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January 31, 1985

Director
Office of Nuclear Reactor Regulation
US Nuclear Regulatory Commission
Washington, DC 20555

Prairie Island Nuclear Generating Plant
Docket No. 50-282 License No. DPR-42
Docket No. 50-306 License No. DPR-60

Detailed Control Room Design Review Status Report
and Response to March 1984 In-Progress Audit

The purpose of this letter is to provide, for the information of the NRC Staff, information related to the detailed control room design review now in progress at the Prairie Island Nuclear Generating Plant. We committed to submit this report in our letter dated November 29, 1984.

The following information is provided:

Appendix A - Detailed response to concerns, recommendations, and information needs identified in the in-progress audit report issued by the NRC Staff on July 17, 1984.

Appendix B - Summary of progress since the NRC in-progress audit.

Appendix C - Description of control panel modifications planned to be completed during the 1985 Unit 1 and Unit 2 refueling outages.

Please contact us if you have any questions related to the information we have provided.

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cc: Regional Administrator-III, NRC
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G Charnoff

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Attach.

Appendix A
In-progress Audit Report Concerns/Recommendations Response

Concerns:

1. Insufficient time may have been allotted for assessment of Human Engineering Discrepancies and selection of design improvements prior to submission of the Summary Reports.

   Response: NSP agrees with this concern and has requested an extension for submittal of the summary report.

2. Existing convention specifications, identified during the control room surveys, should be checked for agreement with NUREG-0700 guidelines.

   Response: NSP agrees with this concern. An evaluation of design conventions specifications against NUREG 0700 guidelines was performed. Appendix A1 is a report describing the evaluation.

Recommendations:

1. Expand use of computers to allow tracking of HEDs from identification through implementation of corrective actions.

   Response: Data base management tools for consolidating the HED data base have been investigated. An IBM PC XT utilizing dBase II has been selected as the best option for a computer based data management. This approach gives the capability to sort HEDs by NUREG 0700 item number, component checklist item number, component identification number, and control panel identification. The management system will also be used to track HEDs from the point of identification through assessment and final implementation of design corrections.

2. Develop a full-scale control room mock-up at Monticello.

   Response: Not applicable to Prairie Island DCRDR.

3,4 and 5

3. Use the control room mock-up(s) to assess the integrated effect of the fullest range of design improvements and enhancements possible (to include labeling and demarcation).

4. Continue to assure participation of an adequate mix of personnel (including operators and human factors professionals) throughout assessment of HEDs and the development and evaluation of design improvements.

5. Coordinate modifications to the control rooms and simulators in a way that will enhance, not degrade, operator performance.

Response: Figure A-1 is a description of the process used for the Prairie Island design improvements. A summary for the design improvement recommendations methodology is:

1. Prepare preliminary concept design for retrofit of existing design or new design effort.
2. Evaluate resolution of HEDs pertaining to old design.
3. Implement design concept on mockup to correct scale.
4. Conduct preliminary design review:
   - o Human factors
   - o CRDR Committee
5. Perform NUREG 0700 checklist and/or survey review of revised design.
6. Conduct walk-through talk-through of EOPs related to revised design.
7. Assess safety consequences of new design.
8. Conduct final design review:
   - o Operating staff
   - o CRDR Committee
9. Obtain final design and budgeting approval.

The described process assures that:

1. The mock-up is used to assess the integrated effect of the design improvements and enhancements.
2. An adequate mix of personnel (including operator and human factors professionals) is used throughout the development and evaluation process.
3. Modifications to the control rooms and simulator are coordinated.
4. New HED's are not introduced.

6. Include human factors review of the remote shutdown panel, any control room modification or additions made as a result of post-TMI actions, as well as lessons learned from operating reactor events.

Response: Northern States Power Company's Administrative Work Instructions for the Uniform Modification Process provides for human factors design inputs and review. Specifically N1AWI:

1. 5.1.3 Design Inputs Sections 6.4.6 requires Human Factors engineering considerations as essential when making changes in the control room and important when making changes in the plant.
2. 5.1.12 Modification Review Package Preparation, Review, and Approval Figure 3, Section 4 requires Human Factors review by a control room design review committee if the modification requires installation of equipment in the control room.

The remote shutdown panel was thoroughly reviewed under EPRI contract RP3014 and design changes (including Appendix R required instrumentation upgrade) for it have been implemented.

