

IN-PROGRESS AUDIT  
OF THE  
DETAILED CONTROL ROOM DESIGN REVIEWS FOR  
NORTHERN STATES POWER COMPANY'S  
PRAIRIE ISLAND AND MONTICELLO  
NUCLEAR GENERATING PLANTS

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This report documents the findings of an in-progress audit of the Detailed Control Room Design Reviews (DCRDRs) for Northern States Power Company's Prairie Island and Monticello Nuclear Generating Plants. The audit was conducted at the Prairie Island site from March 6 through March 9, 1984. The audit team was comprised of the NRC team leader from the Human Factors Engineering Branch, two consultants from Science Applications, Inc. and one consultant from Comex Corporation. The disciplines of human factors engineering, mechanical engineering, and power plant operations were represented on the audit team. This report was prepared by Science Applications, Inc. with the aid of input from Comex Corporation. Comments provided by the NRC team leader have been integrated into the report in order to represent the consolidated observations, conclusions and recommendations of the entire audit team. A list of persons present during the audit is included as Appendix A of this report.

BACKGROUND

Licensees and applicants for operating licenses are required to conduct a DCRDR. The objective is to "improve the ability of nuclear power plant control room operators to prevent accidents or cope with accidents if they occur by improving the information provided to them" (NUREG-0660, Item I.D). The need to conduct a DCRDR was confirmed in NUREG-0737 and Supplement 1 to NUREG-0737. DCRDR requirements in Supplement 1 to NUREG-0737 replaced those in the earlier documents. Supplement 1 to NUREG-0737 requires each applicant or licensee to conduct their DCRDR on a schedule negotiated with the Nuclear Regulatory Commission (NRC).

NUREG-0700 describes four phases of the DCRDR and provides applicants and licensees with guidelines for its conduct. The phases are:

1. Planning.
2. Review.
3. Assessment and Implementation.
4. Reporting.

Criteria for evaluating each phase are contained in NUREG-0801.

A Program Plan is to be submitted within two months of the start of the DCRDR. Consistent with the requirements of Supplement 1 to NUREG-0737, the

Program Plan is to describe how the following elements of the DCRDR will be accomplished:

1. Establishment of a qualified multidisciplinary review team.
2. Function and task analyses to identify control room operator tasks and information and control requirements during emergency operations.
3. A comparison of display and control requirements with a control room inventory.
4. A control room survey to identify deviations from accepted human factors principles.
5. Assessment of human engineering discrepancies (HEDs) to determine which HEDs are significant and should be corrected.
6. Selection of design improvements.
7. Verification that selected design improvements will provide the necessary correction.
8. Verification that improvements will not introduce new HEDs.
9. Coordination of control room improvements with changes from other programs such as SPDS, operator training, Reg. Guide 1.97 instrumentation, and upgraded emergency operating procedures.

Element one is expected to be accomplished during the planning phase. Elements 2 through 4 are expected to be accomplished during the review phase. Elements 5 through 8 are expected to be accomplished during the assessment and implementation phase. Accomplishment of element 9 is expected to cut across the planning, review, and assessment and implementation phases.

A Summary Report is to be submitted at the end of the DCRDR. As a minimum, Supplement 1 to NUREG-0737 requires that it:

1. Outline proposed control room changes.
2. Outline proposed schedules for implementation.
3. Provide summary justification for HEDs with safety significance to be left uncorrected or partially corrected.

The NRC will evaluate the organization, process, and results of the DCRDR. Evaluation will include review of required documentation (Program Plan and Summary Report) and may also include review of additional documentation, briefings, discussions, and on-site audits. In-progress audits may be conducted after submission of the Program Plan but prior to submission of

the Summary Report. Pre-implementation audits may be conducted after submission of the Summary Report. Evaluation will be in accordance with the requirements of Supplement I to NUREG-0737. Additional guidance for the evaluation is provided by NUREG-0700 and NUREG-0801. Results of the NRC evaluation of a DCRDR will be documented in a Safety Evaluation Report (SER) or SER Supplement.

Supplement I to NUREG-0737 requires that significant HEDs be corrected. Improvements which can be accomplished with an enhancement program may be done promptly. Other control room upgrades may begin following publication of the SER (or SER Supplement), resolution of any open issues, and approval of a schedule for upgrade.

