OMAHA PUBLIC POWER DISTRICT
Fort Calhoun Station

APPENDIX R AND FIRE PROTECTION SELF ASSESSMENT

JULY 1997

C. J. Brunnert
Manager - Quality Assurance & Quality Control

Robert Kalantari
EPM - Engineering Services Division Manager, Team Leader

OMAHA PUBLIC POWER DISTRICT
Fort Calhoun Station

APPENDIX R AND FIRE PROTECTION SELF ASSESSMENT

JULY 1997

C. J. Brunnert
Manager - Quality Assurance & Quality Control

Robert Kalantari
EPM - Engineering Services Division Manager, Team Leader

TABLE OF CONTENTS

OMAHA PUBLIC POWER DISTRICT

FORT CALHOUN STATION
APPENDIX R AND FIRE PROTECTION SELF ASSESSMENT

1.0 EXECUTIVE OVERVIEW

Omaha Public Power District (OPPD) with support from Engineering Planning and Management Inc., (EPM) has conducted an Appendix R and Fire Protection Self-Assessment at the Fort Calhoun Station (FCS). The assessment was initiated by OPPD after a recent NRC inspection that identified several potential violations which called into question the strength of OPPD's Fire Protection Program. OPPD therefore committed to perform a thorough, demanding and objective self-assessment to determine whether the Appendix R and Fire Protection Programs had other compliance-related deficiencies or deviations from current industry standards. Management's intent was to use the results of this evaluation to take actions to achieve an overall strengthening of the Appendix R and Fire Protection Programs at FCS.

An integrated assessment team consisting of EPM and OPPD personnel was selected to ensure that the team members possessed a high level of expertise and current knowledge of current industry practice, including Appendix R technical and regulatory issues, and detailed experience in reviewing areas of continuing difficulty and recurring interest. The team composition was also designed to provide different perspectives on issues addressed.

The Self Assessment Team conducted its review on site during the period of June 2 through 13, 1997, reviewing site records, conducting interviews and performing plant walkdowns (see Attachment 1 for list of individuals consulted).

The assessment focused primarily on those elements of the Fire Protection Program that affect compliance with the Appendix R portion of the Fire Protection Program. Specific areas of review were selected based on (l) team experience and familiarity with recurring areas of Appendix R-related difficulties within the industry; (2) the relative safety significance of those areas; and (3) previous NRC inspection and audit findings. In a number of areas, time limitations did not permit a detailed review of program specifics. Within those areas, the assessment effort generally attempted to review a representative cross-section of compliance requirements, known problem areas, or the underlying criteria, assumptions and methodology which would provide fundamental insights to the processes used.

The primary areas selected for review, provided focus on Appendix R, safe shutdown, the fire protection regulatory framework, and key related programs. Emphasis was placed on 10 CFR Part 50, § 50.48, Appendix R, the operating license, selected Generic Letters and I & E Notices, related analyses and the USAR.

The Appendix R requirements, which were determined to apply to FCS to meet the above criteria as appropriate for review are contained in Appendix R, Sections III.G, J and L. The requirements of Section III.O, also applicable to FCS, received limited review based on a recent NRC inspection of the RCP Lube Oil Collection System.

Key Appendix R areas that were reviewed dealt with provisions to assure safe shutdown. Safe shutdown-related efforts focused on those complex areas of recurring NRC concern such as criteria, assumptions and methodologies for safe shutdown; emergency lighting; manual actions related to shutdown, along with related time limits and performance goals; and a selection of the more difficult facets of spurious actuation of associated circuits, including recent MOV hot short modifications (IN 92-18). Important programs related to Appendix R that were reviewed in varying degrees of detail include the quality assurance program, the modification review processes and the actions established to prevent inadvertent actuation of suppression systems.

The assessment team identified several items that could raise possible questions concerning the extent of compliance achieved by the FCS Appendix R Program, based on current NRC interpretations of requirements. These include OPPD's review and actions taken to correct design configuration concerns identified in IN 92–18 in a timely manner and interpretations of provisions in Generic Letter 86-10. Additional areas requiring re-evaluation include Emergency Lighting, Hot Shutdown Repairs, and Spurious Signal Analysis.

The Assessment Team recommends re-evaluation of these issues based on today's industry expectations. Given the NRC scrutiny on a number of these issues in the recent past, the Assessment Team recognizes potential for adverse regulatory risk. It was noted that OPPD had self-identified several of the weaknesses, and analyses to upgrade the program were ongoing. However, these are sensitive industry issues that will require allocation of resources utilizing a plan and time line.

To help OPPD prioritize its responses to the concerns, a three tier ranking was applied to rank the findings by importance.

The Assessment Team also found: (1) weaknesses may exist in the assignment of clear organizational responsibilities for activities related to Appendix R, and (2) a heavy reliance on outside contractors to maintain the program. These may lead to a potential for, or a perception of, lack of program ownership.

The Assessment Team was asked to provide its comments and observations on the overall Fire Protection and Appendix R program based on today's industry environment and NRC int etation. A number of valid and potentially significant issues were noted, the correction of which will substantially upgrade the FCS Appendix R/Fire Protection Program. Although significant resources and monies have been expended in the past years, many aspects of the program remain in an "ongoing" status with no firm completion dates. Completion dates for issues identified in this assessment are included in the Significance/Resolution sections.

The report identifies specific issues that could result in potential non-conformance with NRC Appendix R requirements or deviations from current Fort Calhoun commitments. This assessment also identifies general concerns and observations which warrant Fort Calhoun's review for corrective action and program improvement. As a result of the Self-Assessment, Condition Report (CR) 199700724 has been written which will track the resolution of the issues identified in Section 5 of this report.

2.0 ASSESSMENT PLAN

The primary focus of the assessment plan was to perform a selective, detailed in-depth review of licensing, engineering, and operations support documentation and calculations. The purpose of this review was to verify that regulatory criteria and associated guidance documents are appropriately addressed and compliance was adequately documented. Fire protection systems, equipment, and program controls which support safe shutdown were also assessed to ensure that appropriate controls are in place and that appropriate equipment is installed and maintained to support safe shutdown capability. The physical configuration of the plant and systems separation and/or protection were field verified on a sample basis with respect to the information contained in supporting documentation.

The self-assessment was performed consistent with the guidance and criteria outlined in NRC Inspection Procedures 64100, 64150, 64704, and 40501. An assessment checklist was generated for use on-site during the two-week assessment period.

3.0 AREAS OF SELF-ASSESSMENT

The team completed its on-site assessment during a two-week period reviewing the following topical areas:

- Safety Evaluation Reports
- Fire Water Supply
- RCP Lube Oil Collection System
- Fire Hazards Analysis
- Long Term Compliance Program
- Combustible Loading Calculations
- Associated Circuits Analysis
- Breaker/Fuse Coordination
- Spurious Signals Analysis
- Common Enclosure Concerns
- Manual Hose Stations
- NFPA Code Compliance
- MHIF Analysis
- Cable Identification and Separation
- Instrument Sense Lines
- Safe Shutdown Electrical Loading and Distribution
- Communication Systems
- Abnormal Operating Procedures
- Plant Automatic Functions
- Process Monitoring
- Component Selection
- Hi-Low Pressure Interface
- HVAC
- Appendix R Compliance Report
- Manual Actions
- Operating Procedures
- Calculations, 86-10 Evaluations
- Emergency Lighting
- Alternative Shutdown
- Quality Assurance
- Penetration Seals
- Combustible Material Control
- Safe Shutdown Analysis
- Training
- Structural Steel Protection

During the assessment period, findings, conclusions, open items, and observations were drafted on an on-going basis. Daily interface/debrief meetings were conducted to keep responsible individuals informed of progress and relevant issues. Discrepant conditions were categorized as potential non-conformances, concerns, or observations. OPPD issued Condition Reports (CR), as necessary. So far, five (5) CR's have been issued.

4.0 APPENDIX R PROGRAM SELF-ASSESSMENT TEAM

The assessment was conducted under the direction of OPPD's QA department. Mr. Clarence Brunnert, Manager of QA/QC was directly responsible for the self assessment. The EPM self-assessment technical team was comprised of four senior consultants, each having over 15 years experience in the areas of fire protection, Appendix R, licensing, design, maintenance and operations, and interface with the NRC. The EPM qualifications of the Assessment Team members are described below:

Senior Consultant Licensing/Systems - Mr. Robert Kalantari
EPM Team Member

Mr. Kalantari has over seventeen years of engineering experience in the nuclear power industry. As a senior consultant at EPM, he has had major responsibility for detailed review of plant electrical and mechanical systems, components and licensing commitments for both BWR and PWR plants to support projects such as Component Classification (Q-List), Environmental Qualification (EQ), Station Blackout, Reg. Guide 1.97 Assessment, USI A-46, "Seismic Qualification of Equipment in Operating Nuclear Power Plants," IPEEE, "Independent Plant Examination of External Events," and Fire Protection/Appendix R projects.

A member grade Fire Protection Engineer, Mr. Kalantari has participated in Fire Protection/Appendix R safe shutdown projects at Monticello, D.C. Cook, Point Beach, James A. FitzPatrick, Peach Bottom, Indian Point 3 and Cooper.

Mr. Kalantari was a consultant to DOE for preparation of Reactor Core Protection Evaluation Methodology for Fires at RBMK and VVER Nuclear Power Plant. He also provided safe shutdown analysis methodology training to over 50 executives and analysts from Russian, Ukrainian, and Armenian nuclear power plants.

Mr. Kalantari is currently assisting Korea in the implementation of safe shutdown and fire hazards analysis in Korea nuclear power plants.

Senior Consultant Licensing/Systems - Keith L. Parkinson (Sonalysts, Inc.)
EPM Team Member

Mr. Parkinson has participated in conduct of NRC Appendix R post fire safe shutdown team inspections at 21 different commercial nuclear power plants. He has developed inspection plans and prepared written inspection reports of inspection findings. Participated on NRC Appendix R Post Fire Safe Shutdown Inspections as the electrical expert and as the mechanical expert. Mr. Parkinson contributed to the Peach Bottom Nuclear Power Plant post fire safe shutdown safety evaluation report (SER). Reviewed proposed and as built designs for separation, common enclosure, associated circuits, high impedance faults, circuit coordination, spurious signals, circuit isolation schemes, associated engineering and technical support practices.