Information Needs:

1. An outline of proposed control room changes.

2. An outline of proposed schedules for implementation.

3. Justifications for leaving safety significant HEDs uncorrected or partially corrected.

   Response: These items will be reported in summary report.

4. Additional documentation of the systems function and task analyses.

   Response: The Westinghouse Owner's Group and NRC Staff have agreed on the approach taken by the owners group to satisfy the Systems Review and Task Analysis requirements of Supplement 1 to NUREG 0737. Appendix A3 is a report describing the Prairie Island approach to System Review and Task Analysis

5. Use of mirror imaging. The audit team observed the use of mirror-imaging between Units 1 and 2 control rooms. This is believed to be critical as the mirror-imaging used presents reversed arrangements of components within a panel segment. This can be a considerable problem for the operator who moves from Unit 1 to Unit 2. NSP indicated that the control room survey will include a study to identify these instances with an assessment of how to best correct the problem. The audit team members determined that NSP will conduct further survey activities to resolve their concerns.

   Response: A study has been performed to verify the degree of mirror-imaging design in the Prairie Island 2 unit control room. Appendix A3 is a report describing the study and conclusion reached.

Appendix A1

EVALUATION OF DESIGN CONVENTIONS SPECIFICATIONS AGAINST NUREG 0700 GUIDELINES

INTRODUCTION

This report documents the review of Northern States Power Company's current design requirements and conventions for the Prairie Island Nuclear Generating Plant. The review was conducted in response to a concern identified during the In-Progress Audit of the Detailed Control Room Design Review.

Existing convention specifications for PINGP identified during the control room surveys are described in the report entitled Human Engineering Design Requirements and Conventions Regarding Component Design, Labeling, and Abbreviations, August 1984. To address the NRC concern, the contents of this report were evaluated for compliance with items in the NUREG 0700 guidelines.

The remainder of this report presents the approach followed in conducting the review, the results of the review, and a discussion of the discrepancies.

APPROACH

All the checklist items in Section 6 of NUREG 0700 were checked for agreement with the corresponding design requirements and conventions contained in the specifications document. A copy of Section 6 was used to perform the check and record the results. The annotated copy is included in Appendix A.

Although the entire contents of Section 6 were included in the review to ensure comprehensiveness, many of the guidelines address topics that are outside the scope of the PINGP design requirements and conventions. When this is the case, a checkmark was placed in the "N/A" column of the Section 6 compliance checklist, and the comment "Outside scope of convention specification" was entered in the "Reference/Comment" column.

For NUREG 0700 Section 6 items that are in agreement with PINGP conventions specifications, a checkmark was placed in the "Yes" column of the Section 6 compliance checklist. A figure number was also entered in the "Reference/Comment" column. This figure number refers to a figure in the Human Engineering Design Requirements and Conventions Regarding Component Design, Labeling, and Abbreviations.

For NUREG 0700 Section 6 items that are not in agreement with conventions specifications, a checkmark was placed in the "No" column of the compliance checklist. All such items are described in the "Results" section below.

RESULTS

All the NUREG 0700 Section 6 items that do not fully agree with PINGP design requirements and conventions are listed below. A description of the existing design specification is provided for comparison. Finally, any rationale for the existing design specification at PINGP is discussed.

[1]
GUIDELINE: 6.3.3.5.d(3) Numeral width-to-height ratio should be 3:5.

CONVENTION: Numerals are treated in the same manner as alphabetic characters with a recommended width-to-height ratio between 1:1 and 3:5.

RATIONALE: NUREG 0700 recommends an uncondensed sans-serif font like helvetica for label characters--letters and numerals. The numeral "1" is less wide than the other numerals in this font type, but all numerals should retain a standard block size (including blank space in front of the "1") so that numerals line up from row to row.

[2]
GUIDELINE: 6.4.2.1 To minimize operator error, control movements should conform to the following population stereotypes:
On, start, run, open functions for up, right, forward, clockwise, pull control actions; off, stop, close functions for down, left, backward, counterclockwise, push control actions.

CONVENTION: "TRIP" is to the left (counterclockwise) and "CLOSE" is to the right (clockwise) on breaker switches--with disagreement indicator, without disagreement indicator, and with second trip coil.

RATIONALE: This arrangement is logical for breaker switches since a closed breaker means an energized circuit and a tripped breaker means a deenergized circuit.

[3]
GUIDELINE: 6.4.4.5.d (1)(a) Positive indication should be provided. Desirable alternatives are: (a) illuminated indicator lights.

CONVENTION: Indicator lights are not used for positive indication of rotary selector controls.

