PRAs.

However, the premise of the NUREG-1842 report, as stated, appears to sidestep this more constructive need and instead seeks to: (1) focus on isolated applications or individual crew actions; and, (2) principally discuss examples of inappropriate uses in an anecdotal approach:

> Depending on the application, some methods may be better suited and, in fact, more appropriate to use than others; particularly if the characteristics of a method are incompatible with those needed based on the application. For instance, if an application requires an examination of potential causes leading to human failures and a submittal presents an analysis performed using an HRA method that analyzes human failures using a simple time-reliability correlation, whereby time is the surrogate underlying cause for all errors or failures to respond, the use of such a method would not be appropriate for that type of application. Thus, knowing how a particular HRA method fares with respect to the good practices and being knowledgeable of each method's strengths, limitations, and underlying bases, provides a starting point for analysts, reviewers, and users to determine whether an analysis is appropriate and of sufficient quality to address the specific issue examined.

The "guidance" document should identify approaches (methods) that would support a quality PRA (e.g., one that is sufficient to be used for Capability Category II applications). In addition, references need to be provided to support any conclusions to be presented in NUREG-1842 regarding decisions that individual HRA methods are inappropriate for applications.

2. Conclusion

To satisfy the quality expectations for an American Society of Mechanical Engineers (ASME) PRA Capability Category II PRA application, an effective HRA should:

1) Meet the high level and supporting requirements of the ASME PRA Standard.
2) Address the Good Practices (NUREG-1792).
3) Use an acceptable methodology for both qualitative and quantitative analysis.
4) Be performed by qualified analysts.
5) Be properly linked into the PRA.

The intent of draft NUREG-1842 appears to address Items (2) and (3). Exelon/AmerGen do not believe that Items (4) and (5) have been appropriately addressed. Item (1) may be generally addressed, but there is no methodical verification that the requirements of the ASME PRA Standard are treated within this "guidance" document.

With regard to Item (3) above, the results of the report appear to indicate that no method meets the NRC expectations. In addition, no statement was made about how multiple methods might be combined to create a composite HRA qualitative and quantitative strategy that would be acceptable in meeting the ASME PRA Standard. This would appear to leave the PRA community and the NRC without viable alternatives for implementing risk-informed regulation.

It is acknowledged that the draft NUREG-1842 provides input to decision makers relative to the selection of an HRA method from among the existing HRA methods. However, this critique of methods is not performed with respect to the ASME PRA Standard nor does it appear to acknowledge the need to be consistent with the ASME PRA Standard.

It is clear that guidance for HRA implementation using existing methods and technology is needed to support both ASME PRA Standard implementation and risk-informed applications. However, draft NUREG-1842 does not appear to fulfill this need.

The guidelines should indicate which methods (if performed correctly) could provide an adequate basis for a Capability Category II PRA base model and corresponding risk-informed applications.

3. Reproducibility

The NUREG-1842 strong implications are that the on-going effort to develop a new HRA method, ATHEANA, is the leading candidate to satisfy the Good Practices for risk-informed applications.

However, the draft Report seems to place significant value on methods that emphasize Performance Shaping Factor (PSF) manipulation, contextual evaluations, expert elicitation, and "holistic" means of assessing HEPs (structured guessing). On the other hand, NUREG-1842 appears to suggest that one of the important factors in a useful HRA methodology is reproducibility. It is not clear that the methods which employ these types of strategies will fulfill that need. For example, ATHEANA is intended to be based on expert PSF evaluations. While it does not appear to have been used in any large-scale application, nor as the subject of a demonstration to confirm reproducible results, it seems to be presented as a capable method in this draft NUREG-1842.

This emphasis on the promise of ATHEANA as a viable method to replace the other available methods would appear to be misleading to the readers and users of this "guidance" document based on the status of ATHEANA as an unproven methodology.

4. Simulator

It is judged appropriate that additional emphasis be included to acknowledge that simulator runs alone are not an adequate basis for human error probabilities. In the discussion of methods such as HCR/ORE, it is mentioned that the simulator runs have yet to be demonstrated as an adequate basis for failure probabilities; however, it is not clear regarding the role that simulator data should play in HRA.