In addition, Mr. Parkinson prepared draft Salem Nuclear Power Plant Appendix R SER. Reviewed licensee and NRC correspondence, design documentation, and inspection history for determination of compliance with 10 CFR 50 Appendix R requirements. He assisted New York Power Authority in resolution of Appendix R restart issues for the Indian Point 3 Nuclear Power Plant. Reviewed mechanical and electrical designs for compliance with Appendix R. Provided assistance and advice in revision of the fire protection and post fire safe shutdown procedures

Technical Consultant Systems/Electrical - W. Cecil Thomas, Jr.
EPM Team Member

Mr. Thomas is an electrical engineer with over 25 years of experience in the nuclear industry. Mr. Thomas was involved with the performance of Appendix R Safe Shutdown Analysis at Watts Bar and Browns Ferry Nuclear Power Plants. Mr. Thomas was a senior team member on the Appendix R (Fire Safe Shutdown) analysis team. As part of this task, he designed and implemented a computerized system for identification and analysis of critical Appendix R attributes. He participated in Watts Bar Nuclear Plant startup and was a member of the Emergency Response Team and Trip Evaluation Team. He prepared and reviewed engineering/design change notice packages and performed, reviewed, and verified calculations pertaining to control systems.

Mr. Thomas was also a systems engineer for various plant systems including reactor coolant, decay heat removal, chemical addition/boron recovery system, turbogenerator controls, and waste disposal.

Senior Technical Consultant Systems/Mechanical - Mr. Paul Colman
EPM Team Member

Mr. Colman has over 19 years experience in reactor plant operation, overhaul and testing. He has a background in all phases of nuclear plant operation, including construction, maintenance and overhaul, power operation, operator training, and troubleshooting of mechanical and electrical systems. He has extensive hands-on experience with all types of mechanical, electrical and I&C equipment. He has knowledge of diesel, nuclear and steam power generation. Mr. Colman was Lead Mechanical Engineer on the Watts Bar Appendix R reanalysis which eliminated the need for 70% of proposed TSI fire wrap. Work included plant walkdowns, system logic and model development, computerized analysis, compliance strategy development, modification concept proposal and technical interface with client.

Mr. Colman was EPM's lead systems engineer for a recent extensive Appendix R re-evaluation at Cooper Nuclear Station and for 10CFR50.54(f) Licensing Basis reviews at Millstone Units 1 and 3. Mr. Colman provides on-going modification review support for Appendix R Safe Shutdown compliance for the Cooper Nuclear Station (one of two primary systems engineers for CNS issues), Indian Point 3 and James A. FitzPatrick Power Plants. He is a registered P.E. (Mechanical Engineering), in the Commonwealth of Massachusetts.

5.0 SUMMARY

Section 5.1 lists the positive aspects of OPPD's Fire Protection Program and following sections identify the concerns raised as a result of this self assessment. To help OPPD prioritize its responses to the concerns, a three tier ranking was applied to rank the findings by importance. The concerns are divided into the three categories that were introduced above: Potential Non-conformance; General Concern; and General Observation. Each category is defined as follows:

Potential Noncompliance: A potential non-compliance is defined as a physical plant feature and/or documentation characteristic that deviates or could potentially deviate from Fire Protection regulations or plant license conditions as they are interpreted today. Each of the items in this group will be addressed appropriately in the corrective action program to ensure compliance.

General Concerns: A general concern is identified when a physical plant condition appears to deviate from guidance documentation or when documentation is not available to support compliance consistent with current industry standards. These issues impact on the ease of the regulator to both understand and concur that the fire protection program conforms to the regulation and licensed plant conditions. All general concerns are being further evaluated to avoid a future noncompliance.

General Observation: A general observation is identified when a condition is noted that appears to be inconsistent with conditions at other nuclear stations that are recognized as good performers, or where plant documentation, procedures, and/or organizational structure, restrain effective implementation of the program. No specific action is required as a result of an observation, however, each should be evaluated for action such that program enhancements can be implemented.

In order to explain the significance of each concern identified by the team, and to identify the FCS position on and actions taken or planned for that item, a Significance / Resolution section was prepared by FCS personnel for each concern. These responses help clarify the overall significance of the concern. Items identified as closed have not been independently verified by the assessment team. These items will be verified during the Fire Protection Functional Inspection which is scheduled for completion by October 31, 1997. Other items from this assessment will be verified on subsequent audits.

5.1 Positive Aspects of the Program

- Centralized Fire Protection Document Records: Significant effort has been invested into gathering all the historical information concerning the fire protection program into a single location, where retrieval is most convenient. The records are concise, complete and arranged to facilitate easy reference.

- Positive Attitude by Design Engineering, System Engineering, Operations and Fire Protection Personnel: FCS personnel were cordial and helpful in aiding the

assessment team and answering questions. The openness of the FCS team did much to make the investigation proceed smoothly.

- Excellent Housekeeping: Cleanliness of both the RCA and BOP were noted during the assessment team walkdowns. Precautions are being taken to control both fixed and transient combustible material throughout the plant. Fire fighting equipment and equipment requiring local operation was unobstructed. It was evident that a great deal of emphasis has been placed on good housekeeping practices. The first impression of the assessment team was strongly favorable.

- Management Involvement: Management personnel attended all of the daily assessment briefs and were aggressive in formulating corrective action. It is apparent that fire protection issues are receiving an appropriate level of priority and importance.

- Breaker & Fuse Coordination Study: This study was comprehensive, well documented, and presented in a fashion which facilitated review.

- Ongoing Efforts, Upgrade in Progress: Several areas identified as potential areas of concern by the assessment team had been identified by FCS personnel. In addition, FCS's approach to the NRC's concerns, to include a self assessment of the entire program, is evidence of strong management direction and a willingness to enhance the program.

- Frequently Updated FHA: FCS's FHA, now up to Revision 21 indicates a document that receives regular scrutiny and is a functional, useful document.

- Participation in Industry Groups: FCS's membership in industry groups (i.e., NFPA, NEI and FP counterparts industry meetings) demonstrates an attitude of leadership and initiative in addressing industry issues that is notable.

5.2 Potential Noncompliances

These concerns are items where corrective actions are strongly recommended. OPPD is addressing the concerns in this group in order to assure compliance. Each of the items in this group will be appropriately included in the corrective action program. Seven (7) Potential Non-compliances were identified.

5.2.1 Fuse Pulling to Achieve and Maintain Hot Shutdown Conditions

- NRC letters dated April 8 and August 12, 1992 to OPPD forwarding the Fort Calhoun Nuclear Power Station Safety Evaluation Reports Revision 10 CFR 50, Appendix R, Items III.G and III.L, contained the following statements:

  "It is our understanding that the District will make modifications to the plant such that no wiring changes or pulling of fuses will be necessary to achieve and maintain hot standby."

"In our SER, we stated that the licensee is to install all necessary equipment and devices such that no wiring changes or pulling of fuses is necessary to achieve and maintain hot standby."

"The Licensee must make modifications to the plant such that no wiring changes or pulling of fuses is necessary to achieve and maintain hot standby, in accordance with Appendix R."

Although these statements appear to be generally applicable to fire protection equipment covered by Sections III.G.2 and III.G.3 of Appendix R, it is clear from the contexts of the statements that they apply only to Section III.G.3.

- Information Notice 85-09 discusses the NRC's concern that fire damage may occur prior to operation of isolation switches related to Section III.G.3 equipment. Such an event may require replacement of blown control power fuses in order to achieve and maintain hot standby conditions. Therefore, it is necessary to have transfer switches that do not require replacement of the blown fuse.

- Throughout the Appendix R inspection process, NRC inspectors have consistently evaluated fuse removal using a fuse puller (tool) as a hot shutdown repair. This interpretation has been applied to both the case where replacement of the fuse is required and where the fuse is removed for circuit isolation to prevent spurious operation.

  Fort Calhoun Nuclear Power Station's procedures direct operators to pull fuses to achieve and maintain hot standby conditions for the purposes of Section III.G.2 areas. Because fuses are not pulled for the purposes of Section III.G.3, Fort Calhoun Station is in full compliance with the SER discussed. (Example: fuses in panel AI-179 for HCV-1107A for fire areas 28, 30, 34A). The Assessment Team recognizes that some instances exist when fuse carriages are removed and evaluates this as an acceptable action.

RECOMMENDATIONS:

It is recommended for applicable III.G.2 areas that, upon completion of the revision of the associated circuit analysis and safe shutdown analysis Fort Calhoun Station (FCS) should adopt current industry practice regarding the pulling of fuses by, either:

1. Designing and installing appropriate plant modifications (isolation / transfer switches) that eliminate the need to pull fuses, or

2. Development of post-fire safe shutdown procedures that do not require fuse pulling.

SIGNIFICANCE / RESOLUTION:

Fort Calhoun Station is in compliance with the SER related to III.G.3 areas and has determined that as part of its intention to upgrade its Fire Protection Program to the high standards set by recognized, good performers, the limited practice of pulling fuses under Section III.G.2 will be discontinued.

For a limited number of low probability fire scenarios, FCS has relied on the pulling of fuses to avoid spurious actuations which could interfere with achieving and maintaining hot shutdown. Even though FCS has concluded, for the reasons discussed below, that fuse pulling was an acceptable action for achieving and maintaining hot shutdown for the purposes of Section III.G.2, a more consistent approach to this aspect of the fire protection program will be either to trip breakers upstream of those fuses or adopt other comparable changes. Procedures will be revised consistent with this decision in a time commensurate with the low significance and probabilities of the limited number of fire scenarios which are involved.

FCS limited fuse pulling to trains of equipment that were needed for compliance with Section III.G.2 of Appendix R. Fuse pulling was adopted as the preferred, acceptable alternative because it minimized the number of components that would potentially have to be isolated in the event of a fire thereby enhancing FCS's overall ability to respond to a fire.

For equipment required for alternate shutdown under Section III.G.3, fuse pulling was not adopted because FCS had committed not to take such action for that purpose. This commitment was documented by the NRC in its SER dated April 8, 1982 and August 12, 1982, which were limited to compliance with Section III.G.3 and III.L of Appendix R. FCS also was aware of documented NRC guidance on this issue which, although somewhat ambiguous, indicated that the simple pulling of fuses, without their replacement, would not be considered a repair for the purposes of achieving and maintaining hot shutdown for the purpose of III.G.2. IN 85-09 was limited to the replacement of fuses and did not address the simple pulling of fuses without their replacement.

Despite this, FCS has now concluded that internal consistency of fire response procedures and current industry practice indicate that fuse pulling should no longer be relied on. Accordingly, fuse pulling will be eliminated from the Fire Protection program as indicated above. This action is expected to be completed by the end of the fourth quarter of 1997.

