# SUMMARY REPORT ON THE OYSTER CREEK

# CONTROL ROOM DESIGN REVIEW

April 1984

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# SUMMARY REPORT ON THE OYSTER CREEK CONTROL ROOM DESIGN REVIEW

# I. INTRODUCTION

## A. History and Schedule

This report describes the results of a review of the design of the control room for the Oyster Creek Nuclear Generating Station. The review examines and evaluates the controls, displays, and physical environment of the control room, as they affect the ability of the control room staff to operate the plant.

An overview of the schedule of the design review activity is shown in Figure I-1. The review began in late 1980, with the construction of a control room mockup to facilitate the control room evaluation process; the mockup has also been used to assess the effect of plant modifications on the control room and to verify modifications proposed to correct control room deficiencies. In early 1981, guidelines and objectives were formulated to provide a formal basis for the control room design review. The review process itself began in mid-1981 with walkthroughs, in the mockup, of several plant operational evolutions.

Shortly after the review began, work on the evaluation of the control room as a whole was temporarily deferred, and the effort was focused on the evaluation of the human factors of about twenty modifications affecting plant controls and displays, and planned, at that time, for implementation in the near future. Examples of modifications for which human factors evaluations were performed are listed in Table I-1.

The most extensive modification planned was the replacement of the entire plant alarm system, primarily to improve reliability and to provide space for the addition of new alarms. A major review of the alarm system was undertaken, with the objective of adapting the lessons learned from a similar review of the TMI-1 alarm system to the improvement of the Oyster Creek System. This effort was completed in late 1981 and has been documented in a separate report.(1)

A substantial review effort has also been devoted to many of the other planned changes - the improved core spray

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(1) An Evaluation of the Oyster Creek Main Process Alarm System, MPR 701, December 1981.

# HISTORY, STATUS & SCHEDULE

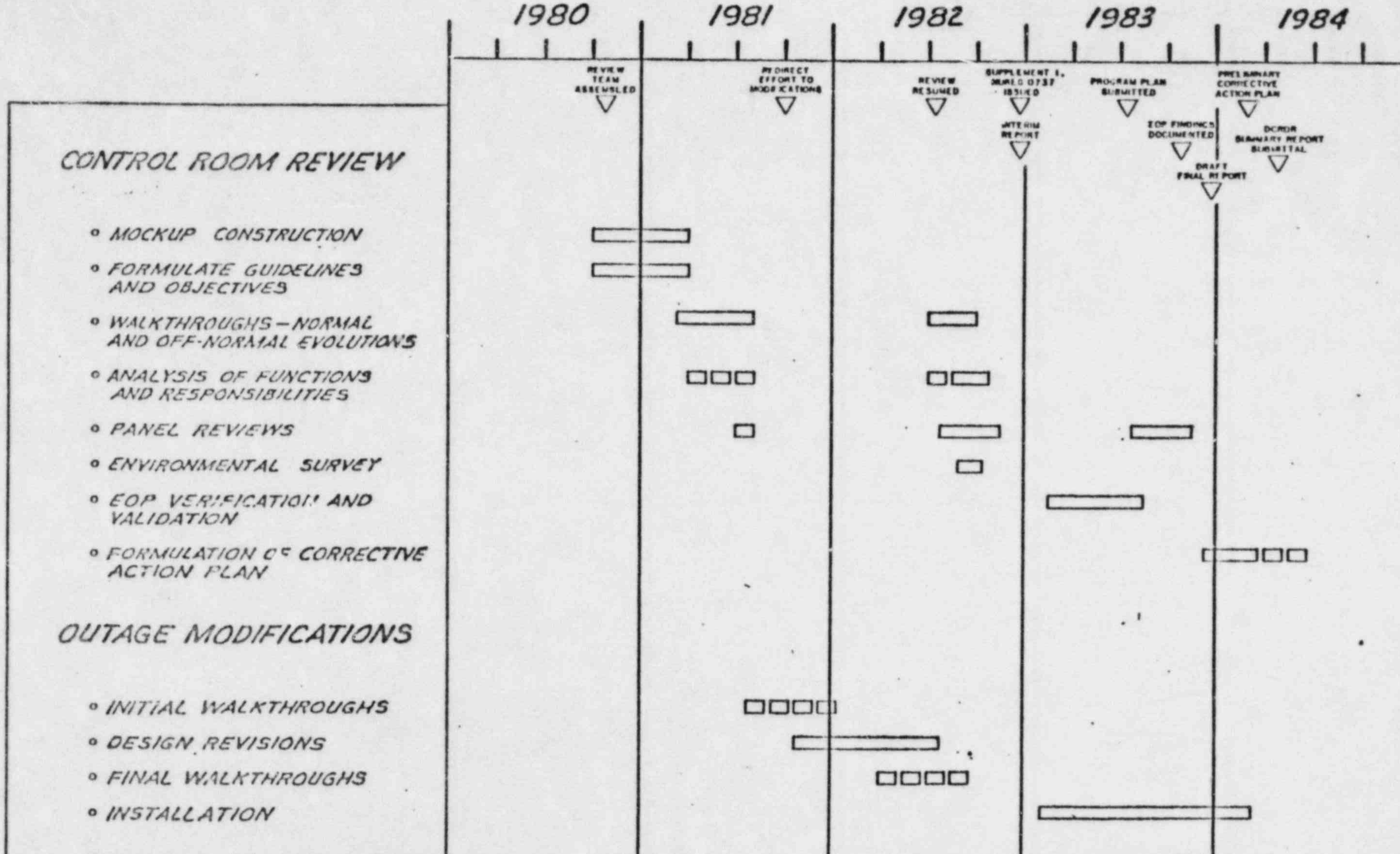


Figure I-1

pump control logic, and the controls and displays for the modified scram discharge volume vents and drains, for example.

The continuing human factors effort on control room changes notwithstanding, it was decided early in the summer of 1982 to resume the review of the control room as a whole. Work continued through 1982 and 1983. A program plan was submitted to NRC in July of 1983.[2] A significant effort, also in 1983, undertook to analyze the tasks associated with executing symptom oriented emergency operating procedures; this process was part of putting these procedures in place at Oyster Creek, in accordance with NRC guidance.[3]

B. <u>Structure of This Report</u>

In addition to defining improvements of control room human factors, this report and the review it describes are intended to fulfill the regulatory requirements for a control room review, specifically, the requirements of NRC Generic Letter 82-33.[4] A comparison of the elements of this review and the requirements of Generic Letter 82-33, as well as the guidance applicable to human factors reviews[5], is contained in the program plan previously cited. This program plan also describes, in detail, the responsibilities and qualifications of the members of the review team, the sources of information for the review, and the methods used in the review process. In the interest of brevity, all of this material will not be repeated here. However, an overview of the structure of the review team and the basic division or responsibility is included in Section II. Section III describes the functions and task analysis used in the Control Room Design Review. This analysis was conducted in two parts: (1) an evaluation of operator

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(2) Letter P. B. Feidler, GPU Nuclear, to D. Eisenhut, NRC, dated July 1, 1983, forwarding "Program Plan for the Control Room Human Factors Review at Oyster Creek Nuclear Generating Station.

(3) SECY-82-111, <u>Requirements for Emergency Response Capability</u>, United States Nuclear Regulatory Commission, March 11, 1982.

(4) NRC Generic Letter 82-33, Supplement 1 to NUREG 0737, dated December 17, 1982.

(5) NUREG 0700, Guidelines for Control Room Design Reviews.

functions and responsibilities as contained in the guidelines and objectives for the review (submitted with the program plan) and (2) a review of operator tasks as defined in the symptom based Emergency Operating Procedures (developed from generic BWR procedure guidelines).

The principal conclusions of the Oyster Creek Control Room Design Review are summarized in Section IV. Programs to correct the deficiences uncovered by this review are outlined in Section V. A table summarizing the findings, corrective actions and schedule for implementation of the Design Review is also contained in Section V.

Detailed findings are contained in other design review documentation not submitted with this report.

C. Integration of Other Projects into the Control Room Design Review

This design review examined all the control hardware installed in the control room at the beginning of the review and was extended to cover all modifications made to the room or planned to be made during the 1983 refueling outage. Also specifically of concern are future modifications that will be made to the control room. Important examples include the Safety Parameter Display System, instrument modifications for compliance to Regulatory Guide 1.97 and the Remote Shutdown Panel. In order to address this concern and to ensure that the high standards established during the Control Room Design Review (CRDR) are maintained, GPUN has developed procedures which integrate Human Factors reviews into the design process. The procedures are supported by a full time Human Factors staff, which was in place prior to the beginning of the CRDR.

The design process at GPUN is divided into a conceptual design phase and detailed design phase. Human Factors inputs to these phases include:

- Preliminary Engineering Design Phase

  (1) Human Factors Standards for control room controls, displays and alarms are contained in an engineering procedure for use by design engineers;

(2) Engineering procedures require a Human Factors section in the conceptual design specification;

(3) All conceptual design documents are reviewed by Human Factors staff who also participate in the Preliminary Design Review Meeting.

° Detailed Design Phase

(1) Engineering procedures require a Human Factors section in the Detailed Design Specification (System Design Description, Division-II).

(2) All Final Control Panel Layout Drawings require Human Factors signoff.

The scope of the human factors review in the conceptual design phase includes considerations of control and display types, control-display relationships, physical location, labeling, demarcation, and alarm requirements. The review always includes a review of the panel layout drawing and usually includes a walkthrough of the preliminary layout with the experienced plant operators, using a draft system procedure. The scope and method of the review is specified in the design documents.

This process has already been applied to the preliminary design of the Remote Shutdown panel and included, in this case, the construction of a mockup of the panel face. This was reviewed using a draft remote shutdown operating guideline in a walkthrough at the plant location proposed for the remote shutdown panel. An analogous process is presently being used for the SPDS and Reg. Guide 1.97 modifications.

In summary, the methods used in this review, the standards established, and the process for generating improvements will be maintained in the future by a well-defined process at GPUN.

Table I-1

EXAMPLES

HUMAN FACTORS REVIEW AND ENHANCEMENT

OTHER MODIFICATIONS

- REGULATORY COMPLIANCE
  - CONTAINMENT PRESSURE/TORUS LEVEL/$H_2$/$O_2$ MEASUREMENT SYSTEM
  - SECOND SCRAM DISCHARGE VOLUME ADDITION, WITH INSTRUMENTATION
  - RADIOACTIVE GASEOUS EFFLUENT MEASUREMENT
  - VITAL INSTRUMENT POWER SUPPLY STATUS DISPLAY
- SAFETY IMPROVEMENTS
  - CORE SPRAY LOGIC UPGRADE
  - FIRE JOCKEY PUMP ELIMINATION, POND PUMP ADDITION AND OTHER FIRE SYSTEM MODIFICATIONS
- OPERATIONAL IMPROVEMENTS
  - ALARM SYSTEM UPGRADE
  - IRM RANGE 10 ADDITION
  - RECORDER UPGRADE; ADDITION OF DIGITAL READOUTS

## II. REVIEW TEAM STRUCTURE AND METHOD OF OPERATION

The Program Plan[1] identified the review team members and included their resumes. It briefly discussed their responsibilities and functions. A more detailed discussion of the review team structure and method of operation is provided below.

