APPENDIX B

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Inspection Report: 50-285/90-20 License: DPR-40

Docket: 50-285

Licensee: Omaha Public Power District
444 South 16th Street Mall
Omaha, Nebraska 68102-2247

Facility Name: Fort Calhoun Station (FCS)

Inspection At: FCS Site, Fort Calhoun, Nebraska

Inspection Conducted: August 20 through 31, 1990

Inspector: T. O. McKernon, Team Leader, Operational Programs Section, Division of Reactor Safety, Region IV — Date 10/19/90

Team Members: J. Pellet, Chief, Operator Licensing Section
Division of Reactor Safety, Region IV

J. Whittemore, Examiner, Operator Licensing Section
Division of Reactor Safety, Region IV

J.E. Bess, Reactor Inspector, Operational Programs Section, Division of Reactor Safety, Region IV

R. Mullikin, Senior Resident Inspector, FCS

A. Sutthoff, Human Factors Specialist, Consultant

C. Meeker, Reactor Systems Specialist, Consultant

Approved By: J. E. Gagliardo, Chief, Operational Programs Section, Division of Reactor Safety, Region IV — Date 10/18/90

Inspection Summary

Inspection Conducted August 20 through 31, 1990 (Report 50-285/90-20)

Areas Inspected: This special, announced inspection was conducted of the FCS emergency operating procedures (EOPs). The inspection team reviewed the plant-specific EOPs, the EOP training program, and the quality assurance activities related to the development, implementation, and maintenance of the EOPs. The inspection team also evaluated the technical and human factors considerations incorporated in the EOPs and the use of the EOPs during plant-specific simulator exercises and plant walkthroughs.

Result: Within the areas inspected, one violation was identified (failure to establish and maintain procedures, Sections 2.3 and 2.4 and Attachment C). The team concluded that although the EOPs were adequate, the EOP verification and validation (V&V) program was inadequate. In addition, the team was concerned about the ability of the operating crew to perform EOP actions with staffing at the minimum levels required by Technical Specification. The team was also concerned about the licensee's lack of guidelines for the plant condition requiring entry into the EOPs and the lax communications among operators.

EXECUTIVE SUMMARY

From August 20 through 31, 1990, an NRC inspection team evaluated the Fort Calhoun Station (FCS) emergency operating procedures (EOPs). The inspection was conducted to verify that the EOPs were technically accurate; that their specified actions could be physically carried out in the plant using existing equipment, instrumentation, and controls; and that the staff could correctly perform the procedures. The inspection was conducted in accordance with the guidelines in Temporary Instruction 2515/92, Revision 1, "Emergency Operating Procedures Team Inspection," July 5, 1989.

Conclusions

The team concluded that the EOPs were adequate in structure to function as an operations tool to mitigate accident events and to assist in the safe shutdown of the plant during emergency conditions. However, the team questioned the ability of the operating crew to perform EOP actions with the staffing at the minimum level required by the Technical Specifications. The team was also concerned with the licensee's lack of guidelines for plant conditions requiring entry into the EOPs. In addition, the team concluded that the licensee's EOP verification and validation (V&V) program was inadequate.

- Strengths

  The licensee's strengths are summarized below and discussed in more detail in Sections 2.3 and 2.4 and Attachment D of the inspection report.

  * Operators' experience, plant knowledge, and diagnostic skills compensated for weaknesses in the EOPs.

  * The labeling upgrade program contributed to easily and readily identifiable plant hardware (i.e., the human factors aspect of placarding with regard to size, color, and readability).

  * There was easy access to plant equipment designated for operation in the EOPs and abnormal operating procedures (AOPs).

  * The physical condition of the plant was well maintained, and housekeeping was good.

- Weaknesses

  Weaknesses were grouped according to the three key purposes of the EOP team inspection and are summarized below under each category. The specific weaknesses are referenced to the applicable sections of the report.

(1) Technical Adequacy of the EOPs

* The EOP Basis/Deviation Document was not formalized, controlled, and current (Section 2.2 and Attachment A).

* The EOPs had a number of inconsistencies because no formalized EOP procedure configuration control program existed (Sections 2.3 and 2.4 and Attachments A, B, and C).

(2) Capability of Physically Carrying Out the EOPs in the Plant

* The EOPs contained a number of deficiencies that, in some instances, were considered safety significant (Section 2.4 and Attachment C).

* The V&V process failed to perform adequate validations to ensure procedures could be performed as written.

(3) Ability of the Staff To Correctly Perform the EOPs

* The EOP writers guide lacked adequate guidance (Section 2.4).

* The EOPs contained numerous human factors deficiencies (Section 2.3 and Attachment B).

* No guidance or established operations policy existed for EOP entry for recovering from plant conditions other than in Modes 1 and 2 (Section 2.5 and Attachment D).

* Inconsistencies were noted in the use of EOP floating steps (Section 2.5 and Attachment D).

Commitments:

The licensee committed to take specific immediate and long-term actions to correct the weaknesses discussed above. These commitments, which were discussed during the exit interview, are understood to be as described below:

o Immediate

The licensee will take appropriate actions to ensure that operators have consistent guidance for entry into the EOPs for recovery from off-power conditions.

o Long-term

The licensee will take those corrective actions necessary to ensure that a complete and comprehensive V&V process is performed for the EOPs and AOPs.

The V&V process will include the guidance of NUREG-0899, including walkthroughs of EOPs and AOPs, inside and outside of the control room as appropriate.

The findings of the V&V will be used to upgrade the EOPs and AOPs.

CONTENTS

		Page
EXECUTIVE SUMMARY		iii
1.	INTRODUCTION	1
2.	FINDINGS	1
	2.1 Followup to Previously Identified Inspection Findings	1
	2.2 Technical Adequacy of Plant Specific Guidelines (Task 1)	3
	2.3 Technical Adequacy of EOPs and Consideration of Human Factors (Task 2)	4
	2.3.1 Technical Adequacy	4
	2.3.2 Human Factors	5
	2.4 Review of EOPs by Control Room and Plant Walkthroughs (Task 3)	6
	2.5 EOP Evaluation Using the Plant-Specific Simulator (Task 4)	8
	2.6 EOP Training	10
	2.7 Ongoing Evaluation of EOPs (Task 5)	11
	2.8 Personnel Interviews (Task 6)	12
3.	EXIT MEETING	13

ATTACHMENTS

A TECHNICAL ADEQUACY DEFICIENCIES
B HUMAN FACTORS DEFICIENCIES
C CONTROL ROOM AND PLANT WALKTHROUGH DEFICIENCIES
D SIMULATOR AND EOP TRAINING SCENARIOS AND DEFICIENCIES
E PERSONNEL CONTACTED AND EXIT MEETING ATTENDEES
F DOCUMENTS REVIEWED

DETAILED INSPECTION

1. INTRODUCTION

The purpose of the announced team inspection was to evaluate the licensee's emergency operating procedures (EOPs). The team reviewed the EOPs, the documents used to develop the EOPs, the Basis/Deviation Document, and the EOP writer's guide; performed plant walkthroughs of the EOPs; evaluated the EOPs during the performance of accident scenarios on the site-specific simulator; and evaluated the human factors aspects of the EOPs during all phases of the inspection. The objective of this inspection was to determine if the EOPs were technically adequate, could be physically carried out in the plant, and could be correctly performed by plant personnel.

The tasks referred to in the report are described in Temporary Instruction 2515/92, Revision 1, dated July 5, 1989. Attachments A through D of this report support the findings discussed below, Attachment E lists personnel contacted and attendees of the exit meeting, Attachment F lists documents reviewed.