A human factors evaluation of the design of the remote shutdown capability provided to meet 10 CFR Part 50, Appendix A, GDC-19 and 10 CFR Part 50, Appendix R is not specifically identified as a requirement in Supplement I to NUREG-0737. NRC staff review of this issue is not completed. In the interim, the NRC staff recommends that the scope of the DCRDR include a human factors evaluation of the design of the remote shutdown capability. To the extent practical, without delaying completion of the DCRDR, the NRC staff also recommends that the DCRDR address any control room modifications and additions (such as controls and displays for inadequate core cooling and reactor system vents) made or planned as a result of other post-TMI actions, as well as the lessons learned from operating reactor events such as the Salem ATWS events. Implications of the Salem ATWS events are discussed in NUREG-1000 and required actions are described in Section 1.2, Post Trip Review - Data and Information Capability, of the enclosure to Generic Letter 83-28.

## DISCUSSION

Northern States Power Company's (NSP's) Prairie Island and Monticello Nuclear Generating Plants have been operational for eleven and thirteen years respectively. The DCRDR process has begun at both plants. The Program Plan for the Prairie Island DCRDR was submitted on May 27, 1983. The Program Plan for the Monticello DCRDR was submitted on December 28, 1983. NRC staff comments on the Prairie Island and Monticello Program Plans were provided on November 14, 1983, and February 29, 1984, respectively. The Program Plans indicated NSP's commitment to satisfaction of the DCRDR requirements. However, limited information on some aspects of the DCRDRs suggested the need for an in-progress audit.

The in-progress audit was conducted at the Prairie Island site from March 6 through March 9, 1984. The audit team met with the Monticello DCRDR team while at the Prairie Island site but did not go to the Monticello Nuclear Generating Plant for any direct observations of the Monticello control room. Available at the audit site were the following:

1. The Prairie Island control room.
2. A full scale mock-up of the Prairie Island control room.
3. The Prairie Island simulator.
4. Portions of a one-third scale photomosaic of the Prairie Island control room.
5. Color slides of both the Prairie Island and Monticello control rooms.
6. The Prairie Island remote shutdown panels.

Also available at the audit site were documents used in and developed by the Prairie Island and Monticello DCRDRs. The titles of these documents are provided in the reference list. Finally, NSP (Prairie Island and Monticello) and Honeywell Technology Strategy Center (HTSC -- human factors consultant to NSP) personnel were available on a daily basis during the audit.

The in-progress audit included observation of the Prairie Island control room, remote shutdown panels, simulator, and mock-up; briefings and discussions concerning various aspects of the Prairie Island and Monticello DCRDRs; and an examination of available documentation. Major emphasis was on evaluation of the organization and process of the DCRDRs. Evaluation of the results of the DCRDRs was limited, but the NRC audit team did use the Prairie Island full-scale control room mock-up for a limited evaluation of the results of that DCRDR. In-progress audit findings are summarized below.

#### PLANNING PHASE

The following issues are those indicated by NRC guidelines as important to satisfaction of planning phase objectives:

1. Review team selection.
2. Management responsibility.
3. Data management.
4. Equipment and workspace.
5. Scheduling.

Another key issue during the Planning Phase is the coordination of control room improvements with changes from other programs required by Supplement 1 to NUREG-0737. Each issue was addressed by NSP. Specific findings related to planning phase activities are provided below.

Review team selection. The Prairie Island and Monticello Control Room Design Review Teams are comprised of seven members. Six members of each team are from the NSP staff, and one is from HTSC. Orientation of the review teams was primarily through previous activities of their members -- an Electric Power Research Institute (EPRI) study at Prairie Island and a Boiling Water Reactor Owners Group (BWROG) survey at Monticello. Both teams appeared to have the authority appropriate to carry out their missions.

Examination of review team resumes indicated that each team had a mix of disciplines including all those recommended for the core group in NUREG-0801. Other expertise was said to be available through the review teams' abilities to call on other NSP and HTSC personnel. At the time of the in-progress audit, technical assignments appeared to be appropriate and both teams appeared to be organized adequately to conduct the DCRDR. Continued participation of an adequate mix of personnel (including operators and human factors professionals) through the remainder of the process will increase the value of the DCRDRs.

Management responsibility. The Control Room Design Review Teams at both plants are chaired by NSP employees who serve as overall managers of the DCRDR. Assumption of DCRDR management by NSP personnel at Prairie Island and Monticello is consistent with NRC guidelines.

Data management. The data generated from the Prairie Island and Monticello DCRDRs are primarily managed in a hard copy form. That method does not appear to have presented any problems to date. Some computerized capability is available. Expanded use of computers for data management was discussed and is recommended as a very useful way of tracking HEDs from the point of identification through assessment and final implementation of design corrections.

