



Electric Power
Research Institute

Leadership in Science and Technology

December 18, 1992

Mr. James H. Wilson
United States Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

Subject: URD Changes, Chapter 10

Dear Mr. Wilson:

Enclosed are pen-and-ink changes to the Utility Requirements Document which resulted from discussions with Human Factors personnel on November 3. Updated "database" pages are also provided.

If you have any questions, please call John D. Trotter at 415/812-2810.

Very truly yours,

George Bockhold
Senior Program Manager
Advanced LWR Program

980L/GB/cdl

Attachment A: URD Changes
Attachment B: Database Changes

cc: Document Control Clerk

120096

9301140032 921218

PDR PROJ

669A

PDR

D035

Attachment A

Changes to Chapter 10

Sections 1.1.10, 3.1.2.4, 4.1.3.3, 4.9.2.6

VOLUME III, CHAPTER 10: MAN-MACHINE INTERFACE SYSTEMS

Paragraph No.	Requirement	Rev.
---------------	-------------	------

2.2.10 MCR (Continued)

0

The location and appropriate layout of the MCR will be based on reducing the need for access to the MCR by other plant personnel, yet maintain the necessary capability for the MCR staff to interface effectively with the field equipment operators and maintenance staff. The MCR environment is to be designed using human engineering principles to provide a comfortable, professional atmosphere for the operators that enhances their effectiveness. Attention will also be given to the use of colors and lighting levels to enhance operator alertness and minimize operator fatigue.

0

The layout of the MCR and the inventory of alarms, displays and controls will be selected as part of the design process to explicitly, comprehensively, and consistently support a top down, functionally based, decision making approach for investigating, planning, executing and verifying control for all plant conditions. Furthermore, the MCR equipment and information will be integrated and coordinated with other plant functions: engineering, maintenance, management and emergency response facilities (Technical Support Center and Emergency Off-Site Facility).

0

The MCR shall contain compact, redundant, operator work stations with multiple display and control devices that provide organized, hierarchical access to alarms, displays, and controls. Each work station shall have the full capability to perform MCR functions as well as support division of tasks between two operators. An additional work station shall be located in the MCR for use by a supervisor. Redundancy in the work stations shall be provided so that the inoperability of any one work station does not prevent the operators from sharing their tasks between two operators at different work stations. In addition, certain controls important to safety shall be provided in a separate and diverse manner (e.g., conventional, hardwired controls). These controls will provide a diverse backup capability independent of the work stations. A means of readily obtaining hardcopy output of the work station displays will be provided for the operating staff.

0

The selection and arrangement of the display and control features for the redundant work stations shall be established during the design process described in Section 3. The design shall consider the use of multi-functional display and control features to obtain an integrated, compact work station design which provides a consistent interface for all conditions and actions. This includes, for example, the use of a multi-functional control device for the operation of redundant safety trains and for the operation of both safety and non-safety equipment.

0

as initial starting point for the design

add new paragraph here

Beth III

Insert paragraph Section 2.2.10

"The specific features described here are to be used as the starting point for the design. They must be tested and validated as part of the M-MIS design process, described above and in more detail in Sections 3 and 4 of this chapter, and the human factors studies and evaluations of human performance that are used as the basis for the design and its validation. The requirements on the design process and testing and validation of the design are most important and, where the evaluations show conflicts or the need for modifications, the design process requirements shall take precedence over the specific features identified as the starting point."

Volumes II and III

VOLUME II, CHAPTER 10: MAN-MACHINE INTERFACE SYSTEMS

Paragraph No.	Requirement	Rationale	Rev.
3.1.2.4	Design Plan	Design Plan	0
	The M-MIS Designer shall prepare a comprehensive plan for the development and implementation of the M-MIS design which includes at least the following:	A documented plan for development and implementation of the M-MIS design is necessary because of the large scope of the M-MIS and the number of organizations involved.	0
	<ul style="list-style-type: none"> An M-MIS design, development and implementation schedule, which includes specific milestones, updating and tracking capability, and which is consistent with the overall ALWR plant schedule; 	<ul style="list-style-type: none"> This is needed to ensure coordination among the various organizations and teams and to meet the aggressive overall ALWR plant design and construction schedule. 	0
	<ul style="list-style-type: none"> A plan for controlling the configuration of the design and design tools, e.g., computer analysis software and program compilers; 	<ul style="list-style-type: none"> In addition, the Plant Designer must comply with the design process and software design requirements of Section 6.1.2 and Section 6.1.3. 	4
	<ul style="list-style-type: none"> A plan for developing and qualifying the tools, including software and human factors evaluation tools, that will be used in the design, development, and testing of the M-MIS. 	<ul style="list-style-type: none"> Design tools used in developing, testing, and implementing the M-MIS design are important to ensuring quality of the design and should themselves be qualified appropriate to their use in design. 	5
	<ul style="list-style-type: none"> A plan for accomplishing the interaction between the M-MIS design team and the various plant systems designers, including formal methods for communicating and controlling system interfaces; 	<ul style="list-style-type: none"> In order to achieve a coordinated design and to provide for the iteration of requirements and design features, a formal method for establishing and maintaining interaction and communication among the M-MIS Designer and the plant systems designers will be needed. 	0
	<ul style="list-style-type: none"> Provisions for engineering, operations, health physics, and maintenance personnel representing the utility user to actively participate throughout the entire design development and implementation, testing and installation. 	<ul style="list-style-type: none"> User participation and input throughout the entire M-MIS design process is necessary to assure a satisfactory design and adherence to proven human factors engineering principles. 	0

new front bullet

Both
10/11/68

Section 3.1.2.4, Chapter 10

new-first bullet (Both Volume II & III)

Add the following as a new, first bullet under 3.1.2.4:

- "• A description of the overall structure of the approach that will be taken for systems analysis and integration in the M-MIS design, and how this approach will be implemented."

Corresponding bullet under Rationale

- "• It is important that the M-MIS Designer take an overall people-oriented, systems approach to the M-MIS Design, applying principles and techniques of systems analysis such as identification of system interactions, function identification and allocation, personnel workload evaluation, task analysis, and integration with hardware and software designs." *See NUREG-0709, Appendix B for guidance on systems analysis for M-MIS designs.*

VOLUME II, CHAPTER 10: MAN-MACHINE INTERFACE SYSTEMS

Paragraph No.	Requirement	Rationale	Rev.
---------------	-------------	-----------	------

3.1.2.4 Design Plan (Continued)

- A plan and method(s) for assuring that applicable requirements, including those in Chapter 10 and in other chapters of this Requirements Document are consistently and systematically addressed in the design process.