2. FINDINGS

2.1 Followup to Previously Identified Inspection Findings (92701)

2.1.1 (Closed) Inspector Followup Item (IFI) (285/8936-01): Development of Acceptance Criteria Regarding the Classification of Safety-Related Procedures.

The licensee's actions to develop definitive acceptance criteria associated with the classification of safety-related procedures to be included in the procedures upgrade program appeared appropriate and responsive.

The inspector reviewed Procedure No. 5, "Criteria for Safety Classification of Procedures," and the licensee's memorandum that provided the status of the procedures upgrade project. The inspector had no further questions regarding this item.

This item is considered closed.

2.1.2 (Open) Inspector Followup Item (285/8936-03): Abnormal Response Procedure Upgrade Program

The licensee's actions to upgrade the abnormal response procedures (ARPs) was progressing. The licensee anticipated completion of the ARP upgrade by February 1991. The licensee had developed a draft version of an ARP writer's guide, defined the scope of the upgrade program, and identified the required resources needed to complete the task.

This item will remain open.

2.1.3 (Closed) Violation (285/8940-01): Failure To Maintain Emergency and Abnormal Operating Procedures.

The licensee's actions to revise technical inadequacies in the procedures by addressing the specifics of the violation were adequate. However, there were instances in which procedure revisions were inconsistent and failed to include all the applicable related procedure steps. For example, the licensee resolved Violation Item 2.a by providing additional instructions in EOP-02 and EOP-20, Step 11.5, to augment cooling water to the air compressors. However, the same corrective actions were not translated to other similar procedure steps (e.g., Step 15.54 of EOP-20). Although the revised EOPs were sufficiently structured to resolve the specifics addressed by Violation Item 2.c related to EOP-06 and the once-through-cooling action steps, the inspection team raised additional concerns related to this issue. These new concerns are addressed in this inspection report and support the apparent violation (285/9020-01) regarding the licensee's failure to establish and maintain procedures, which is documented in paragraph 2.4 of this report.

This item will be closed and corrective actions will be followed up under Violation 285/9020-01.

2.1.4 (Closed) Deviation (285/8940-02): Failure To Validate EOPs Using the Control Room Mockup Facility.

The licensee's response to the deviation involving a discrepancy between the procedure governing EOP validation and the actual validations performed included changing the validation requirements of Standing Order G-74, EOP Writer's Guide, to require validation using the new site-specific simulator. The licensee had committed to validate the latest revisions of EOPs by July 31, 1990.

The team reviewed documentation of the licensee's validation of the EOPs and had concerns related to the sufficiency of the validations. These concerns are addressed in this inspection report and suppo the apparent violation in that the licensee failed to establish and maintain procedures (50-285/9020-01).

This item will be closed and the remaining corrective action will be followed up with Violation 285/9020-01.

2.1.5 (Open) Violation (285/9014-01): Inadequate Abnormal Operating Procedures

This violation cited examples of specific abnormal operating procedures (AOPs) that were not adequately established, such as AOP-16, "Loss of Instrument Bus Power," and of failure to establish procedures for 4160V AC Vital Bus 1A3 or 1A4, 480V AC vital buses, and 125V DC Vital Bus DC1 or DC2.

The licensee was revising Procedure AOP-16 as well as establishing new AOP procedures addressing loss of offsite power; station blackout during shutdown conditions and loss of any single Vital 4160V AC power bus, Vital 480V AC power

bus, or a 480V AC motor control center. In addition, the licensee had contracted vendor assistance to develop the procedures and the verification and validation (V&V) process. The procedures were to be validated using the plant-specific simulator. The licensee anticipated the completion of the corrective actions by October 1, 1990, and March 1, 1991, as stated in their violation response letter (LIC-90-0409) dated May 29, 1990.

This item will remain open.

2.2 Technical Adequacy of Plant-Specific Guidelines (Task 1)

The EOPs were developed using generic emergency procedure guidelines (EPGs) developed by the Combustion Engineering Owner's Group. The EOPs corresponded to the EPGs, except that the licensee combined the functional recovery guidelines of the EOPs for containment integrity, containment temperature and pressure control, and containment combustible gas control into one EOP, "Functional Recovery of Containment Integrity."

In developing its EOPs, the licensee did not follow the guidance contained in NUREG-0899, which states that the technical development process for plant-specific EOPs should include documentation of the assumptions upon which the analyses were based. This documentation should have been available to the plant staff personnel who are responsible for writing and maintaining the EOPs along with all of the other documentation included in the plant-specific technical guidelines (PSTG).

The PSTG deficiencies also reflect on the adequacy of the quality assurance (QA) program because the PSTG, which was the primary basis of the EOPs, should have been subjected to examination under the QA program. Standing Order G-74, "FCS's EOP and AOP Writer's Guide," Section 2, paragraph 2.1, included the source documents which EOP and AOP writers should have used to prepare and upgrade EOPs and AOPs. The list contained CEN-152, existing EOPs, operation procedures, operation instructions, the updated safety analysis report, writer's guide, as-built plant drawings, and licensing commitment letters. However, the list did not include the EOP Basis/Deviation Document or the existing AOPs. In addition, the EOP Basis/Deviation Document was not controlled or maintained current to document the present status of the EOPs properly. This concern had previously been conveyed to the licensee through an NRC safety evaluation report, transmitted to the licensee under NRC cover letter dated October 5, 1989, and reiterated as a finding of the licensee's safety review group's technical review dated August 10, 1990.

A number of discrepancies existed in which the EPG step was not incorporated into the EOP, the EPG step was modified in the EOP, or an action step not in the EPG was added to the EOP. No justifications for these deviations had been provided in the Basis/Deviation Document. Specific examples of this weakness are contained in Attachment A. The licensee's technical review of the Basis/Deviation Document cited a number of discrepancies similar to those found during this inspection. The licensee stated that the Basis/Deviation Document

was under review and would be upgraded to the current CEN-152, Revision 3, EPGs issued by December 1990. The formalization of the Basis/Deviation Document into a controlled and current document is an inspector followup item (IFI) pending further NRC review (285/9020-02).

2.3 Technical Adequacy of EOPs and Consideration of Human Factors (Task 2)

2.3.1 Technical Adequacy

The team reviewed the EOPs and supporting procedures listed in Attachment F to ensure that the EOPs were technically adequate and appropriately incorporated the CE EPGs, Revision 3, by considering:

- The prioritization of accident mitigation strategies in the EOPs
- The extent of EOP deviation from CE's EPGs
- The step sequence of CE's EPGs
- Procedure entry and exit points
- Transitions between and within the procedures
- Notes and caution statements
- Plant-specific values, setpoints, and adverse containment values
- The clarity of decision points
- The human factors aspects of the EOPs and the EOP structure and format

Although there were a number of general and specific technical concerns, the team concluded that none were significant enough to make the EOPs inadequate. The EOPs contained a number of inconsistencies because the licensee had no formalized configuration control program for the EOPs. Specific examples of technical inadequacies are listed in Attachment A. The more significant issues are discussed below.

Numerous steps in CE's EPG were marked with an asterisk to indicate that these steps were to be performed continuously. The licensee used "floating steps" as attachments to the EOPs to indicate those functions that required periodic monitoring, such as high-pressure safety injection "stop and throttle criteria." However, the floating steps in the EOPs did not include these actions, and there were no other provisions in the EOPs to cause these steps to be performed continuously. In some cases, the monitoring function was listed as a particular step, but there was no assurance that once the monitoring was initially performed, the step would be repeated.