Equipment and workspace. The full-scale mock-up of the Prairie Island control room is sufficiently detailed to permit meaningful surveys, verification and validation walk-throughs, and design verifications. In addition to the mock-up, the control room itself along with the remote shutdown panels and a full-scale real-time simulator are available to conduct portions of the control room survey. The Prairie Island DCRDR team appears to have been provided with adequate equipment and work space to accomplish the DCRDR effort.

The Monticello DCRDR team's equipment and work space were not observed by the audit team. Discussions with the team indicated that a full-scale mock-up of the Monticello control room was not scheduled to be part of the DCRDR equipment. The audit team encourages the Monticello DCRDR team to consider the use of a full-scale mock-up in light of the excellent results obtained from the use of a full-scale mock-up at the Prairie Island facility.

Scheduling. Summary Reports for the Prairie Island and Monticello DCRDRs are expected in the fourth quarter of 1984 and July 1985 respectively. The audit team expressed concern that insufficient time may have been allotted

for the assessment of HEDs and the selection of design improvements prior to the submission of the Summary Report for both the Prairie Island and Monticello DCRDRs. While the resolution of some HEDs may not be fully determined by Summary Report time, some level of detail is expected in the required Summary Report descriptions of proposed control room changes, schedules, and justifications for leaving HEDs uncorrected or partially corrected. The planned schedule for the submission of the Summary Reports may also be jeopardized if additional work is needed to perform acceptable systems function and task analyses.

Coordination of the DCRDR with other improvement programs. Coordination of control room improvements with changes from other programs will be accomplished through the DCRDR teams at Prairie Island and Monticello. Members of the DCRDR teams also serve as the responsible persons for the other improvement programs (i.e., the SPDS, upgraded EOPs, Regulatory Guide 1.97 and the emergency response facilities). In the audit team's judgment, the overlap of team involvement in all programs will facilitate coordination of these efforts. Particular attention should be paid to coordinating control room and simulator modifications so that operator performance is enhanced, not degraded.

#### REVIEW PHASE

The following activities are those recommended by NRC guidelines as contributing to satisfaction of review phase objectives:

1. Review of operating experience.
2. Systems function and task analysis.
3. Control room inventory.
4. Control room survey.
5. Verification of task performance.
6. Validation of control room functions.

Each activity was addressed in some manner by NSP. Specific findings related to review phase activities are provided below.

Review of operating experience. The review of operating experience was in progress as part of the DCRDR for both Prairie Island and Monticello. Operator interviews had been conducted with twelve Prairie Island licensed operators which represented a broad spectrum of reactor operator and senior reactor operator experience. There are a total of thirty-six licensed operators at Prairie Island. The interviews consisted of a combination questionnaire and oral interview. The Prairie Island operator interviews resulted in approximately 80 human engineering deficiencies to be considered for resolution.

The Monticello DCRDR team had completed six operator interviews as part of the BWR operators group work done at Monticello in 1981. Six additional operator interviews are planned to assure an adequate coverage of the full



range of operator expertise and experience. Human engineering deficiencies resulting from these interviews were to be identified and organized upon completion of all twelve licensed operator interviews.

The operational history review for both Prairie Island and Monticello includes an examination of Licensee Event Reports, Significant Operating Event Reports, Shutdown Reports and Trip Reports. In addition, both facilities have utilized the INPO-sponsored program, "SEE-IN," Significant Event Evaluation and Information Network, as an input to the operating experience review for the DCRDR effort. Approximately 60 percent of the available material has been reviewed for the Prairie Island DCRDR and all the material from the initial startup through 1981 had been reviewed for the Monticello facility. Both facilities plan to review all of the material added since 1981. Even though these documents were not written in such a way as to identify HEDs easily, the operations specialists at the respective plants and the HTSC human factors specialists have attempted to relate the recorded operating experience to possible human factors problems. This working relationship between the human factors engineer and the operations specialists was observed to be very important by the audit team.

The operating experience assessment programs at Prairie Island and Monticello provide a potential means for assessing the impact on safety and performance of the plants' interfaces with personnel. That potential has been recognized at Prairie Island, and a Section Work Instruction (SWI-PERP-6.4, "Guidance for the Identification of Type and Probable Cause of Human Error,") has been developed as guidance in writing reportable occurrences and significant operating events. The specific means by which that potential will be realized at Monticello had not been determined at the time of the audit.

Based on the above findings, the audit team concluded that the operating experience review was being performed in a manner which supports the DCRDR programs at Prairie Island and Monticello. The audit team recommends development of a plan for keeping the operator surveys current after completion of the DCRDR. Such a plan would have value throughout the lives of the plants.

