SEC 4

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

MAR 31 1980

MEMORANDUM FOR: Chairman Ahearne
Commissioner Gilinsky
Commissioner Kennedy
Commissioner Hendrie
Commissioner Bradford

FROM: Harold R. Denton, Director
Office of Nuclear Reactor Regulation

(Signed) William J. Dircks

THRU: William J. Dircks, Acting Executive
Director for Operations

SUBJECT: CONSIDERATION OF OL FOR NORTH ANNA 2

Since the issuance of the Supplemental Safety Evaluation Report for North Anna Power Station, we have completed our review of the control room, and have documented our evaluation in Enclosure 1.

Our March 26, 1980 transmittal stated that the control room deficiencies would be sorted into two categories:

Category 1: Deficiencies which can and should be corrected immediately; and,

Category 2: Deficiencies to be corrected at a later date.

As described in Enclosure 1 we intend to require that six Category 1 items (as described in the Enclosure) be completed prior to operation in Mode 2. We also intend to require that eleven Category 2 items (as listed in the Enclosure) be completed prior to operation above 5% of rated power.

We were informed by letter from Vepco dated March 27, 1980 of a significant change in the organization of North Anna. We are reviewing that submittal for consistency with our discussion and conclusions of the Section I.B.1.1 of the SSER, Part II. This modification conforms to the criteria of our draft guidelines.

We have also recently received a proposed organization for the Safety Engineering Group (refer to our SSER, Part II, Section I.B.1.2). Vepco proposes an on-site Safety Engineering Group which blends the function of the STAs. Specifically the group consists of seven engineers, four of whom are STAs. During the routine Monday-through-Friday day shift it is expected that the on-site staffing would be comprised of either four or five engineers. (All of the STAs have both college degrees and plant experience; two would be on the off shifts). The technical disciplines represented include electrical, operations, mechanical, radiation protection, and nuclear (with some overlap by one person covering more than one of these disciplines). This on-site organization facet is considered acceptable.

We have reevaluated our requirements regarding two unit shift manning. Based on our reevaluation, we have determined that Vepco's operating organization is acceptable for full power operation of Unit 1 and operation of Unit 2 in operating modes five and six.

For full power operation of Unit 1 and operation of Unit 2 at power levels not exceeding 5 percent power, we will require two senior reactor operators qualified on both Units 1 and 2, three reactor operators, at least one of whom must be licensed on each unit and one of whom must be licensed on both units.

We have informed Vepco of our requirements on the control room and on shift manning for licensed operators.

Harold R. Denton, Director
Office of Nuclear Reactor Regulation

Enclosure:
Control Room Design Review

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ENCLOSURE

Control Room Design Review

As a part of the staff actions following the TMI-2 accident, we will require that all licensees and applicants for operating licenses conduct a detailed control room design review. We expect those reviews to be initiated within the next several months and require over a year to complete. As an interim measure, VEPCO was required to perform a preliminary design assessment of the of Unit 2 control room to identify significant human factors deficiencies and instrumentation problems. Our contractor, the Essex Corporation, audited the VEPCO assessment and concluded that, while the VEPCO study uncovered some problem areas, many others were overlooked.

To better establish the acceptability of the North Anna Unit 2 control room design, the NRC staff, together with our consultants, conducted a 5 day on-site review of the Unit 2 control room. NRC staff members participating in the review included instrumentation and control, operator licensing, and reactor systems engineers. The review included the assessment of control and display panel layout, annunicator design, labeling of panel components, and the usability and completeness of selected emergency procedures. The review was performed by means of detailed inspection of the control panels, interviews with operators, and observation and videotaping of operators as they walked through selected emergency procedures.

Our review identified numerous human factors deficiencies. In general, the control room was not designed to promote effective and efficient operator action. We found that control devices and associated parameter displays were not grouped together in a logical fashion and that meters and recorders were difficult to read. The annunicator system was not designed to promote early operator recognition of abnormal conditions. The noise level in the control room was so high that communication

between operators was difficult. Procedures which are well written and clearly understood by the operator can compensate for many of the control room deficiencies we identified. However, we judged the procedures at North Anna Unit 2 to be in need of some revisions. Further, the operators' knowledge of these procedures needed considerable improvement. Finally, we noted a number of deficiencies, which by themselves are minor, but which we believe indicate a need for better attention to detail by the management at North Anna.