In assembling a review team, the most significant consideration was, of course, the proper conduct of the control room design review. But there were other considerations in selecting the review team members and in developing a method of operation. First, it was GPUN's intent in performing the review not simply to satisfy a regulatory requirement -- there was none when the review started -- but to develop effective corrections for deficiencies identified by the review. In addition, GPUN structured the review so as to build skills and experience in the GPUN staff which could enable that staff to maintain high control room human factors standards in subsequent modifications to the plant and its controls.

### Review Team Structure

The review team was composed of members from GPUN, MPR Associates, and human factors consultants. Table II-1 identifies the individuals who participated and staff support, as well as the specialties that they contributed to the team.

The GPUN participation was intended to cover all areas required for conduct of the review and for subsequent evaluations of modifications with control room human factors input.

### Method of Operation

Overall direction of the review was provided by GPUN. In particular GPUN acted as contract manager for MPR and consultants, set the review schedule, integrated the control room design review and corrective actions with other plant activities and scheduled correction of deficiencies. The degree of GPUN involvement in specific review activities is summarized in Table II-2.

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[1] op. cit.

As indicated by the table, the GPUN team members participated in and contributed to all phases of the review except the detailed panel review. This "close in" participation provided an opportunity for GPUN staff to learn the review process and understand the review guidelines and how to apply them in the future.

MPR Associates has brought experience to the review in integrated control system design and continues to perform design changes in nuclear power plants. They developed the framework of the review, coordinated each phase of the review, drafted the detailed report findings and provided clerical and drafting support.

The human factors consultants provided expertise in development of review guidelines; guidelines were necessary since the review commenced prior to the issue of guidelines specifically applicable to nuclear power plants. The consultants also participated in the walkthroughs and in the evaluation of deficiencies.

A summary of MPR and consultant involvement in the review is contained in Table II-3.

Table II-1

REVIEW TEAM ORGANIZATION AND STRUCTURE

| ORGANIZATION/PERSONNEL | SPECIALTY |
|---|---|
| **GPUN** | |
| ° TECHNICAL FUNCTIONS | |
| P.S. WALSH | - NUCLEAR SYSTEMS ENGRG<br>- PLANT ANALYSIS<br>- PLANT OPERATIONS |
| T.G. BROUGHTON | - NUCLEAR SYSTEMS ENGRG<br>- PLANT ANALYSIS<br>- PLANT OPERATIONS<br>- PLANT SAFETY |
| HUMAN FACTORS STAFF | - HUMAN FACTORS |
| SYSTEM ENGRG/SAFETY ANALYSIS STAFF | - PLANT ANALYSIS AND DYNAMICS<br>- SAFETY ANALYSIS |
| PROJECT ENGRG | - HARDWARE ENGRG<br>- PROCUREMENT<br>- SCHEDULE<br>- PLANT DETAIL DESIGN DATA |
| SHIFT TECHNICAL ADVISORS | - PLANT OPERATIONS<br>- SYSTEMS ENGINEERING |
| ° OCNGS | |
| J. YOUNG (SRO) | - PLANT OPERATIONS AND TRAINING |
| OPERATING STAFF<br>SROs<br>ROs | - PLANT OPERATIONS |
| TRAINING STAFF | - PLANT OPERATIONS<br>- EOP TRAINING<br>- OPERATIONS TRAINING |
| ENGINEERING STAFF | - PLANT OPERATIONS<br>- PLANT CONFIGURATION |

Table II-1, continued

REVIEW TEAM ORGANIZATION AND STRUCTURE

| ORGANIZATION/PERSONNEL | SPECIALTY |
|---|---|
| MPR | |
| H. ESTRADA | - POWER PLANT DYNAMICS AND CONTROL<br>- POWER PLANT OPERATIONS<br>- INSTRUMENTATION<br>- HUMAN FACTORS<br>- CONTROL ROOM DESIGN |
| MPR STAFF | - POWER PLANT ENGRG<br>- HUMAN FACTORS<br>- DRAFTING SUPPORT<br>- CLERICAL SUPPORT |
| CONSULTANTS | |
| DR. T. SHERIDAN | - HUMAN FACTORS<br>- MECHANICAL ENGINEERING<br>- SYSTEMS ENGINEERING<br>- APPLIED PSYCHOLOGY |
| DR. J. CHRISTENSEN | - HUMAN FACTORS<br>- EXPERIMENTAL PSYCHOLOGY |

## Table II-2

## REVIEW TEAM METHOD OF OPERATING

GPUN

- MANAGES CONTRACTS FOR MPR AND CONSULTANTS
- INTEGRATES CONTROL ROOM DESIGN REVIEW WITH OTHER PLANT ACTIVITIES
- DEFINED PLANT SPECIFIC OPERATOR RESPONSIBILITIES
- APPROVED GUIDELINES AND OBJECTIVES
- FIXED SCHEDULE AND SCOPE OF WALKTHROUGHS
- REVIEWED AND COMMENTED ON WALKTHROUGH SCENARIOS
- OBSERVED AND CRITIQUED WALKTHROUGHS
- PROVIDED FINDINGS TO MPR FOR COLLECTION/ORGANIZATION
- PROVIDES SUPPORTING DETAIL ON PLANT CONFIGURATION AND OPERATING CHARACTERISTICS
- CONCURS IN FINDINGS AND RESOLUTION OF FINDINGS
  - ANALYSIS OF FUNCTIONS AND RESPONSIBILITIES
  - DETAILED PANEL REVIEW
  - ENVIRONMENTAL SURVEY
  - FUNCTIONS AND TASK ANALYSIS OF EOPS
- WRITES SUMMARY DCRDR REPORT
- SETS SCHEDULE FOR IMPROVEMENTS

Table II-3

REVIEW TEAM METHOD OF OPERATING

MPR

- CONSTRUCTED MOCKUP
- DRAFTED GUIDELINES AND OBJECTIVES
- DEVISED WALKTHROUGH SCENARIOS
  - Conducted Prebriefing
  - Conducted Debriefing
- COLLECTED REVIEW TEAM COMMENTS
  - Walkthroughs
  - Panels
- PERFORMED DETAILED PANEL REVIEW
- CONDUCTED ENVIRONMENTAL SURVEY
- DRAFTED DETAILED REPORT OF FINDINGS AND PROPOSED RESOLUTIONS

CONSULTANTS

- SUGGESTED GUIDELINES
- REVIEWED AND APPROVED GUIDELINES AND OBJECTIVES
- PARTICIPATED IN WALKTHROUGHS AND PANEL REVIEWS
- REVIEWED AND CONCURRED IN FINDINGS OF REVIEW

# III. FUNCTIONS AND TASK ANALYSES

Analyses of the functions and tasks that operators should be able to carry out in the control room were performed as part of two elements of this review:

- The analyses of operator functions and responsibilities in 1981 and 1982

- The analyses of the functions and task requirements of the symptom-based emergency operating procedures in 1983, as one of the initial steps of implementing these procedures.

## A. Analysis of Operator Functions and Responsibilities

The analysis of operator functions and responsibilities was based on the guidelines and objectives of the Program Plan.(1) These guidelines spell out the specific technical and administative functions for which the plant management hold the operating staff responsible for controlling at Oyster Creek. The technical functions include:

- Control of the reactivity balance and the neutron flux shape in the reactor core

- Control of the core's thermal energy production, the transport of this energy, the conversion of some of it to mechanical, then electrical energy in the turbine generator, and the rejection of the balance in the condenser

- Control of the overall inventory of water in the plant, and the distribution of this inventory among the reactor system and its auxiliaries, the main, reheat and extraction steam systems, and the feed, condensate, and heater drain systems

- Control of the thermodynamic state of the reactor fluid

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(1) op. cit.

- Control of the chemistry of the fluids throughout the plant

- Control of the temperature and chemistry of the plant effluent (by the dilution of circulating water, and other measures)

- Control of the inventory of radioactive material in all fluid systems for which control room operators are responsible

- Control of the quality and distribution of power -- electric, hydraulic and pneumatic - for plant auxiliaries

- Control of the purity, inventory, and thermodynamic state of the primary containment atmosphere

- Control of the readiness of the fire fighting system, detection of fire, and direction of fire fighting activities

Among the administrative responsibilities of control room operators:

- Blocking and tagging -- the administrative control, for personnel and plant safety reasons, of the removal of equipment from service for maintenance, and of the restoration of such equipment to service on completion of maintenance

- Implementation of the appropriate level of the site emergency plan when the condition of the plant requires it

- Maintenance of required logs and records of daily plant activities

The review team analyzed each of the technical responsibilities listed in the guidelines using a "control loop" approach, to establish the process variable measurements that are necessary to execute each responsibility, and the means by which changes to the process can be effected in response to deviations of a process variable from its desired value.

The review team utilized its own knowledge of plant dynamics, as well as piping and instrumentation diagrams, electrical one line diagrams, and other design data to establish these requirements for each area of responsibility. The process by which requirements were established includes not only considerations of detecting that a variable has deviated from its desired value, but also the sensitivity and speed with which the process responds to the means the operator may use to control it. Needs for the detection of intermediate variables, for stabilizing feedback, as a means for confirming control actions, fall naturally out of this process, as do requirements for the grouping of controls and displays.

The controls and displays actually provided in the control room were then compared against these requirements. Knowledge of how operators presently use the controls and displays to carry out their responsibilities -- there are often alternatives -- were gained from extensive walkthroughs of both normal and off-normal[2] operational evolutions. In the review of operator functions and responsibilities, the review of plant experience (see the program plan) was used to formulate certain of the scenarios used for the off-normal evolutions and was also used to gain insight as to particular functions where existing controls and displays might be deficient. Operator interviews, conducted as an adjunct to the walkthrough process were also used as sources of information on control problems.

The review of operator functions and responsibilities generated some 135 findings, many involving multiple hardware deficiences.

B. Functions and Task Analysis for Emergency Operating Procedures

In early 1983, GPUN began the process of implementation of symptom-oriented emergency operating procedures for Oyster Creek. Generic guidelines for these procedures

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(2) It should be noted that the walkthroughs of off-normal evolutions for this review of operator functions and resonsibilities utilized event-oriented emergency procedures then in place (in 1981, 1982).

had been developed by a BWR Owner's Group and approved by NRC. The generic guidelines were converted to plant specific guidelines which, in turn, were translated into a first-cut set of procedures. It is important to note that the translation of the guidelines into the first-cut procedures dealt primarily with the elimination of certain segments of the generic guidelines which were not applicable to Oyster Creek, because the fluid systems required by these segments are not incorporated at Oyster Creek (the use of a high pressure coolant injection system to restore reactor water level, for example; Oyster Creek has no such system).

In formulating the first-cut procedures, there was no effort to "tailor" the procedures, and particularly the process variables and controls called out by them, to displays and controls installed in the control room (and, in fact, several of the variables called for by the procedures were not displayed in the control room).

By way of background, the symptom-oriented procedures for BWRs are currently divided into two groups.[3] One group of procedures maintains a set of three key reactor variables (reactor power, water level, and pressure) in bounds, the second group -- there is only one procedure in this group -- maintains a set of key containment variables (drywell temperature and pressure, torus water temperature and level) in bounds. The top level procedure for the key reactor variables calls on certain contingency procedures if efforts to maintain the variables by "first line" means are unsuccessful.

