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Sent: Wednesday, September 19, 2012 3:50 PM
To: 'Poslusny, Chester'; Pope, Steven M
Subject: NRC Staff Comments on mPower HFE Technical Reports
Attachments: mPower HFE TRs- NRC Observations - Discussed at June 2012 Meeting (2).doc

Follow Up Flag: Follow up
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Chet,

As we discussed at our closed meeting on June 21, 2012, the staff provided comments on the HFE technical reports submitted by B&W mPower, Inc. Those comments are included in the attachment to this email.

This email will be made publicly available consistent with our Official Agency Record release policy, please advise immediately regarding whether any of the information herein, including the attachment, should be considered proprietary and be withheld from public disclosure consistent with the affidavits accompanying the proprietary versions of these reports.

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NRC Staff Comments on B&W mPower Technical Reports
MPWR-TECR-005002 Rev-000, May 2012
ADAMS Accession Number ML12165A702
Human Factors Engineering Program Management Plan

Specific Comments/Questions:

1. P. 7- Consider defining “risk important local control stations.”
2. P. 7- Consider defining “operation vigilance.”
3. P. 8, second paragraph, second bullet: What is meant the term used in the bullet that is credited by safety analysis, PRA, or emergency procedure guidelines?
4. P. 8- “Responsibilities”: why isn’t HFE included as a discipline considered, at a minimum, part of the HFE Design Team?
5. P. 9- “Methodology”: explain how an HFE Program interacts with members of the design design team...” how does a “program” interact with personnel?
6. P. 10- “HFE Program”: is there a rationale for why the process items are listed in the order they are, i.e., why does HRA come before FRA/FA?
7. P. 11- Figure 1- title of the figure is, “HFE Process Overview.” Yet the text emphasizes the HFE program. This seems inconsistent. The figure uses the terminology, requirements development, and management to describe the first element. Not certain to what this corresponds to in the overall HFE program because the term is not used in the text to describe process elements. The figure identifies 3 simulator types that are used in different phases of the HFE process. Consider explaining the purpose and differences among the three or providing a pointer to the explanation that is in section 5.
8. P. 12- Explain the terminology, “HFE program element engineering instructions...” What are they? Are they same/different than the TRs/IPs we’re reviewing? Is it just the 7 items listed that has engineering instructions or is there other elements as well? The next section begins a discussion about subsections providing “High-level descriptions of each of the elements of the HFE process. Do these items/elements have engineering instructions?
9. P. 16- Title for 3.2.7, human system interface development, seems inconsistent with use elsewhere.
10. P. 19- Term “operational life-cycle monitoring” is used. Is this comparable to 0711’s, “human performance monitoring?” Term should be explained.

11. P. 21- Table 1. What's the rationale for not including HFE input into the PFRA, SFRA/TA activities?
12. P. 27- "Requirements Management Tool." What is it? How it's used is explained but not what it is or what it consists of, e.g., is it computerized, hard copy databases, what?
13. P. 28- Same comment as #11.
14. P. 31- "Issues Tracking Process and Responsibilities": Under discussion of Section 4.1.1.2, the description of the assessor responsibilities should be clarified and made consistent with earlier discussion related to the system/process being described as one for non-HEDs.
15. P. 33-37- Good discussion of simulation development and use. However, it is confusing trying to sync-up figure 3 with the preceding text. For example, it's unclear how and where, in the figure, part-task simulator is used and for what purpose. Seems like some HFE activities are contained in the simulator development row and simulator activities in the simulator row.
16. P. 36-37, Figure 4. This figure is hard to follow and understand its purpose and how it relates back to the text on p. 36, under the heading, "HFE/Simulator Milestones." For example, I'm not seeing anything in the figure that clearly describes an "HFE milestone." I'd expect to see some relationship that links, for example, completion of HFE program elements to the progressive development of the simulator. Consider a brief explanation on the purpose of the figure.