Design Plan (Continued)

- The M-MIS Designer must integrate a large number of requirements from various sources and the other chapters of the Utility Requirements Document to develop a satisfactory M-MIS design. Systematic identification of those requirements and appropriate means to assure that they are considered in the M-MIS design process are necessary.

3.1.3 Required Design Process Features

3.1.3.1 Resolution of Past Problems

The M-MIS design process shall ensure that problems with the existing LWR M-MIS designs are identified and that features are incorporated in the ALWR M-MIS which provide satisfactory solutions to those problems. To implement this requirement, the M-MIS Designer shall include the following in the design process:

- At the beginning of the design process, a comprehensive and systematic review shall be made to identify problems which have raised safety concerns, reduced plant availability, or increased maintenance burdens.
- Each identified problem shall be assessed for its applicability to the ALWR.
- The final M-MIS design shall specifically identify how each applicable problem has been solved.
- Independent reviews per 3.1.4 shall be performed of the identification, assessment, and solution of the problems.

Required Design Process Features

Resolution of Past Problems

The solution of existing problems is a basic objective of the ALWR program. The obvious first step is the identification of the problems to be solved. There is substantial information on these problems available from such sources as License Event Reports, Nuclear Power Experience, the Nuclear Plant Reliability Data Systems, and from the Institute of Nuclear Power Operations. Additionally, this review will aid in identifying those parts of the M-MIS design which will benefit from the application of new technology. The M-MIS Designer is required to explicitly address each of the problems so that the merit of the solutions can be independently evaluated and so that the basis for the design features which represent solutions are maintained for the Plant Owner to evaluate future changes.

New Last Bullet - Section 3.1.2.4

Both Volumes / Chapter 10

Add the following new bullet at the end of 3.1.2.4:

- "• Appropriate administrative systems for ensuring that human factors issues identified in the design process are adequately communicated, tracked and resolved systematically and consistently, including a definition of how the design team will communicate and coordinate on human factors issues and the requirements on the technical content of those communications."

Corresponding bullet under Rationale:

- "• In order to ensure that human factors is properly addressed in the design, it is important that appropriate mechanisms be in place for identifying, communicating, and tracking the resolution of human factors issues that arise during the design process. In addition to having an administrative system (e.g., an issues tracking system), the designer must define the required technical content for the issues that are tracked."

VOLUME III, CHAPTER 10: MAN-MACHINE INTERFACE SYSTEMS

Paragraph No.	Requirement	Rationale	Rev.
4.1.3.1	Makeup of Review Team (Continued) • Individuals familiar with other disciplines appropriate to the functions of the particular control station, for example, maintenance, testing, procedures, lighting, radiation protection, communication, licensing, and reactor engineering.	Makeup of Review Team (Continued)	0 0
4.1.3.2	Use of Mockup Control Stations The design process shall provide for the fabrication of a mock-up of each control station for use in the review process. Mockups shall be capable of being readily modified so that changes can be made easily and evaluated. Mockups shall be available early in the plant design so that results of evaluations can impact the M-MIS and plant system designs.	Use of Mockup Control Stations Although some initial reviews with drawings can be made, it is essential that accurate pictorial mockups be made at an early stage. This improves the quality of any reviews.	0 0
4.1.3.3	Use of Active Simulators The control station design review process shall provide for the use of active simulation of the control stations. Dynamic simulation devices shall be made available early in the design process and progress in scope and detail to full scope design simulator during the design process so that results of evaluations can impact the M-MIS and plant system designs.	Use of Active Simulators Although mockups can provide a review of some features, they inherently lack the time input and operational context which is important in some tasks. For such tasks, the early use of simulation helps to avoid unreasonable demands on the operators.	0 0
4.1.4	Iteration of Functions, Tasks, and Designs The design process shall provide for the iteration of the control station design with the functions and tasks assigned to the control station. That is, the design process shall specifically provide for feedback from the design of the individual control stations to the overall identification of functions and tasks and their assignment to particular control stations.	Iteration of Functions, Tasks, and Designs The design process needs to be such that difficulties found in the course of the review can result in reassignment of tasks. Otherwise, there is no mechanism to correct initial assignments of functions and tasks which lead to unsatisfactory control station designs.	0 0

*Insert new paragraphs here
Both Volumes II and III*

Chapter 10, Section 4.1.3.3
(Both Vol II & III)

Modification to requirement 4.1.3.3:

Add at the end of existing requirement 4.1.3.3:

"Evaluations conducted using simulators shall be based on appropriate qualitative and quantitative measures of human-system performance and pre-defined acceptance criteria, and these shall be specifically reviewed by the review team. For evaluations involving operating teams or crews, this shall include appropriate qualitative and quantitative measures of team performance."

Addition to Rationale

"Evaluations using active simulation with operators should be carefully planned, including specific definition of performance measures, both qualitative and quantitative, and the acceptance criteria that will be applied. Team performance is an important aspect of overall M-MIS effectiveness. Although definitive quantitative measures of team performance are not yet well developed, as such measures become available they should be considered for use in M-MIS evaluations."

