

October 3, 1995

Mr. Nicholas J. Liparulo  
Nuclear Safety and Regulatory Activities  
Westinghouse Electric Corporation  
P.O. Box 355  
Pittsburgh, Pennsylvania 15230

SUBJECT: COMMENTS ON THE AP600 DRAFT IMPLEMENTATION PLAN FOR INTEGRATING  
HUMAN RELIABILITY ANALYSIS WITH HUMAN FACTORS ENGINEERING DESIGN

Dear Mr. Liparulo:

The Nuclear Regulatory Commission (NRC) staff has recently completed review of the Westinghouse draft implementation plan for integration of Human Reliability Analysis with Human Factors Engineering design. The plan was sent to the NRC via facsimile on May 24, 1995, and describes the interrelation among the activities conducted by the man-machine design group, the procedures development group, the probabilistic risk assessment group, and the human reliability analysis group. In an enclosure to this letter, the staff has provided comments on the draft plan as it relates to the draft safety evaluation report open items concerning Element 6 of the Human Factors Engineering Program Review Model.

If you have any questions regarding this matter, you can contact me at (301) 415-1141.

Sincerely,

Original signed by  
William C. Huffman, Project Manager  
Standardization Project Directorate  
Division of Reactor Program Management  
Office of Nuclear Reactor Regulation

Docket No. 52-003

Enclosure: AP600 DSER Open  
Item Resolution  
of Element 6  
Human Reliability  
Analysis

cc w/enclosure:  
See next page

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WASHINGTON, D.C. 20555-0001

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Mr. Nicholas J. Liparulo  
Westinghouse Electric Corporation

Docket No. 52-003  
AP600

cc: Mr. B. A. McIntyre  
Advanced Plant Safety & Licensing  
Westinghouse Electric Corporation  
Energy Systems Business Unit  
P.O. Box 355  
Pittsburgh, PA 15230

Mr. Ronald Simard, Director  
Advanced Reactor Programs  
Nuclear Energy Institute  
1776 Eye Street, N.W.  
Suite 300  
Washington, DC 20006-3706

Mr. John C. Butler  
Advanced Plant Safety & Licensing  
Westinghouse Electric Corporation  
Energy Systems Business Unit  
Box 355  
Pittsburgh, PA 15230

STS, Inc.  
Attn: Lynn Connor  
Suite 610  
3 Metro Center  
Bethesda, MD 20814

Mr. M. D. Beaumont  
Nuclear and Advanced Technology Division  
Westinghouse Electric Corporation  
One Montrose Metro  
11921 Rockville Pike  
Suite 350  
Rockville, MD 20852

Mr. James E. Quinn, Projects Manager  
LMR and SBWR Programs  
GE Nuclear Energy  
175 Curtner Avenue, M/C 165  
San Jose, CA 95125

Mr. Sterling Franks  
U.S. Department of Energy  
NE-42  
Washington, DC 20585

Mr. John E. Leatherman, Manager  
SBWR Design Certification  
GE Nuclear Energy, M/C 781  
San Jose, CA 95125

Mr. S. M. Modro  
EG&G Idaho Inc.  
Post Office Box 1625  
Idaho Falls, ID 83415

Barton Z. Cowan, Esq.  
Eckert Seamans Cherin & Mellott  
600 Grant Street 42nd Floor  
Pittsburgh, PA 15219

Mr. Frank A. Ross  
U.S. Department of Energy, NE-42  
Office of LWR Safety and Technology  
19901 Germantown Road  
Germantown, MD 20874

Mr. Ed Rodwell, Manager  
PWR Design Certification  
Electric Power Research Institute  
3412 Hillview Avenue  
Palo Alto, CA 94303

Mr. Charles Thompson, Nuclear Engineer  
AP600 Certification  
U.S. Department of Energy  
NE-451  
Washington, DC 20585

AP600 DSER Open Item Resolution  
Element 6 Human Reliability Analysis  
(September 28, 1995)

To address open items related to Element 6 of the Human Factors Engineering Program Review Model, Westinghouse has submitted a draft document entitled "Integration of Human Reliability Analysis with Human Factors Engineering Design Implementation Plan" (Westinghouse Implementation Plan) transmitted by fax on May 24, 1995.