NRC Staff Comments on B&W mPower Technical Reports
MPWR-TECR-005003 Rev-000, May 2012
ADAMS Accession Number ML12165A703
Operating Experience Review

Specific Comments/Questions:

1. P. 6- "Responsibilities": Are the activities and team members related to FRA/FA or OER?
2. P. 7- "Development of "summary reports": Done on a system basis plus one for the entire B&W design project. How is the report going to be accomplished and what that entails (i.e. more details, examples)?
3. P. 9- "Structure and flow": "When an engineer is assigned an OE search topic..." What initiates this action?
4. P. 12- "Risk-important human actions":---Suggest that this be revisited in light of forthcoming 0711 R-3 "treatment of important HAs."
5. P. 17- "Summary Reports": Summary reports are developed for each system. How is OER for HFE accomplished with summary reports that are/seem to be produced for each plant system or for all systems that will not have HFE-related OER data/information?
6. P. 17- "Definitions, Abbreviations, and Acronyms": Uncertain why this set of definitions included and how related to OER, specifically. Should this set of definitions be expanded/revised? Rationale for including the limited set explained.

**NRC Staff Comments on B&W mPower Technical Reports
MPWR-TECR-005004 Rev-000, May 2012
ADAMS Accession Number ML12165A704
Functional Requirements Analysis and Function Allocation**

Approach

1. There is currently no discussion of predecessor plants
 - Criterion 3 of NUREG-0711 states in part: “A description of the functions and systems should be provided along with a comparison to the reference plants/systems, i.e., the previous plants or plant systems on which the new system is based...”
Although this is in many ways a first of a kind plant there are many functions/systems that are similar to predecessor designs.
 - Functions: Reactivity Control, Pressure Control, Electricity Generation etc.
 - Systems: Rod Control System, Pressurizer Control System, Turbine Systems etc.
 - Figure 2 (proprietary) on page 10 shows a level [beginning with the letters “m, l”]. This is a unique consideration for SMRs that may vary from industry OER. What considerations are made to account for this deviation?
 - Establishing and documenting these considerations helps to create the bases needed for several other NUREG-0711 criteria within the FRA/FA section.
2. This technical report reads like an implementation plan. If it will be used as an implementation plan in it should contain all of the information necessary for a reviewer to make a safety determination (or incorporate references to other documents).
 - Example: Page 11 paragraph 5, last sentence, the proprietary terminology [beginning with letters “b, m, g”] is not defined in the current document.
 - “Behavioral maintain function” is defined on page 39 of the HFE PM document, but the term is not exact.
 - Additionally, the sentence on page 11 is unclear as to how it relates. How will non-functional requirements be handled?

Level of Detail

Below are examples demonstrating ways in which the report is still unclear.

1. Section 1.3 (page 7) describes the personnel who will be used to complete the FRA/FA. The description contains an expanding scope that does not clearly define the qualifications of those that will conduct FRA/FA activities.
 - The description commits to only operations and systems engineering personnel and makes no mention of skills related to HFE or mPower™ experience.
 - Page 14 (final paragraph) and page 15 (top paragraph) both refer to Analysts, a term that has not been defined. The qualifications for the Analyst position are unclear.

2. Page 8 (top paragraph) describes an unusual conceptualization of automation.
 - The description included here is not clear.
 - Is there research supporting the basis for this definition?
 - What guarantee is there that “integral” human involvement will be present and “in-the-loop” when the function is needed?
3. Page 11 (paragraph 1) refers to an assumption made regarding functional requirements.
 - What basis is there to make this assumption?
 - Is there any plan to verify this assumption? If so, how will it be done?
4. Page 17 (3rd paragraph from the bottom) describes the methods used for maintaining the FRA/FA throughout the lifetime of the plant.
 - Who is responsible for this activity?
 - Where and how will this be documented?
5. Has any consideration been given to the *interaction effects* that can happen when interacting with automation (e.g. complacency/disuse/effects of miscalibration of trust in automation)? How will this be included in the Function Allocation?
 - Is there potential for over-reliance on automation/complacency with one unit while interacting manually with another?
 - How does the current plan support avoiding errors that are caused by the interaction between the human and automation (as opposed to simply the weaknesses of the human/automation alone)?
6. Section 4: Summary Conclusions (page 21) describes that the FRM tool output.
 - Does the tool automatically create the report? The wording seems to imply that it might. If so, what sort of analysis is used to ensure that it provides accurate and thoughtful allocations? Clarification would be helpful if the tool only creates diagrams and tables that will be included in the RSR.