The incorporation of a setpoint change into applicable EOPs and AOPs was a manual process. However, there was no method to ensure that all setpoint changes would be incorporated in the EOPs and AOPs. The team sampled some of the setpoints found in EOP-03 and compared them with the controlling document listed in the Basis/Deviation Document. The team found two examples where data points differed. Contingency Action Step 3.8.a.(v) showed the reactor coolant pump lower seal to have a temperature operating limit of less than 200° F while Operating Instruction OI-RC-9 showed this limit as less than 170° F. In addition, Contingency Action Step 3.12.a, stated that the reactor coolant system pressure should be verified to be of less than 2300 psia, while the Updated Safety Analysis Report stated that it was to be less than 2400 psia.

The licensee stated that the EOP was correct in the first example and that the operating instruction had not been revised yet. No reason was given for the discrepancy in the second example. Neither example involved significant safety concerns. However, the examples illustrated the need for an adequate EOP maintenance program to ensure that the EOPs reflect the current setpoints and action level initiators.

In addition, some instructions in the EOPs and AOPs, such as "abnormal" and "increase greater," could cause confusion among the operators, because these instructions left the interpretation of the action term's meaning up to the operator performing the task. In other instances, no specific acceptance criteria were given in the procedures to delineate variances and deviations from normal.

2.3.2 Human Factors

The writer's guide, the licensee responses to the NRC's evaluation of the procedure generation package, and selected EOPs and AOPs were evaluated for consistency with the human factors principles described in NUREG-0899 and NUREG-1358. The desktop review identified a number of human factors concerns, most of which could be traced to either lack of adherence to the writer's guide (see Section 2.4 of this report) or to missing or inadequate guidance in the writer's guide and responses to the evaluation of the PGP submittal. The findings are discussed below and specific examples are given in Attachment B.

The writer's guide addressed many of the elements found in the EOPs and AOPs. However, it lacked some of the guidance necessary to control the presentation of information in the EOPs and AOPs. Precise methods and formats to be used in the EOPs, and applying human factors principles were not clearly defined in the writer's guide. As such, EOP format decisions were left to the writer's judgement and preference.

In a letter dated October 5, 1989, the NRC provided its review of the licensee's submittal of the PGP in an evaluation dated March 1, 1985. The NRC requested the licensee to revise the PGP to reflect identified NRC concerns and to retain justification for any comments not integrated into the PGP for subsequent review by NRC staff. During its review of the licensee's responses, the team identified a number of inadequate responses to the evaluations, which were included in an internal memorandum from G. E. Guliani to J. K. Gasper, dated August 15, 1990. These inadequate responses apparently contributed to the apparent violation (285/9020-01), cited in paragraph 2.4.

The EOPs and AOPs included numerous inconsistencies in procedure structure, terminology, formatting, and level of detail. There was a potential for confusion and differences in the way individual operators would understand and perform the procedures because of the magnitude of inconsistencies in the procedures.

The EOPs and AOPs had numerous variations in the use of logic terms and in the structure of logic steps, which were both inconsistent and presented in a complex manner. Furthermore, numerous variations existed in the terminology,

structure, and the emphasis methods used for referencing and branching instructions. Movement within and between procedures appeared to be disruptive and confusing and could have caused unnecessary delays and errors.

In addition to the above, the EOPs and AOPs contained very long and complex caution statements and notes, which in some instances contained operator actions. Caution statements and notes are used to warn operators of possible hazards and to provide important supplemental information, respectively. It was noted that the inclusion of actions in a caution statement or note could be disruptive and confusing to an operator who expected to find actions in a numbered sequence in the procedure. Likewise, overuse of caution statements and notes, or use of extremely complex caution statements and notes, could have been disruptive during the use of a procedure, and the procedure could have failed to serve its intended purpose.

2.4 Review of EOPs by Control Room and Plant Walkthroughs (Task 3)

Selected procedures were walked through in the control room and in the plant with licensed and nonlicensed operators who would normally perform the procedures. The objective of the walkthroughs was to verify that all operator actions called for in the procedures could be performed in a timely manner with minimal potential for error. The team's findings are summarized below and specific examples are given in Attachment C.

Numerous deficiencies existed between the EOPs and AOPs and instrumentation and controls in the control room. However, even though the AOPs and EOPs had deficiencies, the operators were able to locate and identify all instrumentation and controls and, in most instances, implement the procedures as written.

The location of the EOPs within the control room was clearly defined, easily accessible, and the current revision was available. Control room lighting was adequate for the implementation of the EOPs. The control room layout did not appear to interfere with the efficient execution of actions called for in the EOPs.

A number of weaknesses were found with regard to the adequacy of information provided in procedure steps. These weaknesses included the omission of information to identify tasks that were to be performed outside the control room, failure to identify tasks that required operators to enter high-radiation areas, and failure to consistently identify equipment or component locations. These weaknesses were further amplified during the walkthroughs with the operators. For example, during the walkthrough of Procedure EOP-20, Step 9.29 ii, the operators searched for Panels ELP1 and ELP2 in the switchgear room and the turbine building. The panels were later determined to be in the auxiliary building. In another instance, Procedure EOP-20, Step 15.113, instructed the operator to turn on Breaker 1A at Motor Control Center 481. This step was intended to energize pilot-operated relief valve, PCV-102-2, allowing the block valve to be opened, and to complete the flow path for partial, once through cooling. It appeared that this breaker was actually in cubicle position 1B instead of 1A as stated in the procedure. This item

confused the operators during the walkthroughs. Throughout the plant there were a number of labeling deficiencies between the EOPs and plant equipment. However, the licensee had initiated a labelling upgrade program to ensure that nomenclature reflected in the procedures was the same as plant nomenclature. The licensee stated that the schedule to complete the labeling upgrade is December 1990. After the relabeling program had been completed, the EOPs would be revised to reflect the as-built configuration of the plant. These deficiencies were examples of the apparent violation (285/9020-01) regarding the licensee's failure to establish and maintain appropriate plant procedures.

The operators, in most instances, were able to locate the required equipment in a timely manner and to perform the required task in accordance with the EOPs. Equipment specified to be operated locally in the EOPs was accessible. Equipment accessibility, the labeling upgrade program, and housekeeping were considered strengths.

The team reviewed the V&V program as delineated in the writer's guide (Standing Order SO G-74). The V&V process was necessary to ensure that the EOPs and AOPs
(1) integrate plant-specific technical information (including setpoints)
(2) were written using the format and structure defined in the writer's guide,
(3) reflected the plant labeling used in the control room and plant,
(4) understood and used by operators to mitigate potential plant events, and
(5) could successfully bring the plant safe shutdown.

A number of weaknesses were identified in the V&V programs. Examples of which are delineated below:

The verification part of the program failed to require (1) plant walkdowns to verify plant labeling against procedure nomenclature and (2) independent verification by excluding the individual procedure writer or revision initiator from participation. It provided a checklist that did not accurately reflect the content of the writer's guide. For example, the checklist required the verifier to ensure that "GO TO" and "REFER TO" were used as transition terms (i.e., all capital letters and an underline) although the writer's guide indicated using lower case without underlines. The program also failed to describe the criteria for reverification when changes were made to the procedures as a result of initial verification.