5.2.2 Potential Concerns with the Associated Circuit Analysis

- EA-FC-89-050, UPDATED ASSOCIATED CIRCUITS ANALYSIS, Rev. 5, contains statements, discussions, and explanations that are inaccurate, incomplete, or contrary to regulatory requirements or guidance. The extent to which these factors affected the associated circuit analysis needs to be documented. The following specific examples demonstrate observed deficiencies in the associated circuit analysis:

Page 16: "Individual conductor(s) within a cable are shorted to individual conductor(s) of a different cable." COMMENT: Short circuits can also occur between conductors in a cable. Hot shorts between conductors in a cable must be included in the associated circuit analysis. Generic letters 81-12 and 86-10 refer.

Pages 22 & 23: "Over-current devices are used for loads off of the post-fire and non-post-fire safe shutdown power supplies. These devices ensure that electrical faults are cleared before they create a fire hazard remote from the location of the fault. Therefore, because EA-FC-91-084 demonstrates that the coordination of all is acceptable, associated circuits by common enclosure do not exist at Fort Calhoun." COMMENT: Circuit coordination demonstrates protection for the common bus concern, not the common enclosure concern. Generic Letter 81-12 refers.

Page 23: Spurious Operation - The uncontrolled operation of a component caused by the energization of associated electrical circuits as a result of fire damage. COMMENT: This is not an accurate definition of a spurious operation. A spurious operation may also be initiated by de-energizing a circuit. The definition of a spurious operation should encompass open circuits, short circuits, shorts to ground, and hot shorts. Generic Letters 81-12 and 86-10 refer.

Page 25: "High impedance fault (HIF) - A fault on a cable which causes it to have a high impedance." COMMENT: An HIF causes the impedance between a cable conductor and another cable conductor or ground to decrease from the normal high impedance provided by the cable's insulation. The HIF causes a fault current that is just below the cable's protective device setpoint (i.e., there is a high impedance in the fault circuit that limits the fault current, rather than a low impedance in the fault circuit that would allow a high fault current).

Page 30: "Identify each location where the identified cables are separated by less than a wall having a three-hour fire rating from cables for the redundant device." COMMENT: If a 3 hour barrier is not provided, then adequate separation may be achieved by having 20 feet of horizontal separation free of intervening combustibles, or a 1 hour barrier with detection and suppression provided. Appendix R, Section III.G.2 refers.

- 10CFR50 Appendix R and Generic Letter 81-12 require that associated circuits be analyzed for the common bus concern, the common enclosure concern, and the spurious signal concern. Generic Letter 86-10 specifies that evaluations (analysis) be available for review on-site.

- EA-FC-89-050 is essentially a multiple high impedance fault (MHIF) analysis rather than a comprehensive associated circuit analysis. Consequently, the analysis appears to be an incomplete associated circuit analysis.

- Because of the concerns with the existing documentation of the associated circuit analysis, it may be incomplete. Therefore, it appears as though Fort Calhoun Nuclear Power Station does not have the documentation needed to demonstrate compliance with Appendix R.

RECOMMENDATION:

1. It is recommended that Fort Calhoun Nuclear Power Station assemble or create the documentation required to accurately demonstrate the analysis for the common bus concern, the common enclosure concern, and the spurious signal concern. Generic Letter 81-12 refers.

2. It is recommended that the associated circuit analysis be integrated into the safe shutdown analysis to minimize errors in translating (applying) the associated circuit analysis to the safe shutdown analysis.

SIGNIFICANCE / RESOLUTION:

- Fort Calhoun Station has upgraded its documentation to current industry standards. The earlier version of EA-FC-89-050 reviewed by the team did contain the identified deficiencies. However, a review of the associated circuit analysis shows that these deficiencies involved assumptions and statements that were in the analysis but were not applied. These statements have since been removed from the documentation and do not impact the analysis.

- In 1994 FCS began an effort to re-evaluate the cable selection methodology. This was done in an effort to develop a cable selection analysis which could be used to demonstrate compliance. This methodology was contained in calculation FC06342. In addition, FCS identified statements contained in EA-FC-89-050 which did not seem to be applied in the analysis. To address this FCS began to develop a cable selection methodology that could then be applied to the existing Appendix R documentation. It was intended that this methodology would then be used to demonstrate compliance with Appendix R. As part of this effort it was determined that EA-FC-89-050 should be revised to more clearly demonstrate compliance. During the time of the audit, the FCS documents for associated circuits (EA-FC-89-050) were in transition. As a result of this there were a number of confusing statements contained in the analysis. The statements were being removed and the methods for evaluation of spurious operations as described in FC06342 were being applied. The specific issues identified by EPM are addressed as follows:

  - In response to the concerns identified by EPM, FCS re-evaluated the MHIF analysis to ensure that it had been performed correctly. No compliance issues were identified.

- The discrepant statements contained in 89-050 have been removed. These statements had no impact on design processes used at the plant. This document is used as a compliance document and not as input for plant design. GEI-15 is used as the design tool to ensure adequate cable separation.

- A discussion which addresses FCS compliance with the Common Bus Enclosure issues has been added to 89-050.

- The spurious signals analysis is contained in FC06342 and EA-FC-89-055. Discussions concerning spurious signals have been removed from 89-050. The spurious signal analysis addresses hot shorts, shorts to ground and open circuits as required by Generic Letter 81-12.

- The exemption granted for fire area 32 was re-evaluated for application to the MHIF analysis. Review of the compliance document shows that the equipment set lost as a result of the MHIF is enveloped by the compliance analysis for the area. Therefore the exemption enveloped a MHIF scenario.

The Fort Calhoun Station will evaluate integrating the associated circuit analysis into the safe shutdown analysis. This action is expected to be completed by the end of the fourth quarter of 1997.

5.2.3 Incomplete Documentation of Spurious Signal Analysis

- A comprehensive spurious signal analysis is an essential and fundamental part of the associated circuit analysis / safe shutdown analysis for 10 CFR 50, Appendix R, and Generic Letter 81-12.

- FC06342, CABLE IDENTIFICATION, Rev. 0, and EA-FC-89-055, SAFE SHUTDOWN ANALYSIS, Rev. 4. Over the years, Fort Calhoun Nuclear Power Station may have performed a complete spurious signal analysis; however, existing analysis documentation does not demonstrate that such an analysis has been completed. Representative spurious signal analysis documentation deficiencies that were noted include:

  1. Cable worksheets are not provided for all safe shutdown cables

  2. The existing spurious signal analysis is fragmented and difficult to evaluate. The information is presented in several different records and locations, rather than in a integrated comprehensive analysis

- Limitations and conflicts in the existing analysis are demonstrated by the following examples:

1. FC06342, CABLE SELECTION, cable worksheets 17 and 18 identify HCV-1103 and HCV-1104 as having cable failure modes of loss of power, loss of control, and spurious operation; however, EA-FC-89-055, SAFE SHUTDOWN ANALYSIS, does not identify how these spurious signals are mitigated.

2. There are no cable worksheets for HCV-347 and HCV-348, LPSI LOOP SHUTDOWN COOLING ISOLATION VALVES.

3. Standing Order SO-G-28, specifies manual actions for HCV-347 in fire area FA 34B.1; however, FA 34B.1 does not contain cables for HCV-347.

RECOMMENDATIONS:

1. Develop comprehensive spurious signal analysis documentation that demonstrates analysis of safe shutdown and associated non-safety related associated circuit cables (Generic Letter 81-12 refers); and

2. Revise the safe shutdown cable work sheet to include required reference numbers such as cable block diagram numbers, schematic numbers, and elementary wiring diagrams. This work is in progress. Reference related CR 199700523.

SIGNIFICANCE / RESOLUTION:

Fort Calhoun Station is upgrading its documentation to current industry standards by developing new documentation for the spurious signal analysis. The earlier version of the spurious signal analysis reviewed by the team did contain examples of the concerns identified. Those concerns will be removed from the upgraded documentation. Also, a review of the examples shows that they did not adversely affect the analysis.

In the case of HCV-1103 and HCV-1104, EA-FC-89-055 shows that for fire areas that contain cables for these valves, the valves are assumed to spuriously operate and are not credited for safe shutdown. For the case where a manual action is identified for HCV-347 in an area that contains no cables for the component, this manual action is required because the power supply for the valve is lost in this area.

For item 2, as described in the response to item 5.2.3 of this report, cable worksheets have been completed for these valves. Cable worksheets will be provided wherever appropriate.

A review of the examples shows that despite documentation concerns the methods used to evaluate spurious operation of components (as contained in FC06342 and EA-FC-89-055) address the requirements of Generic Letter 81-12. Related documents are CR 199700679 (LER 97-04 and 97-09) and CR 199700772 which identified deficiencies and implemented corrective actions.

In conclusion, Fort Calhoun Station is upgrading its documentation to current industry standards by developing new documentation for the spurious signal analysis. This action is expected to be completed by the end of the fourth quarter of 1997.

5.2.4 IN 92-18

- Reviewed licensing documents in response to this IN. Also discussed the issue with the responsible engineer. Although the susceptible alternate shutdown MOVs have been identified since 1992, no actual modifications have been performed. It should also be noted that the concern raised in the notice is applicable to both alternate shutdown as well as normal shutdown areas. The Appendix R rule requires separation of cables and equipment required for safe shutdown to be separated. This includes both safe and alternate shutdown.

RECOMMENDATION:

Identify the valves requiring manual action post fire. Perform weak link analysis to justify the existing wiring configuration. If weak link analysis indicates valve failure, then perform modifications.

SIGNIFICANCE / RESOLUTION:

Fort Calhoun Station has reviewed its position on IN 92-18 and determined that no actions (modifications) were necessary due to its demonstrated ability to avoid the concerns identified in that IN.

For equipment covered by Section III.G.3 areas, actions are proceduralized in AOP-06. AOP-06 instructs operators to take immediate actions to prevent components from being damaged by isolating the components by opening circuit breakers during the initial phases of a control room / cable spread room fire. By taking these actions, damage to the component is precluded. This methodology is characterized in FCS's response to the NRC on how High /Low pressure interface valves are addressed. This is further discussed in FCS's response to 5.2.5. The concerns do not appear apply to Section III.G.2 areas. Preliminary results show redundant trains of safe shutdown valves would remain available.

In conclusion, based on this concern identified by EPM and in light of more recent NRC concerns regarding this issue, FCS will review its position with respect to IN 92-18. This will include the commitment to evaluate the implementation of a modification to reroute cables as recently discussed with the NRC. This action is expected to be completed by the end of the second quarter of 1998.