Because the simulator has several features that make the direct translation of results of value only when tempered with caution regarding the simulator limitations, it is important to reiterate these simulator limitations:

- Controlled, non-life threatening environment
- Events terminated before 1 hour
- Fidelity of the simulator results, especially for significantly degraded conditions or unanticipated failure modes (e.g., partial failures)

5. Inadequate Guidance

Statements such as those found in the conclusions of the draft Report are of minimal assistance in providing guidance or in formulating a risk-informed process that needs to be in place for 2008 to support risk-informed regulations:

> Clearly, the above implications suggest that more needs to be done to fully understand when a method is appropriate (or not), and the extent to which various methods might yield very different results. We may also need to modify the methods to bring them more "in sync" with each other. Further, there is a vital need to validate the methods and (in particular) the underlying data values. Nonetheless, just as PRA has been used in the past without all of its issues being totally resolved, HRA methods can be used today, *as long as they are used within their current capabilities and match up well with the issue and decisions being addressed.* Research (such as benchmarking methods and performing validation studies) should (and likely will) come along to further improve the credibility of HRA. Such projects are already underway or (in some cases) being contemplated.

A "guidance" document is of limited value when it focuses on negative comments. The industry and NRC are in need of a guidance document that would clearly explain how to perform the analysis to meet the ASME PRA Standard. Exelon/AmerGen suggests that the NRC consider a viable HRA alternative.

6. Fundamental Deficiency

The generalizations made in Sections 5 and 6 seem to advocate that any HRA method can be used if justified for the decision at hand. However, no guidance is provided regarding what applications requiring Capability Category II HRA methods can be met. The negative critique provided in the Section 3 and the summary tables of NUREG-1842 make defense of any HRA method very difficult. Further, some methods are stated to be explicitly excluded.

What utilities require today are real decisions in a risk-informed environment. The applicability of a report that calls into question any and all available HRA methods would seem to preclude the following advances in risk-informed decision making:

- Development of a robust base PRA model
- Implementation of an effective online risk monitoring tool[1]
- Development of Maintenance Rule rankings
- Development of component rankings for MOVs, AOVs, check valves, heat exchangers
- SDP evaluations
- AOT extensions
- Option 2
- Option 3

The draft Report does not appear to provide the most basic guidance or roadmap regarding the methods that could be used to support Capability Categories I, II, or III of the ASME PRA Standard and applications that are tied fundamentally to the capability category of the Base PRA model.

One specific example is Page 6-1:

> Nonetheless, the current HRA "tool box" [including the NRC's HRA good practices (NUREG-1792)] collectively contains good guidance for ensuring the HFEs are correctly identified and modeled, important influencing factors are considered, and the overall HRA is correctly performed. In

[1] The ability to effectively discriminate among HRA methods and to select those methods that support a Capability Category II on-line risk monitor is considered a desirable near term goal.

> most cases, HRA methods can estimate reasonable HEPs, produce consistent results, and identify conditions that tend to make errors more likely, *provided that* analysts follow the good practices, and choose and apply the methods in ways that do not require manipulation and levels of accuracy beyond their capabilities. This allows users to identify human performance vulnerabilities and related improvements.

The implication, by specifying "vulnerability identification" as the only use of current HRA methods, is, therefore, that these HRA methods could not be used for performing risk-informed applications.

The NUREG-1842 report should make definitive statements regarding the ability to satisfy the ASME PRA Standard, or risk being open to wide interpretation by both the industry and future reviewers and critics of the risk-informed process.

7. External Hazards

The following is the statement regarding HRA for external events:

Page v:

> Nonetheless, these evaluations should generally be applicable (although not entirely sufficient) for HRA assessments of low power and shutdown operations and external events, as well as analyses related to nuclear materials and safeguards.