RATIONALE: The NUTAC Control Room Design Review Survey Development Guideline maintains that this guideline is a suggested method for meeting a very general principle (Appendix B, p. B-12). The method indicated is not the only way to provide acceptable positive indication of rotary selector control position. Control handle orientation is used at PINGP for positive position indication.

[4]
GUIDELINE: 6.4.4.5.d(1)(b) Position indication should be provided. Desirable alternatives are: (b) a line engraved both on the top of the knob and down the side.

CONVENTION: A colored dot is provided on the top of thumbswitches to line up with a labeled, black engraved line for positive indication of control position.

RATIONALE: Same rationale as for Item 3.

[5]
GUIDELINE: 6.4.5.1.d(2)(b) Discrete thumbwheel controls should conform to the following specifications: (b) trough distance--minimum 0.45 in., maximum 0.75 in.

CONVENTION: Trough distance is 1 1/8 in.

RATIONALE: Thumbwheel controls at PINGP are slightly difference than those described in NUREG 0700. They are intended to be grasped by the entire hand, and consequently, trough distance dimension is larger to provide a better grip with the fingers.

[6]
GUIDELINE: 6.5.1.3.c(1) Visual displays should normally contain black markings on a white background.

CONVENTION: All labels in the control room except the control board panels system identifiers are specified to be black characters on white background with one exception--adhesive-backed white vinyl lettering on the black annunciator bezel for identification of annunciator row and column coordinates.

RATIONALE: Black is an effective background for annunciator panels so that tiles that are illuminated have good contrast. White labels for the coordinates are the best choice against the black background.

[7]
GUIDELINE: 6.5.1.3.d(3) Numeral width-to-height ratios should be 3:5.

CONVENTION: See Item 1 above.

RATIONALE: See Item 1 above. This guideline is redundant with NUREG 0700 guideline 6.3.3.5.d(3).

[8]
GUIDELINE: 6.5.1.6.c(2) Red, green, and amber (yellow) should be reserved for the following uses: red: unsafe, danger; green, safe.

CONVENTION: Red lights indicate breaker closed or pump running which are normal operating conditions. Green indicates breaker open or pump stopped.

RATIONALE: Utility power industry conventions for red and green usage are followed at PINGP.

[9]
GUIDELINE: 6.5.3.1.c(1) System/equipment status should be inferred by illuminating indicators, and never by the absence of illumination.

CONVENTION: Absence of illumination of amber light indicates "motor start not recommended" on certain motor control switches.

RATIONALE: Present use convention is not best design practice.

[10]
GUIDELINE: 6.6.2.1.a Labels should be placed above the panel element(s) they describe.

CONVENTION: Labels are consistently placed below the indicators to which they refer, and above the controls to which they refer with one exception: controllers have their label below the indicator and control.

RATIONALE: The NUTAC Control Room Design Review Survey Development Guideline recommends that labels be placed consistently above or below the labeled item because this meets the intent of preventing confusion in labeling of adjacent items (Appendix H, p. H-1).

[11]
GUIDELINE: 6.6.2.4.c Controls--Labels should be visible to the operator during control actuation.

CONVENTION: Labels for controllers with a setpoint scale and auto/manual switch are difficult to see when actuating the controls.

RATIONALE: The number being set on the setpoint scale is visible at the top, above the operator's hand, even though the other numbers on the dial may be obscured. The convention for the "auto" setting being down on certain "auto/manual" switches reduces the seriousness of obscuring the "auto" label.

[12]
GUIDELINE: 6.6.3.8.a Position--All discrete functional control positions should be identified.

CONVENTION: Center, spring-return positions on certain T-handle controls are not labeled.

RATIONALE: The condition of controls set to the center, spring-return position is inferred to be "automatic." Labeled indication of this state has been considered unnecessary.

[13]
GUIDELINE: 6.6.4.1.b(1) To ensure adequate contrast and prevent loss of readability because of dirt, dark characters should be provided on a light background.

CONVENTION: See Item 6 above.

RATIONALE: See Item 6 above. This guideline is redundant with NUREG 0700 item 6.5.1.3.c(1).

[14]
GUIDELINE: 6.6.4.2.b(2) Numeral width-to-height ratio should be 3:5 except for the number "4" which should be one stroke width wider and the number "1" which should be one stroke in width.

CONVENTION: See item 1 above.

RATIONALE: See item 1 above. This NUREG 0700 guideline is inconsistent with items 6.3.3.5.d(3) and 6.5.1.3.d(3).