The procedures are truly symptom-oriented -- one enters them on the basis of explicitly defined entry conditions generally related to the key process variables. The procedures then guide the user as to the means he should use to restore the variables to their normal range. The means are essentially independent of what caused the variable(s) to depart from established limits in the first place; for situations when one or more of the means are not effective, alternatives are always offered.

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(3) A third group of procedures related to the control of secondary containment is contemplated.

The first-cut procedures were used to define the functions and tasks that the control room operators must perform under emergency conditions. The process of task definition involved two preliminary steps:

(1) A desk-top review of the procedures from an engineering and understandability viewpoint

(2) Construction of logic diagrams[4] to ensure that the procedures and the tasks implicit in them do not lead the operator to any "dead end" or trap him in an infinite "do-loop."

After these initial steps, the first-cut procedures were walked through in the Oyster Creek Control Room Mockup, on May 19 and 20, 1983. In the walkthroughs, the following measures were used to analyze the ability of the operators to understand and to perform the operations called for by the first-cut procedure tasks.

(1) Each of the entry conditions for the two top level procedures (reactor control[5], and containment control[6]) was reviewed with the operators to determine whether the condition was clearly and unambiguously displayed to them in the control room.

(2) The procedures themselves were talked through -- the two top level procedures, and the contingency procedures.[7-12] As has been stated, the procedures involve many logical branches ("If ... then") and conditioned responses. The talk-through process therefore involved compounding of conditions, not

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(4) Because of their symptom orientation, BWR emergency operating procedures involve many interactive and conditioned responses.

(5) EMG-3200.01, 3/23/83, RPV Control
(6) EMG-3200.02, 4/21/82, Containment Control Procedure
(7) EMG-3200.03, 3/10/83, Level Restoration
(8) EMG-3200.04, 4/21/83, Emergency RPV Depressurization
(9) EMG-3200.05, 3/24/83, Steam Cooling
(10) EMG-3200.06, 3/23/83, Spray Cooling
(11) EMG-3200.07, 3/10/83, Alternate Shutdown Cooling
(12) EMG-3200.08, 5/ 2/83, RPV Flooding

necessarily mechanistically, to ensure that each logical avenue was explored. For each step, an assessment was made to determine:

- whether the operator understood the operation called for

- whether the operator conditioned his response according to the conditional requirements of the procedure(s)

- whether the operator was capable of understanding and executing the step in combination with other steps in other procedures he was using at the same time

- whether the manning in the control room was sufficient in numbers and organization to carry out, simultaneously, all the steps that applied

- whether, if the operator's execution of a step were conditioned on specific values of process variables, the information on those variables was displayed to him in appropriate units, with appropriate precision, at a location where he would be able to see it

- whether controls or communications or both were provided in the control room, as needed to execute the step in a timely manner

- whether displays provided in the control room gave the operator necessary visual feedback on the success or failure of his control action.

This process verifies that the controls and displays provided in the control rrom effectively support the tasks required by the emergency operating procedures (or, as was the case for several tasks, specifically identifies needed displays or controls which the control room does not have). The above process does not, however, validate the overall compatibility of procedures, manning, training, and control room -- that, in real upsets, the operators can carry out the tasks

of the emergency procedures in a timely and effective manner.

To validate the procedures, two steps were taken:

(1) Walkthroughs of mechanistic upsets were walk-through, on a more or less real-time basis, in the mock-up

(2) Evaluations were made of operator responses in training exercises for the procedures at the Dresden Simulator, in June 1983

In the walkthroughs of mechanistic upsets, two full-length scenarios were walked through:

(a) a loss of off-site power with a number of additional complications, and

(b) a load rejection with a malfunction of the turbine bypass and subsequent sticking open of two reactor safety valves.

Several "mini scenarios" were also talked through to explore specific issues (e.g., disagreement among water level instruments). The mini-scenarios also included events of relatively high frequency, such as reactor scrams evolving from feed system upsets, generator trips, etc. These scenarios were selected to generate symptoms requiring entry into the emergency operating procedures (e.g. low reactor water level) in situations where the cause of the event and the appropriate response was obvious, or appeared to the operators to be obvious. The object was to ensure that in such situations, the operators could and would follow the new emergency operating procedures, and that the procedures and the displays and controls called for by them would lead the operators to information and action appropriate to the situation.

The evaluations of the training exercises at the Dresden Simulator were based on observations of the operators' actions in responding to simulated upsets and on the comments of the operators themselves. The controls and displays of the Dresden Simulator are substantially different from those at Oyster Creek. Consequently, one must draw conclusions from these observations with care. Table III-1 is a checklist used to assist in this process.

The analysis of the tasks associated with the symptom-oriented emergency operating procedures produced findings in three general categories:

(a) Findings related to the controls and displays and the control room itself -- similar in nature to the findings of the analysis of operator functions and responsibilities, the findings of the detailed panel review, and the findings of the environmental survey.

(b) Findings related to the format and organization of the procedures themselves, or to the manner in which the responsibilities implicit in the procedures are assigned to control room operators -- findings of an editorial or administrative nature.

(c) Findings on the technical content of the procedures.

Items in the first category -- findings on control room hardware -- are clearly within the purview of the detailed control room design review.

Although items in the second category -- editorial and administrative findings -- are not so obviously a part of this review, a summary of them has also been included in this report; a major product of this analysis of the emergency operating procedures has been the improvement of the human factors of the procedures themselves.

Items in the third category -- technical findings related to the procedures -- are clearly outside the purview of the detailed control room design review and have been documented in separate correspondence. It is important to emphasize, however, that the analysis has identified no significant technical deficiency. On the contrary, the review team found no hypothetical situation, however compounded or subtle, that the procedures did not effectively handle. The procedures are truly symptom-oriented. They effectively maintain the reactor and its containment within acceptable thermodynamic bounds, regardless of the upset or upsets that bring about their use. They do not require diagnosis by the operator as to the cause

of the upset (though the operators, being human, tend to expend some of their mental energy on figuring out what's wrong while the upsets are occurring). The technical quality of the procedures is evidenced by the enthusiasm of the operating staff for them; their acceptance of these new and different procedures appears universal.

The analysis of emergency operating procedure tasks generated a total of thirty-three findings in the first two categories. The count could have been higher, but the analysis of operator functions and responsibilities described in Section III.A above is somewhat redundant to the emergency operating procedure task analysis. The findings in the latter category relate primarily to tasks unique to the EOPs and not those originally contemplated in the control of boiling water reactors. They treat, for example, problems in using containment variables to trigger responses in the control of reactor pressure. Also, obviously, findings relating to the format and presentation of the emergency procedures themselves were, and could only be, generated by the EOP task analysis.

## IV. SUMMARY OF CONCLUSIONS

1. The Oyster Creek Control Room has a number of important strengths including:

   a. System controls are generally well defined as a group, and located sensibly with respect to one another. Displays are typically near related controls. The system arrangements lead to a clear cut assignment of operator responsibilities during normal and off-normal operations. Control room operator traffic patterns are orderly and are not characterized by crossing or other undesirable features.

   b. Most of the control hardware -- the switches, controllers, indicator lights, and meters -- has been very reliable. Notable exceptions are recorders, some of which are now being replaced, and alarm annunciators, which are also being replaced.

   c. Meter scales typically are easily read and properly ranged; many of them comply with the human factors guidelines.

   d. Communications from the control room to and from most or all operating stations within the plant are excellent.

   e. The improved Plant Alarm System (installed while this review was in progress) meets applicable human factors standards. It possesses visual, audible and arrangement attributes that are expected to contribute to effective plant operation, particularly under off normal conditions.

   f. In addition to the alarm system upgrade, most of the plant modifications scheduled for performance during the 1983 refueling outage have upgraded control room human factors. Specific examples include:

      ° Addition of controls for scram discharge volume vents and drains in mimic format,

- Displays and controls for core spray control logic which will allow the operator easily to assimilate system status and effectively to control reactor water level by means of the core spray systems.

g. The new, symptom-oriented emergency operating procedures have been demonstrated in walk-throughs and in simulator training to be an important contributor to effective operations in the control room.

2. The Oyster Creek Control Room also has a number of deficiencies; the review generated roughly 1,000 findings of items which were or might be judged to be deficient from a human factors viewpoint. As was noted in the preceeding section, the two analyses of operator functions and tasks generated between them 168 findings. The preponderant majority of the remainder -- over 800 -- were uncovered by the detailed review of the inventory of control room hardware. These deficiencies are summarized in Section V of this report where actions to correct them are also defined.

Some of the generic deficiencies of the control room include the following:

a. Although controls and displays are typically well grouped by system, individual controls and displays within a system group are often confusingly arranged.

b. Many controls and displays are confusingly labeled. Some are not labeled at all. Meter labels are particularly obscure. Label plates, which have white letters on black background, are dirty. Letter size does not conform to the readability standard, and lighting is marginal. Consequently, label plates are very difficult to read.

c. General Electric Type SB switch handles are used throughout the control room for the control of pumps, valves, and circuit breakers, and for the selection of control modes. The same style switch handle is used on almost all SB switches (though different

styles are available). To distinguish visually among these controls is difficult. There are no tactual differences among them.

d. Protective covers are generally not employed. For example, controls for the generator field circuit breaker and the condenser vacuum breaker are not distinctive and could be activated inadvertently.

e. Operational limits and other informational aids are typically not provided. When they are, they are often of a temporary and potentially uncontrolled nature. Red and green bands are not used on meters.

f. Some controls and displays on vertical panels fail to meet anthropometric standards. Examples include test pushbuttons and operating switches for Main Steam Isolation Valves, Bypass Switches for certain containment functions, one of the recorders for drywell pressures.

g. As in most Boiling Water Reactors, the feedback to the operators of information on the change in neutron flux shape that results from a change in control rod position is deficient. Interpretation of flux data requires computer analysis by a reactor engineer.

3. The control room also has some deficiencies in specific controls and displays:

a. There are no frequency displays for diesel generators. Such displays are necessary to control diesel generator power effectively when the off-site power source has been lost.

b. Certain sump level indications needed to confirm a reactor leak are missing from the control room; to wit: reactor building sump levels and the torus room sump level.

c. There have been some difficulties associated with the use of the intermediate range neutron monitors during reactor start-up. One of these difficulties -- an inadequate overlap between the intermediate range and

the power range monitors -- is being resolved by a system modification.

d. Some important displays are not readable by an operator standing at the controls associated with these displays:

   (1) The narrow range reactor pressure recorder is not readable from the turbine bypass controls

   (2) The reactor water level is difficult to read from the cleanup system let-down valve control (which is used to control level during startup). The level is also difficult to read from the core spray system controls (which control level when the core spray system is in operation).