VOLUME II, CHAPTER 10: MAN-MACHINE INTERFACE SYSTEMS

Paragraph No.	Requirement	Rationale	Rev.
4.9.2.5	<p>Unauthorized Use</p> <p>The M-MIS Designer shall identify those controls at normally unmanned local control stations which have serious consequences if activated by unauthorized persons. Serious consequences are:</p> <ul style="list-style-type: none"> • Violation of plant technical specifications; • Immediate trip of the plant; • Actuation of safety systems; • Damage of expensive equipment or repairs that require an extended outage. <p>For such controls, the M-MIS Designer shall provide positive means to prevent unauthorized actuation, except where such means would interfere with emergency use of the control. Where no positive means is practical, the M-MIS Designer shall assure that the conditions caused by the unauthorized action will be adequately annunciated in the MCR.</p>	<p>Unauthorized Use</p> <p>Although security against unauthorized use is prudent, such measures can easily impede the operators' actions in an emergency. The M-MIS design must balance these considerations.</p>	<p>0</p> <p>0</p> <p>0</p> <p>0</p> <p>0</p> <p>0</p>
<p><i>add new</i> 4.9.2.6</p> <p><u>Vol II & III</u></p>	<p>Remote Shutdown Control Stations</p> <p>The M-MIS design shall provide for control stations outside the MCR which have the capability to bring the reactor to hot standby and maintain it in that condition indefinitely. The M-MIS design shall also allow the plant to be brought to cold shutdown within 72 hours using these control stations as well as local controls. The remote shutdown stations shall also provide for the performance of special functions and tasks as defined in other sections of this chapter and in other chapters.</p>	<p>Remote Shutdown Control Stations</p> <p>It is the intent that the ALWR have a capability to meet applicable regulations with regard to MCR evacuation. Functions and tasks in addition to those required by regulation have been identified.</p>	<p>0</p> <p>1</p>

Changes to ALWR URD Volumes II and III Chapter 10

Add new requirement 4.9.2.6:

4.9.2.6 Functions and Tasks and Their Centralization

The M-MIS Designer shall identify all the functions and tasks which involve use of each local control station. The M-MIS Designer shall specifically consider centralizing functions rather than distributing them among several local control stations, where distributing them could place an undue burden on communications, crew coordination, or operator workload associated with carrying out the required operations. The functions and tasks that are defined shall be used in selecting the specific controls, displays, communications devices and other equipment required for each local control station. Problems experienced with local control stations in operating plants shall be addressed specifically by the M-MIS Designer in identifying, locating, assigning functions, arranging and designing local control stations for the ALWR.

Rationale

A number of problems and concerns have been identified regarding operations carried out at local control stations in present plants. For example, see NUREG/CR-3696, *Potential Human Factors Deficiencies in the Design of Local Control Stations and Operator Interfaces in Nuclear Power Plants*, and NUREG/CR-5572, *An Evaluation of the Effects of Local Control Station Design Configurations on Human Performance and Nuclear Power Plant Risk*. The problems have included human engineering deficiencies in the control panels, and more fundamental problems relating to the number of local control stations required to accomplish a function or task and deficiencies in communications, feedback information, procedures, and equipment to support local operations. The lack of "functional centralization" of local operations has been identified by NRC as a significant concern with respect to the probability of human error in carrying out operations at safety-significant local control stations (see NUREG/CR-5572). It is the intent in ALWRs that the problems with local control stations in present plants will not recur in the ALWR. Local control functions and tasks should be clearly identified as part of the M-MIS design process. Also, specifically considering centralization of functions versus distributing them among many stations and locations should help achieve a design that allows functions to be carried out efficiently and without overburdening communications and excessive workload and coordination of personnel.

Attachment B

Database Pages

Issues P.1B.O-31, Issues P.1B.O-32, Issues P.1B.O-36, Issues P.1B.O-66,
Issues P.1B.O-67, Issues P.1B.O-68, Issues P.1B.O-69, Issues P.1B.O-70,
Issues P.1B.O-71, Issues P.1B.O-72, Issues P.1B.O-73, Issues P.1B.O-74,
Issues P.1B.O-82

ALWR/NRC OPEN ISSUES

P.1B.O-31

ALWR Ch Mgr Status:
closed(cert)

NRC SER Input Status:

Next Action:
NRC

electronic display of procedures, use of mixed types of procedures from one control station to another, and use of active simulator to validate procedures (3.2.33)

Abstract	Industry Position	NRC Position	Action Description
(DSER, p 1B.3-52) "The staff concludes that the information provided in these sections of the Requirements Document is not sufficient for a determination that the requirements for the design, development, and validation of plant procedures are acceptable. Although the electronic display of procedures may enhance information display flexibility, the limitations and constraints associated with this technology, as well as the operability, maintainability, and reliability of this technology, should be fully evaluated in the context of the entire control room and other control station designs before committing to such an approach. Further, the staff concludes that EPRI should evaluate issues concerning the use of mixed types of procedures from one control station to the next, as well as the requirement for the active simulator to be used for the validation of procedures."	Please see the response to "E10-N-80" and "P.10.O-66". --- (11/3/92 meeting) Although the "design process" has priority over specific design features in the URD, this particular feature has received a great deal of emphasis from the USN.	(DSER) See Abstract --- (11/3/92 meeting) See P.10.O-66. Will close by passing to the designers.	NRC prepare SER input

NRC Review
DRCH/HHFB G. Galletti

ALWR/NRC OPEN ISSUES

P.1B.O-33

ALWR Ch Mgr Status:
Open

NRC SER Input Status:

Next Action:
NRC

centralization of safety functions (3.2.34)

Abstract	Industry Position	NRC Position	Action Description
<p>(DSER, p 1B.3-57) "The staff has determined that this commitment is acceptable, however, the staff concludes that EPRI should:</p> <p>"2. Address the issue of functional centralization in the Requirements Document, since a key element in the handling of safety functions is the degree of centralization that exists, which is reflected in the number of different local control stations (LCSs) required to carry out safety functions. As the number of LCSs increases, so does the time required to execute procedures and the workload associated with crew coordination, communication, and operating procedure verification. Each introduces potential sources of human error which can be expected to increase with the number of panels involved."</p>	<p>(original resp): Please see the response to "E10-N-71".</p> <p>----</p> <p>(11/3/92 meeting) Will consider adding reference to NUREG/CR 5572</p> <p>----</p> <p>(12/18/92 response): A new Requirement 4.9.2.6 will be added to Volumes II and III of Chapter 10 as follows:</p> <p>"4.9.2.6 Functions and Tasks and Their Centralization</p> <p>Requirement</p> <p>The M-MIS Designer shall identify all the functions and tasks which involve use of each local control station. The M-MIS Designer shall specifically consider centralizing functions rather than distributing them among several local control stations, where distributing them could place an undue burden on communications, crew coordination, or operator workload associated with carrying out the required operations. The functions and tasks that are defined shall be used in selecting the specific controls, displays, communications devices and other equipment required for each local control station. Problems experienced with local control stations in operating plants shall be addressed specifically by the M-MIS Designer in identifying, locating, assigning functions, arranging and designing local control stations for the ALWR.</p> <p>Rationale</p> <p>A number of problems and concerns have been identified regarding operations carried out at local control stations in present plants. For</p>	<p>(DSER) See Abstract</p> <p>-----</p> <p>(11/3/92 meeting) NRC clarifies that this is more than just the remote shutdown panel. Recommended examination of NUREG/CR 5572 for the benefits of centralization of controls that are outside the control room.</p>	<p>NRC Review URD change</p>