Systems function and task analysis. The purpose of the systems function and task analysis is to identify control room operators' information and control requirements during emergency operations. Those information and control requirements are to be compared with a control room inventory (i.e., information and controls available in the control room) during the verification of task performance capabilities. The Division of Human Factors Safety considers that an acceptable process for conducting the systems function and task analysis is:

1. Analyze the functions to be performed by systems in responding to transients and accidents to define, and describe, the tasks the operators are expected to perform.

2. From the tasks identified in Item 1 above, define the information necessary (e.g., parameter, value, status) for the operators to determine the need to perform the task, the control capabilities needed to perform the task and the information necessary to determine that the task has been performed successfully. (Note that no instrumentation has been identified yet; only operator needs derived from the task.)
3. Analyze the operator needs (from 2 above) to determine the characteristics of the information and control capability needed to perform the task. (Information characteristics include parameter type, dynamic range, setpoints, resolution/accuracy, speed of response, units, and the need for trending, alarming, etc.) Control characteristics include type (discrete or continuous, rate, gain, response requirements, transfer function, locking functions, and information feedback associated with control use).

Both Prairie Island and Monticello are using generic technical guidelines developed by their respective reactor owners groups. During the in-progress audit, the Prairie Island review team indicated that they were using the Westinghouse Owner's Group (WOG) generic Emergency Response Guidelines (ERGs) to develop their plant-specific emergency operating procedures (EOPs). Those ERGs were the topic of a March 29, 1984 meeting between the NRC and the WOG. Based on the results of that meeting (Reference 8):

1. "... it appears that Revision 1 of the ERGs 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 ERGs 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 Procedures Generation Package (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 of the instruments and controls were determined. These needed characteristics should be derived from the information and control needs identified in the background documentation of Revision 1 of the ERGs or from plant-specific information.
5. "It appears that the Basic version of the ERG and background documentation provide 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."

The Monticello review team indicated that they were using the Boiling Water Reactor Owners Group (BWROG) Emergency Procedure Guidelines (EPGs) to develop plant-specific EOPs. Those EPGs were the topic of a May 4, 1984 meeting between the NRC and BWROG. Based on the results of that meeting (Reference 9):

1. "... It appears that Revision 3 of the EPGs provides a functional analysis that identifies, on a high level, generic information and control needs. However, these EPGs do not explicitly identify the plant-specific information and control needs, which are necessary for preparing emergency operating procedures and determining the adequacy of existing instrumentation and controls.
2. "Because detailed plant-specific information and control needs cannot be extracted directly from the EPGs, plant-specific analysis is required.
3. "Each licensee and applicant must describe the process used to identify plant-specific parameters and other plant-specific information and control capability needs and must describe how the characteristics of needed instruments and controls will be determined. These processes may be described in either the PGP or the DCRDR Program Plan with appropriate cross-referencing.
4. "For each instrument and control used to implement the EOPs, there should be an auditable record that defines the necessary characteristics of the instrument or control and the bases for that determination. The necessary characteristics should be derived from analysis of the information and control needs identified in NRC approved EPGs and from analysis of plant-specific information."

As previously noted, Prairie Island and Monticello have already submitted their DCRDR Program Plans. Prairie Island has also submitted a PGP. A

request for more information, based on the results of the March 29, 1984 meeting with the WOG, has been forwarded from the Procedures and Systems Review Branch of NRC to the Division of Licensing for transmittal to NSP (Reference 10). Monticello was scheduled to submit a PGP in May 1984. Given the above circumstances, it appears that the function and task analysis information requirements resulting from meetings with the two owners' groups cannot be satisfied in the DCRDR program plans for Prairie Island or Monticello. For Prairie Island, one reasonable alternative appears to be response to the request for additional information on the PGP with reference to that response in the DCRDR Summary Report. In the event Monticello's PGP is delayed or additional PGP information is required, a similar approach would be reasonable for that plant.

Control room inventory. The in-progress audit team determined that a control room inventory for Prairie Island was being compiled. Review of that inventory indicated that it would be adequate for comparing characteristics of available instruments and controls with those determined necessary from the task analysis. However, the inventory may require additions and updates as the DCRDR proceeds. The control room inventory for Monticello was not reviewed.

Control room survey. At the time of the in-progress audit, the control room surveys for Prairie Island and Monticello were 99% and 50% complete, respectively. The Prairie Island survey team was comparing the control room against NUREG-0700 guidelines with some quantitative differences as recommended by INPO. A photomosaic mock-up of the Prairie Island control room (which will be compared for assurance of high level of fidelity) is being used. Access to the control room, remote shutdown panels, and simulator is available to the survey team when necessary. The survey will include all instrumentation and controls in the control room and at the remote shutdown panels. A special study of the "modified" mirror-imaging between Unit 1 and 2 control rooms will be included. At Prairie Island the available results of the control room survey were contained in three documents; a components checklist, a survey checklist, and a record of HEDs. Those documents were spot checked to assess the adequacy of the control room survey. See Appendix B for observations resulting from that spot check.