Appendix A2
System Review and Task Analysis

Background

On March 29, 1984 NRC staff representatives met with representatives of the Westinghouse Owners Group (WOG) Procedures Subcommittee to discuss the task analysis requirements of Supplement 1 to NUREG-0737. The purpose of the meeting was to discuss 1) how operator information and control needs had been addressed by the Emergency Response Guideline (ERG) development effort, and 2) for the NRC staff to identify any additional analysis or documentation needed for review.

At the March 29 meeting, the WOG representatives described to the NRC how the operators' needs (information and control) were identified and evaluated as part of the development program for the Emergency Response Guidelines. The process for ERG development was a multidisciplined and iterative process wherein operator response strategies and technical guidance were developed to address operator needs in response to emergency transients. The technical guidance (guidelines) defined the actual generic tasks (guideline steps and actions) and generic instrumentation and control requirements necessary to implement the response strategies. Consequently, operator information and control needs were not explicitly identified in the guidelines. Although not specifically required per NUREG-0737 Item I.C.1, the information and control needs that were identified during the development program for the ERGs were contained in the ERG background documentation. To put the ERG System Review and Task Analysis (SRTA) program in perspective, the WOG representatives explained that this program was developed to provide a task analysis methodology and example documentation based on the ERGs (Basic version). The program was structured to compile operator tasks, and instrumentation and control requirements as an input to the CRDR process. It was not intended to identify operator information and control needs.

The NRC provided the following comments to the Westinghouse Owner's Group to clarify task analysis requirements of NUREG-0737 Supplement 1:

(1) It appears that Revision 1 of the ERG and background documents do provide an adequate basis for generically identifying information and control needs.

(2) Each licensee and applicant, on a plant-specific basis, must describe the process for using the generic guidelines and background documentation to identify the characteristics of needed instrumentation and controls. For the information of this type that is not available from the ERG and background documentation, licensees and applicants must describe the process to be used to generate this information (e.g., from transient and accident analyses) to derive instrumentation and control characteristics. This process can be described in either the PGP or DCRDR Program Plan with appropriate cross-referencing.

(3) For potentially safety-significant plant-specific deviations from the ERG instrumentation and controls, each licensee and applicant must provide in the PGP a list of the deviations and their justification. These should be submitted in the plant-specific technical guideline portion of the PGP, along with other technical deviations.

(4) For each instrument and control used to implement the emergency operating procedures, there should be an auditable record of how the needed characteristics should be derived from the information and control needs identified in the background documentation of Revision 1 of the ERG or from plant-specific information.

(5) It appears that the Basic version of the ERG and background documentation provides an adequate basis for generically deriving information and control needs. However, because of the differences in the organization of the material in the background documents between Basic and Revision 1, it is apparent that it would be easier to extract the needed information from the Revision 1 background documents.

Plant Specific System Review and Task Analysis

o Program Description

General:

The Westinghouse System Review and Task Analysis High Pressure Version dated April 15, 1983 is being used as guidance for Prairie Island's plant specific task analysis methodology. The SRTA will be adapted to account for the differences between the generic high pressure procedures and the Prairie Island plant specific Emergency Operating Procedures.

The Prairie Island Emergency Operating Procedures were developed from the Westinghouse Emergency Response Guidelines Revision 1 and background documents. To determine the applicability of actions specified in the generic technical guidelines to Prairie Island, a comparison was performed between the reference plant, used for development of the generic guidelines, and Prairie Island.

The reference plant is described in the Westinghouse Emergency Response Guideline (ERG) background information. It described each of 25 separate plant systems to the extent necessary to provide technical guidance on the operation of plant systems in response to an emergency transient but not in a detail which exceeds that specifically identified in the ERGs. Each of the generic plant system descriptions was compared to Prairie Island systems and a list of differences was obtained. Review of this list indicates no safety significant differences exist between Prairie Island and the generic instrumentation and controls of the reference plant.

The method used to generate procedures from the generic guidelines, involved review of the guidelines, supporting background information, existing plant emergency, abnormal, and normal operating procedures and other plant reference material as necessary (Technical Specifications, USAR, Flow and Logic Diagrams). The ERGs are generally specific in what operator tasks are required to perform a required step. In some areas the ERGs require that plant specific steps or setpoints be entered. These were researched by reviewing existing procedures, system drawings or discussions with operators. Appropriate tasks were written and entered into the procedure. Consolidation of certain ERG steps were done to assist in operator performance of the tasks. For example, three steps are used in the ERGs to assure auxiliary feedwater flow: 1. Verify AFW pumps running, 2. Verify AFW flow, and 3. Verify AFW valve alignment. These were consolidated into one step dealing with AFW flow. Setpoints are another area which required input into the ERGs to create plant specific Emergency Procedures. These were researched through review of plant documentation and a setpoint document was created for use in procedure development to insure consistent and accurate application of the setpoint information.