NRC Review
DRCH/HHFB G. Galletti

ALWR/NRC OPEN ISSUES

example, see NUREG/CR-3696, Potential Human Factors Deficiencies in the Design of Local Control Stations and Operator Interfaces in Nuclear Power Plants, and NUREG/CR-5572, An Evaluation of the Effects of Local Control Station Design Configurations on Human Performance and Nuclear Power Plant Risk. The problems have included human engineering deficiencies in the control panels, and more fundamental problem relating to the number of local control stations required to accomplish a function or task and deficiencies in communications, feedback information, procedures, and equipment to support local operations. The lack of "functional centralization" of local operations has been identified by the NRC as a significant concern with respect to the probability of human error in carrying out operations at safety-significant local control stations (see NUREG/CR-5572). It is the intent in ALWRs that the problems with local control stations in present plants will not recur in the ALWR. Local control functions and tasks should be clearly identified as part of the M-MIS design process. Also, specifically considering centralization of functions versus distributing them among many stations and locations should help achieve a design that allows functions to be carried out efficiently and without overburdening communications and excessive workload and coordination of personnel.

ALWR/NRC OPEN ISSUES

P.1B.O-36

ALWR Ch Mgr Status:
Open

NRC SER Input Status:

Next Action:
NRC

development of quantitative measures to assess human-system performance (3.2.35)

Abstract	Industry Position	NRC Position	Action Description
<p>(DSER, p 1B.3-58) "However, the staff concludes that EPRI should require additional human factors test and evaluation activities, including development of:</p> <p>"3. Quantitative measures to assess human-system performance."</p>	<p>(11/3/92) Need to determine response. Original cross-reference to P.10.O-82 was wrong.</p> <p>-----</p> <p>(12/18/92 response):</p> <p>We agree that quantitative measures of human-system performance should be used in developing and validating the M-MIS design. To emphasize this, additional material was added to Section 2.2.8, Human Factors Engineering, of Chapter 10 (Rev 2 of Vol III) which discusses testing and validation of the design. It states that "evaluations shall be based on selected measures of human performance, both qualitative and quantitative, and predefined acceptance criteria" and discusses the uses of measures such as error reduction, response time and mental workload. Further, Section 3.4.1.1 requires that the M-MIS Designer specify in the design plan which operator workload measures are to be used. And Section 4.3.1.4 requires that specific measures be defined for measuring alarm system effectiveness and discusses the interaction between these and the measures used to judge overall control room and work station effectiveness.</p> <p>To further emphasize this point, the following will be added at the end of Section 4.1.3.3 of Chapter 10 (Vols II & III) on Use of Active Simulators:</p> <p>"Evaluations conducted using simulators shall be based on appropriate qualitative and quantitative measures of human-system performance and predefined acceptance criteria, and these shall be specifically reviewed by the review team. For evaluations involving operating teams or crews, this shall include appropriate qualitative and quantitative</p>	<p>(DSER) See Abstract</p> <p>-----</p> <p>(11/3/92 meeting) This should not be linked directly with P.10.O-82.</p>	<p>NRC review URD change</p>

NRC Review
DRCH/HHFB G. Galletti

ALWR/NRC OPEN ISSUES

measures of team performance."

Add to Rationale:

"Evaluations using active simulation with operators should be carefully planned, including specific definition of performance measures, both qualitative and quantitative, and the acceptance criteria that will be applied. Team performance is an important aspect of overall M-MIS effectiveness. Although definitive quantitative measures are not yet well developed, as such measures become available they should be considered for use in M-MIS evaluations."

(Submitted 12/13/92)

ALWR/NRC OPEN ISSUES

P.10.O-66

ALWR Ch Mgr Status:
Open

NRC SER Input Status:

Next Action:
NRC

scheduling of human factors studies before start of control rooms design process (3.1.3 of Appendix B)

Abstract	Industry Position	NRC Position	Action Description
<p>(DSER, p 10.B.3-4) "It is the staff's position that the major portion of human factors studies should be completed before the start of the control room design process. Results of the human factors studies should be available to the M-MIS designer during the early phases of the design process when critical decisions are being made concerning the conceptual framework, the baseline design of the control room, the design of the control boards, and the depth and breadth of hardware and software systems. If the results of human factors studies and evaluations are not available during the design process when the information is needed, the design will progress without the benefit of human factors input.</p> <p>"Incorporating man-machine interfaces into the control room using a verification and validation approach places human factors in a retrofit mode from the very beginning of the design process. Such an approach tends to focus the human factors effort on specific issues rather than on the control room as a whole. The studies and evaluations performed before the start of the actual design process contribute valuable insights concerning the human factors aspects of the individual man-machine interfaces considered for the control room, as well as the synergistic effects created by various combinations of the interfaces within the control room. The scheduling of human factors studies is an open issue that must be resolved before the staff can complete its review of the Passive Requirements Document."</p>	<p>It is EPRI's position that it is both impractical and undesirable to have the major portion of the human factors studies done before the design is started. This is because meaningful human factors studies are best done on a real design, with real requirements, in the context of a real overall plant. To require the majority of the human factors work be done before design efforts can provide a focus for the human factors studies, would be much less efficient than basing the studies on a real plant design. Furthermore, it ignores the importance of iteration of the M-MIS design with the plant systems designs, which is specifically required in Chapter 10. Of course, the features selected as the starting point for the development and the focused human factors studies should be chosen based on current human factors principles and practices. This is the case for the basic design features outlined in Chapter 10.</p> <p>A new paragraph will be added to Section 2.2.10 of Chapter 10, between the existing fourth and fifth paragraphs, as follows: "The specific features described here are to be used as the starting point for the design. They must be tested and validated as part of the M-MIS design process, described above and in more detail in Sections 3 and 4 of this chapter, and the human factors studies and evaluations of human performance that are used as the basis for the design and its validation. The requirements on the design process and testing and validation of the design are most important and, where the evaluations show conflicts or the need for modifications, the design process requirements shall take precedence over the specific features identified as the starting point."</p>	<p>(DSER) See Abstract --- (10/1/92 Whitaker & Wilson/Smith) The NRC thinks the order of business is to develop a concept, study it, develop requirements, and then design the system. Task analysis is a discovery tool, not a Validation and Verification tool. For example, the URD starts with the assumption that compact workstations are the preferred design without doing studies that arrive at that conclusion.</p> <p style="text-align: right;">NRC Review DRCH/HHFB G. Galletti</p> <p>---- (11/3/92 meeting) NRC believes the issue can be resolved by an "up front" clarification that the design process required by the URD takes precedence over the specific design features also found in the URD</p>	<p>NRC review URD change</p>