4. Analyses of operations required by the newly installed Emergency Operating Procedures indicate a number of shortcomings:

   a. Average Torus Water Temperature and certain Drywell Temperatures are used as entry conditions for the procedure. There are four torus water temperature indications; none is clearly identified as the average. The displayed drywell temperatures are not representative of the hottest drywell temperature. In addition, the alarms associated with these variables are not accorded appropriate status, even with the improved alarm system arrangement. Also, the drywell temperature alarm legend is poor. (Miscellaneous Drywell Temperatures High).

   b. Emergency operating procedures can require flooding of the drywell to a level as high as 104 feet. The operator has no instrument by which he can read this level.

   c. The procedures call for reading the shell side pressure differential of the containment spray coolers. This reading is available only locally. The operator might confuse the called-for reading with the tube-to-shell side pressure differential, which is displayed on the panel.

d. The value of drywell pressure, following a high drywell pressure entry based on a 2 psig alarm, can only be confirmed by leaving the main control area to consult a back panel recorder. Trending of this variable also requires use of several back panel recorders.

e. Procedures call for lining up the core spray system to flood the drywell. The valve line up, if executed in the wrong sequence, could lead to damage of the core spray pumps. Appropriate warnings in the procedure and on the panel are needed.

5. Environmentally, the control room review generated 20 deficiencies. Among the most important:

   a. The air conditioning is said to be unreliable. When one of the units is out of service, operators say that the room becomes uncomfortably warm and that the operation of some electronic systems is affected.

   b. Dust accumulates in the room.

   c. There is no humidity control; the room is said to be uncomfortably dry in the winter.

   d. Normal lighting levels are below the minimum standards. As has been mentioned, this leads to difficulty in reading labels for controls and displays. Lighting levels at the operators desk, where procedures are generally used, are particularly low. It should be noted that lighting at the control panels is maintained at a low level to reduce glare from the curved face vertical meters (G.E. Type 180) which are used throughout the control room. The luminance of indicator lights is also too low . The state of these indicator lights (lit/unlit) would be very difficult to detect if room lighting levels were increased.

6. The arrangement of the overall control area (as opposed to the arrangement of the panels themselves) has several deficiencies:

   a. The location of the Group Shift Supervisor's office tends to isolate the GSS

from the control area, penalizing his role in off normal evolutions, and reducing his ability to control casual traffic into the control room proper.

b. The practice of carrying out blocking and tagging from the control room operators' desk in front of panel 4F leads to traffic by equipment operators and maintenance personnel into the center of the control room area.

c. The control room operator's desk does not provide adequate space for storage or laydown of procedures.

## V. CORRECTIVE ACTION PROGRAM; RESOLUTION OF DEFICIENCIES

The deficiencies uncovered by this review vary in the degree to which they can affect the performance of the control room operators in carrying out their jobs. For purposes of formulating a corrective action program, each deficiency has been classified according to its importance to the safe and efficient operation of the plant and has been assigned a schedule for correction. There are three importance categories, as follows:

### Importance Category A

The most serious deficiencies fall in this category. A Category A deficiency may impair an operator's performance under off-normal conditions. These deficiencies often involve a failure to display information that the operator needs to respond correctly in a particular off-normal situation, or a failure to provide the controls he needs for a timely response. Not all of the deficiencies in this category are in hardware, however. A procedure may fail to guide the operator adequately as to the sequence in which he should perform a specified set of tasks, when failure to do so can lead to the loss of an important system. And a test may be necessary to establish whether a system needed to respond to a specific off-normal condition will, in fact, respond in the desired manner. In such cases, the corrective measure is an administrative action rather than a control hardware modification.

### Importance Category B

This category is made up of deficiencies that clearly violate one or more of the human factors guidelines used in the review.[1], but are unlikely to lead to an irreversible operator error in an off-normal situation. Category B deficiencies may include items that could lead to operator error under normal conditions, however. The category also includes generic deficiencies that individually are not likely to

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1 op. cit.

degrade operator performance seriously but, taken together, can be significant. Again, some of the deficiencies in this category are administrative in nature rather than involving control hardware.

Importance Category C

Deficiencies which are unlikely to affect operator performance irreversibly under any condition or for which solutions are not clear-cut are placed in this category.

Clearly classifying the deficiencies as to importance involves significant human factors and engineering judgment -- the likelihood of operator error must be assessed, as well as the impact of such error on the plant. The classification of deficiencies as to importance, therefore, involved the review team as a whole; the final classification of each deficiency represents the consensus of the team.

Scheduling of the corrective action for each deficiency has been accomplished by placing it in one of four categories:

| | |
|---|---|
| Schedule Category 1: | Accomplish at the earliest opportunity, but in no case beyond the next refueling outage. |
| Schedule Category 2: | Accomplish by the end of the next refueling outage (1985) |
| Schedule Category 3: | Accomplish by the end of the 1987 refueling outage |
| Schedule Category 4: | Accomplish as convenient, or after the 1987 refueling outage, or, if the need for corrective action is not established, take no action. |

During the conduct of the review, a significant number of the deficiences uncovered by it were corrected, as part of the human factors input to other control room modifications. Where such corrective actions have already been taken; the deficiency has been placed in a fifth schedule category: "Corrected."

Table V-1 summarizes the deficiencies found by this review as well as the actions which have been taken or are planned to correct them. Every deficiency is not listed in the Table; many of the findings of the detailed panel review have been combined and are listed generically. Also, it was not unusual for two different elements of the review -- the panel review and the functions and responsibilities analysis, for example -- to generate similar findings. Such findings have been merged and listed as a single item in the Table.

To assist in formulating a coordinated program of corrective actions, the deficiencies of Table V-1 are organized in seven groups, according to the nature of the action required to correct them. These groups are defined in Table V-2. The preponderant majority of deficiencies merit corrective actions involving changes or additions to control room hardware -- groups 2, 4, 5, and 6 of Table V-2. About 15 percent of the deficiencies require some administrative corrective action such as a test or procedural change (Group 3), while about 7 percent require further study or no action at all (Groups 1 and 7). Included in the "no action" category are those deficiencies that have been corrected in the course of making other control room modifications.

As noted above, a deficiency listed in Table V-1 may have been uncovered by one or more of the four main elements of this review -- (1) the review based on operator functions and responsibilities, (2) the detailed review of the inventory of control panel hardware, (3) the survey of the control room physical environment, and (4) the review of the functions and tasks implicit in Oyster Creek's new emergency operating procedures. Deficiencies uncovered by the review of Oyster Creek operating experience, and in the walkthrough process have been documented under one of the four major elements, typically element (1), the review based on operator functions and responsibilities.

The deficiencies of Table V-1 are also classified according to the three importance categories discussed above; the schedular category for each corrective action is also given. Obviously, deficiencies of Category A importance merit prompt corrective measures; generally, actions to correct, or at least to mitigate these deficiencies are given the first schedular priority. Deficiencies in Importance Category B are for the most part, placed in the second and third schedular categories -- scheduled to be performed by the next refueling outage or the outage after that. In prioritizing these corrective

measures, the benefits of an improvement relative to its costs were considered, as well as the ease with which the improvement can be dovetailed with other modifications planned for the control room. The high benefit improvements include the correction of certain generic deficiencies.

The specifics of the corrective action program merits some discussion beyond that contained in Table V-1. This discussion follows.

A. Corrective Actions for Importance Category A Deficiencies

The Category A deficiencies are relatively few, and unique. Actions to correct or to mitigate such deficiencies have been assigned to Schedule Category 1 -- the first priority. It should be pointed out that it is not possible to make the final and most desirable fixes for all Category A items on this schedule. Where this is the case, some interim corrective action will be (or has been) taken on a top priority schedule, while the engineering and procurement activities, as appropriate for the final corrective action, go forward. The corrective actions for these deficiencies include:

1. Addition of frequency meters for diesel generators so that the quality of electric power to emergency busses can be effectively controlled during a loss of off-site power.

2. Coordinating the displays of the several reactor water level instruments, including these for the fuel zone, so that

   ° a common approach to reactor water density compensation is adopted

   ° the fuel zone instrument can be used effectively (to measure water separator pressure differential) during normal operations, to build operator confidence in this instrument

   ° the level instrument standpipe temperatures can be read out. The operators should be given clear instructions on when and how to correct the instrument readings for these temperatures, and at what temperatures and

indicated levels the instrument reading becomes invalid.

3. Providing a clearly identified instrument or set of instruments on which to read drywell temperature, as required for entry into the emergency operating procedures for containment control.

4. Providing a clearly identified instrument or set of instruments on which to read average torus water temperature, as required for entry into the emergency operating procedure for containment control.

5. Providing improved means (over the then-installed multipoint recorders) with which to read out variables such as torus water temperature and containment temperatures. A modification to replace plant recorders has corrected this deficiency. The new recorders are significantly more readable. In addition, digital readouts by means of which individual recorder points can be clearly read on a continuous basis, have been added.

6. Providing improved means for controlling the reactor water level after the core spray system has been called into operation. If the core spray system capacity exceeds the outflow from the leak which has caused it to operate, inflow must eventually be controlled, to match outflow. As the core spray logic was implemented at the time the review began, such control was extremely difficult; the operator would trip pumps off to limit level; then be unable to get them on again promptly, because of an anomaly in the pump control logic. This deficiency was corrected by a modification performed during the review. Human factors considerations led not only to more straight-forward control logic, but also to the provision of a complete and self-expanatory status display for this important system.

7. Several of the category A deficiencies are correctable by the addition of appropriate warning labels to the panel, or words to the appropriate procedure, or both:

- Instructions to warn against starting a core spray booster (i.e. topping) pump before a core spray pump is operating, and stopping a core spray pump before stopping any operating booster pump. Such operation could lead to damage of the booster pump.

- Instructions to warn against an incorrect sequence in lining up the suction valves for the core spray system. The sequence must be such that the core spray system, should it start, is not deprived of water.

- Labels, meterscales, or procedural visual aids to correlate the reading of the narrow range torus water level instruments (which read in inches of water referenced to normal water level) to the wide range torus water level instruments (which read in feet of water referenced to the bottom of the torus).

8. There are two Category A deficiencies for which administrative actions are appropriate (to establish the necessity and nature of further action, if any).

   - A test of in-plant communications when off-site power has been lost. The repeater which enhances the signal on the radio channel normally used for in-plant communications is powered from a non-vital power source. Transmission and reception of the emergency channel (which does not use a repeater) have not been tested at all locations at which this channel might be used.

   - A test to determine the maximum flow capacity of both control rod drive pumps operating together (these pumps are used for reactor makeup when off-site power is lost). The test must also determine a practical means for setting the flow, if it is less than that obtained with wide open discharge valves.

## B. Importance Category B Corrective Actions

Many of the deficiencies in Importance Category B can be fixed by a limited set of well-defined generic corrective actions. These generic corrective actions are tabulated in Table V-3. For each item of Table V-1 to

which a generic corrective action applies, a generic corrective action program number (e.g., G-1), based on Table V-3, is given. Many of the actions are relatively simple and straight forward -- they can be accomplished without major alterations to control panels. The relabeling and demarcation program, the meter scale improvements, replacement of lens caps, and removal of unused or unnecessary hardware are examples.

The degree of difficulty of the other generic corrective action programs varies. All require some change to panel hardware; the most substantial is probably the enhancement of information displays through the use of a plant computer. The plant computer facilities presently in use at Oyster Creek are very limited; the addition of a new computer represents a major change. Accordingly, corrective actions requiring an upgraded computer are in a lower schedular category than most of the other category B deficiencies. It should be noted that a computer upgrade is planned for Oyster Creek.