This would appear to be inadequate guidance for the most difficult areas of HRA. The guidance document should to provide realistic guidance with current HRA methods in the treatment of PSFs for fire, seismic, flood, and wind events. These include the following:

- Crew response to incredulous events such as massive seismic events or major internal flood events
- Level of crew response that can be anticipated for PSFs related to fires:
  - Within a compartment
  - In zones required to be traversed
  - With no other impacts
  - The above with and without the added burden of protective personal breathing apparatus

Similarly for low power and shutdown, the following HRA related items would require guidance:

- Treatment of the extended time available
- Abnormal instrumentation and configurations on PSFs
- Interface among maintenance and operations
- Availability of systems and indication for mitigation of accidents

Since there appears to be a lack of discussion and guidance in draft NUREG-1842, external hazard effects and considerations of low power and shutdown on HRA appear not to be effectively considered in this HRA guidance for a fully developed regulatory risk-informed program.

8. Interface With The ASME PRA Standard

The following statement appears to leave the door open to controversy and confusion regarding the HRA approaches that satisfy the ASME PRA Standard:

> The bottom line is that (1) the burden is on the analyst to justify why a given method is used and appropriate for a given application, and (2) it is the burden of the reviewer or user of the results to agree (or not) with that justification. Assuming agreement as to the method used, it is then the burden of both parties to demonstrate (on the part of the analyst) and to agree (on the part of the reviewer or user) that the method has been properly used and reasonable judgments and interpretations have been made in carrying out the method for the postulated plant conditions and actions being analyzed.

To avoid the potential for confusion or controversy, Exelon/Amergen suggest that the NRC clarify its position concerning this particular issue.

9. Dependence

The "limitations" section of the summary tables (Tables E-1, 4-1, and 4-2) do not discuss the treatment of dependencies for any of the methods. This is the single most important modeling (epistemic) uncertainty in the HRA, yet it is not discussed as a limitation, nor is there guidance provided for its treatment.

Table 4-3 does provide a comparison of dependency treatment among methods, but it appears to lack an objective description of the dependency treatment and its viability to support the ASME PRA Standard Supporting Requirements and risk-informed application.

10. References

There are a large number of assertions made in the report, many of which are based on allusion to anecdotal evidence. These would appear to be poor reference points for a report that has the potential for such far-ranging impacts on the industry and the regulatory process. Specific references for assertions in the report are considered necessary to provide a rational basis for its use as guidance for future reviewers.

11. Time Dependence

It is agreed that the effects that determine a crew's response are related to a number of PSFs and that the thorough incorporation of such PSFs in the assessment is needed. For one of these PSFs, the time available versus the time required, draft NUREG-1842 does not appear to provide adequate information. Each of the methods that are available for the quantitative assessment of the time PSF is not considered in the draft report. This appears to be shortsighted and without basis. It is recognized that the TRC curves are approximations; however, draft NUREG-1842 does not appear to offer a viable alternative. ATHEANA provides a potentially powerful tool to provide extensive insights in the qualitative assessment of HEPs. Nevertheless, no tool is cited to allow the translation of these insights (particularly time restricted PSFs) on the inputs to the quantitative PRA.[1]

It is judged that a combination of available methods would offer the advantages of a thorough qualitative evaluation and a quantitative process for its implementation. For example, the use of the Cause-Based Method (CBDT), coupled with the TRC through simple addition of the HEPs, represents a reasonable and measured approach to the estimation of HEPs until the data-based method envisioned by NUREG-1842 can be formulated and made available to PRA developers.

12. Contradictions

Page 5-1

The stated purpose of the Report is to assess the HRA methodology capabilities to satisfy the good practices (Page xi). However, the document states the following regarding justification for the HRA method used in a PRA application:

[1] The ATHEANA report (May 2000) on page 6-14 states that "The ATHEANA quantification method is still under development." However, no published NUREG currently addresses the ATHEANA quantification. There is a published article ["Expert Elicitation Approach for Performing the ATHEANA Quantification", Reliability Engineering and System Safety, Elsevier, 2003] that provides an extensive qualitative summary of the desirable attributes of the quantification method. However, the method has no quantification basis. Instead, it references the yet to be developed database of quantitative benchmark cases. (It is noted that these yet to be performed benchmark cases are critical to the quantification.)