Task Analysis Preparation:

- o The plant specific SRTA will follow the generic SRTA as closely as possible and supplement plant specific information.
- o The generic Emergency Response Guideline System Review and Task Analysis Users Guide will be used as guidance.
- o The developed specific documentation will consist of the documents as described in the generic guideline and outlined below:

- o Element Tables

  - o The Element Tables identify detailed operator task requirements. This information expands upon the technical guidance in the Emergency Operating Procedures. The tables provide a vehicle to identify knowledge requirements that are beneficial to the understanding or performance of the task or subtask decision and action requirements. This element is intended to identify special knowledge or training requirements beyond general knowledge of overall plant operations and the availability and location of instruments and controls on the control board. The tables identify the tasks that are repeated in the Emergency Operating Procedures. This information is provided in the identification number listing in the upper right hand corner of the Element Tables. This information is used by procedures personnel to improve consistency between procedures and by training personnel to identify common tasks between procedures.

- o Task/System Sequence Matrix

  - o The Sequence column identifies required sequential relationships between guideline tasks. This information is used by procedure personnel to evaluate plant-specific sequencing of tasks.

- o The Systems columns of the matrix identify the plant systems utilized in the Emergency Operating Procedures.
- o The matrix portion identifies the plant systems that the operator must access to perform specific tasks. This information is used by procedures personnel in evaluating plant-specific sequencing of tasks to optimize systems operation efficiency.

o Instrumentation Requirements Tables and Control Requirements Tables

- o The Instrumentation Requirements Tables and Control Requirements Tables summarize the instrumentation and controls, respectively, that are utilized in the Emergency Operating Procedures. This information is used to compare generic requirements against the applicability of the Emergency Operating Procedures to a plant-specific application. The tables also identify where in the guidelines that instrumentation and controls are used.

The ERG Revision 1 background material documents the generic information and control needs. To determine the applicability of the information and control needs specified in the generic guidelines to Prairie Island, a comparison was performed between the generic instrumentation and controls used in performing the Emergency Response Guidelines and Prairie Island. Review of the generic requirements indicates that there are not any safety-significant plant-specific deviations from the generic instrumentation and controls.

Verification of Task Performance Capabilities

The objective of the task capabilities verification process is to assure that operator tasks can be performed in the existing control room with minimum potential for human error. To accomplish this, information and controls needs identified for effective monitoring and control of the power production process will be used to define required characteristics of instruments and controls. Then, the existing inventory of controls and displays will be checked against the required characteristics to determine if the necessary instruments are present, and if they are suitable to accomplish the tasks.

The verification process performed as part of the Prairie Island Control Room Design Review will consist of two steps described in NUREG 0700:

1. Verification of availability--verify the presence or absence of instruments and equipment that provide the information and control capabilities necessary to implement each task.
2. Verification of suitability--determine whether the man-machine interfaces provided by the displays, controls, and other control room features are effectively designed to support task accomplishment.

The verification of task performance capabilities for Prairie Island will be accomplished by a multidisciplinary team representing control room operations experience, system function and task analysis expertise, and human factors engineering expertise.

The basis of instrument availability and suitability will be information and control needs associated with plant emergency operating procedures as defined in the Westinghouse Owner's Group Emergency Response Guidelines and supporting background material. In particular, Step Description Tables describe generic information and control requirements in the "ACTIONS," "INSTRUMENTATION," and "CONTROL/EQUIPMENT" sections of the form. Characteristics of instrumentation necessary for meeting these requirements in the Step Description Tables are reflected in products of the system review and task analysis--Prairie Island plant-specific Element Tables, Instrumentation Tables, and Controls Tables.

Worksheets will be prepared to record and audit the information/control requirements, required characteristics, and available control room instrumentation from the plant inventory for each task of the emergency operating procedures. This step will verify availability of required instruments and controls. Any information indicators or control capabilities not available in the control room will be described in Human Engineering Discrepancy forms.

