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ACCESSION NBR:8309300244 DOC.DATE: 83/09/27 NOTARIZED: NO DOCKET #
FACIL:50-400 Shearon Harris Nuclear Power Plant, Unit 1, Carolina 05000400
50-401 Shearon Harris Nuclear Power Plant, Unit 2, Carolina 05000401
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DENTON,H.R. Office of Nuclear Reactor Regulation, Director

SUBJECT: Forwards addl info responding to NUREG-0737,Suppl 1 re detailed control room design review,Areas of concentration include main control board & task analysis & verification/ validation process for emergency operating procedures.

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CP&L

Carolina Power & Light Company

SERIAL: LAP-83-426

September 27, 1983

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Washington, DC 20555

SHEARON HARRIS NUCLEAR POWER PLANT
UNIT NOS. 1 AND 2
DOCKET NOS. 50-400 AND 50-401
SUPPLEMENT 1 TO NUREG-0737 - DETAILED CONTROL ROOM DESIGN REVIEW

Dear Mr. Denton:

On August 15-19, 1983, the NRC staff conducted a Detailed Control Room Design Review audit of Carolina Power & Light Company's (CP&L) Shearon Harris Nuclear Power Plant (SHNPP) Units 1 and 2 control rooms. During the audit, your staff requested the following additional information to complete their review on Section 5 of Supplement 1 to NUREG-0737:

1. A description of the system's functional analysis performed on the SHNPP Unit 1 Main Control Board during its redesign (Attachment 1),

2. A description of the method and a general target date for completion of the Task Analysis of the plant specific Emergency Operating Procedures, (Attachment 2) and;

3. A description of the Development, Verification and Validation process for emergency operating procedures (EOPs) and a general target date for completion (Attachment 3).

We trust this submittal provides the information your staff needs. Should you require clarification of the information provided, please contact my staff.

Yours very truly,

M. A. McDuffie
Senior Vice President
Nuclear Generation

MSG/tda (7896MSG)
Attachments

cc: Mr. B. C. Buckley (NRC)
Mr. G. F. Maxwell (NRC-SHNPP)
Mr. J. P. O'Reilly (NRC-RII)
Mr. Travis Payne (KUDZU)
Mr. Daniel F. Read (CHANGE/ELP)
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ATTACHMENT 1
CAROLINA POWER AND LIGHT COMPANY

SHEARON HARRIS NUCLEAR POWER PLANT (SHNPP) - UNIT NO. 1
SYSTEMS FUNCTIONAL ANALYSIS PERFORMED ON THE
MAIN CONTROL BOARD DURING REDESIGN

Introduction

Carolina Power & Light Company's (CP&L) Shearon Harris Nuclear Power Plant (SHNPP) Unit 1 Main Control Board (MCB) was redesigned during January through March of 1981, based upon a Human Factors Review performed by Essex Corporation of Alexandria, Virginia, using Draft NUREG-CR/1580 criteria. The Human Factors (HF) Review identified 134 Human Engineering Discrepancies (HEDs); 49 of the HEDs were considered significant. These 49 HEDs concerned grouping and sequencing of controls, displays, light boxes, and annunciators. All 49 of these discrepancies were resolved with the redesign of the MCB.

The redesign and functional analysis were performed by CP&L engineering, operations, training, industrial engineering, and Essex Corporation personnel. Assistance from both the Architect-Engineer (Ebasco) and the Nuclear Steam System supplier (Westinghouse) was provided as needed.

Functional Analysis

Carolina Power & Light Company's design philosophy for the MCBs dictates the placing of controls on the bench section, indicators with light boxes (such as Status Light Boxes (SLBs) and Monitor Light Boxes (MLBs)) on the vertical section, and annunciators on the top tilted section of the MCB. Experience has proven that this philosophy is both practical and effective. This design philosophy allows the Control Operator to perform administrative duties at his desk while still maintaining the ability to scan the MCB to determine plant status. It also allows the Shift Foreman and other plant personnel to determine plant status from a distance, outside of the primary operating area, without interfering with the Control Operator. During the redesign process, CP&L established conventions for the MCB redesign effort.

The conventions chosen are as follows:

1. Bottom to top layout based upon the physical layout (from Piping and Instrumentation Diagrams (P&IDs)).

2. Layouts that must be horizontal will be left to right with appropriate demarcation lines or arrows to clearly indicate the system flow.