> At the other extreme, if decisions require the "best" answer we can provide because they are very sensitive to the probabilistic inputs and associated results from the HRA, it is important for the analyst to justify any method used, with regard to why the method is appropriate for the decisions being made. Such justification may be, for instance, that significant qualitative evaluation demonstrates that the method directly handles the most important factors affecting the human action of interest (i.e., other factors beyond a pre-established list of factors within the method are not very relevant) and, thus, the method is adequate for obtaining qualitative and quantitative insights affecting the decision. Another justification may be that the method used is particularly strong in searching for and examining many influencing factors and, thus, is most appropriate for the accuracy required by the decision process.

There may be more than 100 HFEs that need to be methodically treated and incorporated quantitatively in the PRA (and applications). Each of these HFEs would presumably require a different written evaluation. This "guidance" document does not appear to provide either:

a) A template for this written evaluation.

b) The criteria to establish the sufficiency of the supporting evaluation.

It appears that NUREG-1842 only provides generalities about the prudent approach to performing an HRA:

- Ensure applicability of the approach
- Apply the approach correctly
- Verify the results are reasonable and consistent

In addition, the NUREG-1842 statement contradicts the summaries provided in Section 4, which specifically exclude some methods from use in "most regulatory applications."

13. Solution

Consider the conclusions and statements such as the following:

> ...remaining shortcomings point the way to research that is still needed in HRA – particularly to validate the methods and data values upon which current quantification is based, as well as to improve the judgments provided by experts for those methods that use such an approach.

These represent an apparent theme in draft NUREG-1842 that justifies continued research while at the same time calling into question the viability of the available HRA methods used by industry and the NRC to support risk-informed regulation. This conclusion appears to be misplaced and not substantiated by the Report.

For current PRA upgrades or risk-informed applications, the available methods are judged appropriate and adequate. The Report should address the viability of continuing with PRA upgrades and risk-informed activities using available HRA methods, and to address the evolving nature of the methods as a function of the NRC phased program implementation.

14. HRA Practitioner Qualifications

Emphasis is placed on ensuring that an HRA is performed by qualified personnel; however, no guidance has been provided that defines the level of training or experience that would be required to be considered a "qualified" HRA "practitioner" or "expert." While it is difficult to develop a definition that envelopes the high standards that are desirable without excluding a significant portion of the industry personnel, it would be helpful to document the general expectations of a lead HRA analyst. The requirements could include the following:

Practitioner (able to perform analysis independently using existing HRA methods, but not able to serve as a lead analyst in the HRA):

- Understands the details of the method(s) to be used in a given evaluation (this may be part of a utility or contractor training program).
- Has performed detailed quantifications using the method to be applied in a given HRA application.
- Has participated in the operator interview process and has integrated the results into the quantification and documentation process.
- Has an engineering degree (or equivalent) and has at least five years of experience in nuclear power plant PRA and PRA applications.

Expert (able to review HRA and serve as a lead analyst):

- Understands the details of the HRA methods(s) to be used in the evaluation as well as those of other methods commonly used in the U.S. Nuclear industry.
- Has independently performed HRA detailed quantifications using at least two different HRA methods.
- Has developed operator interview scenarios, led the operator interview process, and has experience integrating the results into two or more HRA/PRAs.

- Understands the degree of uncertainty in the HRA evaluations and has characterized the uncertainties as a practitioner.
- Has an engineering degree (or equivalent) and has at least ten years of experience in nuclear power plant PRA and PRA applications.

METHOD SPECIFIC COMMENTS

ATHEANA

Page 3-160

Because ATHEANA does not address the reasonableness of the HEP results, it would appear that the method could introduce significant biases in the results.

Page 3-161

Because ATHEANA relies on expert judgment to quantify HEPs, it would appear that the experts must be carefully selected to be:

a) qualified in the method
b) qualified in nuclear power plant operation
c) calibrated to a "standard"

These qualifications are not currently identified in a meaningful manner.