The staff has the following comments on the draft report as it relates to the Element 6 open items:

<u>Open Item DSER # (OITS #)</u>		<u>Current Status</u>
18.7.3-1 (1348)	HRA-HFE Integration Implementation Plan	Resolved (Action W)
18.7.3-2 (1349)	Process for Identification of Critical Human Actions	Action W & Action N
18.7.3-3 (1350)	Critical Human Actions Task Analysis	Resolved (Action W)
18.7.3-4 (1351)	Detailed Examination of Critical Actions	Resolved (Action W)
18.7.3-5 (1352)	Use of PRA/HRA Insights	Action W
18.7.3-6 (1353)	HRA Validation	Resolved (Action W)

Enclosure

Open Item 18.7.3-1: HRA-HFE Integration Implementation Plan

Criterion: While the HFE PRM criterion for this element does not explicitly include an implementation plan, such a plan is needed to address the HFE PRM criterion-based review to follow. This criterion addresses the availability of an implementation plan in the SSAR.

DSEI Evaluation: Based on the material reviewed, Westinghouse does not have an implementation plan for HRA-HFE integration. Such a plan is needed and should consider the information that follows. The plan should address how and when the HRA will be requantified as the HFE program completes the design. This is especially important because the current HRA/PRA was finished though many aspects of the HFE have not yet been completed; for example: functional allocation, task analyses, HSI design, procedures, operator training programs. In other words, since AP600 HFE design is not complete, the HRA has not taken into account the human performance effects of the new advanced HSI design. The lack of completion of these areas holds true in the MCR, remote shutdown panel and local control stations and could significantly impact the results of the HRA as well as the PRA. Concern over human error probability (HEP) estimation was expressed by the staff in a meeting with Westinghouse on February 23, 1994 and February 25, 1994. The staff noted that Westinghouse calculated very optimistic human error probabilities considering no EOPs and ERGs are available, the control room layout has not been well defined, the functional relationship of the SRO and STA has not been well defined, and many significant operator actions require a response in a short time frame. These concerns were provided to Westinghouse in RAI's 720.276 through 720.278. An accurate HRA/PRA is important to the HFE process because of their use in determining the critical operator actions. Further, for the newly designed passive plants, such as the AP600, the HRA/PRA is being used for other significant determinations such as the appropriate regulatory treatment of non-safety systems. Therefore, once the HFE design is complete it is important to requantify the HRA/PRA and to reverify decisions made based upon the results of the HRA/PRA.

Proposed Resolution: In the draft Westinghouse Implementation Plan (May 24, 1995) the various items associated with proper integration of the PRA/HRA and the HFE process are discussed in detail, including: use of HRA/PRA insights to guide HFE design; identification of critical human actions and risk important tasks; task analyses for critical human actions and risk important tasks; re-examination of critical human actions and risk important tasks; and validation of HRA performance assumptions. Thus Westinghouse has developed an Implementation Plan with appropriate scope. The acceptability of the individual items is discussed under the individual criteria which follow.

In Sections 3.2 and 5.0 of the Westinghouse Implementation Plan, Westinghouse addresses the issue of whether there is a need to re-evaluate and possibly requantify the HRA/PRA after the HFE design is complete. Here they state that performance assumptions will be confirmed as part of both the Task Analyses and the control room validation. An evaluation will be made as to whether any of the assumptions and whether the HRA must be changed. If necessary the HRA

will be modified and the impact on the PRA will be assessed. Reports will be generated documenting the results, which will be submitted to the Westinghouse HRA/PRA group and the NRC for review.

Based upon this information, this DSER issue is considered resolved.

This criterion will be satisfied when the SSAR is revised to include the implementation plan is submitted in final form and it is reviewed and accepted by the NRC.

**STATUS OF OPEN ITEM: Resolved (Action W)**

#### Open Item 18.7.3-2: Process For Identification of Critical Human Actions

Criterion 1: Critical human actions should be identified from the PRA/HRA and used as input to the HFE design effort. These critical actions should be developed from the Level 1 (core damage) PRA and Level 2 (release from containment) PRA including both internal and external events. They should be developed using selected (more than one) importance measures and HRA sensitivity analyses in order to ensure that an important action is not overlooked due to the selection of the measure or the use of a particular assumption in the analysis.