3. Series flow will be indicated by placing controls (and displays if possible) directly above each other from bottom to top, OR arrows or lines and arrows will be utilized to denote system flow.

4. Parallel flow will be indicated by placing controls (and displays if possible) side by side with "A" or "1" (if applicable) on the left and "B" or "2" (if applicable) on the right.

5. Common suction or discharge (header) will be denoted with a solid bar, as necessary, to clarify the arrangement.

6. Demarcation lines will be used to separate control display groups.

7. Demarcation lines or lines and arrows will be used where system flow is not obvious by components arrangement i.e., memic or partial memic.

8. Summary labels and brackets will be utilized to clarify the arrangement.

9. Indicators will be placed in the order they physically appear in the system. If this is not practicable, indicators for level, pressure, flow, and temperature will be placed in this order (preferably from left to right (first choice) or bottom to top (second choice)).

10. Recorders on the MCB will be placed on the vertical section at a level (height) where they can be easily read and maintained.

During the HF Review process, we determined which unnecessary components could be removed from the MCB. This review and subsequent determination was based upon design philosophy, operational need, operating experience, staffing, operating philosophy, and our decision to provide an advanced computer system. Our review culminated in the removal of approximately 200 controls and displays and approximately 250 annunciators from the MCB. In addition, concurrence for removal of components from the MCB was sought and obtained from both Ebasco and Westinghouse.

A review of MCB systems locations of the current design (i.e. prior to January 1981), revealed extensive thought and logic had been applied to systems locations. Generally, the systems location on the MCB remained unchanged during the redesign. A detailed review of each system, the method of which will be described later, revealed some components not properly located within their respective system and indicated arrangement of components within each system could be improved to facilitate operation. Different methods of arranging components such as frequency of use, like components (pumps, valves) grouping, modes of operations, and arrangement of physical layout (from P&IDs) were evaluated. The physical layout method was chosen because: 1) it was more practicable from an operations standpoint, 2) this is how our operators learn plant systems, and; 3) systems have many different operating modes where sequences of operation vary.

The redesign began by constructing a quarter scale, single plane mock-up on cardboard, utilizing the same dimensions and MCB shape as a standard "D" sized engineering front panel view drawing of the MCB. The cardboard mock-up with the MCB panel outline was then covered with clear plastic. A set of the current design (i.e. prior to January 1981) front panel drawings was then utilized by cutting out each component, pasting it to a piece of the same type cardboard and applying "stick-um" which would allow the component to be removed for rearrangement. Each component was then attached to the mock-up to reflect the current design. String was stretched across the mock-up to indicate primary and secondary viewing heights.

The redesign team was provided an oral description of each system, prior to the system rearrangement, by operations personnel which included system function (and how that function interrelated with the overall operation of the plant), the physical layout, and the instrumentation included in the design to accomplish the function. Each control, display, and other indications located on the MCB was then marked on the system P&ID. The controls and displays were then arranged on the mock-up, utilizing the (P&ID) and the conventions previously outlined. Demarcation lines were then added to the mock-up and the necessary labeling was determined. Exact labeling was cross-referenced to the mock-up with a numbering system because labeling would not fit on the mock-up.

Annunciators were rearranged into groups according to their applicable system by cutting and pasting drawings. Where possible, the annunciators were arranged bottom to top in relation to their respective components or sensor input in the physical layout. In cases where this annunciator arrangement was not practicable, the annunciators were logically grouped by function.

Next, all Status Light Boxes, Monitor Light Boxes, Trip Status Light Boxes, the Bypass Light Box, and the Engineering Safety Features (ESF) Light Boxes were reviewed for logical groupings by either system or function. These light boxes were then rearranged into logical groupings by cutting and pasting the drawings.

As panel sections of the MCB redesign were completed and translated to engineering drawings, Ebasco and Westinghouse (which included the appropriate disciplines), the review team and other CP&L personnel held review meetings where the redesign was evaluated. Comments were incorporated and the redesign was implemented.

Adequacy of instrumentation was continually evaluated by the team throughout the redesign process. In several cases, additional instrumentation was needed to accomplish systems functions. The additional instrumentation was added to the drawings during the redesign process.

As a result of our redesign effort and continual review process, CP&L believes the SHNPP Unit 1 main control board is a well designed, operationally functional, and Human Factored Control Board.