The major generic corrective actions for deficiencies in Importance Category B include:

1. Upgrading panel labeling and demarcation, coordinating this improvement with the new alarm system installed during the 1983 outage. Specifically, the demarcation and labeling program should include:

   ° improved headings and demarcation for control and display groups and subgroups

   ° upgraded label plates for individual controls and displays, to enhance readability and understandability

   ° information label plates, as appropriate, to provide limits, set points, cautions and other information currently provided by temporary means.

2. Providing displays, readable from any location at the main panel (1F/2F through 9XF and from the operators' desk) of the following:

   ° narrow and wide range reactor pressure

   ° reactor water level

- coolant temperature
- rate-of-change of coolant temperature
- reactor power (from neutron monitors)
- drywell pressure (narrow and wide range, as appropriate)
- rate of change (or trend) of drywell pressure
- drywell temperature
- torus water level
- torus water temperature

The purpose of this display is to promote effective display and control of key plant variables (including those required for entry into the emergency operating procedures) at any location at which they might be used, and, in particular, at the operator's desk.

3. Providing tactually different operating handles for the controls for valves, pumps, breakers and control mode selectors

4. Replacing missing or incorrect label plates

5. Replacing temporary operator aids with more permanent and approved operator aids

6. Generally upgrading panel appearance. For example: touching up chipped or scratched paint, refurbishing areas from which control hardware has previously been removed.

In addition to the generic corrective action programs, there are a number of Category B deficiences which require unique corrective actions. For example:

- Increasing the lighting level at the operators' desk to meet minimum illumination standards for reading

- Correcting turbine generator controls and displays that violate rules with respect to direction of motion -- meter indicators that go clockwise when controls are rotated counterclockwise, "raise" controls which require counterclockwise motion, etc.

Incorrect operation of these controls can lead to upsets.*

C. Importance Category C Items

Generally, deficiencies in Importance Category C describe situations that operators have demonstrated their ability to live with over the 15 years that Oyster Creek has operated. As stated before, in no case is a Category C deficiency likely to lead to an irreversible operator error or to affect plant safety. Some examples of category C deficiencies include:

- The lack of a humidity control in the control room (as a result, the room is said to be dry during winter months)
- Some local temperatures in the control room are higher than desirable (approaching 80°F). But operators do not need to spend a lot of time in these areas, and equipment life has generally been satisfactory.
- There is no consistent convention used in locating the "automatic" position of mode selector switches relative to the "manual" position. Operation of such switches is a deliberate action. Furthermore, an attempt to rotate the switches in the wrong direction will be resisted by the switch detent.

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* The most efficacious approach to correcting turbine controls may be to await the replacement of the present "EPR" pressure regulating governing system. This hardware is growing obsolescent; when it is replaced, the new controls will be sufficiently different to correct present deficiencies without risking errors from habits acquired with the present controls.

TABLE V-1

SUMMARY OF REVIEW FINDINGS

GROUP 1

FURTHER EVALUATION REQUIRED

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| Yarway and reactor protection level instruments are not density compensated causing unnecessary alarms if density-compensated recorder is used for control. | Evaluate removing density compensation from control level instruments. | 1 | A | 1 |
| Core region level instruments are not used. | Evaluate making core region instruments operational when pumps are running. | 1 | A | 1 |
| Need temperature indications for elevations in drywell, torus and H & V system. | Upgrade temperature instrumentation. | 1 | A | 1 |
| Synchroscope operates counter to Industry standard. | Evaluate making synchroscope rotate in standard direction. | 3 | B | 1 |
| The added facades may aggravate the problem of high temperature in the spaces behind panels. | Measure temperatures if facades are installed. Correct as necessary. | 3 | B | 1 |
| The differential pressure instrument currently provided for the containment spray system measures the difference between shellside and tubeside pressure and has no functional use. The emergency procedure calls for a shellside differential reading, which is only provided locally. | Evaluate use of present dp meter to display needed information. | 3 | B | 1 |
| Displays associated with Rod Worth Minimizer are distracting to operator. Rod Worth Minimizer displays and controls are not needed on front panel. | Consider relocating the electronics (Note that a few of the indicator lights are used and would remain). | 3 | C | 1 |
| Condensate return valve control lacks ability to equilibrate heat removed by condenser and decay heat from reactor. | Operators can work with present on-off control. Evaluate throttle control. | 3 | C | 1 |

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| Condensate demineralizers have limited capacity especially at high powers. | A fluid system modification is necessary to correct this problem fully. Individual "runout" alarms for feed pumps would help. Evaluate after completion of demineralizer mod now being made. | 2 | C | 1 |
| Operator is deprived of a rate-of-makeup indication as flow increases. | Evaluate reranging CRD flow meter. | 2 | C | 1 |
| Low power feedwater control requires full-time operator attention and results in thermal cycles to reactor vessel nozzle. | Evaluate a fluid system modification (addition of Main Feed Regulator Block Valves) to correct. | 3 | C | 1 |
| Excessive reach required to operate valve to control reactor level during startup. | Consider automatic control or improve location for manual control. | 3 | C | 1 |
| Need controls for diesel generator output breakers. | Analyze, not clear control is required. | 3 | C | 1 |
| Some controls are too sensitive. | Evaluate on a case basis. | 3 | C | 1 |
| Controls rotate opposite way expected. | Evaluate on a case basis. | 3 | C | 1 |
| Some variables values are not accurately measured by recorders. | Treat on a case basis. | 3 | C | 1 |

GROUP 2

RELABELING, DEMARCATING AND OTHER IMPROVEMENTS

NOT REQUIRING MODIFICATIONS

TO ELECTRICAL CIRCUITS

OR FLUID SYSTEM CONFIGURATION

(Including Mimicing of Existing Arrangements)

- CONTROLS/DISPLAYS
- METER SCALES (Bands, Setpoints, Limits)
- RECORDER SCALES
- LENS CAPS (Colors, Legends)
- NORMAL/OFF NORMAL STATUS
- SBM ESCUTCHEONS

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| No warning labels to prevent startup of 2nd stage (booster) core spray pump before 1st stage pump is on. | Add appropriate labels. (G1) | 1 | A | 2 |
| No ready means on either rod display or selector mimic to identify the group to which reach rod has been assigned. | Improved labeling and demarcation; including possible temporary group labe's should mitigate. (G1) | 2 | B | 2 |
| The rod display mimic is difficult to correlate because of the difference in shape from the rod select mimic. | Improved labeling and demarcation; including possible temporary group labels should mitigate. (G1) | 2 | B | 2 |
| Difficult to determine axes of symmetry; hard to make quick visual check of rod position. | Improved labeling and demarcation; including possible temporary group labels should mitigate. (G1) | 2 | B | 2 |
| Nomenclature for the locater - labels in the rod mimic for the SRM detectors and IRM detectors is obscure. | Improve labeling. (G1) | 2 | B | 2 |
| Indicator Lights for IRMs and APRMs are not clearly tied to specific channels. | Label and demarcate. (G1) | 2 | B | 2 |
| Labeling is not clear for key operated "rod out permissive" switch. | Relabel. (G1) | 2 | B | 2 |
| Status lights not clearly labeled. | Relabel. (G1) | 2 | B | 2 |
| Turbine steam flow recorder is mislabeled. | Relabel. | 2 | B | 2 |
| Reheat and extraction steam displays are hard to pick out on panel 7F. | Provide labeling and demarcation. (G1) | 2 | B | 2 |
| Controls for air ejectors and related equipment confusingly arranged. | Relabel. Rearrangement not recommended. (G1) | 2 | B | 2 |
| Gland seal displays hard to see among other indicators on 7F. | Relabel. (G1) | 2 | B | 2 |

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| Some level meters have confusing scale divisions. | Provide consistent and improved meter scales. (G2) | 2 | B | 2 |
| Control system water level signal recorder is calibrated in feet (versus inches for nearby meters). | Correct recorder scale. (G2) | 2 | B | 2 |
| Level set points for alarm or protective actions are not indicated on level meters themselves. | Provide appropriate red and green bands on level meters, or other set point display. (G4) | 2 | B | 2 |
| Core spray system labels lack clarity. | Relabel. (G1) | 2 | B | 2 |
| Status lights for EHRVs not accurately labeled. | Relabel. (G1) | 2 | B | 2 |
| Difficult to correlate electrical displays with controls on benchboard. | Provide new labeling and demarcation. (G1, G5?) | 2 | B | 2 |
| Some electrical displays and controls are mirror-imaged causing confusion. | Provide new labeling and demarcation. (G1, G5?) | 2 | B | 2 |
| Emergency service water controls and displays are confusingly labeled. | Relabel. (G1) | 2 | B | 2 |
| Arrangement and labeling of ventilation system controls is confusing. Mimic would help. | Relabel and consider incorporation of limited mimic. (G5) | 2 | B | 2 |
| Because of design modifications, many controls and displays are add-ons (such as recorder and meter scales). | Upgrade jury-rigged recorder and meter scales. (G2) | 2 | B | 2 |
| Controls for radioactive off-gas are obscurely labeled. | Relabel. (G1) | 2 | B | 2 |
| Dilution system controls obscurely labeled. | Relabel. (G1) | 2 | B | 2 |
| Chemical poison system pressure and flow meters are unlabeled. | Label. (G1) | 2 | B | 2 |

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| Chemical poison system indicator lights confusingly labeled. | Relabel. (G1) | 2 | B | 2 |
| Label plates of fire detection system difficult to read and interpret. | Relabel. (G1) | 2 | B | 2 |
| Nomenclature for fire protection system controls inconsistent and confusing. | Relabel. (G1) | 2 | B | 2 |
| No setpoints or limits are formally incorporated on Oyster Creek displays. | Add red and green range bands or setpoint/limits label plate. (G4) | 2 | B | 2 |
| Displays are rarely labeled with system headings. | Relabel. (G1) | 2 | B | 2 |
| Controls used under "off-normal" conditions are not distinctively labeled. | Relabel. (G1, G6) | 2 | B | 2 |
| Inadvertent actuation of wrong control has occurred. | Relabel. (G1) | 2 | B | 2 |
| Labels not easy to read - dirt, wear, letter size, etc. | Relabel. (G1) | 2 | B | 2 |
| The identifying component number is not engraved on most label plates. | Relabel. (G1) | 2 | B | 2 |
| Difficult to coordinate backboard displays with related benchboard controls. | Addition of demarcation lines, system overview labels, and better individual labels will correct this deficiency. (G1) | 2 | B | 2 |
| Displays on panel backboards have horizontal oriented progression, while related controls on adjacent benchboard have vertical progression. | Inconsistency does not appear to create significant operational difficulties; relabeling and demarcation should alleviate this problem. (G1) | 2 | B | 2 |
| Some meters have excessively fine scale graduations. | Correction of display meter scales is best handled on a case basis. (G2) | 2 | B | 2 |