5.2.5 Shutdown Cooling High/Low Pressure Interface

- The SDC suction valves are not maintained in the condition expected to meet hi-low interface criteria (breaker racked out to prevent spurious operation). Having these breakers closed gives rise to the possibility of a phase-to-phase short in control cables A3876 and B3874 (which both run in the CSR and the

MCR) resulting in a Hi-Low pressure violation and subsequent LOCA. Reference CR 199700713.

- Although proper separation is not provided for the power cable for HCV-348. [Cable A395, shares tray segment 12S(P1A) with cable A10066 for CH-1C cooling pump power, also 480V, 3ø] proper separation does exist for the HCV-347 counterpart.

RECOMMENDATION:

Revise operating procedures to maintain the power supply breakers for HCV-347 and HCV-348 open.

SIGNIFICANCE / RESOLUTION:

Fort Calhoun Station has evaluated this recommendation and determined that additional defense in depth can be achieved by opening the breakers to HCV-347 and HCV-348 during Modes 1, 2 and 3. FCS is currently preparing procedure changes to open the breakers as identified in Condition Report CR 199700713.

Up to now, FCS has not opened the power supply breakers for HCV-347 and HCV-348 during Modes 1, 2 and 3. FCS relied on actions credited in AOP-6 to preclude spurious operations and damage to HCV-347 and HCV-348, Shutdown Cooling Isolation Valves. This action is within the design basis of the NRC SER of April 8, 1982, with respect to high/low pressure interface and for III.G.3 components.

In conclusion, FCS is in compliance. A revalidation of other III.G.2 High/Low interface components to reaffirm that they have proper separation will be performed. This action is expected to be completed by the end of the fourth quarter of 1997.

5.2.6 Emergency Lighting

- Appendix R section III-J requires 8 hour lights in all areas requiring operation of safe shutdown components.

  1) Control Room lighting has not been documented.

  2) Manual actions (or repairs, fuse pulling) are being performed in the control room panels where no emergency lighting is provided.

  3) Manual actions in the yard area are being performed where no emergency lighting is available.

  4) Manual actions (or repairs, fuse pulling) are being performed in the Aux Shutdown panel with no emergency lighting.

  5) Station DC emergency lighting has been credited in lieu of 8 hour battery lights without an evaluation to ensure that such lighting will be available.

RECOMMENDATION:

Install emergency lighting where feasible. In the areas where other lighting will be available, such as the yard area (i.e., security lighting) ensure the lighting will be unaffected by the fire and request an exemption for relying on such lighting. Also evaluate and document the adequacy of fixed Station DC emergency lighting during a fire scenario.

SIGNIFICANCE / RESOLUTION:

Fort Calhoun Station's emergency lighting is in compliance for Section III.G.3 areas. FCS will address the limited deficiencies identified for the documentation and availability of emergency lighting. Emergency lights are not fully available for the pulling of fuses for III.G.2 areas as discussed in 5.2.1. However, the lack of emergency lights would not have prevented safe shutdown because at any time during a III.G.2 fire scenario, the operations department could have isolated components by opening circuit breakers, in an area that did contain E-Lights. Also, it should be noted that for a number of these manual actions, III.G.3 emergency lighting, Security lighting, or normal plant lighting would have a high probability of being available to support the action. Additionally, Standing Order SO-O-1 requires as a commitment for Station Blackout that operators carry a flashlight.

As a result of this finding FCS will re-evaluate the manual actions required for III.G.2 safe shutdown to ensure that adequate lighting is available and upgrade documentation of lighting for the Control Room. This action is expected to be completed by the end of the second quarter of 1998.

5.2.7 Documentation Deficiencies in the Safe Shutdown Separation Analysis

- Reviewed the following evaluations and drawings:

FC06342	EA-FC-89-055
FC06355	B-4250, cable block diagrams

The following discrepancies were noted:

1) Safe shutdown cables listed in Attachment 1 of FC06355 and Attachment 4 of FC06342 do not match.

2) Safe shutdown cables have not been identified for some safe shutdown devices listed in Attachment 4 of FC06342. Examples of such components are 1B4A and 1B4C. Review of the associated block diagram (dwg B-4250 sh. 1) revealed numerous discrepancies between the cables listed on the drawing versus cables listed in Attachment 4 of FC06342. Examples:

   a) Cables EB983, B1696, and B1850 are listed on the Attachment 4 of the FC for component 1B4B. However, cable B21 is the only cable shown on the drawing.

b) Cable EA921 is listed on the Attachment 4 of the FC for component 1B3C. However, cable A17 is shown on the drawing.

c) Diesel fire pump has been credited for safe shutdown. Several cables are listed in the Attachment 4 of FC06342 as safe shutdown cables. These cables are routed in areas 31, 32, 41 and 42. However, review of the separation analysis (EA-FC-89-055) for these fire areas revealed the following:

(1) Area 31, 41 and 42: Under the list of safe shutdown equipment lost for the area, the analysis indicates this pump will be lost. Under the list of credited equipment, the analysis indicates the equipment is available.

(2) Routing of cables from the diesel fire pump to the control room is incomplete. It does not show the routing through area 31A.

(3) Area 31A and 32: the analysis does not indicate the diesel fire pump will be lost, even though there are safe shutdown cables associated with the equipment in the area.

The above findings of inadequate documentation indicate a possibility of "Non demonstrable compliance with the rule".

RECOMMENDATION:

Re-baseline the separation analysis, based on verified safe shutdown cable list and cable routing information. Ensure the separation analysis is auditable and can demonstrate compliance with the Rule (see also Sections 5.2.2 and 5.2.3).

SIGNIFICANCE / RESOLUTION:

The items identified by EPM have been reviewed by Fort Calhoun Station to ensure that they are limited to documentation issues. During this review, no compliance issues were identified. FCS will review this documentation again to ensure that the discrepancies are eliminated and compliance is demonstrated. This action is expected to be completed by the end of the fourth quarter of 1997.

5.3 General Concerns

This section contains twenty-four (24) General Concerns. These concerns are recommended to be completed and incorporated into the compliance program. All general concerns are being further evaluated to avoid a future noncompliance.

5.3.1 Structural Steel Protection

- Appendix R Section III, G.2a states in part, "structural steel forming a part of or supporting such fire barriers shall be protected to provide fire resistance equivalent to that required of the barrier."

- Generic Letter 83-33 states that if "the structure steel is not protected and has a lower fire rating than the required rating of the fire barrier, an exemption must be requested and justified by fire hazards analysis." The updated FHA and the Appendix R Compliance Report do not mention anything about the subject issue. A general walkdown of the plant indicated that in most cases, the structure steel is embedded in the barrier. However, some structural membranes were found, although it is not certain whether they are required to maintain any fire area integrity.

RECOMMENDATION:

Perform a complete plant walkdown. Identify structural steel, if any. Follow the guidelines of Generic Letter 83-33.

SIGNIFICANCE / RESOLUTION:

Based on a walkthrough, there is a high degree of confidence that no unprotected structural steel supports fire barriers at FCS. A plant walkdown to verify this will be performed and documented in 10CFR50, Appendix R compliance documents. This action is expected to be completed by the end of the second quarter of 1998.

5.3.2 Combustible Loading Calculation

- The combustible loading inventory in area 20.1 and area 31 were reviewed. The loading calculation indicates that there are two methane bottles in area 31. It states that the volume in each bottle is 22.5 ft^3. However, the amount of methane in both bottles is calculated to be 1.88 lbs with an equivalent of 44,936 BTU. This appears to be a low value. The loading calculation for area 20.1 indicates that there are two acetylene bottles in this area. Each bottle is listed to be 12" in diameter and 4' high. However, the amount of acetylene in both bottles is calculated to be only 0.43 lbs with a BTU equivalent of 9,242. This also appears to be underestimated.

RECOMMENDATION:

Re-baseline the Combustible Loading Calculation based on defendable data. Revise the FHA as necessary to reflect the correct combustible loading data. The current evaluation is bounding. Reference CR 199700669.

SIGNIFICANCE / RESOLUTION:

The accuracies in the calculations of combustible loads did not raise a safety concern because the deviations were within the analyzed, bounding conservative transient load assumptions. Nevertheless, a complete review of the Combustible Loading Analysis will be performed and CR 199700669 has been written. This action is expected to be completed by the end of the second quarter of 1998.

5.3.3 Breaker/fuse Coordination Problem Resolution

- EA FC-91-084, BREAKER / FUSE COORDINATION STUDY, was performed as part of the Fort Calhoun Nuclear Power Station design basis reconstitution project. The breaker/fuse coordination study is a very comprehensive analysis for both safety related and non-safety related power supplies. Several coordination problems were identified in the analysis and corrective actions developed to resolve the problems.

RECOMMENDATION:

It is recommended that EA-FC-91-084, BREAKER/FUSE COORDINATION STUDY, be reviewed to verify that either:

1. Coordination problems identified in the study have been corrected; or

2. Manual actions as appropriate have been implemented to ensure that protection is provided for the associated circuit common bus concern. Generic Letter 81-12 refers.

SIGNIFICANCE / RESOLUTION:

The issues identified were reviewed and no coordination issues were found. Moreover, the issues arose because at the time of the team's review, the calculation had not yet been updated to reflect modifications recently installed in the plant. However, the modifications had been reviewed separately prior to installation to ensure that coordination has been maintained. The calculation will be updated. The action is expected to be completed by the end of the first quarter of 1998.

5.3.4 Common Enclosure Associated Circuit Concern

- EA-FC-89-050, UPDATED ASSOCIATED CIRCUIT ANALYSIS, was reviewed to verify that Fort Calhoun Nuclear Power Station had been completed for the associated circuit common enclosure concern. The analysis for common enclosure circuits was found to be incomplete for the following reasons:

1. The analysis did not include common enclosure analysis for circuits within a fire area of concern. The common enclosure concern can exist both within and outside the fire area of concern.

2. EA-FC-91-084, BREAKER/FUSE COORDINATION, was incorrectly identified as justification for demonstrating protection for the common enclosure concern.

- In accordance with Generic Letter 81-12, the typical methods for demonstrating protection for the common enclosure concern are:

  1. Demonstration that all cables are electrically protected; or

  2. Demonstration that non-safety related cables are never routed between safety related trains.

- The nuclear industry has demonstrated compliance with either of the above methods by:

  1. Referring to the cable routing specifications listed in the facility Final Safety Analysis Report (FSAR); or

  2. Referring to the wiring specifications contained in the architect engineer construction specifications; or

  3. Reviewing the as-built cable routing documentation; or

  4. Physically walking-down cable routing in the plant.

  Any of these methods, individually or in combination if necessary, are acceptable demonstrations of protection for the common enclosure concern.