ATTACHMENT 2
CAROLINA POWER AND LIGHT COMPANY

SHEARON HARRIS NUCLEAR POWER PLANT (SHNPP) UNIT NOS. 1 AND 2
TASK ANALYSIS OF THE UPGRADED
EMERGENCY OPERATING PROCEDURES (EOPs)

Introduction

Carolina Power & Light Company's (CP&L) April 15, 1983 response to Supplement 1 of NUREG-0737 for the Shearon Harris Nuclear Power Plant (SHNPP) Unit Nos. 1 and 2 stated our Emergency Operating Procedures (EOP's) Procedures Generation Package (PGP) would be submitted to the NRC nine months prior to fuel load. The PGP will provide plant-specific technical guidelines, a Writer's Guide, and a description of our verification and validation program. Operator training will be accomplished prior to SHNPP Unit 1 fuel load which is currently targeted for June 1985. Carolina Power & Light Company anticipates completing the EOP Task Analysis concurrent to submittal of the PGP.

Task Analysis Method

A Task Analysis has been performed on the High-Pressure (HP) Basic version of the Westinghouse Owners' Group (WOG) Emergency Response Guidelines (ERGs) by a working group under the purview of the WOG Procedures Subcommittee. The primary outputs of this generic Task Analysis are tables listing all Instruments and Controls utilized in performing the ERGs. The detail of the generic Task Analysis is consistent with the detail provided in the generic ERGs.

The generic Task Analysis utilized a top-down approach that identifies the guidelines (i.e., event sequences), plant systems utilized in responding to event sequences, operator functions and operator tasks performed in responding to event sequences, and detailed elements that comprise the operator tasks. Figure 1 illustrates this approach.

As a minimum, CP&L intends to identify the deviations from the generic ERGs for the SHNPP-Unit 1 EOPs, task analyze those differences and generate plant specific lists of Instruments and Controls necessary to perform the EOPs in the SHNPP-Unit 1 control room. Figure 2 describes this approach. These Instruments and Controls listings will then be compared to control room instruments and controls to identify missing components or needed components not included in the design.

Additionally, CP&L will review the generic Task Analysis along with the ERGs deviations analysis, thus insuring review of each step of the SHNPP-Unit 1 EOPs. Discrepancies identified during the review and analysis will be judged applicable to the EOPs, Control Room or both and will be resolved and corrected by us. We believe that no major discrepancies will be identified because of our extensive functional analysis performed during the SHNPP-Unit 1 MCB redesign process and because of the task analysis performed on the event-based procedures during the Control Room Design Review.

ATTACHMENT 3
CAROLINA POWER AND LIGHT COMPANY

SHEARON HARRIS NUCLEAR POWER PLANT (SHNPP) UNIT NOS. 1 AND 2
DEVELOPMENT, VERIFICATION AND
VALIDATION OF EMERGENCY OPERATING
PROCEDURES

Development:

Carolina Power and Light Company's (CP&L) Shearon Harris Nuclear Power Plant (SHNPP) Emergency Operating Procedures (EOPs) are currently being developed utilizing the Westinghouse Owners' Group (WOG) Emergency Response Guidelines (ERGs) High Pressure (HP) version, Revision 1, as Technical Guidelines. The EOPs will follow the ERGs as closely as possible and any deviations will be documented, explained, and/or justified. Documentation will also be generated for the basis of the plant-specific calculations called for in the generic guidelines.

The basic version of the WOG ERGs have undergone one week of simulator verification and validation testing. A program for a week of simulator verification and validation testing of Revision 1 of the ERGs is now being assembled by Westinghouse and will be performed during the week of October 31 - November 4, 1983.

Carolina Power & Light Company has been deeply involved in the development of the ERGs since their inception through participation in both the full Owners' Group and the Procedures Subcommittee.

Verification and Validation Methods

Tabletop Evaluations

Tabletop evaluations will be performed on all EOPs and will consist of a talk-through of the procedures by qualified operations personnel and members of the team responsible for developing the EOPs. Scenarios will not be utilized during the tabletop evaluation. The evaluation will be documented as to time and date of performance, personnel involved, procedures utilized, problems or suggested improvements noted and, later, the solution of those problems or suggested improvements. The evaluation criteria utilized during the tabletop exercises are:

1. EOPs are technically correct.

2. EOPs are understandable as written.

3. EOPs are written in conformance with the Writer's Guide.

4. Level of detail in the EOPs is consistent with the qualifications, training, and experience of the operating staff.

Tabletop evaluations will be held in the spring of 1984.