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| Water level meters and recorder have inconsistent units and zero. | Correct scale units, use consistent zero for meters and recorder. | Corrected. | B | 2 |
| Meters do not have color bands nor limit markers. | Color bands should be added. (G4) | 2 | B | 2 |
| Several meters and recorders employ odd scale divisions or multipliers. | Correct odd scales. (G2) | 2 | B | 2 |
| "Reheat" and "Intercept" valve positions are displayed on common dual scale meters. The indicators are very confusing and should be color coded. | Color code label plate and meter pointers. | 2 | B | 2 |
| Some display scale graduations and unit labels are too small and difficult to read. | Scale graduations and labels should be improved, where practical. (G1, G2) | 2 | B | 2 |
| There are many instances where operators and technicians have hand-lettered meter scales. | Replace meter scales as necessary. (G2) | 2 | B | 2 |
| Labels not easy to read, letter size criteria not met. | Relabel. (G1) | 2 | B | 2 |
| Display labels are located below display, while control labels are above controls. | When displays are relabeled, labels should be moved above respective displays. (G1) | 2 | B | 2 |
| Information on detector which drives the display is seldom provided. | Provide information on new labels. (G1) | 2 | B | 2 |
| Descriptive labels for individual meters are confusing to read. | Relabel. (G1) | 2 | B | 2 |
| Control room displays do not have limits and setpoints in a clear, unambiguous manner. | Correct as part of general meter upgrading. (G4) | 2 | B | 2 |
| Yellow color code has various meanings. | Yellow indicators should be changed on a case basis to the color commonly used in the utility industry. (G6) | 2 | B | 2 |

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| AEOPs control display labels are not oriented horizontally. | Reorient. (G1) | Completed. | B | 2 |
| Recorder scales are often difficult to read. | Provide improved scales. (G2) | 2 | B | 2 |
| Recorders are supplied with temporary dynotape labels, one of which indicates the file number of the recording. The purpose of the other number is unknown. | Provide permanent label plates. (G1) | 2 | B | 2 |
| A number of recorder scales and variables are hand lettered. | Replace scales. (G2) | 2 | B | 2 |
| On a number of 2 pen recorders on panels 10F and 12XR, the color code of the recorder pens is not correlated with the label plate that identifies the variable. | Relabel with color coded plates. (G1) | 2 | B | 2 |
| Glare on benchboard label plates. | If label plates are replaced, low glare black-on-white plates should be used. (G1) | 2 | B | 2 |
| Pump and valve indicator lights are less than 10% brighter than their backgrounds. | Replace old and discolored lens caps. Evaluate solutions to light variability problem. | 2, 3 | B | 2 |
| Some controls have temporary labeling. | Relabel. (G1) | 2 | B | 2 |
| Temporary aids do not look professional. | Relabeling program should include the replacement of temporary operational aids. (G1) | 2 | B | 2 |
| The alarms which provide the first cue as to a condition requiring entry into the emergency operating procedure do not have unique identifications and/or locations. | Add unique identifiers for reactor and containment control emergency operating procedures to alarm panels, and elsewhere as appropriate. | 2 | B | 2 |
| Labeling of the alarms for drywell temperature high is inappropriate. | Relabel alarm tile. | 2 | B | 2 |

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| The alarm currently labeled "containment spray auto start disabled" is mislabeled. | Relabel. | 2 | B | 2 |
| The 3 indicator lights on the controllers for the 5 electromatic relief val es are labeled misleadingly. | Relabel. (G1) | 2 | B | 2 |
| The containment spray system control currently labeled "dynamic test" is misleadingly labeled. | Relabel. (G1) | 2 | B | 2 |
| It is not clear that the ammeters p vided for the containment spray system apply to the emergency service pumps and not to the containment spray pumps. | Relabel. (G1) | 2 | B | 2 |
| It is not clear that the flow-meters provided for the containment spray system are total containment spray flow and not emergency service water flow. | Relabel. (G1) | 2 | B | 2 |
| Drywell vent and purge controls are located on a back panel and arranged in a confusing way with inadequate labeling. | Relabel and demarcate. Consider rearranging to provide mimic. (G1, G5) | 2, 3 | B | 2 |
| Control switches for valves in cleanup system are confusingly arranged. | Relabeling will mitigate; mimicing should be evaluated. (G1) (G5) | 2, 3 | B, C | 2 |
| Controls on containment spray system are mirror-image. | Relabeling will reduce chance for error; control operations are deliberate. (G1, G5?) | 2 | B, C | 2 |
| The condenser backwash controls are mirror imaged. | Relabel, evaluate rearrangement and/or mimicing. (G1, G5) | 2, 3 | B, C | 2 |
| Electrical system displays not well grouped. | Labeling may mitigate. Consider selected rearrangements. (G1, G5?) | 2, 3 | B, C | 2 |
| A mimic would be useful in checking valve lineup (Condenser Backwash Controls). | Consider rearrangement or mimicing. (G5) | 3 | C | 2 |

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| No universal color code for "off-normal" condition. | Where "off-normal" status is operationally useful, employ yellow or amber color. (G6) | 3 | C | 2 |
| No indication of "normal" lineup of valves and other controls for ease of checking | No corective action recommended (problem has been lived with). | 4 | C | 2 |
| For certain angular positions, the needle of the GE circular electrical meters can obscure the number adjacent to the scale mark to which it is pointing. | Consider replacement of meter scales. (G7) | 4 | C | 2 |
| Differences in units exist between rate and integral displays for fluid system. | Improvements should be incorporated where practical. Additional labeling showing tank capacities will help. | 3, 4 | C | 2 |

GROUP 3

ADMINISTRATIVE

- MODIFY PROCEDURES (Provide visual aids)
- TRAINING
- MAINTENANCE PRACTICES
- HOUSEKEEPING
- TESTS

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| Single selectable CRD flow control valve has limited capacity. | No hardware change recommended at this time. Test of CRD system as makeup source is recommended. | 1 | A | 3 |
| No procedural guidance or test basis for setting maximum flow from CRD pumps. | No hardware change recommended at this time. Test of CRD system as makeup source is recommended. | 1 | A | 3 |
| Procedures are not heavily used in many off-normal evolutions. | Symptom oriented emergency procedures are being developed for OCNGS. | Complete | A | 3 |
| Need valve controls, suction pressure and total flow indication for CRD pumps. | Run CRD makeup test. Develop plan of modifications, if shown necessary by the test. | 1, 3 | A, Test<br>C, Hardware | 3 |
| Walkie-Talkie communications have not been fully tested when repeater power has been lost. | Perform test. | Complete | A | 3 |
| Not obvious which of the outputs of the 4 instruments measuring torus water temperature represents the bulk average torus water temperature needed for the containment control procedure. | Provide specific instructions. | 1 | A | 3 |
| Reactor operators appear to misinterpret the "failure to scram" entry condition to the reactor control procedure. | Training item. | 1 | A | 3 |
| The conditions for exiting the procedures are not explicitly defined and operators think they can exit from a specific second level procedure before they can exit from the procedures as a whole. | Training item. | 1 | A | 3 |
| Simultaneous implementation of the site Emergency Plan with the emergency operating procedures places an excessive burden on the shift superintendent. | Consider assigning direction of the emergency plan to the director of operations or his designate, who could be on call. | 1 | A | 3 |

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| The scale units and zeros on the newly-added wide range torus water level indicators are not consistent with those for the narrow range level indicators. Also, the wide range limits in the procedure are inconsistent with the narrow range limits. | * Provide dual scale information in procedure (short-term). | 1 | A | 3 |
| | * Provide dual scale information on meters and recorders. (G2) | 2 | B | |
| Appropriate warning regarding the consequences of lining up the core spray system valves needed in the procedure and on the control panel. | * Include appropriate warning in procedure and training. | 1 | A | 3 |
| | * Add appropriate warning labels. | 2 | B | |
| Speed/load changer switch works in opposite direction expected. | No action recommended because of risk if changed. Training allows operators to adapt. | Complete | B | 3 |
| Present emergency plan format is cumbersome to use. | Provide summary action level matrix. | 2 | B | 3 |
| Control room operators do not carry a pass key to control room. | Make keys available to operator. | 1 | B | 3 |
| A third control room operator is desirable. | On many shifts one is provided. Evaluate providing one on all shifts. | 2 | B | 3 |
| Lack of regular calibration program with some instruments. | Upgrade calibration program for nonsafety related equipment. | 2 | B | 3 |
| Chart paper is not correctly matched to scales on a number of recorders. | Provide better stock of recorder paper, appropriately indexed, and readily accessible to control room operators. | 1 | B | 3 |
| Filters were not in place at the fan suction. | Maintain filters in place. | 1 | B | 3 |
| Set of operating procedures on desk is worn and dirty. | Replace procedure binder and tabs. | 1 | B | 3 |

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| It is difficult to establish accurately the existence of power level above 2 percent if the actual power level is the order of 2-5 percent and the reactor operator uses the Average Power Range Monitor recorders to read power level. | Provide appropriate training for operators to use intermediate range instruments. | Complete | B | 3 |
| The operator has no instrument by which he can directly read the level reached when flooding the drywell. | Add appropriate instructions. Add instrument, if necessary. (Consider use of drywell pressure instrument and wide range torus water level instrument.) | 1, 3 | B | 3 |
| Emergency operating procedures must be stored in the control room. | Provide storage space in the control room. | 1 | B | 3 |
| Scrams may result if operator incorrectly switches IRM ranges. | Training compensates. | Complete | C | 3 |
| Off gas flow recorder on IRM not used because of lack of experience and knowledge. | Training item. | 1 | C | 3 |
| Generator power output meter is inaccurate. | Calibrate "nonsafety" instruments more frequently. | Complete | C | 3 |
| Changes in plant operating practice are not reflected in written procedures. | Revise written procedures to reflect present plant status and practice. | Complete | C | 3 |
| Some procedures have not been revised to reflect practices shown to be effective. | Revise written procedures to reflect present plant status and practice. | Complete | C | 3 |

GROUP 4

HARDWARE

- REMOVAL (Unused, non-functioning)
- REARRANGEMENT/RELOCATION (Meters, Switches, etc.)
- MODIFICATION (Control Logic, Interlocks, etc.)
- REPLACEMENT (Recorders, Switch Handles)
- ADDITION (Integrated-Consolidated Display, etc.)
- FLUID SYSTEM CHANGE

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| Operator is unable to confirm by meter reading the "triple-low" water level. | Display output in terms different from downcomer water level or correlate to other instruments. | 1 | A | 4 |
| Need displays of frequency for diesel generator. | Provide frequency displays. | 1 | A | 4 |
| Local drywell temperatures that are recorded and alarmed in the control room are the 5 temperatures at the five drywell coolers - near the bottom of the drywell. | Provide specific instruments (as necessary) and instructions on which drywell temperature should be used as an entry condition. | 1 | A | 4 |
| There are many differences among the various reactor water level instruments in terms of the process variables they respond to and their sensitivity to the drywell temperature. | Provide reference leg temperature measurements and clear instructions on how to use them to correct reactor water level measurement. | 1 | A | 4 |
| LPRM trend recorder is seldom used by operators. | Remove recorder. (G10) | 2 | B | 4 |
| Blank vertical meter on 4F backboard distracting. | Remove meter. (G10) | 2 | B | 4 |
| Order of instruments is not natural. | Interchange steam flow and condenser vacuum displays. | 2 | B | 4 |
| Steam pressure recorder not easily seen on control board. | Provide integrated easily viewed consolidated display. (G11) | 2 | B | 4 |
| Hard to view pressure recorder while using turbine bypass controls. | Provide consolidated display. (G11) | 2 | B | 4 |
| Lack of reactor coolant temperature information on Oyster Creek control board. | Provide consolidated display. (G11) Add satuation temperature to CRT. | 2 | B | 4 |
| Direction of motion of turbine control switches work the opposite way expected. | Modify switches. Consider change when replacing pressure regulator. | 4 | B | 4 |
| Circular meter pointers move opposite the motion of associated control switch. | Correct if control switches are modified. | 4 | B | 4 |
| Should be a protective cover on vacuum breaker control. | Provide protective collar. | 2 | B | 4 |
| Some controls are not used on generator section of control board. | Remove unused (or disconnected) controls (G10) | 2 | B | 4 |