One of ATHEANA's weaknesses would appear to be the subjectivity of the analysis (e.g., identifying error forcing contexts and using them to quantify the HEP), but the document does not consistently reflect this (see pages 3-161 and 3-162).

Page 3-163

Errors of commission are not addressed in a methodical manner. They are addressed by example.

Page 3-164

The "helpful hints" appear to be more than that – they appear to be fundamental methodological issues.

ATHEANA appears to be advocated as the standard for the HRA, yet on every specific issue, it lacks:

- A defined method (e.g., dependency treatments)
- Data to support its viability

- Explicit items to include (e.g., PSFs)
- A quantification method
- Demonstration of its use in a full scale PRA

Examples of these deficiencies include:

- Consideration of potential interactions between factors is encouraged in obtaining the HEP distributions (Page 4-19); however, guidance on how to assess the dependence is not provided.
- The method does not specify a fixed set of PSFs. (Page 4-18)
- To the extent analysts fail to identify and consider the dominant scenario characteristics per the ATHEANA guidelines, the potential for analyst-to-analyst variability and inaccuracy is increased. (Page 4-20)
- Methods like ATHEANA are more flexible and do not use prescribed formulas or similar guidance; if not used correctly, they may also reduce the level of consistency among analysts, adding to analyst-to-analyst variability when using such methods. (Page 4-23)
- As previously noted, some methods (e.g., ATHEANA, SLIM/FLIM, or THERP if fully implemented) can be much more resource-intensive than others. In the case of ATHEANA, one of the main reasons for this is the emphasis on investigating a broader range of potential plant conditions for a given scenario (particularly deviations in conditions that could cause problems for the crew) and the emphasis on considering a broader range of PSFs and their potential interactions in modeling human performance and estimating HEPs. While it seems likely that this approach will improve accuracy and identify potentially error-prone situations, how frequently the additional effort will improve accuracy and prove critical to making appropriate risk decisions has still not been empirically tested. At some level, as discussed in Section 5, it will depend on the objectives of the analysis.
- The concept in ATHEANA that a comprehensive examination of all scenarios that involve an action can be addressed would appear to be optimistic. It is optimistic both from the ability to formulate those scenarios for discussion and then to characterize them to the implied level of detail with a PRA model.

- The ATHEANA report (May 2000) on page 6-14 states that: "The ATHEANA quantification method is still under development."

  This deficiency in ATHEANA should be included in the "limitations," unless a later ATHEANA report exists that provides the quantification method. The cited reference for the quantification process "Expert Elicitation Approach for Performing the ATHEANA Quantification," Reliability Engineering and System Safety, Elsevier, 2003 identifies a high level description of a process. The ATHEANA process is indeed a comprehensive approach to the evaluation of HRA [some questions remain about the validity of the proposed dependence treatment]; however, the practicality of PRA implementation is that there are finite resources available to support the PRA and there are eight other PRA "elements" that demand equal attention. The roadblocks to ATHEANA include the following:

  - No published NUREG currently addresses the ATHEANA quantification. There is a published article ["Expert Elicitation Approach for Performing the ATHEANA Quantification," Reliability Engineering and System Safety, Elsevier, 2003] that provides an extensive qualitative summary of the desirable attributes of the quantification method. However, the method has no quantification basis. Instead, it references the yet to be developed database of benchmark cases. (It is noted that these yet to be performed benchmark cases are critical to the quantification.)
  - The qualification of the ATHEANA team members is not enumerated.
  - The time and resource requirements associated with the team commitment are not defined.
  - The facilitator appears to be critical to the analysis. Yet this likely is not a member of the utility staff. This appears to be an area where the expectations for the facilitator are unreasonable,[1] i.e., the method places too many requirements and expectations without a structural method to allow them to be realized.
  - Traceability and ease of update: While documentation might provide a means of identifying the factors driving an HEP, there would be nothing connecting the factor mathematically to the end distribution. As procedures and training change, the entire process would have to be re-performed to obtain an updated HEP.

[1] High demands would be placed on the facilitator to 1) obtain results in the way required by ATHEANA (unbiased, accounting for most appropriate information, etc), 2) prove that it was collected and accounted for as required by ATHEANA.