DSER Evaluation: Westinghouse's response to RAI 720.133 indicates that the identification of critical human actions is not completed pending the completion of sensitivity analyses.

Proposed Resolution: The issue of selection criteria for critical and risk-important actions is being addressed in separate discussions between the staff and Westinghouse and remains open. It should be noted that resolution of the issue impacts a number of other items in this section. While Items 18.7.3-3, 4, 5, and 6 below are all evaluated as "resolved" based upon technically thorough discussions and commitments made in the Westinghouse Implementation Plan, their complete resolution is dependent on this issue.

**STATUS OF OPEN ITEM: Action W & Action N**

#### Open Item 18.7.3-3: Critical Human Actions Task Analysis

Criterion 2: The details of human performance of critical human actions and their associated tasks and scenarios identified through the initial PRA/HRA should be specifically addressed during Element 4 - Task Analysis. This will help ensure that these tasks are within acceptable human performance capabilities, e.g., within time and workload requirements.

DSER Evaluation: The methodology for task analysis with respect to treatment of time and workload considerations was identified as part of Open Item 18.5.3-3: Task analysis methods.

Proposed Resolution: Section 3.0 of the Westinghouse Implementation Plan, provides a commitment that the HRA/PRA group will specify human actions and task sequences to be used as input to the task analyses. This will include critical actions (if any) and risk-important actions. It may also include other actions that the HRA/PRA group has determined to be in need of a more detailed analysis. The analyses will include performance requirements, such as time windows within which an action needs to be completed. Workload of the operators will also be addressed as discussed in Section 3.2 of the Westinghouse Implementation Plan.

Based upon this information, this DSER issue is considered resolved.

This criterion will be satisfied when the SSAR is revised to include the implementation plan submitted in final form and it is reviewed and accepted by the NRC.

**STATUS OF OPEN ITEM: Resolved (Action W)**

#### Open Item 18.7.3-4: Detailed Examination of Critical Actions

Criterion 3: Critical human actions that are identified via PRA/HRA as posing serious challenges to plant safety and reliability should be reexamined by function analysis, task analysis, HSI design, or procedure development to either change the operator task or the control and display environment to reduce or eliminate undesirable sources of error.

DSER Evaluation: The relationship between the HFE function allocation and the modeling of manual human actions should be clarified. Westinghouse's response to RAI 720.177, for example, discussed manual and automatic valve actuation during reduced inventory operations. Additional information is needed on the impact on HRA of HFE function allocations yet to be performed. In response to RAI 720.118, Westinghouse indicated that the HEPs were not evaluated to account for "the use of advanced digital technology or to account for the role of the operator as a monitor and decision maker rather than performing actions directed by procedures." This approach is inconsistent with the role of the operator described in SSAR Section 18.6.6 and operator training in SSAR Section 18.9.9.3. The M-MIS is being designed to support an operator trained as a decision-maker and one who doesn't accept procedures in an unquestioning manner. It is expected that such an operator might spend additional time following procedures (for information validation and confirmation of procedure appropriateness and adequacy) and this should be reflected in the evaluation of critical actions for HEP estimation.

Westinghouse must, taking into account the concerns identified by the staff in their DSER Evaluation of this criterion, describe the process that will

(1) provide additional information on the impact on HRA of HFE function allocations yet to be performed, (2) provide detailed evaluations of critical actions to reduce or eliminate sources of error, and (3) clarify the possible inconsistency between the operator role assumptions in the HFE design and the HRA.

Proposed Resolution: Section 4.0 of the Westinghouse Implementation Plan states that any critical human action or risk important task that is determined to be a significant contributor to risk, based on the PRA, will be reexamined by task analysis, M-MIS design, and procedure development to identify changes that may reduce or eliminate undesirable sources of error.

Section 3.2 of the Westinghouse Implementation Plan discusses how the task analyses will be used to address the assumptions used in the HRA by developing more accurate estimates of workload and task completion times. This information will be provided to the Westinghouse HRA/PRA group.