Deficiencies Identified During the Control Room Review

Significant human factors related control room design deficiencies identified by the review team were:

1. Control-Display and General Control Room Organization - controls and displays have poor functional grouping, and appeared to confuse the operator while he demonstrated the use of emergency procedures for the review team. In many cases, displays are not located near the controls with which they are associated.

   Most of the safety related system controls and indicators are located on vertical panels behind the main control console. Some of these are not visible to the operator normally stationed at the console.

2. Meter Displays - vertical meters, used extensively on the vertical panels behind the main control console, are difficult to locate and read by the operator at the console because identical meters are mounted together in strings or clusters of five or more. In addition, an inconsistency in the numerical coding on labels for controls and associated meters impedes quick location and identification.

3. Annunicators - there is no indication of priority or significance of a particular annunicator. Safety and non-safety alarms are intermingled throughout the annunicator panel and are characterized by display windows of the same size and color. Operators must visually search the annunicator panels for the priority alarms.

   Further, when an alarm condition is cleared the alarm display window extinguishes without provicing the operator with an audible indication.

4. Control Room Noise Level - the control room is fairly compact which, by itself, should enhance communications. However, a ventilation duct which exhausts battery room air into one end of the Unit 2 control room generates continuous high level noise. To this is added high level periodic announcements over the public address system. The speaker for the PA system is mounted in the ceiling directly over the control console. Therefore, communication is difficult and essential messages could easily go unheard or be misinterpreted.

5. Safety Injection System Status Monitoring - there is no system level indication of safety injection system status. In addition, no system level indication is available to the operator to verify normal S.I. operation after automatic initiation. In both cases, status information is obtained by visually checking displays, none of which are located on the main control console.

6. Core Cooling Monitors - Redundant core cooling monitors which indicate subcooling margin have meter displays which are installed on the vertical panels behind the main control console. The meter readings are subject to error due to significant parallex problems. In addition, the scale on the meters cannot be read from the operator's normal position in front of the main control console.

For precise readings, the operators we consulted indicated that they rely on digital outputs displayed on the front of these same monitors which are located at one end of the control room and are accessible only through the use of a ladder.

7. Strip Chart Recorders - we found that on some strip chart recorders, pen positions and trend lines were obscured; some charts lacked labeling and pen labeling; others were installed a few feet off the floor making reading and interpretation of information very difficult; and other had scale increments which were inconsistent with increments on the chart paper.

8. Lamp Test - most illuminated displays cannot be tested for burned out lamps.

9. Procedures - abnormal procedures are not tabbed for easy and quick identification and access by operators. Other significant deficiencies relating to procedures in general are: operator action steps are contained within other steps, general notes, warnings, and cautionary statements; some instructions are vague, ambiguous, and contained in extremely long sentences; some instructions require overly precise control settings beyond the capability of the operator and the controller; little feedback information is provided to the operator with regard to system response to operator actions taken; and procedural steps have been overlooked or omitted. We observed that at least one abnormal procedure could not be performed to completion by an operator because the instructions were not sufficiently clear. Emergency and abnormal procedures have not been verified by walkthroughs on the Unit 2 control panel by a full complement of operators.

10. Violation of Design Conventions - some design conventions established by the applicant which were violated include: switch positions for open-close, off-on, lower-raise; indicators which are arranged in a C-B-A order contrary to stereotypical and plant convention; and plant color conventions where the color "red" had several meanings.

11. Process Computer - the process computer system does not provide a cross referencing index system which would enable easy and quick operator access to important sensor information.

    In addition, there is no formal procedure for logging or documenting computer alarm setpoints which may be changed from time to time by operators or programmers.

12. Process Controller - some Hagan process controllers do not give the operator positive indication of valve operation, but only indicate that the initiating or control signal has been transmitted. In addition, the operation of certain Hagan controllers violate sterotype and convention where the control is increased to cause a decrease in the controlled parameter.