Next, a cross-check of available instrumentation against the plant inventory and the comprehensive photo library of control room components will be performed. To evaluate suitability of instruments and controls, a set of the applicable survey items from Section 6 of NUREG 0700 will be prepared for each major component type. These items will be selected from the subsections on controls, visual displays, and control-display integration and address guidelines such as scale range, measurement precision, and feedback of control position. The components will be rated against this survey form to verify suitability of the available instruments and controls. Features of the existing components that make them inappropriate for the tasks in which they are used will be documented in Human Engineering Discrepancy forms.

Appendix A3

UNIT 1 - UNIT 2 PANEL LAYOUT CONVENTIONS

A comparison of the control panels for PINGP's Unit 1 and Unit 2 was undertaken. The purpose of this comparison was to determine the degree to which the controls of the two units resemble each other, and evaluate if any differences would impact the operator on his ability to operate either unit.

METHOD

Photographs of PINGP's Unit 1 control panels mock-up were updated to correspond to the actual control panel status in place in January 1984. These updated photographs were then compared with color slides of PINGP's Unit 2 control panels taken in January 1984. Any physical differences between the control panels and component location for Unit 1 and those for Unit 2 were recorded.

Actual control board layout drawings were then checked to determine if components of the same type arranged in a row on one unit, are located in the corresponding area of the other unit's control board and to determine whether the order of the components has been altered (e.g., from A B C to C B A or B A C, etc.).

RESULTS

The control panels for the two units are arranged in a U-shape. Controls for Unit 1 are located on one half of the "U" and controls for Unit 2 on the other half. At the subsystem level, the control panels for the two units are mirror-imaged, however, the individual components within the subsystems are "cookie-cuttered," that is, arranged in the same formation and order on both units.

Any differences between the two units' control panels which did not conform to the rule described in the previous paragraph are documented in Tables 3-1 through 3-7. These differences are indicated on the updated photographs of the main control panels for PINGP Unit 1 shown in Figures 3-1, 3-3 through 3-7, and 3-10. Occasionally, an additional figure is included (see Figures 3-2, 3-8, 3-9, and 3-11) to further illustrate such differences.

EVALUATION OF RESULTS

The differences were analyzed to determine if they would impact the operator on his ability to operate either unit. Differences that could affect the operator were either identified as being corrected during our panel redesign efforts (Panel B CVCS Letdown and C Reactor Control) or were listed as HED's to be evaluated during the CRDR HED evaluation phase.

CONCLUSION

Forty-five individual components were identified and evaluated as follows:

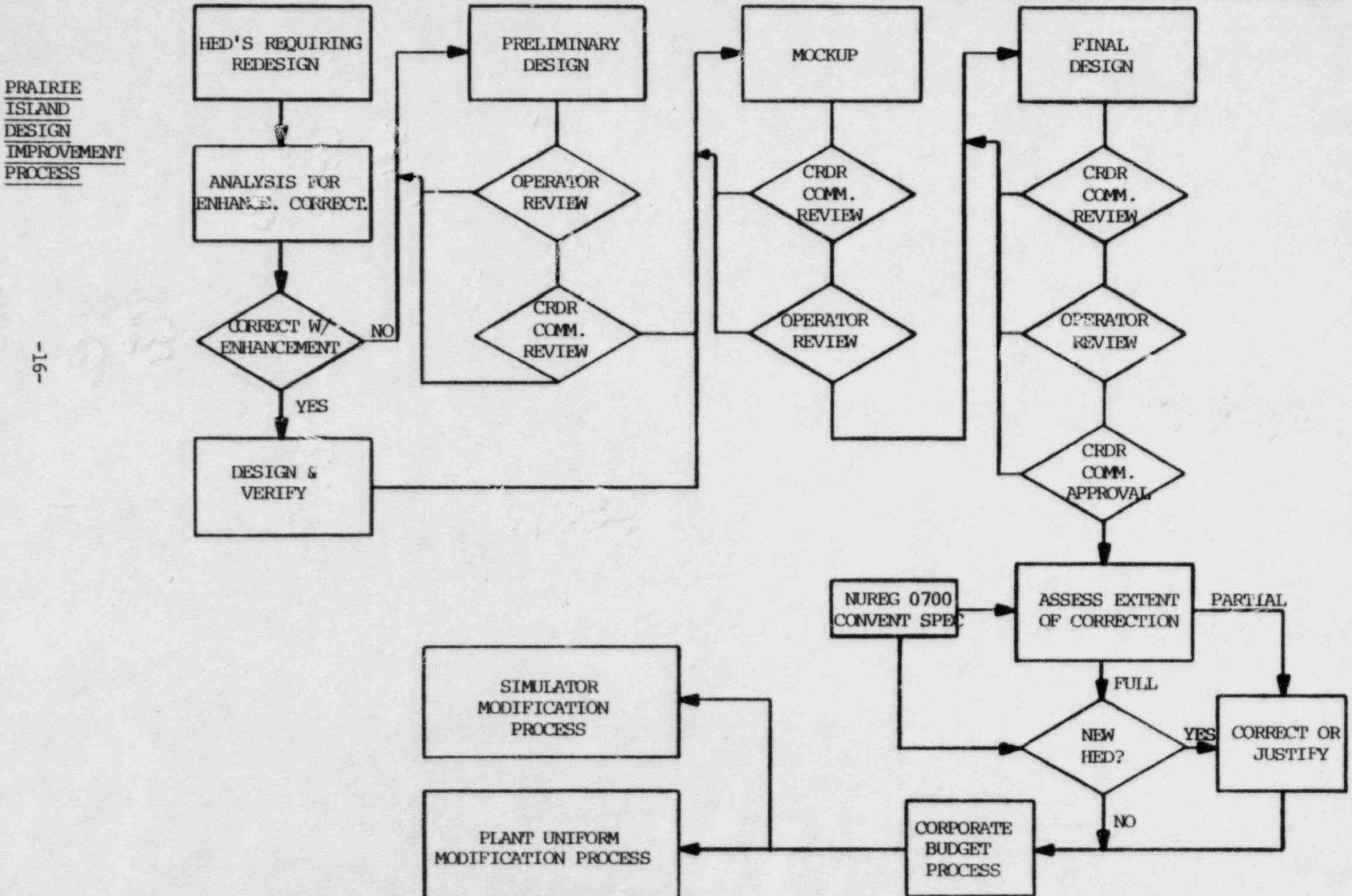
No impact on operator:	27
Differences being changed due to redesign of Panels C & B:	13
HED's written:	1

In addition portions of the turbine-generator control panels have been identified as violating the control room panel conventions and will be studied in further detail to determine any impact on the operator.

FIGURE A1

NORTHERN STATES POWER

DETAILED CONTROL ROOM DESIGN REVIEW



APPENDIX B

Progress To Date Since March 1984 In-Progress Audit

Considerable progress has been made since the March, 1984 in-progress audit. Figure A2-1 in our response to Generic Letter 82-33 dated April 15, 1983 detailed the major tasks being considered in the Control Room Design Review. The status of each major task is:

1) Develop Emergency Operating Procedures System Review and Task Analysis (SRTA)

   The plant specific system review and task analysis as described in Appendix A is completed for the Emergency Operating Procedures. In order to validate the Emergency Operating Procedures, an individual and integrated task evaluation has been performed for each Emergency Operating Procedure.

2) Control Room Inventory Review

   The control room inventory review for each unit has been reverified in order to assure the control board mockup complies with the plant control board.

3) Operating Experience Review

   Operating Experience Review is divided into two parts: Operator Interviews and Operating Event Document Review.

   a) The Operator interview had been previously completed.

   b) The document review has been completed and Human Engineering Discrepancies have been assigned.

4) Control Room Survey Ergonometrics

   The survey had been previously completed.

5) Control Board Specification Development

   This specification has been completed. It describes the human engineering design requirements and conventions regarding component design, labeling, abbreviations and panel layout for control room components. These design requirements and conventions will be used in preparing specifications for replacement, addition, or modifications to existing control room equipment.

6) Interface With Other Control Room Projects

The following projects have been completed since the audit:

a) Shift Supervisors Office Redesign
A new shift supervisors office featuring an elevated design and incorporating space for SPDS displays and controls has been installed.

b) SPDS and Plant Process Computer Display Consoles
A human-engineered computer console and lead reactor operator station has been mocked up, evaluated and is in the fabrication phase. The first console will be installed in the simulator in order to enhance operator training and familiarity.

c) Post Accident Monitoring Instrumentation
A scheme has been developed for identifying control board instrumentation that are post accident monitoring qualified. Coordination with the PAM team, Emergency Operating Procedures writing team, and system review and task analysis team have resulted in a list of PAM instruments required on the control board.

7) Human Engineering Discrepancies (HED) Assessment

HED Assessment Procedures have been developed utilizing the guidance in NUREG-801 and the recently published NUREG-0800. The following six steps are used in the process for assessment.