The validation part of the program failed to require (1) plant walkdowns to validate actions required outside the control room, (2) independent validation by excluding the individual procedure writer or revision initiator from participation, and (3) individual use of the validation checklist by evaluators to document validation instead of using it as a tool during validation. In addition, the checklist included very subjective questions (e.g., "Is the EOP and AOP easy to read?") rather than questions that checked the EOP and AOP against the requirements of the writer's guide with regard to type size, copy quality, etc. The program also failed to describe the criteria for revalidation when changes were made to the procedures as a result of initial validation.

In addition, the absence of a complete and current PSTG prevented adequate verification against the technical bases of the procedures (see Section 2.2). These weaknesses in the V&V program were directly reflected throughout the procedures. Specific examples are given in Attachment C.

As stated in Section 2.3.2, the licensee's responses to the NRC's comments with regard to its evaluation of the PGP were insufficient. Because these responses were integrated into the current version of the writer's guide, there was a high potential for continuing deficient V&V of the EOPs and AOPs. The V&V program and its implementation appeared inadequate. In response to the inspection team's concerns regarding the V&V program, licensee representatives committed to the following actions: (1) to take those corrective actions necessary to ensure that a complete and comprehensive V&V process is performed for the EOPs and AOPs; (2) to include in the V&V process the guidance of NUREG-0899, including walkthroughs of EOPs and AOPs, inside and outside of the control room as appropriate; and (3) to incorporate the findings of the V&V into the upgrade of the EOPs and AOPs.

The V&V discrepancies discussed above and those discussed in Section 2.3 and 2.4, constituted an apparent violation (285/9020-01) of Technical Specification 6.8.1, and Regulatory Guide 1.33, which require that written procedures be established and maintained to combat emergencies and abnormal occurrences. This requirement is amplified for EOPs and AOPs by NUREG-0737 (Item I.C.1) and NUREG-0899, which describes the need for a V&V process to demonstrate procedural effectiveness.

2.5 EOP Evaluation Using the Plant Specific Simulator (Task 4)

The EOPs, as they existed, served to guide the control room operators in mitigating the events imposed during the evaluated scenarios. The two crews observed were generally able to initiate and to enter the correct procedure and transition to those sections required to ensure that safety limits were not exceeded. Plant-specific simulator modeling limitations and time constraints precluded long-term evaluation of safety functions that would be challenged and the stable conditions that would eventually be obtained.

The EOPs provided recovery guidance for optimal and functional recovery of all the events considered during the plant-specific simulator scenarios. In some cases, the crews were reluctant to proceed with optimal recovery procedures. When functional recovery was entered, recovery time was prolonged if operators were unsure that the optimal safety function status checks were satisfied because the operators would take the conservative approach and enter Procedure EOP-20 (Functional Recovery). After each scenario, the inspection team debriefed the operating crew to determine their level of understanding of the events that had occurred, the planned, extended recovery actions, and the reasons for the planned long-term actions. The operators also were encouraged to inform the team of any problems they experienced in using the particular EOPs exercised by the scenario. In fact, operators commented about improper simulator machine response (i.e., the simulator response was different than the plant response would have been). This comment was offered as a reason for the altered crew response on two occasions.

During all scenarios the operators responded as they would to a real event in the plant. They generally demonstrated excellent diagnostic skills and good ability to enter the correct procedure. In some cases the optimal recovery procedure was the preferred procedure, but it was considered conservative action when the crew elected to enter the functional recovery procedure.

There was no defined operating policy or clear direction from operations management on how operators were to perform EOPs. With roles and responsibilities undefined, individual crew supervision established the operating policy for the crew. Decisions to enter Procedure EOP-00 to recover or to exit EOPs were made by the operator while rationalizing their choices out loud, with no obvious policy guidance or common philosophy of EOP execution in mind. There were also cases when guidance was needed to determine if a safety function success criterion had been met. In all cases but one, the operators chose to take the conservative functional recovery approach when more explicit or complete safety functions could have been satisfied using the optimal recovery procedure. In the one instance, the crew chose not to enter Procedure EOP-00 at all while meeting three of the five entry conditions when only one entry condition was necessary for entry. Licensee representatives committed to take appropriate actions to ensure that operators have consistent guidance for entry into the EOPs for other than Mode 1 or Mode 2 plant conditions.

The ability of the control room licensed operator crew to mitigate events using the EOPs was marginal when the crew complement was at the minimum level required by the Technical Specifications. Reducing the number of licensed operators in the control room during one scenario resulted in the minimum crew being unable to maintain effective control of safety functions and to diagnose the occurrence of complicating events. When the two operators who had been absent from the control room during the initial stages of the event returned 5 to 10 minutes into the scenario, they were of little assistance in regaining control of safety functions.

Individual operators had to analyze the task to be accomplished by some specific procedure steps to determine the necessary sequence of the actions needed. The analysis avoided the needless delay in recovery because of the awkward or incorrect structure of the steps. The proper sequencing of steps in the EOP would reduce the risk of inadvertently omitting a step.

The operators used the EOP floating steps inconsistently. Some operators tried to remember the floating steps while others infrequently reviewed the steps.

Panel manipulations routinely required crew supervision. Command and control responsibilities during these manipulations appeared to vary, and a single individual did not maintain a continuous leadership role. It became apparent that there were inconsistencies in communicating orders to nonlicensed operators for the performance of steps outside the control room. Followup inquiry indicated that during the performance of EOPs and AOPs outside the control room, nonlicensed operators were given a page, or pages, from the control room copy of the procedure, or they made a copy for themselves in order to perform the actions locally.

The high noise level from audible alarms in the simulator room was detrimental to the mitigation of events because crew members paid more attention to silencing the alarms than to executing steps in the EOPs. The team did not determine if a similar problem existed in the control room.

The team concluded that events could be successfully mitigated using the EOPs only if the control room was staffed beyond the minimum level required during power operation. In addition, licensee attention was needed to formulate policy for control room staff to enter and use the EOPs. It was noted that the success realized in performing the scenarios was directly related to the high level of experience and inherent knowledge of the operators and the observed tendency of the operators to follow a conservative path when there was a lack of direction or policy. Licensee representatives committed to evaluate the staffing needs required to implement the EOPs and AOPs and to take appropriate actions to assure that the minimum staffing level is maintained during plant operations.

2.6 EOP Training

The licensee conducted initial training on the site-specific simulator for the newly revised EOPs in parallel with the EOP simulator validation effort. Subsequently, EOP lesson plans had been developed to familiarize all operators with usage of all EOPs and to make operators familiar with individual EOPs. The EOP simulator scenarios and lesson plans were organized and administered in accordance with instructions in the Nuclear Operation Division Training Administrative Manual (TAM). The TAM provided detailed instructions of sufficient complexity to develop and use event scenarios for training. It also provided a number of methodologies to use for evaluating for operators evaluations during administration of simulator scenarios.

These scenarios were of sufficient complexity and detail to challenge the operators' ability to use the EOPs for event mitigation. Instrument failures, component problems or degradation, and instructions to perform shift assignments involving surveillance tests or administrative duties were included in the scenarios. Operators were further challenged by scenario events requiring transition into and out of procedures.

However, EOP lesson plans were shallow, and important aspects of EOP execution were addressed superficially. Floating steps were only listed, and no insight was provided as to when specific steps would be required or expected in a given procedure. Little operating experience had been incorporated into these lesson plans, and no consistent attempt had been made to provide reasons for specific procedure steps. Many important aspects of a specific procedure were not addressed in lesson plans. Complex evolutions that required timing and integration were not sufficiently explained to the students. This type of EOP training could not be effectively conducted on the simulator, especially for those students whose duties were normally outside the control room.