Based upon this information, this DSER issue is considered resolved.

This criterion will be satisfied when the SSAR is revised to include the implementation plan submitted in final form and it is reviewed and accepted by the NRC.

STATUS OF OPEN ITEM: Resolved (Action W)

#### Open Item 18.7.3-5: Use of PRA/HRA Insights

Criterion 4: The use of PRA/HRA results by the HFE design team should be specifically addressed; i.e., how critical personnel tasks are addressed (through HSI design, procedural development, and training) by the HFE program to minimize the likelihood of operator error and provide for error detection and recovery capability.

DSER Evaluation: In response to RAI 720.117, Westinghouse indicated that "HRA analysts worked together with system designers to perform the individual system analyses used to develop fault trees for the various systems modeled in the PRA, complete the HRA and finalize the system design." The response indicates that specific insights from the HRA were incorporated in the system design and that the individual system designs were modified to support performance of the modeled operator actions. Dominant cutsets were reviewed to identify sequences where human reliability was a significant contributor to failure. For limiting sequences, changes were made to provide necessary operator-related improvements (design and operation) to eliminate the limiting human failures. HRA was integrated with the development of high-level operator action strategies. However, no examples of the process were provided.

Proposed Resolution: As noted in the DSER and in Section 1.2 of the Westinghouse Implementation Plan, Westinghouse has designed the AP600 taking into account: lessons learned from existing plant experience, results of past HRAs and PRAs, and specific insights from the AP600 initial HRA. This has



allowed Westinghouse to reduce the potential for human error. Westinghouse states that this simplifies the plant and reduces the number of human actions required. For example, no human actions are required to respond to design basis events.

Further, Section 1.2 of the Westinghouse Implementation Plan provides a discussion of how the HRA/PRA results will be used in task analysis, HSI design, and procedure development to identify changes to the operator task or the control and display environment to reduce or eliminate undesirable sources of error. However, no discussion of error detection or recovery capability is provided.

Regarding training, Westinghouse states that training program development is a COL responsibility. Section 1.2 of the Westinghouse Implementation Plan discusses how Westinghouse will provide the COL with documentation that includes: a description of HRA assumptions, HRA results relevant to training, and insights relevant to training based upon the V&V.

This item remains open pending: (1) receipt of information on error detection and recovery capability and (2) the commitments with respect to training need to be documented in an appropriate ITAAC and the SSAR should be revised to include a description of the process Westinghouse will use to ensure that the transfer of training information to the COL takes place.

**STATUS OF OPEN ITEM: Action W**

#### Open Item 18.7.3-6: HRA Validation

Criterion 5: HRA assumptions such as decision-making and diagnosis strategies for dominant sequences should be validated via walk-through analyses with personnel with operational experience using a plant-specific control room mockup, prototype, or simulator. Reviews should be conducted prior to the final quantification stage of the PRA.

DSEER Evaluation: This issue is not addressed in the methodology described in the AP600 PRA Report - Chapter 5, HRA or the Human Reliability Analysis Guidebook for AP600 Probabilistic Safety Study (ET-SOAR-PRA-91-407).

Proposed Resolution: Section 5.0 of the Westinghouse Implementation Plan discusses the validation of HRA performance assumptions. It states that validation of the HRA operator performance assumptions will be performed as part of the Integrated HFE System Validation. This will include scenarios that include critical or risk important human actions, as well as specific performance assumptions that the HRA/PRA Group identifies for confirmation. Westinghouse will not validate the quantitative HRA probabilities. After review of the results of the validation, the HRA/PRA group will determine whether any changes need to be made to the HRA assumptions or HRA quantification. If changes are needed, the HRA will be modified and the impact on

the PRA will be assessed. A report will be generated, documenting the results of the exercises intended to validate the HRA performance assumptions, and submitted to the NRC for review.

Based upon this information, this DSER issue is considered resolved.

This criterion will be satisfied when the SSAR is revised to include the implementation plan submitted in final form and it is reviewed and accepted by the NRC.

**STATUS OF OPEN ITEM: Resolved (Action W)**