13. General Maintenance - a lack of general maintenance of the control room was exhibited by: use of paper with the wrong scale in at least one recorder; ink and pen colors differing in at least two recorders; incorrect labeling on the main control panel; several non-operating lamps in the emergency lighting system; a vertical meter with no function identification but with a penciled in scale; an air pack (breathing apparatus) which was not functioning properly; lamps in several displays not operating; and step ladders and other maintenance equipment obstructing passage around the control room.

14. Labeling - some print on labels have poor contrast with background. In other cases, label coding nomenclature is not consistent with or related to asociated control identification.

15. Protective Equipment - the number of air packs available in the control room is not sufficient to accomodate the minimum number of operators. The time necessary to don the air pack (breathing apparatus) was unusually long. Protective clothing for operators in the control room is not provided. Communications between operators wearing air packs was extremely limited.

16. Exposed Controls - the applicant has provided protection for certain exposed controls in high traffic areas, however, there are several other switches and controls in these areas which also should be protected against inadvertent actuation.

17. Number of Personnel in the Control Room - large numbers of personnel were observed in the control room in and around primary operating areas during the day shift operation.

18. Emergency Lighting - a requested demonstration of emergency lighting in the control room was not accomplished; however, emergency lights were turned on while normal lighting was maintained. We observed that some emergency lamps did not illuminate.

19. Emergency Operations - walkthroughs of emergency procedures by control room operators indicated that, at times, it was necessary to monitor and control systems from up to four different stations in the control room.

Corrective Actions

We believe that many of the deficiencies identified could cause the operator to take erroneous actions under stressful conditions. These actions could initiate a transient or could exacerbate his response to an abnormal event already underway. Therefore, we have concluded that sufficient corrective actions must be taken prior to operation at power to substantially reduce the likelihood of operator error. While several of these actions can and should be made as soon as possible, we believe that the implementation of most of the corrective measures need not occur until the applicant is prepared to escalate power beyond five percent. Specifically, we will require that the following corrective actions be implemented prior to Mode 2 operation (operation at critical):

- o Significantly improve labeling and instrumentation and control demarcation.
- o Color code annunicator windows as an aid in identifying high priority alarms.
- o Review, and improve where necessary administrative controls used to ensure proper safety injection status.
- o Correct problems associated with general maintenance and implement measures to prevent their recurrence.
- o Institute controls to limit control room access.
- o Test the adequacy of emergency lighting.

Prior to operation above 5% of rated power the following actions must be taken:

- o Correct the control room noise problem.
- o Improve operator accessibility to Core Cooling Monitor displays.
- o Correct deficiencies associated with the strip chart recorders. Commit to purchasing and installing as soon as possible, data recording and logging equipment in the control room.

- o Install equipment for testing lamps on safeguards panels and establish a mechanism for testing other lamps important to safety.
- o Review all emergency and abnormal operating procedures and correct deficiencies. Perform sufficient procedure walkthroughs to ensure that all operators are familiar with and understand these procedures.
- o Correct violations of design convention.
- o Correct deficiencies in operator procedures for utilizing plant computer outputs.
- o Correct operational problems associated with the Hagan controllers.
- o Procure sufficient emergency air packs to supply all operators required to be in the control room during emergencies. Ensure that sufficient replacement air is available when needed. Train all operators to use the air packs.
- o Install sufficient protective guards to prevent inadvertent operation of J-handle switches located in the control room.
- o Assess control room staffing requirements during emergency operation.

The Staff will review all changes to be made by VEPCO prior to escalation above 5% powe

These corrective actions, when implemented, will serve to substantially improve operato effectiveness during emergencies. However, we believe that, in the longer term, other control room modifications should be made. For example, some rearrangement of controls and displays are needed and annunicator and status monitoring systems should be upgrade To ensure that these additional modifications are made in the most efficient and effect manner, we will not require their implementation until VEPCO has completed the detailed control room design review to be required of all operating reactor licensees. We presently expect that this review will be completed and most corrective actions implemented early in 1982.