The BWROG Control Room Survey was completed at Monticello in March 1981. Consistent with the requirements in Generic Letter 83-18, Monticello will also complete the BWROG Control Room Survey Checklist Supplement. Results of the Monticello control room survey were not evaluated during the in-progress audit.

In general, both control room surveys appeared to have been planned in a manner consistent with NRC guidelines. A conventions specification is being compiled at both plants. This should prove to be a valuable tool for standardizing the control rooms. However, the audit team recommends that the conventions specification be checked for agreement with NUREG-0700 guidelines. It is also recommended that the team conduct further evaluation

of the Remote Shutdown Panels as deemed necessary upon completion of the conventions specification.

Verification of task performance capabilities. The verification of task performance capabilities at Prairie Island and Monticello had not begun at the time of the in-progress audit. This activity is equivalent to the comparison of display and control requirements with a control room inventory required by Supplement 1 to NUREG-0737. The control room inventory and results of the systems function and task analysis are needed for that activity. Success of this effort largely depends on the process used to complete a function and task analysis which provides a benchmark for the verification. The focus is the adequacy of instruments and controls for operator tasks. Both the availability and human engineering suitability of the instruments and controls required to provide the information and control capabilities needed by the operator should be verified. Discussions with the Prairie Island DCRDR team indicated that this activity would be included as part of the walk-through/talk-through of tasks identified by the task analysis. The Prairie Island control room mock-up appeared to be of sufficient fidelity to serve in lieu of the control room inventory. Therefore the Prairie Island proposal is an adequate way to perform the verification of task performance capabilities. Monticello's process for the verification was not reviewed.

Validation of control room functions. The validation of control room functions had not begun at the time of the in-progress audit. The focus is on the dynamics of control room task performance. NSP indicated that validation of control room functions at Prairie Island and Monticello would involve walk-through/talk-throughs conducted as part of the task analysis effort. Brief descriptions of those walk-through/talk-throughs during the in-progress audit indicated that they will permit evaluation of control room design on the dynamics of control room performance.

#### ASSESSMENT AND IMPLEMENTATION PHASE

The following activities are those recommended by NRC guidelines as contributing to satisfaction of assessment and implementation phase objectives:

1. Assessment of HEDs
2. Selection of design improvements
3. Implementation.

Each activity was addressed by NSP. Specific findings related to assessment and implementation phase activities are provided below.

Assessment of HEDs. HTSC provided preliminary thoughts on the assessment process to be used in selecting HEDs to be analyzed for correction. The specific methods to be employed for assessment were improved over those described in the DCRDR Program Plans. The process would require an assessment in terms of safety, error probability and documented problems

from operating experience as the means for initial categorization. Final categorization and prioritization would be determined by the DCRDR Committee. Cost and schedule considerations would not be included in the methods for assessment and prioritization of the HEDs. As described, the assessment phase would result in the categorization of the HEDs consistent with the methods described in NUREG-0801.

Selection of design improvements. HTSC described a process for meeting the requirement to select design improvements and to verify that design improvements correct the HED without creating new ones. The process will begin with review of sketches of design alternatives by the DCRDR teams. At Prairie Island, the full-scale control room mock-up will also be used for review of alternatives until a final decision is reached by the committee. Use of the control room mock-up will allow verification that design improvements correct HEDs and do not create new HEDs. The audit team recommends use of the control room mock-up to assess the integrated effect of the fullest range of design improvements possible (to include labeling and demarcation). Operator input will be provided to check operability factors. The plant operations committee will give the final approval for design changes. One-third of the people from the DCRDR team at Prairie Island are also members of the plant operations committee. Committee functions are still being defined at Monticello, but they are expected to be the same as those defined for Prairie Island. The Prairie Island DCRDR team has demonstrated the above process in redesign of the shift supervisor's office. The audit team expects use of the control room mock-up at Prairie Island to select design improvements, verify that HEDs are corrected, and verify that new HEDs are not created to make a strong contribution to satisfying those requirements. Involvement of personnel from all pertinent disciplines (including engineering, operations, and human factors) should be assured. The audit team recommends that NSP take full advantage of the mock-up to assure that the revised control room provides a consistent, coherent, and integrated interface with operators. The audit team also recommends similar use of a control room mock-up at Monticello.