ALWR/NRC OPEN ISSUES

If the staff has human factors or other concerns about the specific features stated as the starting point for the ALWR M-MIS design and would identify those concerns, we would be pleased to address them in detail. We disagree strongly that the ALWR design has or will in the future proceed "without benefit of human factors input." We consider such statements to be incorrect and misleading and request that the statement be deleted from the DSER.

(Underlined Change to "industry position" and to Ch 10, 2.2.10 submitted 12/18/92)

ALWR/NRC OPEN ISSUES

P.10.O-67

ALWR Ch Mgr Status:
Open

NRC SER Input Status:

Next Action:
NRC

guidance to the M-MIS designer to overcome past problems (3.1.4 of Appendix B)

Abstract	Industry Position	NRC Position	Action Description
<p>(DSER, p 10.B.3-5) "In Section 3.1, of Chapter 10 EPRI states that experience has shown that conventional design methods cannot be expected to provide good interfaces between the operators and the plant and that even if all the design requirements are identified, it is unrealistic to expect them to be met in a simple and practical manner unless the design process is systematic and consistent. The staff has identified two important problems in implementing the EPRI requirements as part of a design process.</p> <p>"The first problem is the lack of guidance provided for the M-MIS designer to ensure that past problems related to the implementation of large numbers of design requirements can be identified and successfully overcome. In response to an April 17, 1991, request for additional information, EPRI stated in a letter dated June 13, 1991, that the specific programmatic methods used in the design process are the responsibility of the M-MIS designer. The deficiencies in the Passive Requirements Document regarding the necessary guidance for the M-MIS designer to overcome past problems and are open issues that must be resolved before the staff can complete its review of the Passive Requirements Document."</p>	<p>The URD requires in Section 3.1.2.4 of Chapter 10 that the M-MIS Designer prepare a detailed plan for the development and implementation of the M-MIS design. That section identifies a number of essential attributes of that plan. In order to assure that the M-MIS Designer systematically considers all the requirements in the URD, even those in other chapters, the following additional item will be added to those which the design plan must specifically address as defined in the requirement of Section 3.1.2.4 of Chapter 10 (Volumes II and III):</p> <p>"A plan and method(s) developed by the M-MIS Designers for assuring that applicable requirements, including those in Chapter 10 and in other chapters of this requirements document are consistently and systematically addressed in the design process."</p> <p>The following item will be added to the rationale for that section:</p> <p>"The M-MIS Designer must integrate a large number of requirements from various sources and the other chapters of the Utility Requirements Document to develop a satisfactory M-MIS design. Systematic identification of those requirements and appropriate means to assure that they are considered in the M-MIS design process are necessary."</p> <p>We note that past problems of consistently addressing and resolving large numbers of requirements have been small compared to the problems caused by the omission of key requirements in the first place. The URD is primarily intended to address this more fundamental problem.</p>	<p>(DSER) See Abstract --- (11/3/92 meeting) Reviewer - Galletti - says OK with minor change to 10-3.1.2.4</p>	<p>NRC to review URD change</p>

NRC Review
DRCH/HHFB G. Galletti

ALWR/NRC OPEN ISSUES

(Underlined portion of the first bullet above
submitted 12/18/92)

ALWR/NRC OPEN ISSUES

P.10.O-68

ALWR Ch Mgr Status:

Open

NRC SER Input Status:

Next Action:

NFC

guidance to improve interfaces between the operator and the plant (3.1.4 of Appendix B)

Abstract	Industry Position	NRC Position (DSER) See Abstract	Action Description
<p>(DSER, p 10.B.2-5) "In Section 3.1, of Chapter 10 EPRI states that experience has shown that conventional design methods cannot be expected to provide good interfaces between the operators and the plant and that even if all the design requirements are identified, it is unrealistic to expect them to be met in a simple and practical manner unless the design process is systematic and consistent. The staff has identified two important problems in implementing the EPRI requirements as part of a design process.</p> <p>"... The second problem is that the individual requirements do not provide the M-MIS designer with the necessary overall guidance to establish appropriate programmatic and technical vehicles to facilitate and achieve the goal of improving design methods and interfaces between the operator and the plant. In response to an April 17, 1991, request for additional information, EPRI stated in a letter dated June 13, 1991, that the specific programmatic methods used in the design process are the responsibility of the M-MIS designer. The deficiencies in the Passive Requirements Document regarding the necessary guidance for the M-MIS designer to ... and to establish appropriate methods of interface and exchange are open issues that must be resolved before the staff can complete its review of the Passive Requirements Document."</p>	<p>In Section 3.1.2.4 of Chapter 10 the M-MIS Designer is required to prepare a comprehensive plan for the development and implementation of the M-MIS design. This requirement identifies a number of specific attributes of this plan. The plan is required to define how the M-MIS Designer will address design, including such important features as design tools, integration and iteration with system designers, and how the input from experienced operators and other utility personnel will be achieved. The URD also includes a number of specific design requirements related to improving the human factors design methods and the interfaces between the operators and the plant. For example, the requirements for the use of active simulation, the correction of past problems, the incorporation of experienced operations personnel in the design process, and the definition and use of the operators' functions and tasks as a fundamental building block for the design are particularly important. We consider that the URD provides a great deal of guidance as to how to improve the human factors design methods and the interface between the operator and the plant and has requirements which clearly require the M-MIS Designer to establish a design process which is directed at that goal. The particular "programmatic and technical vehicles" which the M-MIS Designer chooses to apply to meet those requirements would be expected to be addressed in the vendor's design plan. In order to assure that there is no misunderstanding that the M-MIS design plan must address these requirements, the third bullet item in Section 3.1.2.4 of Chapter 10 (Volumes II & III) will be expanded so that it states the following:</p>	<p>(11/3/92 meeting) NRC says EPRI missed the point here. There needs to be a plan and system for tracking HF issues throughout the design process</p>	<p>NRC review change of 12/18/92</p>

NRC Review
DRCH/HHFB G. Galletti

ALWR/NRC OPEN ISSUES

"A plan for developing and qualifying the tools, including software and human factors evaluation tools, that will be used in the design, development, and testing of the M-MIS."