The effectiveness of EOP training for licensed operators and those preparing to obtain a license was reduced by the distinct differences between plant response and simulator response, the differences between the physical environment in the simulator room and that in the control room, and some actual hardware differences

between the simulator and the control room. In addition, some nonlicensed operators had received little or no training on the structure of the EOPs, how the two-column format was used, definition of terms, or how the procedure was designed to work.

Standing Order O-1, Section 8, specified communication requirements, format, and methodology. The training department taught these desired communication attributes in a formal classroom session using Standing Order O-1. This effort was reinforced by insisting on compliance with these requirements during simulator training sessions and by routinely evaluating the communication skills of students during these sessions. Conversely, there appeared to be no standard for compliance to the standing order among the operating crews in the control room.

The team concluded that EOP training was effective, but improvements were needed in the classroom lesson plans for EOPs. The needed improvement, involved the integration of operating experience and operations department policy. Several areas that required attention by training could not be addressed until the licensee had established operational policy in the specific area. Examples of these areas were communications, EOP entry, and safety function evaluations. Additionally, licensee attention was needed to conduct EOP training at the Technical Specifications minimum control room staffing levels.

2.7 Ongoing Evaluation of EOPs (Task 5)

Section 6.2.3 of NUREG-0899 required that licensees establish a program for the ongoing evaluation of EOPs. NUREG-0899 further requires that the ongoing evaluation program include the evaluation of the technical adequacy of the EOPs on the basis of operational experience and use, training experience, simulator exercises, and control room walkdowns of the procedures.

The team concluded that an adequate program did not exist to ensure that all changes to procedures, setpoint documents, and other material affecting the EOPs were being incorporated into the EOPs. Also, the deficiencies noted in the review of procedures and plant walkdowns did not assure that the licensee's V&V process would discover unincorporated changes to the EOPs.

The team reviewed the licensee's actions regarding NRC Information Notice (IN) 88-75, which identified a potential problem in which the capability to close circuit breakers from the control room may be lost as a result of anti-pump circuitry lockout. The licensee's commitment tracking system showed that the IN was reviewed and found not to be applicable. It appeared that this IN was acted upon in a timely manner.

The licensee performed a quality assurance audit of EOPs and AOPs as required by Appendix A, Attachment 1, Section 8.2 of the Updated Safety Analysis Report and Section 10.1 of the Quality Assurance Plan. Audit Report No. 67, dated August 8, 1990, detailed their assessment to determine the adequacy of the procedure generation package in detailing the requirements of NUREG-0899 and Supplement 1 to NUREG-0737. The licensee used NUREG-1359, "Lessons Learned From the Special Inspection Program for Emergency Operating Procedures," as a primary guide for evaluating the EOP and AOP program during the audit.

This QA audit was the first audit performed of the EOP and AOP program. It was currently on a 3-year cycle, but Audit Report No. 67 recommended that EOPs and AOPs be audited again next year to evaluate program effectiveness. Since the QA audit was so recent, it was not possible to assess the overall corrective actions to the identified deficiencies.

In addition, the onsite Nuclear Safety Review Group (NSRG) reviewed EOPs, EOP deviation documents, and emergency procedure guidelines. The NSRG findings were published as Document SRG 90-479 on August 10, 1990.

It was noted that the QA audit and NSRG review had several of the same findings as those identified in this report. However, the number of issues found during this inspection indicated that a more indepth audit and review would have been appropriate.

2.8 Personnel Interviews (Task 6)

The team interviewed eight licensed individuals, including training and operations management representatives, and three nonlicensed individuals involved in the performance of EOPs and AOPs. The interviews were conducted to augment and clarify the team's findings in other areas of the inspection and to discuss the operators' understanding and knowledge of EOPs and AOPs and their actual experience in using EOPs. EOP training, the adequacy of shift staffing to perform the EOPs, and other related topics were also discussed. In addition to the formal interviews, the team held informal interviews during walkthrough with plant personnel and these have been factored into the team's conclusions that follow:

- The operations department had not defined a clear policy for the use of the EOPs and AOPs, including assignment of roles and responsibilities during the performance of EOPs and AOPs. Lead shift operators had to determine the manner in which EOPs were to be performed, resulted in an inconsistent approach to EOP usage and performance.

- Operators believed that the level of detail in the EOPs was inconsistent, with some steps providing unnecessary information and others providing too little guidance.

- Operators expressed dissatisfaction with the overall inconsistency found in the procedures; for example, in references to locating information in other areas of the plant and to plant nomenclature.

- Nonlicensed operators were not provided with specific training on their roles and tasks during performance of EOPs and AOPs. They had received little or no training on how the procedures were structured, written, or performed.

- Emergency communications via the Gaitronic system were very difficult in certain areas which had no Gaitronic stations and also because the system was overloaded. Although hand radios were identified as an alternative, the lack of radios and signal interference from metal shielding diminished the benefits of this alternative.

- o Normal plant staffing was adequate for execution of EOPs and AOPs. However, it was not clear if this would be true for the minimum level of staffing allowed by the Technical Specifications, because the crews had not been trained under this condition.

- o Although comment on EOPs and AOPs were actively solicited from operators, originators seldom if ever receive feedback on their submittals.

- o Licensed operators believed that the EOPs and AOPs were adequate and that their training on the procedures had been adequate.

- o Plant personnel had confidence that, despite the existing problems, the EOPs and AOPs did support operator response to accident conditions. The licensed operators' understanding of the EOPs was generally consistent and satisfactory.

3. EXIT MEETING

The inspection team met with the licensee on August 31, 1990, to discuss the findings of the inspection. The licensee agreed to implement the immediate and long-term commitments discussed in the executive summary. The licensee did not identify as proprietary any of the materials provided to or reviewed by the inspectors during this inspection.

ATTACHMENT A

TECHNICAL ADEQUACY DEFICIENCIES

Specific examples of the technical deficiencies found during the inspection and generally addressed in the inspection report are described below. The examples are representative and not all inclusive of those findings observed during the inspection.

Basic/Deviation Document Discrepancies With Related Emergency Operating Procedures

The following examples of the Basis/Deviation Document not being up-to-date with the current emergency operating procedures (EOPs) were noted:

- EOP-04, Step 3.11 - The wording in the Basis/Deviation Document did not agree with the current version of the EOP.

- EOP-20, Step 14.22 - The Basis/Deviation Document lists an EOP step that was added without a corresponding emergency procedure guideline (EPG) step and contains a different Step 14.22 than the step in the current EOP.

- EOP-20, Section 16 - This procedure combined three separate sections of the EPG into one section, but the Basis/Deviation Document did not refer to the EOP as presently written and referred to only one of the three EPG sections.

- EOP-05, Step 3.15 - The EOP step directed the operator to go to Step 3.18 while the Basis/Deviation Document directed the operator to go to Step 3.22.

The following examples of the EPG step being modified or not included in the EOPs and not justified in the Basis/Deviation Document were noted:

- EOP-01, Step 7 - This procedure did not include the EPG concerns about reactor coolant pump (RCP) seals and seal cooling.

- EOP-20 - Although EPG Section PC-3, Steps 2, 4, 5, 6, 9, 10, and 11, were included in the floating steps of the procedure, they were not referenced in the procedure itself. The other steps were deleted.

- EOP-20 - EPG Section PC-5, Steps 1 through 7, were included in the floating steps of the procedure, they were not referenced in the procedure itself. The other steps were deleted.

The following were examples noted where a step was added to the EOP without justification in the Basis/Deviation Document:

- o EOP-02, Step 3.29 - this step addressed diagnostic actions that were not contained in the EPG.