Implementation. The prioritization scheme which is part of the assessment process groups significant HEDs into those which should be corrected promptly, those which can be corrected in the near-term, and those which can be corrected in the long-term. Prompt, near-term, and long-term are not defined. NRC evaluation criteria suggest the following definitions (Reference 4):

"Prompt: Implement promptly on schedule approved by NRC. Enhancement corrections should be made before the report is submitted to NRC. For corrections involving equipment replacement or reallocation, make changes at the first refueling after submittal of the report or the first outage after receipt of equipment (expedited).

"Near-Term: Implement on delayed schedule approved by NRC. Enhancement corrections are made before the report is submitted to NRC unless acceptable justification is provided to NRC. For corrections involving equipment replacement or reallocation, make changes at the second refueling outage after submittal of the report.

"Long-Term: Implement corrections of those individual or cumulative discrepancies considered "better to correct" on a much delayed schedule approved by the NRC."

If NSP definitions are similar, the basic plan for the implementation schedule is very like that described in NUREG-0801. Specific implementation schedules are required in the DCRDR Summary Reports for Prairie Island and Monticello. These schedules will be evaluated in detail when the Summary Reports are received.

#### REPORTING PHASE

As previously noted, Program Plans for the Prairie Island and Monticello DCRDRs were submitted May 27, 1983 and December 28, 1983 respectively. NRC staff comments on those Program Plans were provided November 14, 1983 (Prairie Island) and February 29, 1984 (Monticello). The NRC requirement to submit a program plan has been satisfied by both plants.

The Summary Reports for the Prairie Island and Monticello DCRDRs are scheduled for December 1984 and July 1985 respectively. The NRC requires that all phases of the DCRDRs be completed by those dates. Prompt and near-term enhancements may also have been completed by those dates. As noted previously, Supplement 1 to NUREG-0737 requires that the Summary Report:

1. Outline proposed control room changes.
2. Outline proposed schedules for implementation.
3. Provide summary justification for HEDs with safety significance to be left uncorrected or partially corrected.

SER supplements addressing the Prairie Island and Monticello DCRDRs will be based on all available information, including that in the Summary Reports. Pre-implementation audits by the NRC staff may be required if the Summary Reports do not provide sufficient information to support SER supplements.

#### CONCLUSIONS

The DCRDRs for Prairie Island and Monticello are underway. The Program Plans have been reviewed and NRC comments provided. An in-progress audit

has been conducted at Prairie Island. To the extent possible, the Monticello DCRDR was also addressed during the audit.

Based on currently available information, the audit team concluded that the Prairie Island and Monticello DCRDRs are generally being planned and conducted in ways which will satisfy the requirements of Supplement 1 to NUREG-0737. Evaluation of those DCRDRs will continue through resolution of items in the SERs which follow submission of the Summary Reports. Current concerns are:

1. Insufficient time may have been allotted for assessment of HEDs and selection of design improvements prior to submission of the Summary Reports.
2. Existing convention specifications, identified during the control room surveys, should be checked for agreement with NUREG-0700 guidelines.

Several additional recommendations resulted from the in-progress audit of the Prairie Island and Monticello DCRDRs. These recommendations are not intended as additional requirements. They are intended to encourage the fullest possible benefit from the DCRDRs. They do not appear to require major changes to the current organization and process of the DCRDRs. The recommendations are:

1. Expand use of computers to allow tracking of HEDs from identification through implementation of corrective actions.
2. Develop a full-scale control room mock-up at Monticello.
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.
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.

Several information needs remain to be filled in order for the NRC to completely evaluate the Prairie Island and Monticello DCRDRs. They are:

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

Supplement 1 to NUREG-0737 requires that items 1 through 3 be reported in the Summary Report. Item 4 is the result of NRC meetings with the WOG and BWROG. Provision of the above information will allow fullest possible close-out of the DCRDRs in the SERs which follow the summary reports. Information needs which are not satisfied by the Summary Reports may result in open items in the SERs and the need for pre-implementation audits.