NRC Staff Comments on B&W mPower Technical Reports
MPWR-TECR-005005 Rev-000, May 2012
ADAMS Accession Number ML12165A705
Task Analysis

1. Consistency issues:

- Page 6, Section 1.2: *“The task analysis output identifies all controls and indications necessary to complete each task or element of the task. The analysis identifies all interface requirements in the control room and local control stations in the plant.”*

Subsequent material (sections 3.1.2, 3.1.3, 3.5, definition of HSI) sometimes uses the term, “controls, alarms, and indications” or, “alarms, controls, and displays.” An alarm could be considered an indication but when it is sometimes called out separately the scope of “indication” becomes unclear. Typically we have used the term, “controls, alarms and displays.” There is no real preference as long as there is consistency.)

- Page 7, Section 2: *“The purpose for performing a task analysis is to define all human actions, including personnel roles and responsibilities for those tasks that were screened into the analysis.”*

The sentence quoted in the first bullet could also be viewed as a purpose statement and it was a surprise to find a purpose statement in a section titled, “Background.” Integrating the two sentences would provide a clearer definition of, “Scope and objectives.”

- Page 10, Section 3.1.4 – Are the results from this step included in the “System Function Matrix as they are for the previous steps?

2. Measurability (key attributes) of some process components needs clarification to have quantitative acceptance criteria for the ITAAC.

- Page 6, Section 1.2 – *“Design assessment includes the human element of the tasks and is completed as part-task or full-scope simulators of sufficient fidelity and completeness to evaluate the task become available.”*

What are the minimum specifications for the completion of the task determine by the term “become available”?

- Page 6, Section 1.2 – *“Design assessment is conducted using trained operators and using applicable procedures.”*

What is minimum qualification? What kind of training?

- Page 9, Section 3.1.1 – *“The normal operating task analysis considers all operational characteristics that are expected for the normal system modes of operation.”*

Besides “normal system functions,” what else is included in the term, “Operational Characteristics?”

- Page 10, Section 3.1.4 – *“Alarm response guidance is found within the B&W mPower standard plants requirement document.”*

This reference has the potential of making applicable parts of this document Tier 2*. If possible it would be better to describe the standards that are being used from that document.

- Page 10, Section 3.2 – *“Any changes made to the original staffing or qualification assumptions are subsequently evaluated from a detailed task analysis view. This is intended to apply to those tasks that originally screened out of the process but subsequently revealed themselves as challenges to initial staffing or qualification assumptions”.*

What is being evaluated and how it is being evaluated? What is a “detailed task analysis view”?

- Page 14, Section 3.3.15 – *“These workload values are assessed and adjusted during the design assessment portion of the task analysis. Concurrent task performance is considered due to the compounding of workloads through all modes of operation.”*

How this is going to be accomplished?

- Page 14, Section 3.3.16 – *“A hierarchical task analysis is performed for groups of tasks when viewed from an integrated level.”*

What are the measurable attributes and acceptance criteria for the completed activity?

- What factors are used to decide when the hierarchical TA is performed?
- What is it that links the groups of tasks (sequential by time, all address a critical safety function, all are taken by one watch stander)
- What does “viewed from an integrated level” mean?
- The next sentence says the hierarchical task analysis produces a comprehensive task description. What are the elements of a comprehensive description? Does it differ from the “initial task analysis” description?

Is the Hierarchical task analysis dependent on the initial task analysis?

This section is causing confusion because it is listed as a subset of the “initial task analysis” yet appears to be describing an analysis that is conducted using output (groups of tasks) supposedly collected and analyzed during the “initial task analysis.”

- Page 16, Section 3.5.2 – Section marked as proprietary. First sentence – use of the term “*as long as*”

What are the minimum specifications for the completion of the task determine by the term “as long as”?

- Page 16 Section 3.5.3 – Section marked as proprietary. Paragraph starting with “Figure 2,” Second sentence.

Do all changes receive this review or only those that meet some significance criterion?

- Page 19, Section 3.5.4 – Section marked as proprietary. Next to last sentence starting with “*An observer ...*”

What is observer minimum qualification? How are ratings defined so there is consistency between observers?

- Page 19, Section 3.5.6 – Section marked as proprietary. Third paragraph, First sentence – Use of the term “*such as*”

What is meant by the term “such as”?