Control Room Walk-Through

The Control Room Walk-Through will consist of walking and talking through each EOP in the Control Room with a full operations staff complement. Scenarios will not be utilized in the walk-throughs. A member of the team responsible for developing the EOPs will lead the walk-through. The walk-through will be documented as to time and date of performance, personnel involved, procedures utilized, problems or suggested improvements noted, and later, the resolution of those problems or suggested improvements. In addition to the criteria utilized in the tabletop evaluations, three additional criterion will be utilized in the walk-through. These criterion are:

1. Control room staff size is adequate to carry out the actions in the EOPs.

2. Instruments and controls necessary to carry out the EOPs actions are available.

3. Operators can carry out the EOPs actions without physical interference.

The walk-throughs cannot be carried out at SHNPP until the Control Room is functional (where functional is defined as):

1. Structurally completed (ceiling, lighting, and HVAC installed; panels correctly and permanently placed; etc.)

2. All instruments and controls installed but not necessarily operable.

3. Manned with a full operations shift complement.

We expect the SHNPP Unit 1 Control Room to be functional in late 1984 or early 1985. The walk-throughs are being planned for this time frame.

Simulator Evaluations

The simulator evaluation will consist of utilizing the SHNPP simulator to dynamically test the EOPs with accident scenarios. Testing of two eight-hour shifts, where preselected scenarios will be imposed on a full complement operating crew using the EOPs, will be performed at the SHNPP simulator. This testing is judged as adequate because:

1. SHNPP EOPs are very similar to H. B. Robinson Unit 2 (HBR) EOPs and the results of the HBR testing (which will be completed first) will be input to the SHNPP EOP's development.

2. The HBR EOPs have undergone 75 hours (as of September 1983) of dynamic testing at the SHNPP simulator.

3. Many of the same personnel involved in the development and testing of the HBR EOPs will be involved in the writing and testing of the SHNPP EOPs.

The simulator evaluations will be documented as to the time and date of performance, personnel involved, procedures utilized, scenarios selected, expected path through the EOPs, actual path through the EOPs with deviations explained, operators' debriefing critiques, observers' critiques, problems or suggested improvements noted, and later, resolution of those problems or suggested improvements.

The simulator exercises will be oriented toward the practical performance of the EOPs and is expected to be performed in the mid- to late-1984 time frame.