- o EOP-04, Step 3.4a - This step directed emergency boration that was not contained in the EPG.

- o EOP-04, Step 3.13 - This step redirected sample drains in Room 60 that were not contained in the EPG.

- o EOP-20, Step 14.13 - The "CAUTION" statement added concerns about the addition of loads to the diesel generators that were not contained in the EPG.

EOP-03, Loss-of-Coolant Accident

Step 2.0, Entry Conditions, contained unclear statements. The procedure stated that indications of "abnormal change in pressurizer level" and "abnormal increase in containment sump level" may be present. However, the procedure did not define what "abnormal" meant. The EOP used indications of "high containment radiation" while the Combustion Engineering Owner's Group EPG looked for "increase in containment radiation." The EPG used either high quench tank level, pressure, or temperature as an indication of a loss-of-coolant accident (LOCA) while the EOP used level, pressure, and temperature.

EOP-04 Steam Generator Tube Rupture

Numerous steps in the EPG were marked with an asterisk to indicate that the actions in these steps were to be performed continuously. However, the floating steps in the EOP did not include these actions, and there were no other provisions in the EOPs to cause these actions to be performed continuously. Examples were EOP-04, Steps 3.2, 3.4, 3.5, 3.6, 3.15, 3.16, 3.18, 3.23, 3.24, 3.27, 3.28, 3.31, and 3.32. In addition, these deviations were not justified in the Basis/Deviation Document.

Step 3.6 directed the operator to stop one RCP in each loop. However, certain power and pressurizer spray capabilities that have an effect on which RCPs are to be secured, and information about these effects would be useful to the operators.

Several of the cautions statements and notes were very long and detailed to the point that they would be difficult to read and could cause significant delay in completing the EOP required actions. Examples were the cautions statements and/or notes before Steps 3.9, 3.10, and 3.27.

EOP-05 Uncontrolled Heat Extraction

Step 3.9.d instructed operators to verify RCP motor radial or thrust shoe temperatures. However, the nomenclature on the control room computer did not match that in the EOP.

Step 3.9.f referred to persistent vibration alarms on the RCPs, but contained no guidance on what "persistent" meant.

EOP-20, Section 9, Functional Recovery of Maintenance of Vital Auxiliaries AC

Step 9.7 directed the operator to to reset offsite power low signal (OPLS). However, the required action was to reset both 86A/OPLS and 86B/OPLS. In addition, they were required to be reset again in Steps 9.8.b and e, an action that appeared to be unnecessary.

The deviation document for Steps 9.11 and 9.12 and the corresponding contingency actions gave instructions to adjust the frequency and voltage for the emergency diesel generators on starting the diesels. However, the EOP did not contain these instructions. Although the operator knew what to do during the walkthrough, the instructions would be helpful as an aid.

Step 9.21.g stated the need to energize normal lighting. However, the step did not reference the applicable operating instruction.

Step 9.66 should be consistent with Step 9.46 in that the applicable designator DC-B1 for the No. 1 battery breaker should be added.

ATTACHMENT B

HUMAN FACTORS DEFICIENCIES

The following are examples of the human factors deficiencies identified in the emergency operating procedures (EOPs) and abnormal operating procedures (AOPs) at Fort Calhoun Station. This attachment is not intended to be an inclusive list of human factors deficiencies; rather, it is intended to illustrate the types of human factors deficiencies identified by the inspection team.

Writer's Guide

The writer's guide failed to:

- Identify the Basis/Deviation Document as a source document for revising and writing EOPs
- Define the structure and relationship of instruction steps and contingency steps
- Clarify the type of information that was included in attachments rather than in the body of the procedure
- Define a clear numbering system for instruction steps versus contingency steps
- Define the minimum type size for figures and resource trees
- Describe the use and format of lists other than those within the logic steps
- Require that a place for operator calculations be provided in the procedure
- Explain how parentheses would be used relative to procedure numbers, sections and figures
- Provide an inclusive list of approved action verbs to be used in EOPs and AOPs

The Licensee's Responses to NRC's Evaluation of the Procedure Generation Package (PGP) Safety Evaluation Report (SER)

The following licensee responses to NRC's evaluation of the PGP were inadequate:

SER Comment A - Although the licensee stated that "OPPD [Omaha Public Power District] believes that the reference of all safety-significant differences in [Standing Order] SO G-74 falls outside the scope of the Writer's Guide," and

it was true that the issue of safety-significant differences from CEN-152 was outside the scope of the writer's guide, the SER comment refers to the PGP, which included the plant-specific technical guidelines.

SER Comment B.1.e. - Resolution required a reference to the second horizontal row of asterisks used to offset caution statements.

SER Comment B.1.f. - Figures 4 and 5 had not been revised.

SER Comment B.2.d. - No Section 4.4.2 existed in the writer's guide.

SER Comment B.3.b. - Resolution indicated that easy configuration management was a higher priority than minimizing operator error. The licensee stated that no section or step numbers would be included in referenced procedures and branches in order to avoid configuration problems when changes to the referenced procedures were made.

SER Comment B.5.g. - The licensee stated that a list of preferred verbs would be provided to procedure writers, with no strict requirements for their use in the EOPs. This lack of restriction could contribute to inconsistency in the instruction steps in the procedures.

EOPs and AOPs

The following are examples of human factors weaknesses in the EOPs and AOPs:

o Logic

Procedure EOP-06, Step 3.11, contingency action: This step violated the guidance on logic structure because of the inclusion of the consequent action within condition "b."

Procedure EOP-06, Step 3.21: This step violated the guidance on logic structure because a "when" conditional statement followed an action.

Procedure EOP-06, Step 3.30, contingency action: The consequent action in this logic step is worded passively, rather than as a directive.

Procedure EOP-06, Attachment 4, Step 20: This step violated the guidance on logic structure because of the use of "THEN" to introduce a second action.

o Referencing and Branching

Procedure EOP-05, Step 3.12: This step directed the operator to go to Step 3.19, however, the Basic/Deviation Document instructed the operator to go to Procedure EOP-06, Step 3.18: This step included an implicit reference to TDB-III.1.a or TDB-111.2. All references and branches should have been clearly identified and structured as directed by the writer's guide.

Procedure EOP-07, Step 3.8, contingency action: This step used the term "complete" to indicate a branch to Steps 3.5 and 3.6, in violation of the writer's guide requirements on branching.

Procedure EOP-07, Step 3.35, contingency action: This step included a reference within parentheses in violation of the writer's guide requirements on both references and the use of parentheses.

Cautions and Notes

Procedure EOP-00, Caution, Step 3.5: The caution statement preceding Step 3.5 was not associated with that step. The first step relating to this caution statement was 3.8, three pages later.

Procedure EOP-04, Cautions and Notes, Steps 3.9, 3.10, and 3.27: These cautions statements and notes were very long and complex, making them difficult to read and likely to cause significant delay in completing the EOP actions.

Procedure EOP-07, Caution, Step 3.36: This caution statement included a conditional action step plus a caution.

Overall Inconsistency

Inconsistency was found in the level of detail provided in the EOPs and AOPs. For example, some steps included references either to operator instructions for basic actions or to information located at a major control board (e.g., EOP-07, Step 3.4; EOP-20, Section 8.0, Step 8.2.a) while other steps failed to identify the necessary references or the multiple actions required to complete the step (e.g., EOP-06, Steps 3.17 and 3.30).