1. Prepare Data Base
   - o Check accuracy and completeness
   - o Expand descriptions where necessary
   - o Incorporate human performance modality

2. Rate the Significant of HEDs
   - o Documented error/unsafe condition
     - Documented error
     - Documented unsafe condition
   - o Operator performance
     - Impact on physical performance
     - Impact on sensor/perceptual performance
     - Impact on cognitive performance
   - o Safety consequences
     - Emergency classification
     - Availability of safety-related system
     - Impact on engineered safety function
     - Impact on EOP-related functions
   - o Plant operating conditions
     - Plant integrity
     - Potential violation of technical spec.
     - Plant availability/efficiency
     - Personnel safety

3. Categorize Human Engineering Discrepancies
   - o Categorize each HED based on factors of:
     - Documented or potential error
     - Safety importance
     - Documented or potential unsafe conditions
     - Documented or potential violation of technical specification

4. Review "Non-significant" Human Engineering Discrepancies
   - o Review for interactive and/or cumulative effects.
   - o Cross-check all non-significant HEDs with other HEDs which are either:
     - In the same system or on the same panel
     - Regard the same component type, function/task, or human performance modality

5. Determine Correction Schedule
   - o Use categorization scheme to establish schedule for correction:
     - Prompt correction
     - Near-term correction
     - Long-term correction

6. Determine Corrective Action
   - o Enhancement
   - o Design Change
   - o Procedural Change

APPENDIX C

Control Panel Modifications Planned for 1985

One of the goals of Prairie Island's Emergency Response Capability plant is to ensure the integration process be performed as efficiently as possible and with the least amount of iteration. To meet this goal, the Control Room Design Review team was chartered with coordinating all control room rework required by:

1) Control Room Design Review
2) Regulatory Guide 1.97
3) Emergency Operating Procedures Task Analysis
4) Emergency Response Facilities Computer System

During the past nine months the team's attention has been focused on rework of the control room panels that contain the instrumentation and control for the Reactor Coolant System, Rod Control and NIS System, and the Chemical and Volume Control Letdown System. In order to accommodate the SPDS display and keyboard requirements, extensive rework is required on these panels. Since the ideal time to do this work is when the core is unloaded the decision was made to do the work in 1985 during the ten year inservice inspection refueling outages. The control room design review group was then pressed into action to determine how all the new requirements would fit on the boards, how they should be placed and displayed to accommodate human engineering considerations and space limitations, and how to solve existing human engineering deficiencies discovered during the control room design review. Display and controls to be added or changed resulted from:

1. PAM Studies

   a) Addition of 2 wide range pressure indicators.
   b) Replacement of existing nonqualified recorders that are used for recording reactor coolant system wide range pressure and temperature.

2. Vessel Level

   a) Our stand at this time is to use the SPDS CRT for vessel level readout. If further task analysis shows this to be unacceptable, level indication will be placed on the board. Space has been reserved for this.

3. Removal of Subcooling Meters and removal of Rod Inseration Limit Recorders (These will be temporarily mounted in the new space reserved for the SPDS High Level Display CRT, and their functions will eventually be replaced by the ERF computer system).

4. Modification of head vent controls to place switches in modules.

5. Addition of SPDS High Level Display CRT and control keypad.

6. Control Room Human Engineering Studies

   a) Relocation of many instruments to enhance functional layouts of controls/instruments.
   b) Removal of part length control systems.
   c) Relocation of safety controls to meet anthropometric standards.

The process for redesign focused on utilizing the operators experience as a basis for a redesign configuration. Each shift of operators were brought in and given the opportunity to move displays and controls around on a paper mockup. In order to examine a total cross section of age and experience we strived to interview all six shifts. After an agreed upon configuration was developed, the total redesign was transferred to our full scale Unit 1 Mockup. At this time our human engineering consultant took over to assure ourselves that we did not cause any new human engineering deficiencies with the redesigned configuration.

The human engineering review of the proposed design entailed five activities:

1) Identification of moved/deleted components.
2) Survey of workspace, environment, and panel layout.
3) Checklist review of component design.
4) Review of Emergency Operating Procedures via walk-through/talk-through analysis.
5) Evaluation of existing Human Engineering Deficiencies.

After the redesign was evaluated and approved, the project was budgeted and turned over to the Nuclear Engineering and Construction Department for implementation. The modification has been completed on the simulator and operating crews are being trained on the new board.