RECOMMENDATION:

It is recommended that Fort Calhoun Nuclear Power Station perform a common enclosure analysis and demonstrate protection for the common enclosure concern. The recommended priority of methods for demonstrating common enclosure protection is in accordance with the order listed above.

SIGNIFICANCE / RESOLUTION:

Fort Calhoun Station documentation did not refer to a common enclosure analysis. FCS's associated circuit analysis was not affected because the general design used for the construction of FCS precludes the concerns identified during the audit. Fuses were installed in control circuits as a general design practice. FCS has a fuse program that has verified that fuses as shown on plant drawings are installed in the field.

Nevertheless, EA-FC-89-050 will be revised to properly address common enclosure associated circuits. This will include a discussion which demonstrates that cables are electrically protected by fuses and non-safety cables are not routed between redundant trains. This action is expected to be completed by the end of the first quarter of 1998.

5.3.5 NFPA Code Compliance

- Section 9.11.4.3 of the USAR states that "Guidelines established in NFPA 12A and 10A were generally followed in the system design and installation." (pages 5 and 6 of 29). Review of the August 23, 1978 SER sections 3.1.13 (Page 3-2) and 4.3.3 (Page 4.9) states "The distribution and arrangement of portable fire extinguishers will be in accordance with NFPA 10, 1976." SER section 4.3.2 (Page 4.9) states "The automatic Halon 1301 suppression systems will comply with the requirements of NFPA 12A."

RECOMMENDATION:

"Generally followed" does not equate to "in accordance with." Evaluate deviations from the code requirements. Document such evaluations by reference in the FHA.

SIGNIFICANCE / RESOLUTION:

Fort Calhoun Station compliance with NFPA Codes is addressed in the USAR. FCS was not required, in general, to rigorously apply all applicable NFPA Codes. Section 9.11.1 of the USAR states that NFPA Codes were used as guidance for the installation of fire protection features at FCS. Fire Protection systems at FCS have been installed to meet the requirements of the hazard present as is documented in the Updated Fire Hazard Analysis.

The FP SER's will be reviewed to determine whether particular systems were expected by the NRC to be installed in strict accordance with a particular NFPA Code. These systems will then be reviewed to determine if there are areas where the installation does not meet NFPA Code requirements. For those areas, either the deviations will be justified using GL 86-10 or compliance will be achieved. This evaluation is expected to be completed by the end of the second quarter of 1998.

5.3.6 Cable Selection Methodology

FC06342 "10CFR50 Appendix R Cable Identification", Rev 0 was reviewed and the following comments noted:

- Assumption 2.2 states that "Design basis fires are not assumed to occur concurrently with non-fire related failures in safety systems, plant accidents or the most severe natural phenomena." It should be stated that a loss of offsite power is assumed to occur concurrently for alternate shutdown and must be considered for any other safe shutdown fire unless it can be demonstrated to be available. The self-initiated loss of offsite power at this plant requires all fires to be analyzed without offsite power.

- Assumption 2.3 states that "Fire induced multiple, simultaneous cable faults are not assumed to occur, except for high/low pressure interface components." [Generic Letter 86-10, Question 5.3.1] The Assessment Team does not interpret

Question 5.3.1 in this way. The only "simultaneous multiple faults" exempted from analysis in other than high low interface components are for three phase AC circuits where three phases would have to short in proper sequence, and for ungrounded DC circuits where two hot shorts of proper polarity would have to occur without grounding. It should be noted that these highly unlikely scenarios are still required to be analyzed for high/low pressure interface components. Assumption 2.3 as stated is non-conservative and if interpreted literally could lead to cable fault analysis not in accordance with Generic Letter 86-10.

- Methodology Section 3.2.2 states:

"Short to Ground: The conductor of the circuit shorts to circuit ground (for grounded circuits only)."

Generic Letter 86-10 does not exempt ungrounded circuits from analysis of shorts to ground. All circuits must be assumed to be subject to shorts to ground. This instruction as stated is non-conservative and if interpreted literally could lead to cable fault analysis not in accordance with Generic Letter 86-10.

- Section 3.2.2 states:

"Hot Short: The conductor shorts to an energized conductor through a wire to wire short within the cable of concern or through a short to another circuit powered from the same power supply"

Components can be spuriously operated by any power supply with sufficient voltage and current capacity to operate the device in question. An example but certainly not the only possible case is a solenoid, relay, or motor control center contactor which can be energized by a single hot short to any other motor control center transformer control circuit. This case is highly likely because Fort Calhoun motor control center control transformer circuits share a common ground. This instruction as stated is non-conservative and if interpreted literally could lead to cable fault analysis not in accordance with Generic Letter 86-10.

- Section 3.2.2 states:

"Hot Short: Hot shorts to shielded low level circuits (e.g. 3-20 mA) are not considered credible due to level of protection offered by the shield. Only wire to wire shorts within the shielded cable are considered."

Generic Letter 86-10 does not support this position. Additionally if this position is taken, does it also apply to high/low circuits? A more conservative approach would be to first determine if any cables of this type fail to have adequate separation and then address the specific situation.

- Section 3.2.2 states:

  "All AC circuits must consider hot shorts, shorts to ground (for grounded systems), and open circuits"

  Generic Letter 86-10 does not exempt ungrounded circuits from analysis of shorts to ground. All circuits must be assumed to be subject to shorts to ground. This instruction as stated is non-conservative and if interpreted literally could lead to cable fault analysis not in accordance with Generic Letter 86-10.

- Section 3.3 addresses use of Cable Block Diagrams OPPD B-4250 series and says that they should be verified and marked up as necessary. The block diagrams do not appear to be QA documents, that is, they do not have two party signatures. If they are to be used in the cable identification process, they should be "QA'd", perhaps as part of the verification and markup process. Otherwise, there is an appearance of using non verified data as design input to a QA process.

- The results of the Cable Identification process (Attachment 2) have only been produced for a small subset of the cables. There is an ongoing project to complete the rest of the cables.

RECOMMENDATION:

Discussions with various engineers at FCS revealed that the actual implementation of the instructions in the original analysis were probably more conservative than the procedure (which was only issued last year) would imply. However, because the cable worksheets were not available for the majority of the cables and time did not allow a full review of all cables, it must be assumed that at least some cables were analyzed non- conservatively in accordance with the assumptions and instructions in the calculation.

The Assessment Team stated that the definitions, assumptions, and instructions discussed above vary sufficiently from Generic Letter 86-10 guidance as to require revision of FC 06342 "10CFR50 Appendix R Cable Identification". The cable worksheets which have been produced should be reviewed for conformance with the revised procedure and all personnel producing new cable worksheets should be trained in the revised procedure.

SIGNIFICANCE / RESOLUTION:

Fort Calhoun Station recognizes that the team's understanding of Appendix R may reflect current industry standards and interpretations. Nevertheless, FCS has a high degree of confidence that cables have been selected consistent with the requirements in Appendix R. As noted by the team, the actual methods used to select cables was more conservative than the methods discussed in the analysis. The Cable Block Diagrams are QA engineering drawings.

Nevertheless, the methodologies used for cable selection will be re-reviewed to ensure that the requirements of Generic Letter 86-10 are incorporated accurately. This action is expected to be completed by the end of the second quarter of 1998.

5.3.7 Alternative Shutdown

- AOP-06, FIRE EMERGENCY, and the safe shutdown analysis provides direction to strip the inputs and loads to the 4 kv buses. This action is initiated to prevent fire induced spurious signals from preventing safe shutdown.

- The alternative to having to initiate extreme measures is the completion of a comprehensive spurious signal analysis which identifies:

  1. Station modifications to prevent fire induced spurious operations powered from off-site power; and/or

  2. Procedurally directed manual actions.

- The Fort Calhoun Nuclear Power Station alternative shutdown methodology has been approved by the NRC in SERs and by previous fire protection/Appendix R inspections.

- As identified in NRC inspection reports at other nuclear power plants, the NRC has determined that a self induced station blackout is not preferred. It increases risk and core damage frequency and has been the subject of NRC attention.

RECOMMENDATION:

It is recommended that Fort Calhoun Nuclear Power Station re-evaluate the existing alternative shutdown methodology and implement an alternative shutdown method that does not require extreme measures.

SIGNIFICANCE / RESOLUTION:

Fort Calhoun has determined that a self induced Station Blackout is an acceptably safe method for responding to certain fires. Various alternatives for preventing spurious actions were reviewed during the design of Alternate Shutdown capability. The design has been reviewed and approved by the NRC per SER of April 8, 1982.

This approach is clearly proceduralized in AOP-06. The operators are trained on the procedure, which provides clear direction on how to achieve safe shutdown for III.G.3 areas. Moreover, AOP-06 is consistent with the licensing basis for FCS's compliance with Appendix R. Therefore, no further actions are planned. This issue is considered closed.

5.3.8 Safe Shutdown and Alternative Shutdown Equipment and Cables

Review of alternative shutdown equipment and cables reveals that alternative shutdown cables are located outside the alternative shutdown areas or are not credited for operation with a fire in those areas. Manual operator actions are used to perform required functions where required cables are lost. The alternative shutdown instrument loops reviewed had proper isolation devices from alternative shutdown areas. The alternative shutdown equipment controlled remotely from auxiliary control stations was properly supplied with double fuses if power was required to put the equipment in its required state. A sampling of cables identified for required alternative shutdown and safe shutdown equipment did not reveal any discrepancies in identification or separation. It should be noted however that the lack of a clear documentation trail for cable selection methodology (lack of cable work sheets on the majority of cables) along with the non-conservative interpretation of Generic Letter 86-10 in FC06342 "10CFR50 Appendix R Cable Identification", Rev. 0 makes a comprehensive review of cable identification imperative.

RECOMMENDATIONS:

According to Fort Calhoun Engineers, a complete review and re-documentation (completion of cable worksheets) of a portion of the cable identification process has been completed in accordance with FC06342 Rev. 0 and there is an ongoing process to complete the re-documentation of the balance of the equipment/cables.

No discrepancies were found in a limited sampling of cables. However, the lack of documentation of methodology for the identification of the existing set of required cables and the problems pointed out in the interpretation of Generic Letter 86-10, 5.3.1 in the existing procedure, make it difficult to defend the analysis. It is recommended that FC06342 be revised to eliminate the non-conservatism addressed in this report and all cables be re-documented under the new revision.