Procedure EOP-06, Steps 3.7.b and 3.7.c: actually constituted one action, which was represented as one step in Steps 3.8.d and 3.9.e. This variation was one example of the lack of a standard step structure throughout the EOPs and AOPs.

Procedure EOP-06, Step 3.10.c, contingency action, failed to provide the necessary level of detail to complete the actions.

The numbering system used for floating steps in Procedure EOP-6 did not provide a parallel structure between floating steps. As a result, there was a potential for confusion and delay. For example, Floating Step 10 was one complete floating step, while the floating step for turbine auxiliaries encompassed Steps 11 and 12.

ATTACHMENT C

CONTROL ROOM AND PLANT WALKTHROUGH DEFICIENCIES

The following are specific examples of deficiencies found during the plant walkthroughs and the verification and validation (V&V) review.

Writers Guide

Although Section 4.5 of the writer's guide stated, that, "a caution. . . cannot direct an action," Procedure AOP-23, Caution 2, page 20, directed the operators to "refer to attached valve position table for valve accident positions and the effects of resetting CIAS [containment isolation actuation signal]." However, this statement was structured as an action instruction, rather than a caution statement, in other sections of AOP-23

Although the writer's guide indicated that "refer to" and "go to" are acceptable referencing and branching terms, respectively. A variety of methods, such as the following, were used in the EOPs to direct operators to move within and between procedures:

- In accordance with EOP-06, Step 3.29, contingency
- Within limits of Procedure EOP-06, Step 3.15
- Continue with. . . Procedure EOP-06, Step 3.9, contingency

The Licensee's Responses to NRCs Evaluation of the Procedure Generation Package

The following licensee responses to NRC's evaluation of the PGP were inadequate:

SER Comment B.2.b. - The licensee incorrectly stated that "AND" or "OR" were no longer in the same statement in the EOPs and AOPs because of the change from a single to a dual-column format. Failure to correctly integrate this SER requirement into the writer's guide had resulted in procedure steps that had more than one possible interpretation and a high potential for error.

SER Comment B.13.a. - No mechanism for ensuring EOPs and AOPs were updated when changes occur in other plant procedures existed.

SER Comment C.3.a. - Section 1.3 of the validation program provided for a table-top review to validate changes to actions performed outside the control room in the EOPs and AOPs. The table-top reviews did not ensure that the actions could be performed by operators and that they would be feasible in the plant.

EOPs and AOPs

Procedure EOP-01, Step 7.6, referred to the containment radiation monitor. However, the monitor was not labeled.

Procedure EOP-04, Step 3.30.a, directed the operator to fill and drain the "A" steam generator. However, filling a steam generator required a reference to Operating Instruction OI-AFW-4, Section 6.12, and numerous actions were required to drain the steam generator, such as blocking CIAS, locally operating drain valves, and starting a pump. Such references and additional instructions were omitted.

Procedure EOP-05, Step 3.19.a(i), required the use of Operating Instruction OI-AFW-4 (Steps 6.7.1-6.7.5). However, the EOP did not reference this instruction. The operator was expected to perform this step and to remember that this instruction was to be used.

Procedure EOP-07, Attachment 2, Step 7.6, contingency action, directed the operator to place the air compressor motor switch at the engine control panel in the "OFF" position. Because there were both primary and secondary motors, it was unclear whether the operator was to place one or both in the "OFF" position.

Procedure EOP-20, Step 9.29ii, instructed the operator to open the emergency lighting breakers located on Panels ELP1 and ELP2. However, it did not give the location of these panels, and the operator could not readily locate the panels.

Procedure EOP-20, Step 9.40, instructed the operator to open the Reactor Coolant Pump RC-3C breaker. The breaker in the field, however, was labeled RC-3D.

Procedure EOP-20, Steps 10.10 and 10.46, instructed the operator to "inspect 1600 AMP in-line fuse link" for DC batteries. During the walkthrough the operator could not locate this item.

Procedure EOP-20, Step 11.5.b.ii, instructed the operator to open Valve AC-1034 on air compressor CA-1A. However, this valve was actually on Air Compressor CA-1B. In addition, Step 11.5.cii, contingency action stated that Valve AC-1042 was actually on CA-1B, but the actual location of this valve was on CA-1A.

Procedure EOP-20, Step 15.113, instructed the operator to turn on Breaker 1A on Motor Control Center 481. However, this breaker was actually located in Cubicle Position 1B instead of 1A.

Procedure EOP-20, Steps 16.61.a and 16.61.b, referred to the selector switch but required manipulation of the enable switch mode selector switches, respectively.

Procedure EOP-20, floating step for safeguards reset, had no entry conditions. It was unclear what conditions should be continuously monitored to determine if reset was required.

Procedure AOP-19, Step 3.14, caution, referred to levels in the safety injection refueling water tank of 16 inches and 72 inches. However, the level indicator for this tank was graduated in 5 inch increments.

ATTACHMENT D

SIMULATOR AND EOP TRAINING SCENARIOS AND DEFICIENCIES

The six scenarios conducted during the simulator evaluation are described below. One crew executed the procedures during the first three scenarios and another crew executed the procedures during the last three scenarios.

First scenario: the reactor was subcritical during startup with the control rod shutdown banks withdrawn, a spurious reactor trip occurred with safeguards actuation, and a main steam safety valve failed open during trip recovery. The team made the following observations:

- The crew chose not to enter Procedure EOP-00 after the reactor trip because the reactor was subcritical before the trip. When the uncontrolled heat extraction occurred, the crew recognized that Procedure EOP-05 provided appropriate guidance; however, the crew mitigated the event without using the EOP because they had not entered Procedure EOP-00.

- Communications were frequently informal and imprecise. Hand signals and terms such as "in the blue" or "screaming up" were used.

- Procedure AOP-23 did not indicate task importance and did not consider competing events in the sequence of restoration. Recovery of pressurizer pressure and level control was needlessly delayed by the sequence of restoration. Also, the procedure did not caution the performer that any reactor trip must be either reset or bypassed to complete diesel generator restoration.

- The shift supervisor had to be prompted to complete the floating step for the reactor coolant pump trip.

Second scenario: the reactor was at approximately 50-percent power, a spurious reactor trip occurred, and a pressurizer safety valve failed open after operators completed Procedure EOP-01. The team made the following observations:

- A mislabeled annunciator in the simulator (pressurizer spray versus safety valve discharge temperature high) significantly complicated diagnosis and mitigation of the actual event.

- When two containment isolation valves in a single steam generator sample penetration line failed to isolate, the operating crew determined that the containment integrity safety function was not being satisfied because the containment isolation actuation signal (CIAS) did not annunciate. The crew indicated that the term "CIAS initiated" would not be satisfied unless all components properly repositioned on a CIAS. Further, the crew indicated that this interpretation had been established during informal discussions among crew members before and during the event, rather than in training or formal policy statements.

Third scenario: the reactor was at 100 percent power, one diesel generator was out of service, three rods were stuck out (unannounced), offsite 161-kV and 345-kV power supplies were lost (all offsite power), and the FW-10 pump failed (the turbine-driven EFW pump, causing a total loss of feedwater). The team made the following observations:

- The crew was not aware that Recovery Procedure HR-4 detailed breaker lineups to restore power to a second high-pressure safety injection pump and pressure operated relief valve.

- The crew elected to delay implementation of Procedure HR-4 and intentionally reduced steam generator inventory before initiating or preparing to implement Procedure HR-4. Because Procedure HR-4 required considerable control manipulations outside the control room during the degraded power conditions, it seemed appropriate to pre-review and plan these activities before initiating Procedure HR-4.