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| Question usefulness of second MVAR meter. | Remove the "add-on" MVAR meter. (G10) | 2 | B | 4 |
| Water level indicators are not easily viewed from clean-up system letdown valve controls. | Add consolidated display. (G11) | 2 | B | 4 |
| No display or alarm for reactor building sumps or torus room sump in control room. | Consider adding appropriate alarms or displays in control room. | 2 | B | 4 |
| Reactor water level meters hard to read from 1F/2F where core spray controls are located. | Add consolidated display. (G11) | 2 | B | 4 |
| Arrangement of control switches for recirc. pump isolation and bypass valves confusing and not same as used elsewhere. | Modification to valve interlocks and control arrangement is planned for long term. | 2 | B | 4 |
| A complicated procedure required to bring cleanup system on line due to valve control logic. | Correct anomaly in isolation valve control logic. | 2 | B | 4 |
| Valve to operate recirculation valve is in high radiation zone. | Move valve operation switch to low radiation location or make system automatic as originally designed. | 3 | B | 4 |
| No information displayed for vital 480VAC motor control centers. | Provide improved status information on vital power. | 3 | B | 4 |
| Controls and displays for emergency diesel generators are confusingly arranged. | Rearrange (it may be necessary to operate controls under marginal lighting conditions). (G5) | 2, 3 | B | 4 |
| The raise-lower control for diesel generators works opposite way expected. | Consider rewiring control to make correct. | 3 | B | 4 |
| Few indications of status of vital low voltage (120VAC, 125 VDC) power distribution systems. | Improved status information on vital power was planned by modification. Some has been provided by alarm system changes. Provide missing status information. | 3 | B | 4 |

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| Newly added fire protection system controls haphazardly arranged (pond pump 2 and backup fire pump). | Rearrange. (G5) | 2 | B | 4 |
| Status lights for fire system jockey pump still remain, though unused. | Remove. (G10) | 2 | B | 4 |
| Need auto-manual transfer control of condenser hotwell control. | Provide transfer function in CR. | 3 | B | 4 |
| Many instances where displays needed to support operations in off normal situations are not conveniently located. | Handle on a case basis. | 2, 3 | B | 4 |
| Valve position indicators generally follow a convention of red for open (flowing) and green for closed (not flowing). Valve positions displayed on panel 10XF, however, use amber for the open positions. | • Change lens caps to appropriate color. (G8) | 2 | B | 4 |
| | • A change to the intensity of the indicator lamp may also be necessary. | 3 | B | 4 |
| Recorders are unreliable, hard to read, hard to maintain. | Replacement of some multipoint recorders is planned. Evaluate need for trend information on remaining recorders (both multipoint and 2-pen). Provide replacement recorders or other means of displaying trend information (e.g. computer trend) where required. (G3, G9) | 2, 3 | B | 4 |
| Handle is removed from the spare exciter field thermostat control on panel 8F/9F. | Remove this never-used device. (G10) | 2 | B | 4 |
| Control switch handles should be coded (size, shape, color). | Correct by coding (size. shape, color) switch handles. | 2 | B | 4 |
| Some controls are not adequately identified nor protected. | Replacement of switch handles with redundantly coded handles, e.g. shape and color, is recommended. | 2 | B | 4 |
| Progression of multiple displays is inconsistent with normal conventions (left to right progression). | Can usually be corrected by interchanging the location of a few displays. (G5) | 2 | B | 4 |

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| There is some chance of misreading the 2-pen, 2-scale recorders used throughout the control room. | Replace. (G3) New recorders should color code pens with labels, to facilitate identification of variables. | 3 | B | 4 |
| Design and operation of strip chart recorders is inadequate. | Replacement of some multipoint recorders is complete. Evaluate need for trend information on remaining recorders (both multipoint and 2-pen). Provide replacement recorders or other means of displaying trend information (e.g. computer trend) where required. (G3, G9) | 2 | B | 4 |
| Recorders are mechanically unreliable. | Replace recorders. | 2 | B | 4 |
| Selection of time scale and recorder speed often do not allow the rate of change information the operator needs to be inferred from the recording. | Replacement of some multipoint recorders is complete. . Evaluate need for trend information on remaining recorders (both multipoint and 2-pen). Provide replacement recorders or other means of displaying trend information (e.g. computer trend) where required. (G3, G9) | 2 | B | 4 |
| Panel components in poor condition. | Refurbish as required. | 1 | B | 4 |
| High drywell pressure must be confirmed by consulting a back panel indicator. | Locate narrow range drywell pressure indicator on front panel or incorporate in consolidated display. (G11) | 2 | B | 4 |
| Rate and direction of change of drywell pressure over a wide range must be read from a newly-added back panel recorder. | Add wide range drywell pressure recorder on front panel or incorporate rate of change information in consolidated display or on computer display. (G11, G9) | 2 | B | 4 |
| All the torus water level instruments utilize a common standpipe. | Investigate means for ensuring standpipe is full. | 2 | B | 4 |

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| The senior operator and the shift technical advisor have difficulty in visually collecting the data they need to execute their overseeing responsibilities. | Add consolidated display with EOP entry variables. (G11) | 2 | B | 4 |
| Operator must confirm the de-energization of the 8 scram solenoids by checking the 8 indicator lights on one of the back panels. In addition, burned out indicator light bulbs can lead operator to make a serious error. | Indicator lights should be put on front panel. | 2 | B | 4 |
| Control of the CRD pumps is lost if power to panel 4F is lost. | Being corrected as part of another modification. | 2 | B | 4 |
| Water pressure meters do not indicate presence or absence of water in water boxes. | A fluid system modification is necessary to ensure that water boxes are full. Remove present meters which are not useful. | 4 | C | 4 |
| Reactor pressure indicator is redundant to two heat exchanger pressure indicators. | Consider removing unnecessary pressure meter, or make scales consistent, or replace with consodliated display. (G10) | 2 | C | 4 |
| Controls for electrically operated relief valves (EMRVs) are illogically arranged. | Rearrange. (G5) | 2 | C | 4 |
| Display for condensate demineralizer dp is poorly located. | Relocate to 5F/6F. (G5) | 2 | C | 4 |
| Distracting extraneous power information is provided for many buses. | Evaluate need for meters, remove unnecessary meters. (G10) | 2 | C | 4 |
| Voltmeters are above ammeters for A & B batteries, below for C battery. | Rearrange. (G5) | 2 | C | 4 |
| Ground detecting indicator, voltmeters and ammeters inconsistent arrangement. | Rearrange. (G5) | 2 | C | 4 |
| Recorder displaying closed cooling water temperatures to reactor building machinery and turbine building machinery is confusingly labeled; temperature information is difficult to read; there are no CCW alarms. | Improve labeling. Recorder modification, (planned 1983 outage) may enhance readability of these variables. Long term: consider adding CCW alarms. (G3) | Completed | C | 4 |

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| Excessive reach to valve controls and test buttons (too high) on panel 11F. | Relocate. | 2 | C | 4 |
| Need containment purge and vent controls and displays on front panel. | Evaluated incorporating displays in integrated display. | 2 | C | 4 |
| ATWOS reactor recirculation pump trip displays/ controls are not needed on front panel. | Consider relocating. | 2 | C | 4 |
| Two-pen recorders fail as is and the absence of chart motion may not be immediately obvious. | On replacement 2-pen recorders, consider use of "power on" light. (G3) | 4 | C | 4 |
| Controls difficult to reach, (ATWOS and Steam line valve controls too high, others too low). | Consider relocation of steam line valve controls, for others, no corrective action recommended at this time. | 4 | C | 4 |
| Vacuum pump controls on panel 13R are opposite the normal left-to-right sequence. | Consider rearrangement, relabeling. (G5, G1) | 2 | C | 4 |
| Certain valve controls on panel 12XR are out of normal sequence. | Consider rearrangement, relabeling. (G5, G1) | 2 | C | 4 |
| Control for the 3 feedwater pumps are in a horizontal array, while the controls for the 3 condensate pumps that supply them are arranged vertically. | Consider rearrangement, relabeling. (G5, G1) | 2 | C | 4 |
| MSIV test Pushbuttons are hard to operate. | Relocation of these pushbuttons (to a lower location) may improve operability. (G5) | 4 | C | 4 |
| On panels 13R, left and right, test selection switches for the reheat stop valves and the selectors for the turbine bypass valves rotate through 360. | Consider switch replacement. | 3 | C | 4 |
| Inconsistent positioning of "auto" or "normal" of several switches. | No recommended actions since action is deliberate; consequences are minor and do not affect safety. | 4 | C | 4 |
| The fuel zone reactor level recorder is located several feet away from other reactor level displays. | Consider providing on consolidated level display or on computer driven CRT. (G11 or G9) | 2, 3 | C | 4 |

# GROUP 5

# COMPUTER SYSTEM ADDITION

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| Dispersion of controls and displays causes difficulty in obtaining coherent picture of state of torus and drywell variables. | Provide coordinated displays on plant computer CRT. (G9). | 3 | B | 5 |
| 2-pen recorders do not display trend information effectively. | Consider use of CRT display for needed trend. (G3, G9) | 3 | B | 5 |
| Important variables are displayed only on multipoint recorder, where they are difficult to read. | Provide selectable computer driven readouts for operators. (G9) | 3 | B | 5 |
| The recorders used to display the output of individual radiation monitors are unreadable. | Replace the recorders or display output on computer driven CRT. (G3, G9) | 3 | B | 5 |
| Operator cannot easily determine if change in flux is that expected for rod movement. | Provide feedback via Computer Driven Displays. (G9) | Completed | C | 5 |
| Perturbations in power demand arise that result in reactivity requirements outside the range foreseen in the night orders. | Provide feedback via Computer Driven Displays. (G9) | Completed | C | 5 |
| Reactor engineers may err, calculationally or typographically, formulating night orders. | Provide feedback via Computer Driven Displays. (G9) | Completed | C | 5 |
| Reactor operator may err, reading night orders and translating them into action. | Provide feedback via Computer Driven Displays. (G9) | Completed | C | 5 |
| No single reactor power level indication. | Display average neutron power on CRT. (G9) | 3 | C | 5 |
| Circ water flow, and other variables not available on front panels. | Display circ water temperature differential, pump current and steam flow on plant computer CRT. (G9) | 3 | C | 5 |
| Circulating water inlet temperature not displayed on front panel. | Provide on plant computer CRT display. (G9) | 3 | C | 5 |