SIGNIFICANCE / RESOLUTION:

Fort Calhoun Station recognizes that current industry standards now include an expectation that cable work sheets will be available. Accordingly cable work sheets have been reconstituted and will be retained. Despite the absence of worksheets, a preliminary evaluation shows that compliance is met in all fire areas. FCS will provide further documentation of methodology. This action is expected to be completed by the end of the second quarter of 1998.

5.3.9 Instrument Sensing Line Analysis/Evaluations

- Instrument sensing lines are an integral functional part of the instrument and must be considered in the analysis just as the instruments and cables.

- Instrument sensing lines are not specifically addressed in the Safe Shutdown Analysis. No documentation was available to demonstrate that instrument sensing lines were evaluated. There is no discussion of the identification of instrument lines, their location or routing, their failure modes during a fire, or a methodology to identify and analyze interactions between instrument lines and cables or equipment of redundant shutdown trains.

RECOMMENDATION:

Issue a calculation to evaluate sensing lines for those instruments which provide process monitoring or diagnostics, or could spuriously operate safe shutdown equipment. The calculation should provide for identification of the sensing lines required for Fire Safe Shutdown and demonstrate adequate separation from equipment, cables, and sensing lines of redundant safe shutdown equipment or provide justification for lack of separation.

SIGNIFICANCE / RESOLUTION:

The inclusion of instrument sensing lines in a calculation for a fire hazards analysis is a recent industry enhancement. Limited industry experience with such calculations shows that the previous practice of not evaluating such lines was not a significant issue.

Nevertheless, FCS will prepare an analysis which documents the routing of Appendix R instrument sensing lines and demonstrate the sensing lines adequately support Appendix R safe shutdown. Preliminary reviews show that redundant instrument sensing lines are adequately separated. This action is to be completed by the end of the third quarter of 1998.

5.3.10 Communications Systems

- Communications must be demonstrated to be adequate for safely shutting down with a fire in any of the fire areas addressed in the analysis.

- EA-FC-89-055 Rev 5 Attachment 3.0 section 3.3 has a very good description of the 800 MHZ Radio System, the Intercom/Paging System, and the Telephone System. The normal and emergency power supply for each of the systems is discussed. It was also noted that the Radio and the Telephone backup diesels are periodically tested. Surveillance of the Intercom/Paging system is not discussed. The description of the sound powered phone system says "This sound powered phone system could be used during an Appendix R Safe Shutdown event". This statement is not definitive.

- EA-FC-97-001, Rev. 0 section 4.1.5 addresses three fires: 1) Fire at 9th Trunking System Site; 2) Fire in Room 20; 3) Fire in the UPS/Radio Room in the Warehouse.

  1. The discussion of the effects of the first fire says that radio capabilities will be lost in the RCS including containment but radio communication

will still be available to "most" of the plant through the prime Trunking System Site located at Nashville. There is no discussion of the other areas where radio will be lost or of redundant means of communication if required.

2. The discussion of the fire in room 20 is vague as to which areas in the RCA will have radio communication and what, if any, redundant means are available. It is noted that the paging cabinet is affected. This is significant if the paging system is to be used in case of radio failure.

3. The discussion of the fire in the Warehouse reveals that Control Room, TSC and OSC radio communications are lost. There is no discussion of redundant means to communicate with all required areas.

- There is no documentation of fire area related testing or area by area analysis of communications requirements or availability. For example, is the 800 MHZ antenna system routed such that a fire will not cause a loss of the antenna system, or if the radio or antenna system is lost, will the cables for the Telephone and/or the Intercom/Paging system be affected?

RECOMMENDATION:

Perform and document functional communications testing in all areas for which communications will be required.

Issue a calculation or revise an existing calculation to specifically identify the credited Appendix R safe shutdown and Alternate shutdown communications systems. Demonstrate that the separation of the cables and equipment of the credited communications systems is adequate to prevent loss of all credited systems due to a fire.

If credit is being taken for the sound powered system then a more detailed analysis should be presented as to its functionality for specific fires, otherwise, it should be discussed as an enhancement but not given credit in the analysis.

Any equipment specifically required to be stored for safe shutdown or alternate shutdown (e.g. additional radios, batteries etc.) should be provided with surveillance and the storage location should be evaluated. For example, are additional radios required for alternate shutdown stored in the fire areas which will be lost when alternate shutdown is used? Reference existing surveillance procedures or add equipment to the Safe Shutdown Equipment List to provide continued assurance that any equipment required for safe shutdown will be operational when required.

SIGNIFICANCE / RESOLUTION:

Preliminary reviews show that the communications systems in place are adequate to provide communications during a plant fire event. This is based on the fact that the

communications system present are diverse. In addition the "talk-around" feature for the portable radios can be used when the repeaters are lost. The portable radios are located adjacent to the shift supervisors office and are easily available to operators prior to leaving the Control Room. Nevertheless, FCS will perform a detailed analysis to evaluate the communications system. This action is expected to be completed by the end of the second quarter of 1998.

5.3.11 Plant System Automatic Functions

- Plant automatic functions such as auto-loading of electrical buses, AFW initiation, pump low suction pressure trips, Main Feedwater isolation etc. which are credited for safe shutdown must be analyzed with the same methodology as required equipment (i.e. equipment and cables must be identified and shown to be separated from equipment and cables of redundant shutdown train). A sample review revealed no credited plant automatic functions without adequate analysis. However, a statement in EA-FC-89-055 attachment 3.0 page 9 says:

  "It should also be noted that circuitry exists which will isolate feedwater to the steam generators after a turbine trip. While this circuitry is not credited for Appendix R safe Shutdown it is expected that the circuitry will be available and will perform its intended function based on the assumption that the cables associated with the circuitry would remain intact for approximately 10 minutes after the start of a fire (Assumption 3.2.2.1)" The paragraph goes on to say that the 4 KV busses powering the main feedwater pumps are de-energized manually within the first 10 minutes of the event.

RECOMMENDATION:

Review all documentation to ensure that no automatic functions are credited without fully analyzing all equipment, cables, power supplies, etc. required to support the automatic function.

SIGNIFICANCE / RESOLUTION:

Automatic plant functions are not presently credited for Appendix R safe shutdown. Therefore it is not strictly necessary to analyze that circuitry. However based on additional discussions, it may be desirable to add some automatic plant features to the shutdown analysis. FCS will review the safe shutdown methodologies and determine if any automatic features should be credited (i.e., feedwater isolation). If automatic features are to be credited then the circuits would be analyzed in accordance with the requirements of Appendix R. This action is expected to be completed by the end of the first quarter of 1998.

5.3.12 Tank Level Indicators

- The level indicator for the BASTs is an air-operated bubbler-type sensor; instrument air is not credited for operation in the Appendix-R scenario at FCS. The SSEL states "not required for SSD; indicator is included to support operator." IN 84-09 interprets that level indication be provided for all tanks used.

- The Safe Shutdown Equipment List (SSEL) does not include a level indicator for the SIRWT.

RECOMMENDATION:

For both SIRWT and the BASTs, the plant credits minimum Tech Spec inventory and rate of usage to demonstrate that tank(s) will not drain; this reasoning should be documented in the Appendix R compliance report. It should be noted that AOP-6 actions (Attachment C) could lead to only one BAST tank in service, reducing the available makeup by ½.

SIGNIFICANCE / RESOLUTION:

The tank levels are maintained in accordance with Technical Specification levels and FCS has already determined that the potential spurious drainage of these tanks is not credible because the leakage paths are protected and/or unaffected due to a fire. The limited absence of credited level indication does not affect the ability to shutdown safely.

FCS will prepare documentation and/or calculations to verify that the credited tanks will have adequate inventory to supply the required water to the safe shutdown systems during a postulated fire scenario. This action is expected to be completed by the end of the second quarter of 1998.

5.3.13 SG Level Instrumentation

- The systems logic credits any of the 11 SG level indicators as satisfying process monitoring requirements. Only 4 of these instruments meet IN 84-09 guidance which specify wide range indication.

RECOMMENDATION:

Credit only wide range SG level instrumentation. As a backup, the NRC has allowed narrow-range instruments plus feedwater flow indication to prevent SG dryout.

SIGNIFICANCE / RESOLUTION:

The four wide range instruments meet IN 84-09 guidance and are credited. Fort Calhoun Station is confident that the operators are capable of determining when the

narrow range monitors cannot be relied on. Nevertheless, FCS will revise the compliance documentation to credit only those instruments which meet IN 84-09 guidance. FCS will ensure that operations personnel are aware of the instruments to be credited for safe shutdown in each fire area. This action is expected to be completed by the end of the first quarter of 1998.

5.3.14 SSD Analysis Outputs

- Fire Area 34A (Lower Electrical Penetration Area): no SG level or pressure indications appear in the List of Credited Equipment.

- Compared the "List of Credited Equipment" for Fire Area 20 (20.1, 20.3, 20.7) which were indicated as requiring Manual Actions to the corresponding list in SO-G-28. The following discrepancies were noted:

  a) Required manual actions for HCV-2808A/B/C/D and HCV-2809A/B do not appear in G-28.

  b) Manual operation of SI-186 was directed in G-28 without Analysis justification.

RECOMMENDATION:

A thorough review of analysis should be conducted to ensure accuracy, completeness, and an auditable analysis.

SIGNIFICANCE / RESOLUTION:

Fort Calhoun Station has reasonable assurance that any documentation deficiencies did not affect the accuracy of the SSD analysis. A review of the issues identified by the team revealed no compliance issues. FCS will completely review the separation documentation to ensure that bases for compliance are accurately documented. This action is expected to be completed by the end of the first quarter of 1998.

5.3.15 SG Overfill

- SG overfill concerns rest on an assumption that no spurious actions will occur within the first 10 minutes. This assumption might be susceptible to challenge based on:

  a) not all cables for SSD devices are purchased under specs appropriate for ESF systems, and

  b) it begs the question of when t=0 (which may in fact be the first spurious action).

RECOMMENDATION:

This assumption is unique in the industry and may be questioned by the NRC, even though it rests on valid experimental data. Evaluate the (many) facets of the Appendix R compliance strategy that credit this "grace period" on their own merits and develop specific time requirements.

SIGNIFICANCE / RESOLUTION:

FCS has recently reinforced the technical bases for its reliance on this time period and the associated approach to safe shutdown with a recent reevaluation of this approach and accompanying modifications to AOP-6. The details of this reanalysis and changes to AOP-6 have been discussed recently with the NRC. Nevertheless, FCS will continue to review this approach to identify either enhancements to it or reasons to reconsider it. This action is expected to be completed by the end of the third quarter of 1998.