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SYSTEM REVIEW AND TASK ANALYSIS DEVELOPMENT APPROACH

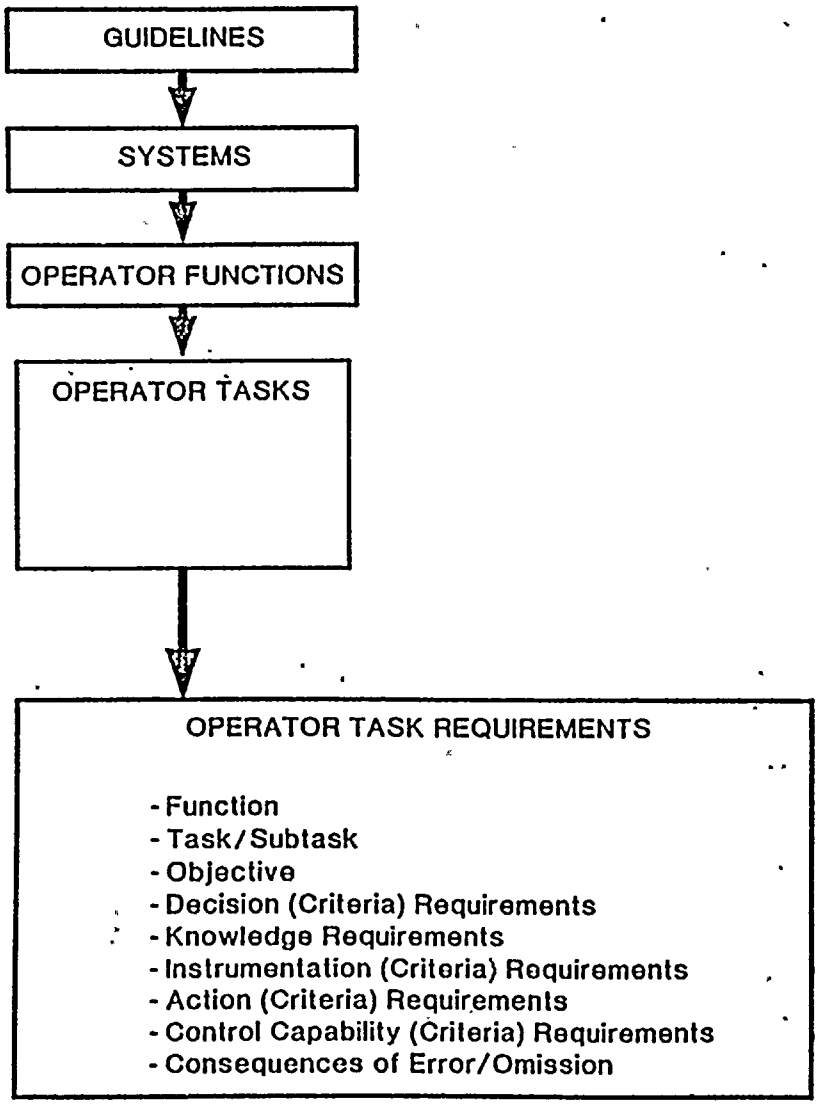

FIGURE 1 TASK ANALYSIS DEVELOPMENT APPROACH

SYSTEM REVIEW AND TASK ANALYSIS DEVELOPMENT APPROACH

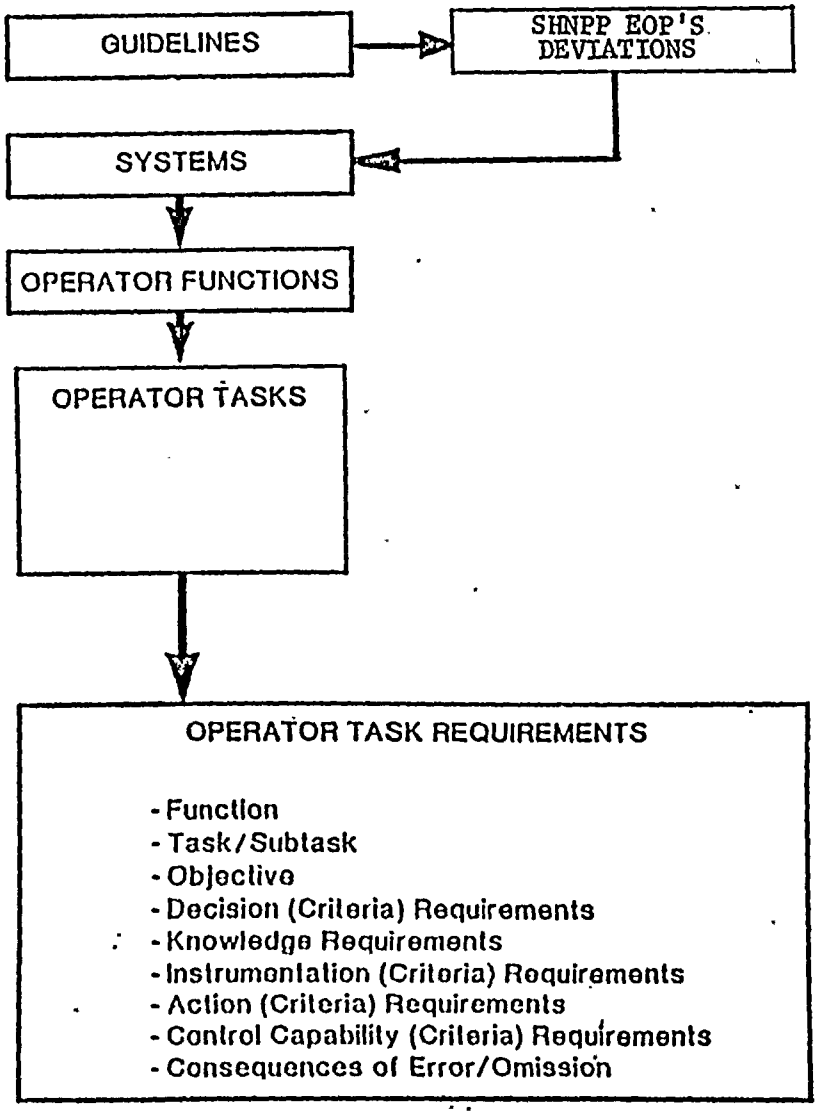

FIGURE 2 TASK ANALYSIS DEVELOPMENT APPROACH