## REFERENCES

1. NUREG-0660, "NRC Action Plan Developed as a Result of the TMI-2 Accident," May 1980; revision 1, August 1980.
2. NUREG-0700, "Guidelines for Control Room Design Review," September 1981.
3. NUREG-0737, "Clarification of TMI Action Plan Requirements," November 1980; Supplement 1, December 1982.
4. NUREG-0801, "Evaluation Criteria for Detailed Control Room Design Reviews," October 1981, draft report.
5. NUREG-1000, "Generic Implications of ATWS Events at the Salem Nuclear Power Plant," April 1983.
6. Generic Letter 83-18, "NRC Staff Review of the BWR Owner's Group (BWROG) Control Room Survey Program," April 19, 1983.
7. Generic Letter 83-28, "Required Actions Based on Generic Implications of Salem ATWS Events," July 8, 1983.
8. Memorandum from H. Brent Clayton, Section Leader, Procedures and Systems Review Branch, Division of Human Factors Safety, Office of Nuclear Reactor Regulation, United States Nuclear Regulatory Commission to Dennis L. Ziemann, Chief, Procedures and Systems Review Branch. Subject "Meeting Summary--Task Analysis Requirements of Supplement 1 to NUREG-0737 -- March 29, 1984 Meeting With Westinghouse Owners Group Procedures Subcommittee and Other Interested Persons," April 5, 1984.
9. Memorandum from S. H. Weiss, Section Leader, Human Factors Engineering Branch, Division of Human Factors Safety, Office of Nuclear Reactor Regulation, United States Nuclear Regulatory Commission to Voss A. Moore, Chief, Human Factors Engineering Branch. Subject "Meeting Summary-- Task Analysis Requirements of Supplement 1 to NUREG-0737 -- May 4, 1984 Meeting With BWR Owners Group Emergency Procedures Guidelines and Control Room Design Review Committees," May 14, 1984.
10. Memorandum from Dennis L. Ziemann, Chief, Procedures and Systems Review Branch, Division of Human Factors Safety, Office of Nuclear Reactor Regulation, U.S. NRC to James R. Miller, Chief Operating Reactors Branch, Division of Licensing. Subject: "Request for Additional Information on Procedures Generation Package for Prairie Island Nuclear Generating Plant (Units 1 and 2)," April 16, 1984.
11. Letter to Director, Office of Nuclear Reactor Regulation, U.S. NRC from D. Musolf, Manager, Nuclear Support Services, NSP. Subject, "Supplement 1 to NUREG-0737 - Response to Generic Letter 82-33," for Prairie Island Nuclear Generating Plant, April 15, 1983.

12. Letter to Director, Office of Nuclear Reactor Regulation, U.S. NRC from D. Musolf, Manager, Nuclear Support Services, NSP. Subject, "Supplement 1 to NUREG-0737, April 15, 1983, Response to Generic Letter 82-33 Control Room Design Review Program Plan Submittal," for Prairie Island Nuclear Generating Plant, dated May 27, 1983.
13. Letter to Director, Office of Nuclear Reactor Regulation, U.S. NRC from D. Musolf, Manager Nuclear Support Services, NSP. Subject, "Supplement 1 to NUREG-0737 - Response to Generic Letter 82-33," for Monticello Nuclear Generating Plant, dated April 15, 1983.
14. Letter to Director, Office of Nuclear Reactor Regulation, U.S. NRC from D. Musolf, Manager, Nuclear Support Services, NSP. Subject, "Supplement 1 to NUREG-0737 Generic Letter 82-33 - Control Room Design Review Program Plan Submittal," for Monticello Nuclear Generating Plant, dated December 28, 1983.

#### REFERENCES AVAILABLE AT THE AUDIT SITE

1. Prairie Island Emergency Operating Procedures.
2. Prairie Island Function Restoration Procedures.
3. Prairie Island Emergency Procedures Set Point Document.
4. Westinghouse Owner's Group Emergency Response Guidelines, System Review and Task Analysis.
5. Westinghouse Owner's Group Emergency Response Guidelines, ORGS, Status Trees, ERGS, and Background Information.
6. Prairie Island Control Room Design Review Team Organization and Structure/Resumes.
7. Prairie Island Control Room Design Review Plan.
8. NUREGs-0700, 0801 and Supplement 1 to 0737.
9. Control Room Design Review Interim Reports:
  - Vol. I Operating Experience Review
  - Vol. II Control Room Inventory
  - Vol. III Component Checklists
  - Vol. IV Surveys
  - Vol. V Task Analysis
  - Vol. VII HED Compilation and Assessment
10. "Human Engineering Guide for Enhancing Nuclear Control Rooms," EPRI NP 2411-May 1982.

11. "Human Factors Review of Enhancement Approaches for Nuclear Power Plants," Honeywell Document, April 1981.
12. BWR Owner's Group Control Room Survey Workshop, Human Factors Engineering.
13. Resumes for both DCRDR Teams (i.e., Prairie Island and Monticello).
14. BWR Owner's Group Survey Workshop, October 1983.
15. BWR Owner's Group Control Room Improvements Committee, Control Room Survey.
16. BWR Owner's Group Control Room Improvements Committee, Human Factors Design Review of Monticello Control Room, Summary Report, 1981.
17. BWR Owner's Group Control Room Improvements Committee, Human Factors Design Review of Monticello Control Room, Appendix C.
18. BWR Owner's Group Control Room Survey, 1981.
19. Folder DCRDR Development and Methodology, 1983 (Monticello).
20. Folder DCRDR Control Room Survey, 1983, from Nicholson (GE Consultant Monticello).
21. Folder DCRDR Materials and Correspondence with NRC, Honeywell, etc. (Monticello).