Fourth scenario: the reactor was at 100 percent power, battery charger 1 failed, a DC bus was temporarily lost while switching to the backup charger, component cooling water (CCW) to the reactor coolant pumps was lost, and a small steam generator tube leak occurred simultaneously with the reactor trip that resulted from the loss of the DC bus. Initially, the control room staff was limited to minimum staffing levels (one senior reactor operator and one reactor operator) required by the Technical Specification. The additional staff returned to the control room about 5 minutes after the reactor trip. The team made the following observations:

- The operating crew was unable to accomplish the standard post-trip actions before restoration of full staffing.

- The crew failed to recognize that the reactor coolant pump seals were without CCW for about 7 minutes, until receiving high pump vibration alarms.

- The successful reintegration of the shift supervisor into crew event response activities was not accomplished during the scenario.

- The lead senior operator determined that a DC bus had been lost and not restored, which required entry into EOP-20, because a burned-out light bulb caused the indication on one panel to appear as if it were conflicting with the computer reading and the indication available at the back panel.

- The crew had difficulty determining what was an abnormal difference between the core exit thermocouple and the reactor cooling systems (RCS) T(hot) resistance temperature detectors (RTDs) temperatures to satisfy the safety function status check for Procedure HR-2, Step 6.8 c.

Fifth scenario: the reactor was at 100 percent power, a steam generator tube ruptured, and offsite power was lost after the generator with the tube rupture was isolated. The team made the following observations:

- Core exit thermocouple temperatures were increasing independent of other RCS temperatures. Also, the HPSI flow and diesel generator load indications were oscillating without apparent cause. These indications appeared to be apparent simulator deficiencies. The many disparaging comments made by operators about simulator fidelity to the actual plant and control room substantiated the team's concern about training effectiveness.

- Because there were not sufficient copies of, or sections to, the EOPs for the shift technical advisor and the panel and outside operators, the control room copy had to be taken either for the individual who needed it or the operator had to make a copy.

Sixth scenario: the reactor was at approximately 30 percent power, the 161-kV and 345-kV offsite power sources were lost causing a reactor trip concurrent with a failure of the output breaker for Diesel Generator 2, and Diesel Generator 1 failed after plant conditions were stabilized after the trip. The team made the following observations:

- There was not a single common method for communicating long / complicated instructions to operators outside the control room. Instead, the method was determined on a case basis each time outside communications were needed.

- Procedure EOP-20 safety function status check for heat removal required that SG levels be restored with AFW, but it did not mention restoring these levels with main feedwater.

- Communications were routinely open ended (i. e., individuals at the supervisory level did not respond to the operator as frequently as the operators responded to them).

ATTACHMENT E

PERSONNEL CONTACTED AND EXIT MEETING ATTENDEES

OPPD Personnel:

W. G. Gates, Division Manager, Nuclear Operations Division
J. K. Gasper, Training Manager
J. J. Fluehr, EOP Coordinator
T. L. Patterson, Manager FCS
S. K. Gambhir, Division Manager, Production Engineering
D. J. Matthews, Supervisor, Station Licensing
C. F. Simmons, Station Licensing Engineer
M. P. Lazar, Supervisor, Operations & Technical Training
D. Trausch, Operations Supervisor
R. L. Andrews, Division Manager, Nuclear Services
R. L. Phelps, Manager, Design Engineering
R. L. Jaworski, Manager, Station Engineering
D. J. Lakin, Nuclear Safety Review Group (NSRG) Specialist
L. T. Kusek, Manager, Nuclear Safety Review Group
W. W. Orr, Manager, Quality Assurance/Quality Control
C. J. Brunnert, Supervisor, Operations QA
J. Friedrichsen, Staff System Engineer
B. Weber, Supervisor Reactor Performance Analysis
R. M. Hawkins, Quality Assurance
L. Sills, Quality Assurance
B. J. Matherson, Quality Assurance
T. G. Therkildsen, Supervisor, Nuclear Licensing

NRC Personnel:

J. P. Jaudon, Deputy Director, Division of Reactor Safety
J. E. Gagliardo, Chief, Operational Programs Section, Division of Reactor Safety
T. Reis, Resident Inspector

ATTACHMENT E

PERSONNEL CONTACTED AND EXIT MEETING ATTENDEES

OPPD Personnel:

W. G. Gates, Division Manager, Nuclear Operations Division
J. K. Gasper, Training Manager
J. J. Fluehr, EOP Coordinator
T. L. Patterson, Manager FCS
S. K. Gambhir, Division Manager, Production Engineering
D. J. Matthews, Supervisor, Station Licensing
C. F. Simmons, Station Licensing Engineer
M. P. Lazar, Supervisor, Operations & Technical Training
D. Trausch, Operations Supervisor
R. L. Andrews, Division Manager, Nuclear Services
R. L. Phelps, Manager, Design Engineering
R. L. Jaworski, Manager, Station Engineering
D. J. Lakin, Nuclear Safety Review Group (NSRG) Specialist
L. T. Kusek, Manager, Nuclear Safety Review Group
W. W. Orr, Manager, Quality Assurance/Quality Control
C. J. Brunnert, Supervisor, Operations QA
J. Friedrichsen, Staff System Engineer
B. Weber, Supervisor Reactor Performance Analysis
R. M. Hawkins, Quality Assurance
L. Sills, Quality Assurance
B. J. Matherson, Quality Assurance
T. G. Therkildsen, Supervisor, Nuclear Licensing

NRC Personnel:

J. P. Jaudon, Deputy Director, Division of Reactor Safety
J. E. Gagliardo, Chief, Operational Programs Section, Division of Reactor Safety
T. Reis, Resident Inspector

ATTACHMENT F

DOCUMENTS REVIEWED

EOP-00	Standard Post Trip Actions	R0 07-31-89
EOP-01	Reactor Trip Recovery	R3 07-31-89
EOP-02	Loss of Offsite Power/Loss of Forced Circulation	R7 01-25-90
EOP-03	Loss of Coolant Accident	R8 01-25-90
EOP-04	Steam Generator Tube Rupture	R5 01-25-90
EOP-05	Uncontrolled Heat Extraction	R5 01-25-90
EOP-06	Loss of All Feedwater	R5 01-25-90
EOP-07	Station Blackout	R1 01-25-90
EOP-20	Functional Recovery Procedure	R7 01-25-90
	Safety Function Status Check	
	Resource Assessment Trees	
	Reactivity Control	
	Maintenance of Vital Auxiliaries	
	RCS Inventory Control	
	RCS Pressure Control	
	RCS and Core Heat Removal	
	Containment Integrity	
	Long Term Actions	
AOP-19	Loss Of Shutdown Cooling	R1 02-23-90
AOP-23	Reset of Engineered Safeguards	R1 05-14-90
AOP-30	Emergency Fill of Emergency Feedwater Storage Tank	R0 01-04-90
OI-RC-9	Reactor Coolant Pump Normal Operation	R3

QA Audit Report #67 Audit of EOP/AOP Program

Nuclear Safety Review Group Document Review Independent Technical Review of EOPs dated August 10, 1990

BASIS/DEVIATION DOCUMENT

SOG-74, Writer's Guide

NRC response letter to OPPD, Subject: Safety Evaluation Regarding the Procedures Generation Program for Ft. Calhoun Station, dated October, 1989.

Note: Additional inspection observations noted to the licensee were recorded, tracked and statused through the licensee's EOP Inspection Observation data base dated August 1990.