- Page 20, Section 3.5.7 – Section marked as proprietary. Second paragraph, First sentence.

Will the factors affecting teamwork be evaluated by the tools? How?

- Page 20, Section 3.5.8 – “*This model also models the expected hard HSIs (e.g., switches, knobs) to the extent practicable. Part-task simulations of risk important local control stations are constructed on an as-needed basis.*”

What are the minimum specifications for the completion of the task determine by the term “to the extent practicable” and “on as as-needed basis”?

- Page 20, Section 3.5.8 – “*The evaluations performed on this simulator are determined by the extent of the models that are programmed within the simulator.*”

What are the minimum specifications for the completion of the task determine by the term “extent of the models that are programmed”?

- Page 20, Section 3.5.8 – “*Part-task simulations of risk important local control stations are constructed on an as-needed basis.*”

What criteria are use to determine the need?

3. Some terms need clarification.

- Page 6, Section 1.2 – “*The design assessment portion of the task analysis tests the systems in combinations and as a whole in a dynamic environment.*”
- Page 6, Section 1.2 – “*This task analysis technical report describes a graded approach for completion.*”

Iterative approach would make sense based on the descriptions. “Graded approach” was not self evident from the descriptions.

- Page 6, Section 1.2 – *“This report describes the process for the initial task analysis, staffing and qualifications determinations, and design assessments.”*

Report needs to describe the entire process. I think it does but this characterization introduces some doubt. “Initial” is used throughout report and needs to be more specifically defined so its relationship to the complete task analysis is clear.

- Page 6, Section 1.2 – *“Tasks that fall outside this screening process are analyzed by system engineers as necessary, but not by the integration design process/ HFE team, with the exception of multidisciplinary team reviews performed during the design review acceptance process.”*
- Pages 8, Section 3.1 – *“The initial task analysis is performed with the detailed design information and each task is broken into discrete task steps (elements).”*
Page 10, Section 3.3 – *“These tasks are then broken down into task steps (elements).”*

Do task steps correspond to subtasks or elements as described in sections 3.3.1 and 3.3.2?

- Page 9, Section 3.1 – *“The basic task description includes all necessary indications and controls that are displayed on the HSI.”*

Is the “Basic task description” the documentation containing the task attributes? What is this “Basic task description” and what it is used for? Is it different from the “task,” “task steps,” and “subtasks” or does it correspond to one of them?

- Page 10, Section 3.2 – *“The tasks in relation to any abnormal or emergency operations (transients).”*

Unclear term. “Included in” seems more appropriate.

- Page 10, Section 3.3 – *“This is a written description of the task and follows the function allocation for each task.”*
- Page 11, Section 3.3.6 – *“All support systems required for the task elements are documented and include the sequence necessary for task performance.”*

Is this a plant support system or an operator support system?

- Page 15, Section 3.5 – Section marked as proprietary. First paragraph, third sentence – use of the term “systems”

Is it the plant systems that are assessed or does the term, "System," have a different definition in this application?

- Page 22, Section 4 – *"The task analysis provides a thorough understanding of the tasks necessary for plant operations and maintenance. The task analysis provides a basis for:
▪ Listing of all tasks including monitoring and task modes of operation."*

Does the task analysis attempt to quantify maintenance tasks in general or just the impact of maintenance tasks on operational personnel? Is "task modes of operation" the modes in which the task is performed?

4. Page 6, Section 1.2 – *"The modeling of tasks in simulators (part-task and full-scope) provides the dynamic assessment of the design."*

Should this be "provides for" or "allows"?

5. Page 6, Section 1.2 – *"Tasks that are identified by operating experience reports or that are of regulatory significance are analyzed."*

Why are OER tasks mentioned but not RIHAs? How are regulatory significant tasks identified?

6. Page 7, Section 1.3 – *"Training and procedure specialists are involved with the emergency procedure guideline development to ensure that the requirements of the emergency procedure guidelines are fully considered within the task analysis process."*

How does this relate to the task analysis participants?

7. Page 10, Section 3.1.4 – *"Staffing and qualifications analysis is done as part of the overall task analysis. The staffing and qualifications initial assumptions are reviewed throughout the task analysis process to ensure that there are no changes necessary."*

Indentation appears to be incorrect. This paragraph does not appear to be directly related to the subject of "alarm response task analysis."