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| The automatic control for two valves involved in hot well level is outside control room, no indication of valve position is displayed in control room. | No short term action recommended on control location. Provide valve position record on plant computer. (G9) | 3 | C | 5 |
| Conductivities displayed on recorders are difficult to read. | Display conductivities in plant computer driven CRT. (G9) | 3 | C | 5 |
| Voltage information is sparse - especially for the 480 buses. | Provide Bus Voltage display from plant computer. (G9) | 3 | C | 5 |
| Little temperature information for service water. | Display service water temperature on plant computer CRT. (G9) | 3 | C | 5 |
| No emergency service water temperatures are displayed. | Display ESW temperatures on plant computer, CRT. (G9) | 3 | C | 5 |
| Multi-point recorders for radiation monitors are unreadable. | Operators currently use output meters on panels 1 and 2R. Provide radiation monitor display on computer CRT. Remove recorders. (G9) | 3 | C | 5 |
| Outputs of instrument channels are displayed on meters outside operator's field of view. | Operators currently use output meters on panels 1 and 2R. Provide radiation monitor display on computer CRT. (G9) | 3 | C | 5 |
| Two-pen recorders for radiation monitors are unreliable and require frequent maintenance. | Replace 2-pen recorders or provide needed trend information on computer CRT or by other means. (G9) | 3 | C | 5 |
| Need condensate dump and vacuum drag valve positions, or flow rates. | Consider adding to computer CRT. | 3 | C | 5 |
| Need closed cooling water system temperature displays on front panel. | Provide on computer CRT. (G9) | 3 | C | 5 |
| Need displays for bearing, winding and water temperature for main generator, reactor recirculation pump and CRD on front panel (on demand). | Provide on computer CRT. (G9) | 3 | C | 5 |

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| Need radiation monitoring readouts on front panel (on demand). | Provide on computer CRT. (G9) | 3 | C | 5 |
| Need turbine information to monitor operation of machine on front panel (on demand). | Provide on computer CRT. (G9) | 3 | C | 5 |
| Some reactor recirculation pump electrical displays are not needed on front panel. | Remove from front panel, provide on CRT. (G9, G10) | 3 | C | 5 |
| Some auxiliary electric power displays are not needed on front panel. | Remove from front panel, provide on CRT. (G9, G10) | 3 | C | 5 |

GROUP 6

CONTROL ROOM ENVIRONMENT

- REFURBISH PANEL FRONTS (i.e., Painting, etc.)
- LIGHTING
- VENTILIATION
- NOISES
- ACCESS CONTROL
- REARRANGEMENT

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| Poor workmanship on newly installed fire system switches. | Refurbish. | 2 | B | 6 |
| Modifications are not consistent with original arrangement codes. | Refurbish modifications not professionally done. | 2 | B | 6 |
| Room is dusty and floor is gritty. | Clean ducts, maintain filters. If problem persists, provide dust removal in air intake. | 2 | B | 6 |
| Operators claim high background sound noise level. | Remove continuous air monitor from control room. Consider addition of carpet. | Completed | B | 6 |
| Poor condition of paint on console benchboard. | Repaint. | 1 | B | 6 |
| Paint on walls has deteriorated. | Repainting of room is planned. | 1 | B | 6 |
| Equipment operators and maintenance technicians sometimes interfere with the operators vision of control board. | A rearrangement of the desks in the control area is under consideration. Relocation of Blocking and Tagging to reduce this problem will be considered. | 3 | C | 6 |
| Location of GSS office inhibits an efficient overview function. | Relocate GSS office to room currently occupied by Prime Computer. | 4 | C | 6 |
| Some controls can be jarred by walking by. | Rearrange traffic pattern by relocation GSS office, Blocking and Tagging desk. | 3 | C | 6 |
| There is no means for adding or controlling humidity. | Evaluate installing reliable humidifier. | 3 | C | 6 |
| Air conditioning system is unreliable. | Install and maintain filters, clean ducts, maintain records. If records indicate compressors a problem, replace and upgrade system. Control Room habitability modification will correct. | 3 | C | 6 |

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| Hard to control traffic, noise and confusion in control room. | Relocate tagging operator's station. Relocate shift supervisor's office to control access. | 3 | C | 6 |
| Present location of GSS/GOS office is unable to prevent casual entry to control area by personnel who have no reason for being there. | Relocate GSS office to room currently occupied by Prime Computer. | 4 | C | 6 |

GROUP 7

NO ACTION REQUIRED OR

DEFICIENCY CORRECTED

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| Core spray valve controls cannot be used to throttle flow. | Modify controls. | Corrected | A | 7 |
| Interplay of breaker and auto start logic complicates the water level control operation on core spray. | Modify logic. | Corrected | A | 7 |
| Auto start logic train status incompletely displayed on alarm panel. | Modify status display. | Corrected | A | 7 |
| Effective confirmation of high drywell temperature and high torus temperature requires that replacement recorders be added. | Add replacement recorders, with selectable digital readouts of individual data points. | Completed | A | 7 |
| IRM and LPRM sensitivities are unable to meet requirements that APRM channels be on scale before entering "run" mode. | Corrected by GPUN Mod "Range 10 Addition". | Corrected | B | 7 |
| Transmissivity of annunciator tiles varies severely. | Annunciators are being replaced. | Completed | B | 7 |
| The conditional statements imposed on the operators appeared only once in the original version of the procedures and are not easily remembered. | Reformating of the procedures has corrected this. | Completed | B | 7 |
| The tables of valve lineups and other data tended to disrupt the information flow of the procedures. | Reformating of the procedures has corrected this. | Completed | B | 7 |
| Some operators have difficulty coping with logical branches (the "If....then" step of a procedure) deciding whether or not to proceed to the next step. | Reformating of the procedures has corrected this. | Completed | B | 7 |

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| There is some difficulty in allocating responsibilities to operators so that they control only one key variable at a time. | * A specific "division of labor" system has been worked out. | Completed | B | 7 |
| | * Procedures for the key variables have been organized by operator responsibility in color-coded, spiral binders which are stored in a 3-ring binder. | Completed | | |
| Inconsistent color codes used for the position displays and positions of air operated scram valves for each rod. | Operators have adapted; no action recommended. | --- | C | 7 |
| Difficult to determine on what channel output is displayed by pen recorder because of different IRM ranges. | Corrected by procedural guidance and training. | Completed | C | 7 |
| Isolation condenser control switch is on SF/AF instead of DF/CF. | Not a serious problem: no corrective action recommended. | --- | C | 7 |
| Operators have never used controls to control the condensate makeup and discharge valves manually. | No action required. | --- | C | 7 |
| Surplus of electrical displays could confuse operators. | No evidence of operator confusion. (GDO) | --- | C | 7 |
| Recirculation cleanup flow controller is never used in automatic mode. | No change recommended. | --- | C | 7 |
| Controls for turbine and reactor building closed cooling water pumps and discharge pressure displays are out of operator's normal field of view. | No corrective action necessary. Alarms alert operator to trouble. | --- | C | 7 |
| Undisplayed steam line radiation channels could lead to half or full scram. | Back panel indication is adequate. | --- | C | 7 |
| Service air compressor controls are not needed on front panel. | No action required. | --- | C | 7 |
| Electromagnetic noise problem with some nuclear instruments. | No corrective action recommended; not a safety problem. | --- | C | 7 |

| DEFICIENCY | DESCRIPTION OF CORRECTIVE ACTION | SCHEDULE CATEGORY | IMPORTANCE CATEGORY | CORRECTIVE ACTION GROUP |
|---|---|---|---|---|
| Neutron flux recorders for IRMs and APRMs have ranges difficult to use. | No action recommended. Training compensates. | --- | C | 7 |
| Inconsistency among scale units exists with temperature displays (C° and F°). | Operators have adapted. | --- | C | 7 |
| The highest temperatures are foundbar access-ways, but no cross-ventilation provided. | No action at this time. When air conditioning runs, temperatures O.K. | --- | C | 7 |
| The exhaust opening is much smaller than the intake opening causing increased air pressure. | No action recommended. | --- | C | 7 |

TABLE V-2

GROUP CLASSIFICATIONS ACCORDING TO
NATURE OF CORRECTIVE ACTION

Table V-2

GROUP CLASSIFICATIONS ACCORDING TO NATURE OF CORRECTIVE ACTION

| GROUP | ACTION |
|---|---|
| 1 | FURTHER EVALUATION REQUIRED |
| 2 | RELABELING, DEMARCATING AND OTHER IMPROVEMENTS NOT REQUIRING MODIFICATIONS TO ELECTRICAL CIRCUITS OR FLUID SYSTEM CONFIGURATION (Including Mimicing of Existing Arrangements)<br>° CONTROLS/DISPLAYS<br>° METER SCALES (Bands, Setpoints, Limits)<br>° RECORDER SCALES<br>° LENS CAPS (Colors, Legends)<br>° NORMAL/OFF NORMAL STATUS<br>° SBM ESCUTCHEONS |
| 3 | ADMINISTRATIVE<br>° MODIFY PROCEDURES (Provide visual aids)<br>° TRAINING<br>° MAINTENANCE PRACTICES<br>° HOUSEKEEPING<br>° TESTS |
| 4 | HARDWARE<br>° REMOVAL (Unused, Non-functioning)<br>° REARRANGEMENT/RELOCATION (Meters, Switches, etc.)<br>° MODIFICATION (Control Logic, Interlocks, etc.)<br>° REPLACEMENT (Recorders, Switch Handles)<br>° ADDITION (Integrated-Consolidated Display, etc.)<br>° FLUID SYSTEM CHANGE |
| 5 | COMPUTER SYSTEM ADDITION |
| 6 | CONTROL ROOM ENVIRONMENT<br>° REFURBISH PANEL FRONTS (i.e. Painting, etc.)<br>° LIGHTING<br>° VENTILATION<br>° NOISE<br>° ACCESS CONTROL<br>° REARRANGEMENT |
| 7 | NO ACTION REQUIRED OR DEFICIENCY CORRECTED |

## TABLE V-3

## GENERIC HARDWARE CORRECTIVE ACTION PROGRAMS

Table V-3

GENERIC HARDWARE CORRECTIVE ACTION PROGRAMS

| Number | Action |
|---|---|
| G1 | Relabel and demarcate using group heading label plates where applicable (includes reference information label plates). |
| G2 | Replace meter scales where they are deficient (multipliers, progression, readability, resolution). |
| G3 | Replace recorders. |
| G4 | Add red and green range bands to meters (or setpoint/limits label plates). |
| G5 | Rearrange and/or add mimic (controls and/or displays). |
| G6 | Indicate normal (or, off-normal, if appropriate) operating position or status (i.e. valve line-up, switch position). |
| G7 | Replace selected switch escutcheons with relabeled escutcheons. |
| G8 | Replace lens caps on indicator lights. |
| G9 | Enhance information display by upgrading plant computer. |
| G10 | Remove unused, inoperative, or unnecessary hardware. |
| G11 | Add a consolidated display of key reactor and containment variables. |