- It would appear that there is no partial or streamlined implementation of ATHEANA. It appears that the full process would need to be implemented in detail to ensure that there is consistency in the HEPs.

SPAR-H

1. Based on information provided in a SPAR-H workshop, it appeared that the method was developed specifically for use in the NRC SPAR models and SDP evaluations. If it is only intended for SDP, that discussion is omitted from NUREG-1842.
2. The SPAR-H model is quoted as having the following limitations (Page 4-9):
   - As intended, the method should not be used for detailed analysis.
   - Resolution of the PSFs may be inadequate for detailed analysis.
   - Despite detailed discussion of potential interaction effects between PSFs, treats PSFs as independent.
   - No explicit guidance is provided for addressing a wider range of PSFs when needed.
   - The method has a weakness in its treatment of uncertainty. (see discussion in Section 3.8.2).
   - Relies on THERP and other data, which SPAR-H adapts for use within the method. Validity of the adaptation process and resulting HEPs has not been demonstrated.

These limitations would indicate that the technique and its results are not adequate to make fine distinctions regarding SDP calculations (i.e., "should not be used for detailed analysis"). SPAR-H should be identified as a method not to be used for Capability Category II PRA applications.

THERP TRC

Page 3-15, paragraph 1:

The THERP TRC is said to not be appropriate for use in regulatory applications. This conclusion is not supported by a basis or reference. It is judged that THERP TRC is an approximate method to address the time PSF and should be retained as one viable approach for this PSF. It should not be used as the sole method to evaluate the non-response probability. It should be used in conjunction with other methods that may appropriately address other PSFs.

THERP

The evaluation of THERP indicates that no dependence model exists for dependencies "within a sequence"; however, the SPAR-H discussion says that it does address these types of dependencies using the THERP dependence model. This appears to be an inconsistency. The THERP discussion of this topic indicates that the dependence model was intended for modeling dependence between subtasks and that it has been subverted by many to be used for inter-action dependence.

There are two areas where draft NUREG-1842 does not appear to provide sufficient guidance:

- First, the fact that THERP has developed a method for dependencies among subtasks is clear. The extension to include application to a series of related actions would appear to be justified. Draft NUREG-1842 appears to miss an opportunity to provide useful guidance in this area to support and allow this extension.
- Second, draft NUREG-1842 does not appear to offer an alternative method for the consistent quantitative treatment of dependencies.

HCR/ORE

An extensive critique of the HCR/ORE method is included:

- The ability to adequately address the range of plant conditions and PSFs that could bear on performance in an accident scenario (regardless of the approach for obtaining response times) has not been demonstrated.
- Guidance for use of expert judgment to obtain estimates of crew response times is not provided. (This creates an issue of validity and reliability).
- The validity of generalizing simulator results from ORE experiments to plant-specific analyses was not demonstrated.
- The method does not provide a systematic approach to identify important aspects of human performance for the actions modeled in the PRA (an important goal of the HRA).
- Until the suitability of using the standard normal distribution is demonstrated and the method is implemented through an adequate number of plant-specific simulator runs to obtain the relevant model parameters, use of the HCR/ORE TRC is not appropriate for regulatory applications.

- Because of these limitations, it is uncertain that using this method will yield appropriate "relative values" of HEPs and, hence, appropriate safety insights and improvements.

EPRI Calculator

Although the Calculator facilitates consistency in applying the specific methods included, the lack of guidance on which methods to use for particular situations could lead to inconsistency in overall results.

EDITORIAL

The following editorial items were identified that should be considered:

1. Page xii, first paragraph:

   "hings" should be "hints."

2. Page xii, last paragraph:

   replace uncertainty (sic) with correct word.

3. Page 1-3, 2nd line:

   "focusing on those that (are) commonly used in ...."

4. Page 1-3, last line:

   delete "being"
   "may be being used"

5. Page 5-156:

   It appears that Pre-Initiator GP-3 was referenced here instead of Post-Initiator GP-4 in the sub-heading.