8. Page 10, Section 3.3 – *"The task analysis process identifies all tasks required to complete functions determined to be within the scope of HFE task analysis."*

Doesn't the screening process described in the previous section really do this? If not then "functions" needs to be defined more completely.

9. Page 12, Section 3.3.8 – *"Identifiers are used for minimum inventory determinations."*

Are you considering identifiers for RG 1.97 (PAM), DAS indications, remote shutdown?

10. Page 15, Section 3.5 – Section marked as proprietary. First paragraph, last sentence – use of the term *“corrections of those tasks.”*

Do you “correct the tasks” or those things that support the operators ability to do the tasks?

11. Page 21, Section 3.5.9 – *“By performing evaluations starting in the design assessment phase of the design process, a greater emphasis is placed on creating an environment for the operator that allows for greater situational awareness and safer control of the plant.”*

Is the term “design process” referring to the “task analysis process”?

12. Page 21, Section 3.6 – Section marked as proprietary. Third Sentence- use of the term *“form a complete task description”*

Does the process provide a “complete task description” or does it ensure a “human-centric HSI design?” I thought the design assessment process did the latter based on Section 3.5.

13. Page 21, Section 3.7 – *“All modifications to the original plant design are analyzed in relation to the degree of change of that task from the original task analysis. The task is matched to the function and the function allocation is confirmed. All risk-important human actions that are affected by the change are reviewed. Changes and modifications are carefully analyzed for any new human actions that are created.”*

Wording is confusing. Is the intent to say that all modifications ...are analyzed to identify changes in tasks from the original task analysis? In the last sentence does “Changes” refer to task changes?

**NRC Staff Comments on B&W mPower Technical Reports
MPWR-TECR-005006 Rev-000, May 2012
ADAMS Accession Number ML12165A706
Human Factors Engineering Integration of Human Reliability Analysis**

Approach Questions:

1. (Section 3.2, pg 8) In the last paragraph, third line from the top... What are the “assumptions”?
2. These [Tables from Generic Human Actions, NUREG-1764] represent possible HAs that are representative of the final HRA. By modifying the design using these inputs, are future design modifications expected to be minimized? (Section 3.2, pg 10)
3. Precedence has it that a preliminary list of RI HAs has been available during DC, will this happen for mPower™?
4. Will the actions described in this report, including Chapter 18, correspond to the ones described in Chapter 19?
5. To the extent possible, the design process identifies potential errors of commission. (Section 3.3, pg 10) How is that done?
6. (Section 3.8, pg 12; Last paragraph, 4th sentence) Is the initial PRA/HRA the one for design certification? What does “completed” mean?
7. Does HFE responsibilities include calculating human error probabilities? (Section 3.8, pg 14; First paragraph, first sentence starting on the first line)
8. Important Human Actions (Criterion 2, Rev. 3)
 - How are the criteria incorporated into the HFE process for RI HAs?
 - Not yet bound to Rev. 3 of 0711; current, not yet approved (is that the word), revision has changed the HRA title to Treatment of Important Human Actions. The point here was to ensure that the RI HAs and “*Important HAs*” together, are accounted for in the HFE design. The *Important HAs* are those identified deterministically (Chapter 15 [accident and transient analysis] and Chapter 7 [D3 coping analysis])

Level of Detail Questions:

1. Human Action Dependency (Section 3.7, pg 12)
 - What does this mean?
 - What are the *Industry-accepted methods for evaluating dependency*? Are they used in the B&W mPower™ PRA?
2. RI HAs are specifically addressed during each part of the HFE process, how is the design evaluated? What criteria are used in the identified elements that lead to a

particular design feature ensuring “successful completion” of the RI Has? What determines “successful completion”? (Section 3.8, pg 13; Sentence starting with “The design...”)

3. Is the evaluation described in this sentence defined in the document? What does “all appropriate means” mean? (Section 3.8, pg 13; Fifth line from the bottom, sentence starting with “The changed...”)
4. How? A part of the V&V process or something different? (Section 3.8, pg 13, Third line from the bottom, sentence starting with “This analysis...”)