Also, a new bullet will be added to Section 3.1.2.4 as follows:

"Appropriate administrative systems for ensuring that human factors issues identified in the design process are adequately communicated, tracked and resolved systematically and consistently, including a definition of how the design team will communicate and coordinate on human factors issues and the requirements on the technical content of those communications."

(11/3/92 meeting) We will consider a requirement for issue tracking system.

(Underlined bulleted item above added in 12/18/92 submittal)

ALWR/NRC OPEN ISSUES

P.10.O-69

ALWR Ch Mgr Status:
open

NRC SER Input Status:

Next Action:
NRC

identification of human factors criteria, guidance, etc. which was used as the supporting bases for M-MIS requirements (3.2.1 of Appendix B)

Abstract	Industry Position	NRC Position (DSER) See Abstract	Action Description
<p>(DSER, p 10.B.3-7) Section 18.1(f) of the SRP requires applicants starting the control room design process to reflect human factors principles in the design concept and identify the supporting bases and criteria. The staff's position on advanced reactors and human factors requirements is that potential human factors design requirements levied on a design should conform to established human factors guidance (e.g., professional standards and military standards), principles, practices, or applicable studies. If no principles, practices, or studies are available, the plant designer should perform the human factors studies or evaluations necessary to establish suitability of a requirement to be included as part of the design basis. Currently, the staff cannot identify the human factors criteria, guidance, principles, or practices that were used as the supporting bases for many of the man-machine interface requirements. This is an open issue that must be resolved before the staff can complete its review of the Passive Requirements Document.</p>	<p>The URD makes use of and specifically cites a number of comprehensive human factors references, for example, EPRI NP-3448, NP-3655, NP-4350, and NP-6209. It was not considered practical or necessary to tie specifically each requirement to one or several of these references or to other human factors literature. We have provided copies of the EPRI references to the staff in the past and we presume that the staff is familiar with the large body of potentially applicable human factors literature. If the staff would identify those specific requirements for which they wish the ALWR Program to provide expanded explanations of the technical bases, we would be pleased to address them individually. We have previously offered to provide such specific technical bases in the RAI response referred to in the DSER (Question E20.3, part 2).</p>	<p>(10/1/92 Whitaker & Wilson/Smith) The NRC thinks the order of business is to develop a concept, study it, develop requirements, and then design the system. Task analysis is a discovery tool, not a Validation and Verification tool. For example, the URD starts with the assumption that compact workstations are the preferred design without doing studies that arrive at that conclusion.</p>	<p>NRC review URD change submitted 12/18/92 under issue #P.10.O-66</p>
	<p>(12/18/92 added note) Please also see the response to P.10.O-66</p>	<p>Furthermore, the NRC thinks the designer needs to know the basis of the requirements in the URD so that rational decisions can be made at the trade-off phase of the design. The URD does not provide the rationale for many of the requirements.</p>	<p>NRC Review G. Galletti</p>
		<p>(11/3/92 meeting) see P.10.O-66. Will end up passing off to designer</p>	

ALWR/NRC OPEN ISSUES

P.10.O-70

ALWR Ch Mgr Status:
open

NRC SER Input Status:

Next Action:
NRC

traceability of human factors requirements to original source (3.2.2 of Appendix B)

Abstract	Industry Position	NRC Position	Action Description
(DSER, p 10.B.3-7) "Section 18.1(II) of the SRP requires applicants to specify the design concept selected and provide supporting design bases and criteria. The staff's position is that human factors requirements levied on a control room design should identify the basis or human factors principles addressed by the requirements. The bases should reflect some aspect of a human factors principle, practice, or study that, through its application, will contribute to improved operator performance or reduce the risk of human error. The plant designer should review the basis for the human factors requirement before making design tradeoffs that involve human performance issues. Currently, the basis for many of the human factors requirements cited in Chapter 10 is not indicated. This is an open issue that must be resolved before the staff can complete its review of the Passive Requirements Document."	As stated in the position on open issue P.10.O-69, it was not judged necessary to tie specifically each requirement to a specific reference, nor does it appear to be practical to incorporate in the URD itself design basis information to the extent which is evidently envisioned by the staff. As previously indicated, if the staff considers that the cited references or that current accepted human factors practices are inconsistent with the requirements, the ALWR Program would be pleased to provide more information on the technical bases for any particular requirement. ----- (12/18/92 added note) Please also see the response to P.10.O-66	(DSER) See Abstract ----- (10/1/92 Whitaker & Wilson/Smith) The NRC thinks the order of business is to develop a concept, study it, develop requirements, and then design the system. Task analysis is a discovery tool, not a Validation and Verification tool. For example, the URD starts with the assumption that compact workstations are the preferred design without doing studies that arrive at that conclusion. Furthermore, the NRC thinks the designer needs to know the basis of the requirements in the URD so that rational decisions can be made at the trade-off phase of the design. The URD does not provide the rationale for many of the requirements. ----- (11/3/92 meeting) see P.10.O-66. Will end up passing off to designer	NRC review URD change submitted 12/18/92 under Issue #P.10.O-66 <div>NRC Review DRCH/HWFB G. Galletti</div>

ALWR/NRC OPEN ISSUES

P.10.O-71

ALWR Ch Mgr Status:
open

NRC SER Input Status:

Next Action:
NRC

method for establishing effective human factors requirements (3.2.3 of Appendix B)