Prairie Island and Monticello  
TAC numbers: 51192, 51193 and 51178  
SAI/1-263-07-557-55, 56 and 41  
Contract NRC-03-82-096

APPENDIX A

Attendance List

<u>Name</u>	<u>Affiliation</u>
Dayle Althaus	Prairie Island N.S.P. Nuclear Tech. Serv.
Dominic C. DiIanni	NRC PM PING
Thomas R. Edman	Honeywell TSC - Surv. Human Factors Tech.
Gerard Goering	NSP General Officer
John Goldsmith	Supt. N.T.S.
Richard Goranson	Monticello Nuclear Plant, Operations Eng.
Paul Hartmann	Resident Inspector NRC
Carol Kain	Science Applications, Inc./NRC
Mike MaImros	Comex Corporation/NRC
Steve Metz	Honeywell
Larry Nolan	Supt Nuclear Tech. Serv., Monticello
Ray Rogers	Monticello Nuclear Plant
Ken Schulz	Honeywell TSC - Prin. Dev. Eng.
Dennis Serig	HFEB/DHFS/NRR/NRC
John Stokley	Science Applications, Inc./NRC
AT Ward	Manager, Nuc. Env. Svs.
Ed Watzl	NSP Prairie Island

## APPENDIX B

### A Summary of Audit Findings From a Review of Prairie Island's Control Room Survey Documentation and Identified HEDs

Members of the NRC audit team conducted an abbreviated control room survey of Prairie Island's control room panels and an audit of the completed checklists and Human Engineering Discrepancies (HEDs) made available to the team. The purpose of the spot-check of Prairie Island's survey results was to assure that the licensee's activities were thorough and documented. An audit of the survey results (HEDs) identified by an applicant's or licensee's control room survey is one means of evaluating a Detailed Control Room Design Review (DCRDR).

The audit team members performed a sample survey on a full-scale photomosaic mock-up of the Prairie Island control panels. The survey was limited to three panels and covered a random sample of human engineering guidelines presented in Section 6 of NUREG-0700. Prairie Island control board design features were compared with selected guidelines for controls, visual displays, labels and location aids, panel layout, and control-display integration. The NRC survey was not intended to be a comprehensive survey of the design features but rather served to provide an indication of the success of Prairie Island's results relative to NRC audit team findings.

The results of the audit and independent survey are described in the following sections.

#### Part A

The following general concerns and observations about NSP's control room survey were identified:

HED Record. The NRC audit team found that NSP was providing hard copy documentation of the checklisting of guidelines and was generating HED forms for violations of guidelines. The HED description was provided from the checklisting process and in most cases sufficiently documents survey results. However, it was observed that HED forms, in some instances, were missing the component identification numbers. Also, in some cases generic findings do not contain a list with specific components. For example, an HED was written for a panel layout discrepancy on the CVCS panel but the specific finding and components involved were not clarified. The absence of this information will require further survey effort by the assessment team and may cause confusion as to the original finding.

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.

## Part B

Observations and concerns from brief survey of the Prairie Island Unit 1 control room mock-up:

NUREG-0700

Section 6

Guideline

Panel  
Number

Observation/Comparison with Honeywell Survey

6.6.1.1	A	Scales oriented sideways. / Honeywell did not find these HEDs. (Component numbers 4100301, 4100401, 4100501, 4100601.)
6.1.2.2.b.1		Control on vertical panel is located outside of the reach of the 5th percentile female. / Honeywell recorded a violation of this guideline for controls labeled Reactor Trip Breakers Trains A and B, but excluded a control labeled Safety Injection Actuate Trains A and B, which is also at the same control height.
6.6.2.2.a		Meters have yellow and white set point markers in the form of thin tape affixed to the meter face. In some cases it was observed to be worn and not securely affixed. / Honeywell has not recorded this HED.

The sample survey conducted by members of the NRC audit team revealed the same findings as those documented by NSP's survey team with exceptions noted above. It appears that the NSP team is doing a reasonably complete survey. However, several HEDs generated by the audit that were not identified by the NSP team may indicate a need for further survey activities. The audit team is concerned that HEDs may have been introduced subsequent to the survey and/or the NSP team has not conducted and documented a thorough control room survey.