5.3.16 VCT Isolation

- The Manual Actions calc allows 30 minutes to isolate the VCT (based on establishing boration within 30 minutes). Given failures of LCV-218-2 and -3, and 3 CCPs operating, with VCT level initially at the bottom of the normal control band, the VCT could be emptied in 12 minutes, with resulting damage to the pumps.

RECOMMENDATION:

Review the Appendix R Manual Actions "groups" for assumptions that may not be valid for all components to which they are applied.

SIGNIFICANCE / RESOLUTION:

A calculation (FC06658) has been prepared which shows that the VCT would remain available for approximately 12 minutes with three charging pumps running. AOP-06 trips these pumps within the first 10 minutes of the event, therefore the pumps will be tripped prior to losing the VCT as a suction source. This issue is considered closed.

5.3.17 Auditor Technical Qualifications

- The Fort Calhoun Nuclear Power Plant Quality Assurance audits of fire protection were reviewed and found to include evaluation of both classical fire protection concerns as well as Appendix R concerns. The fire protection auditors included Fort Calhoun Nuclear Power Station personnel as well as fire protection experts from other nuclear utilities.

Quality Assurance Department representatives were interviewed to ascertain the technical qualifications of the auditors performing the Appendix R evaluations. The selection of these auditors was based on the qualifications listed in their resumés and their experience in managing fire protection and Appendix R programs at their plants.

It has been this reviewer's experience that, although industry fire protection engineers have knowledge of the requirements contained in Appendix R, they rarely have in-depth technical knowledge, experience, and qualifications in associated circuit analysis, safe shutdown analysis, safe shutdown methodologies, and alternative shutdown.

- Based upon the findings of this evaluation team, it appears that past Fort Calhoun Nuclear Power Station fire protection audits have been ineffective in identifying Fort Calhoun Nuclear Power Station Appendix R deficiencies. It is the opinion of this reviewer that the apparent ineffectiveness of the Fort Calhoun fire protection audit program is related to the technical qualifications of the auditors reviewing Appendix R issues.

RECOMMENDATION:

Because Appendix R and safe shutdown capability evaluation requires qualifications beyond classical fire protection qualifications, fire protection audit teams should include auditors having extensive Appendix R and safe shutdown experience.

It is recommended that future Fort Calhoun Nuclear Power Station fire protection audit teams evaluating Appendix R and safe shutdown issues include at least one auditor having extensive Appendix R, associated circuit analysis, safe shutdown analysis, and alternative shutdown experience.

SIGNIFICANCE / RESOLUTION:

Fort Calhoun Station has determined that the fire protection audit team's qualifications need to be enhanced to assure effective audits are conducted. FCS will have additional Fire Protection training for the QA Fire Protection Functional area expert. Fire Protection Audit Teams will include at least one team member having extensive Appendix R and/or safe shutdown experience. An FCS management representative or a member of the Safety Audit and Review Committee will be assigned for each Fire Protection Audit. These actions will provide reasonable assurance that fire protection audit teams have the qualifications, knowledge, experience and management oversight, to effectively monitor and evaluate fire protection program at FCS. The actions are expected to be institutionalized into the QA Program by the end of the fourth quarter of 1997.

5.3.18 Combustible Control Program

Reviewed plant standing order SO-G-91 "Control of Transportation of Combustible Material". The procedure establishes the requirements for the storage and handling of combustible materials. Step 5.1.1 of the procedure allows transient combustible of 100 lbs of class A material, 5 gallons of class B material and 500 scf of flammable gas in the auxiliary building and the intake structure. The procedure does not make an exception for plant vital areas such as the control room, cable spreading room or the switchgear rooms. These areas, especially the cable spreading room and the control room, are vulnerable areas. In fact the fire PRA analysis takes credit for the absence of transient combustible material. Allowing transient combustible in these areas should be restricted. In fact there should be no reason for needing the stated amount of combustible material (I. e., 500 scf of flammable gas and 5 gallons of class B material) in the control room or cable spreading room.

RECOMMENDATION:

Revise SO-G-91 to restrict transient combustibles in the cable spreading room and the control room.

SIGNIFICANCE / RESOLUTION:

Limiting the amount of transient combustibles in vital plant areas would be consistent with industry standards and aligned with PRA. Therefore, this recommendation will be adopted, despite the circumstances that current limits on transient combustibles are within FCS's Appendix R design basis. The action is expected to be completed by the end of the second quarter of 1998.

5.3.19 Training

Because the recent NRC fire protection inspection determined that a module of fire brigade training had not been conducted within the required 2 year training period plus the allowed 25% surveillance frequency window, operator and fire brigade training were reviewed.

- It was determined that the overdue fire brigade training was in progress. The training has been completed for 5 groups of fire brigade members and should be completed for the remaining 2 groups by the end of June.

- Licensed operator training is conducted in two year cycles. Licensed operator training in AOP-06, FIRE EMERGENCY, was last conducted during the 96-2 training rotation, starting 3/7/96 and continued for 6 weeks.

- Non-licensed operator training records indicated that training in AOP-06 for non-licensed operators has not been conducted since 1992. Training representatives stated that non-licensed operators and licensed operators were

trained separately through the 96-2 training rotation. Commencing with the 96-3 training rotation, licensed operator and non-licensed operator training programs covered the same training topics.

- Training materials for the fire brigade and operators was sampled and found to be of very high quality. The training program includes both classroom and practical training.

- Training for personnel involved in Appendix R activities was last conducted in 1992. Some of the personnel involved in the Appendix R engineering process have not been trained in Appendix R techniques.

RECOMMENDATIONS:

1. It is recommended that non-licensed operators receive AOP-06, FIRE EMERGENCY, training at the first opportunity.

2. It is recommended that technical training be conducted for personnel involved in associated circuit analysis, safe shutdown analysis, and related Appendix R and fire protection requirements.

SIGNIFICANCE / RESOLUTION:

All future Fire Brigade training classes have been scheduled to ensure the required training falls within the 24-month limit, no allowance is being taken for the six month grace period. The Fort Calhoun Station Non-Licensed Operator Training Program Master Plan trains on AOP-6. At the time of the audit, the OPTIM records which documented training were not reviewed. Licensed and non-licensed operators have recently been trained on AOP-6. Evaluation for technical training of personnel involved with Appendix R will be performed. This action is expected to be completed by the end of the second quarter of 1998.

5.3.20 Use of Offsite Power

- The Safe Shutdown Analysis does not credit offsite power for safe shutdown or alternate shutdown. However, tripping of the offsite functions is a required function for Appendix R. Therefore, the necessary equipment and cables must be analyzed to assure that offsite power is tripped and cannot be reestablished by fire induced spurious operation. As such, analysis of equipment and cables for voltage regulation, load tap changer operation, transformer cooling equipment, DC power for switchgear operations, etc. for offsite power should be evaluated. In addition, the effects of having offsite power on safe shutdown must be evaluated..

RECOMMENDATIONS:

1. If the tripping of all offsite power is to remain a requirement for safe shutdown and alternate shutdown, the analysis of the cables and

equipment discussed above will be required and therefore, the circuits required for this function must be included in the analysis.

2. Evaluate the effects of offsite power on safe shutdown before it is tripped.

SIGNIFICANCE / RESOLUTION:

FCS will evaluate and, where appropriate, revise EA-FC-89-055 to identify and document actions which must be taken to mitigate any spurious operations that may result from the interim availability of offsite power. In the interim, FCS considers that adequate guidance for this low probability scenario is provided by AOP-06, and also addresses III.G.2 actions. ECP-20 and SO-G-28 provide adequate guidance to operators on how to mitigate any spurious operation of equipment and to achieve safe shutdown. The action is expected to be completed by the end of the second quarter of 1998.

5.3.21 Generic Letters and Information Notices Related to Fire Protection

- Licensing files for the following Generic Letters and Information Notices were obtained

GL86-10	IN85-85	IN88-56
GL81-12	IN87-14	IN91-17
IN83-41	IN92-18	
IN83-69	IN86-35	
IN83-83	IN87-50	
IN84-09	IN88-04	
IN85-09	IN94-28	

The review indicated that a response to each one of the above issues was prepared. It appears that a licensing process for addressing the Generic Letters and Information Notices is in place. In general, the technical adequacy of the responses were found to be adequate. The exceptions are noted and discussed under the respective issue contained in this report.

RECOMMENDATION:

Reevaluate responses to noted exceptions (IN 92-18 and GL-86-10, cable selection methodology topics) and provide enhancements as necessary.

SIGNIFICANCE / RESOLUTION:

The response to a number of Generic Letters was questioned. These issues were addressed by other findings during the audit, therefore, no specific response is required and this issue is considered closed.

5.3.22 Multiple High Impedance Fault Analysis

- EA-FC-89-050, ASSOCIATED CIRCUIT ANALYSIS, contains the Fort Calhoun Nuclear Power Plant multiple high impedance fault analysis (MHIF). The MHIF is a comprehensive analysis that identifies several different power supplies that are subject to loss by MHIFs.

- The analysis was performed using a conservative assumption that all loads on a given power supply would experience simultaneous HIFs. Although this approach is very conservative, it may be unduly restrictive. It is the reviewer's opinion that the analysis was performed systematically, but used overly conservative assumptions.

- The analysis cited SER exemptions from the Appendix R, Section III.G separation requirements as demonstration that protection against MHIFs is acceptable. Refer to Section 5.2.2 for this issue.

RECOMMENDATION:

It is recommended that the MHIF analysis be reviewed as follows:

1. Review the use of overly conservative assumptions in the analysis. In those cases where protection against MHIFs is not demonstrated, analyze using an iterative analysis process with less conservative assumptions may be appropriate until protection against MHIFs can be demonstrated.

2. In those cases where analysis can not demonstrate protection against MHIFs, then, either:

   a. Develop procedural actions to mitigate the effects of MHIFs; or

   b. Implement plant modifications as appropriate.

   Implementation of procedural actions to mitigate MHIFs should be the most cost effective and preferred method for demonstrating protection against MHIFs.

SIGNIFICANCE / RESOLUTION:

FCS acknowledges that the MHIF methods used are conservative. However, these methods will not be revised because they provide an extra margin of safety consistent with today's increased expectations. Manual actions which are required to mitigate the consequences of MHIF, as identified in this analysis, are addressed in AOP-32. No further action is needed and the issues is considered closed.

5.3.23 Fire Water Supply

- During the audit, maintenance and testing was performed on both the electric and diesel driven fire water pumps. As a consequence of this maintenance and testing, both fire water pumps were out of service concurrently. The existing Fort Calhoun Nuclear Power Station documentation does not identify how fire water should be provided during an extended simultaneous loss of both fire water pumps.