Abstract	Industry Position	NRC Position	Action Description
(DSER, p 10.B.3-8) "Chapter 10 of the Passive Requirements Document contains (1) a description of a process for establishing human factors design requirements and (2) design requirements that are unsupported by human factors guidance, principles, or practices. The staff concludes that the analyses performed during the design process should be the vehicles to generate the human factors requirements, which determine the man-machine interfaces incorporated into the final design. To impose human factors requirements (e.g., multiple, compact, redundant workstations and the use of electronic procedures) on the ALWR design before starting the design process negates much of the purpose and benefit of performing the systems and human factors analyses. EPRI should provide information on the method for establishing effective human factors requirements on the design. This is an open issue that must be resolved before the staff can complete its review of the Passive Requirements Document."	As has been discussed in previous responses to requests for information, particularly the responses to the general statements made in the RAIs of April 17, 1991, the requirements in the URD relative to the features of the M-MIS are intended as a starting point for the design process. The URD defines the attributes of the process which must be used to prove out the human factors of the design features and validate that the overall design is effective. It is intended that the design process establish the details of the application and it is fully expected that some of the initial features will be changed in the design process. The methods of evaluation include task analyses and the extensive use of mockup and simulation as well as multidisciplinary reviews. If the staff considers that there are specific human factors problems with the initially required features, e.g., multiple, compact, redundant work stations and electronic procedures, the ALWR Program would be pleased to provide more detailed information to address those specific concerns.	(DSER) See Abstract ----- (10/1/92 Whitaker & Wilson/Smith) The NRC thinks the order of business is to develop a concept, study it, develop requirements, and then design the system. Task analysis is a discovery tool, not a Validation and Verification tool. For example, the URD starts with the assumption that compact workstations are the preferred design without doing studies that arrive at that conclusion.	NRC review URD change submitted 12/18/92 under Issue #P.10.O-66
	(12/18/92 added note) Please also see the response to P.10.O-66	NRC Review ----- DRCH/HHFB G. Galletti (11/3/92 meeting) see P.10.O-66. Will end up passing off to designer	

ALWR/NRC OPEN ISSUES

P.10.O-72

ALWR Ch Mgr Status:
Open

NRC SER Input Status:

Next Action:
NRC

guidance on systems analysis (3.2.4 of Appendix B)

Abstract FROM E10-N-75 (10-1.75)	Industry Position FROM E10-N-75 (10-1.75)	NRC Position (3/13/92 meeting Smith/Wilson & Trotter) Staff will clarify why EPRI/ALWR response rejected	Action Description NRC to review URO change submitted 12/18/92
<p>The DSER (on page D-10 in connection with the subject of Systems Analysis) and with reference to a response to a RAI (6-30-90, V1-Q2) states: "The staff concludes that the Requirements Document does not contain...specifications for a systems analysis that would be part of the human factors program for the ALWR design...Rather, EPRI has left these tasks to be implemented by the plant designer using the policy and the top-tier and specific human factors requirements distributed throughout the Requirements Document should provide guidance for performing a systems analysis...."</p>	<p>In the DSER (on pages D-8 and D-9) the staff identifies six elements for a "systems analysis." Although the terminology "systems analysis" is not used in the Requirements Document, The ALWR Program consider that the elements listed in the DSER are covered by the requirements for the M-MIS which are included in Chapter 10. In particular, the design process requirements in Sections 3.1 and 4.1, two of the major sections of Chapter 10 (about 24 pages of requirements), address many of the listed items. In addition, another section, 3.4 (about 8 pages) addresses operator actions. The six elements listed in the DSER and sections of Chapter 10 which are closely related to each element are listed below. It is suggested that the staff review the requirements for the design process and operator actions, with particular emphasis on the indicated sections, to assess the degree to which the "systems analysis" which they have defined is addressed by the existing requirements.</p>	<p>(11/3/92 meeting) Most of response was acceptable. The first element was not. EPRI should consider "overall approach to systems analysis".</p>	<p>NRC Review DRCH/HHFB G. Galletti</p>
	<ul style="list-style-type: none"> • Identification of interactions between and among systems to meet plant and personnel performance objectives (3.1.1.1); • Definition of functions and tasks and their allocation to personnel or equipment (3.1.3.3, 4.1.4, and 4.1.6.2); • Identification of system processes and their allocation to functional, system, or component level of control (3.1.3.3.3, 3.4.3, and 3.4.4); • Comparison of personnel workload to equipment design constraints and limitations to ensure plant performance objectives are met 		

ALWR/NRC OPEN ISSUES

(3.4.1 and 4.1.3):

- Performance of comprehensive task analyses (3.1.3.2, 4.1.3.2, and 4.1.3.3); and
- Integration into the design of hardware and software (2.1.1.2, 4.1.1, and 4.1.4).

(3/10/92 Marston to Crutchfield) minor discussion needed to clarify if this can be resolved generically via the Requirements SER. ("5)

(12/18/92 clarification) :

To emphasize that a systems analysis approach is to be used in the M-MIS design, an additional bullet will be added to Section 3.1.2.4, Design Plan, of Volumes II and III of Chapter 10:

Requirement:

- *. A description of the overall structure of the approach that will be taken for systems analysis and integration in the M-MIS design, and how this approach will be implemented.

Corresponding bullet under Rationale:

- *. It is important that the M-MIS Designer take an overall people-oriented, systems approach to the M-MIS Design, applying principles and techniques of systems analysis such as identification of systems interactions, function evaluation, task analysis, and integration with hardware and software designs. See NUREG-0700, Appendix B, for guidance on systems analysis for M-MIS Designs.

ALWR/NRC OPEN ISSUES

ALWR Ch Mgr Status:

open

Next Action:

NRC

NRC SER Input Status:

P.10.O-73

organization of plant information (3.2.4 of Appendix B)

Abstract	Industry Position	NRC Position	Action Description
FROM E10-N-76 (10-7-76)	(Original response, from E10-N-76): Section 11 of Chapter 1 (Revision I and subsequent revisions) contains extensive requirements on the design process for the entire plant. A central aspect of those requirements is the organization and handling of plant information. Some sections which are particularly important in this regard are the following.	(11/3/92 meeting) Most of response was acceptable. The first element was not. EPRI should consider "overall approach to systems analysis".	NRC review the URD change submitted under Issue P.10.O-72 (12/18/92)

The DGER (on page D-10 in connection with the subject of Systems Analysis) and with reference to a RAJ (8-30-90, V1-Q1) states: "The staff concludes that the Requirements Document does not contain ... specific guidance on the organization of plant information to meet plant and personnel performance objectives. Rather, EPRI has left these tasks to be implemented by the plant designer using the policy and the top-tier and specific human factors requirements distributed throughout the Requirements Document. The staff concludes that the Requirements Document should provide guidance for organizing plant information.

- Section 11.7, which requires an extensive project information network (PIN) and references EPRI guidance on that subject.
 - Section 11.10, which includes requirements on the methods to be used to achieve design integration such as establishing the design criteria for individual systems and identifying potential systems interactions; and
 - Section 11.12, which requires a computer-based information management system (IMS), references EPRI guidance on that subject, and provides additional guidance in the form of an attachment to the section.
- It is considered that these sections address the concern on guidance for organizing plant information.

(11/3/92) Will consider change to 10-3.1.2.4

(12/18/92) Please see the response to P.10.O-72

NRC Review
DRCH/HHPB G. Galletti

ALWR/NRC OPEN ISSUES

P.10.O-74

ALWR Ch Mgr Status:
open

NRC SER Input Status:

Next Action:
NRC

configuration of operator's workstation (3.2.5 of Appendix B)

Abstract	Industry Position	NRC Position	Action Description
<p>(DSER, p 10.B.3-10) Sections B4.2.2 and B4.3.1 of NUREG-0700 state that system processing capabilities and failure modes should be evaluated as part of the function and task allocation process. Before the function and task analysis is completed, the computer processing capabilities are defined, and an analysis of software and hardware failure modes is performed, it is premature to establish requirements for the operators' workstations. The staff's position is that the capabilities and limitations of hardware, software, and the human component must be understood before committing critical information, controls, and displays required by the operator for the safe operation and shutdown of the plant to one particular configuration. Before the completion of the above analyses, it is premature to establish detailed requirements for operator workstations. This is an open issue that must be resolved before the staff can complete its review of Chapter 10 of the Passive Requirements Document."</p>	<p>Requirements are placed on the operator workstations and other aspects of the M-MIS with the expressed provision that they must be proven in the design process. As previously discussed in the position on open issue P.10.O-71 and in related responses to RAs (such as those on the April 17, 1991, set), changes to the initial configurations are expected. We consider that valid human factors studies of the M-MIS can best be done in the context of a real design and that it is not premature to start on the design process on the basis of relatively well defined initial concept. In fact, it is the ALWR Program's view it is necessary that the initial work have some defined focus.</p>	<p>(DSER) See Abstract --- (11/3/92 meeting) see P.10.O-66. Will end up passing off to designer</p>	<p>NRC review the URD change submitted 12/18/92 under issue "P.10.O-66"</p>

(12/18/92) Please also see the response to P.10.O-66 for further discussion of this issue.

NRC Review
DRCH/HHFB G. Galletti

ALWR/NRC OPEN ISSUES

P.10.O-82

ALWR Ch Mgr Status:
open

NRC SER Input Status:

Next Action:
NRC

team performance (3.7.4 of Appendix B)

Abstract FROM E10-N-86 (10-1 86)	Industry Position (Original response taken from: E10-N-86 -- undefined protions changed 12/18/92)	NRC Position (11/3/92 meeting) Staff reiterated need for appropriate team performance measurements. Recommended contacting Earl Weiner at NASA-Ames(415 604 5726).	Action Description NRC review the URD change submitted 12/18/92 under issue P.1B.O-36
<p>The DSER (on page D-30 in connection with the subject of quantitative measures to assess human-system performance) states: "The EPRI requirements appear to focus on design considerations and limited assessments and tests that address operator performance and maintainer tasks. Team performance is only addressed as a feature that must be considered during the design process. The staff concludes that EPRI should provide a requirement for the development of qualitative (sic) measures to assess team-system performance that would include, for example, verification that the expected team-system performance interaction between MCR operators and personnel staffing the TSC and EOF is achieved."</p>	<p>Since this open issue is part of a discussion of quantitative measures of human performance, it is assumed that there is a typographical error in the DSER and it was intended by the Staff that the issue refer to "quantitative and not "qualitative" measures.</p> <p>Additions will be made to Chapter 10 to emphasize the need for both qualitative and quantitative human performance measures, including appropriate measures of team performance where available. Please see the response to P.1B.O-36.</p>		

Since the Requirements Document is intended to define the design features and process, it must focus on design considerations. The ALWR Program does not consider that the assessments and test to address operator performance and maintainer tasks are "limited." The use of mockups and simulation and the detailed consideration of the operators' and maintainers' tasks are required. Communication and coordination are included in these tasks, particularly for the supervisory personnel. Where teams of persons are involved, the simulations and walkthroughs will necessarily have to include all the parties involved in the activities to make a valid assessment of the design. These evaluations of team activities should use qualitative and quantitative measures, where available and appropriate. However, they are expected to show that the design features support the team activities. An equally important factor in good team performance is the training of the team; however, that is not within the scope of the Requirements Document.

NRC Review
DRCS/HHFB G. Galletti

ALWR/NRC OPEN ISSUES

With regard to the performance interaction between the MCR and the TSC or the EOF. The requirements in Section 4.9.4 of Chapter 10 and its subsections are intended to provide a design which has the flexibility to handle a wide variety of strategies for interactions between the MCR and the TSC or EOF. In particular, all the monitoring information available in the MCR is to be available in the TSC and EOF (Section 4.9.4.3.1 of Chapter 10). This allows the MCR personnel to focus on their tasks rather than on transmitting data or relaying information. All communication tasks for the operators in the MCR are required to be included in the evaluation of functions and tasks required by Section 3.1.3.3 of Chapter 10. Communication between the MCR and the TSC and EOF are necessarily included in those tasks.

(3/10/92 Marston to Crutchfield) minor discussion needed to clarify if this can be resolved generically via the Requirements SER. (*5) Also need to clarify "applicant" in NRC position since there are both Certification and COL applicants.

See 3/12/92 meeting in "NRC Position"