- Although not described in official documentation, a capability to provide water from the Fort Calhoun Nuclear Power Station water treatment plant with makeup from the Blair water system is available. This capability has a capacity of approximately 1000 gpm. This is less than the 1800 gpm flow rate provided by either of the fire water pumps. Per a station fire protection representative, the 1000 gpm flow rate is sufficient for the station hose stations, but is not adequate to supply the station's sprinkler system. This capability is not included in either the Fort Calhoun Nuclear Power Station Fire Hazard Analysis (FHA) or the fire protection system testing and maintenance program.

RECOMMENDATION:

Because a simultaneous loss of both the diesel driven and electric fire pumps occurred, it is recommended that a capability to provide the design fire water flow rate during a simultaneous loss of both fire water pumps be developed. 10CFR50, Appendix A, Appendix R, and FCS SERs refer.

SIGNIFICANCE / RESOLUTION:

Fort Calhoun Station's Updated Safety Analysis Report and Standing Order SO-G-102 and SO-G-103 require a backup fire suppression water system within 24 hours when no fire suppression water system is available. The issue described during the self assessment has been evaluated and documented in 199700683 and subsequent LER 97-006. The LER determined the event had little effect on nuclear safety. FCS will incorporate, as appropriate, the alternate methods of aligning backup fire suppression in the Fire Hazards Analysis. The action is expected to be completed by the end of the first quarter of 1998.

5.3.24 No Abnormal Operating Procedure for Non-Alternate Shutdown (Non-ASD) Areas

- In general, AOP-6 provides inadequate direction for fires other than those requiring Control Room evacuation and fire in the upper electrical penetration area. Specifically, no direction is provided for which manual actions to direct, and the operators are apparently left to consult Table 3.1 of EA-FC-89-055, or SO-G-28, which in turn provide little guidance for prioritizing manual actions.

- As a general comment for Non-ASD areas, no direction is provided to de-energize a valve at the MCC prior to handwheeling the valve.

- The list of Manual Actions (by fire area) in SO-G-28 provides no assistance to the operator in prioritizing the listed manual actions (the manual actions are sorted by Component Identification Number).

- Manual action to close MSIV by failing air (EA-FC-89-055 Table 3.1): no instructions on how to perform, insufficient emergency lights.

RECOMMENDATION:

Develop a new AOP to cover non-III.G.3 plant fire areas. Relocate the manual actions from SO-G-28 to this new AOP and provide guidance on priorities/time constraints for all hot shutdown manual actions. Include information on "paired" actions such as breaker operations for failed MOVs and valve operations requiring specific sequence.

SIGNIFICANCE / RESOLUTION:

Fort Calhoun Station has actions to preclude spurious operation of equipment in III.G.2 areas in Standing Order SO-G-28. Operators have adequate guidance for fires in III.G.2 areas utilizing Emergency Operating Procedure EOP-20, Standing Order SO-G-28 and Operator training. Additionally, any shutdown resulting from a III.G.2 fire would be performed in the Control Room. FCS will review the present procedures to determine the benefit of an additional Abnormal Operating Procedure for III.G.2 areas. This action is expected to be completed by the end of the third quarter of 1998.

5.4 General Observations

A general observation is identified when a condition noted that appears to be inconsistent with conditions at other compliant nuclear stations, or where plant documentation, procedures, and/or organizational structure, restrain effective implementation of the program. No specific action is required as a result of an observation, however, each should be evaluated for action such that program enhancements can be implemented. This section contains twelve (12) General Observations.

5.4.1 Long Term Compliance (GEI-4)

- General Engineering Instruction 4 (GEI-4) provides the mechanism for reviewing design changes for fire protection and safe shutdown impact. The instruction is a high level document. It instructs design engineers to complete the fire protection system interaction review checklist. The checklist does not provide instructions to review the proposed modifications for impact on breaker and fuse coordination study, associated circuits and the Appendix A and Appendix R commitments.

RECOMMENDATION:

Revise GEI-4 check list to include the above-discussed questions. See enclosed sample checklist prepared by EPM.

SIGNIFICANCE / RESOLUTION:

GEI-4, including form GEI-4.1, has been revised to enhance the instructions on how to conduct reviews of modifications that impact the electrical aspects of Fire Protection. No further action is required and this issue is considered closed.

5.4.2 Raw Water Strainers Credit

- Raw Water strainers are not credited for automatic operation and will be manually backwashed as required. The DP instruments are not credited SSD instruments; how will strainer clogging be evaluated?

RECOMMENDATION:

Either justify (by formal calculation) that strainer clogging will not occur over the course of the Appendix R event, or provide remote indication, or provide instruction to monitor DP locally.

SIGNIFICANCE / RESOLUTION:

FCS has procedural guidance in Operating Instruction OI-RW-01 for manually backwashing raw water strainers. Additionally, raw water strainer high differential pressure is annunciated on panel CB-1/2/3 in the Control Room and directs corrective action. A reference to this procedure will be added to the functional requirements analysis. The action is expected to be completed by the end of the fourth quarter of 1997.

5.4.3 Intake Screens and Wash Pumps Not In Functional Requirement Document

- Intake screens and screen wash pumps are not discussed in the Functional Requirements document.

RECOMMENDATION:

There should be a calculation or operating experience-based evaluation that discusses not considering these. Provide a discussion of this in the functional requirement document.

SIGNIFICANCE / RESOLUTION:

FCS will add a discussion with regard to existing capabilities of the intake screens and wash pumps through evaluation or operating experience. The action is expected to be completed by the end of the fourth quarter of 1997.

5.4.4 RCS Hot Leg, PZR Surge Line and SG Sampling Connections

- RCS Hot Leg and Pzr Surge line connections to the sampling system (¾" to ⅜" sample tubing) are not considered RCS boundaries. This should be addressed in some fashion.

- Same comment for SG sampling; at least these are mentioned in the Functional Requirements document, but without specific backup calculation.

RECOMMENDATION:

Justify (by formal calculation) that the losses through sample line paths are within makeup capacity.

SIGNIFICANCE / RESOLUTION:

Fort Calhoun Station has reasonable assurance of RCS inventory control within the current Functional Requirements Analysis. This is based on the fact that for Fire Areas where these isolation valves may spuriously open, adequate make-up capability exists. Nevertheless, FCS will provide a formal calculation and discussion in the Functional Requirements Analysis to document losses through sample lines. The action is expected to be completed by the end of the fourth quarter of 1997.

5.4.5 High/low Pressure Interface Component Selection

- Several components are identified as High-Low Pressure Interfaces which do not require such highlighting. For example, MOVs in the SI system that are backed by check valves (provided those check valves are subject to TS surveillance monitoring) need not be considered High-Low Pressure Interfaces.

- The High-Low Pressure Interface Component List in the SSEL and the corresponding list in the Associated Circuit Analysis do not match.

RECOMMENDATION:

Review High-Low Pressure Interface List and identify only those (1) whose spurious opening would overpressurize low pressure piping and potentially result in LOCA and (2) which are not designed to close against system differential pressure.

SIGNIFICANCE / RESOLUTION:

FCS will enhance the current level of information in both the Functional Requirements Analysis and Compliance assessment documents to meet increasing industry expectations. Refer to the resolution to Item 5.2.5. This information will be clarified and located in the FRA. The action is expected to be completed by the end of the fourth quarter of 1997.

5.4.6 Pressurizer Spray Spurious Operation

- The most serious plant transient from the RCS pressure/ inventory standpoint is considered to be the spurious opening of a pressurizer PORV. The spurious opening of the pzr spray valve should be evaluated as a more serious transient. Spurious opening of the pzr auxiliary spray valve (colder water) should also be evaluated.

RECOMMENDATION:

Although mitigating actions are taken to address this concern, an evaluation of these potential failures (perhaps on the simulator) should be documented/ described in the Appendix R Compliance Report.

SIGNIFICANCE / RESOLUTION:

FCS will meet current industry expectations by adding a bounding discussion of Pressurizer/Auxiliary spray spurious operation (PORV operation worst case) to the compliance assessment EA 89-055. This action is expected to be competed by the end of the second quarter of 1998.

5.4.7 LPSI Cold Shutdown Cable Repair

- Repair on LPSI power cable: the tray segment called out in the procedure could not be located. Splicing appears to be difficult at best. Consider new junction boxes.

- The required material was verified to be pre-staged in the warehouse. However, a deficiency was noted in the labeling of the replacement cable which led to the warehouse operator stating that he would feel free to issue no more than 300 ft. of the cable on the roll. The inventory list indicated that all 1100 ft. were required.

RECOMMENDATIONS:

(1) Label the appropriate cable and tray
(2) Correct the discrepancy between the inventory list and the labeling on the cable roll.

SIGNIFICANCE / RESOLUTION:

Fort Calhoun Station procedure AOP-6, Attachment K references drawings 11405-E-62 and 67 for repair of cable EB14 associated with LPSI Pump SI-1B. The referenced drawings clearly indicate the cable tray where cable EB14 can be located. This is a 5KV cable and is a cable tray by itself. The cable tray section line referenced in the procedure can be found on drawing 11405-E-62, at the east end of the corridor as described in AOP-6.

Nevertheless, FCS will verify that the markings on the side of the tray indicating section 16A are clearly visible and remark the tray. The labeling on the prestaged cable reel and splice material will be evaluated for clarity and relabeled as required. Warehouse personnel will be made aware of the special nature of these materials. This action is expected to be completed by the end of the fourth quarter of 1997.

5.4.8 Electrical Distribution Systems Evaluations

- Electrical distribution systems required for safe shutdown and alternate shutdown must be capable of providing sufficient capacity for loading and maintaining equipment throughout the duration of the event. There are no Fire Safe Shutdown specific Diesel loading, Battery loading, or Inverter loading calculations at this time. Discussion with a Principal Electrical Engineer reveals that there are calculations for accident loading and there is a high level of confidence that the accident loading analysis conservatively bounds the Fire Safe Shutdown loading. A calculation is in progress for Battery No. 1 loading for alternate shutdown. Automatic sequencing is not credited for diesel loading. Loads are reloaded to the shutdown boards manually after the boards have been manually stripped.

RECOMMENDATION:

Issue calculations or other sufficient documentation to demonstrate adequate capacity of required electrical distribution systems to support safe shutdown and alternate shutdown. If accident loading is to be considered to be bounding, it should be done by specific comparison of loads with consideration of those which are manually stripped and reloaded. Prevention of spuriously reloading of non-required loads should be demonstrated and the manual reloading sequence should be demonstrated to not challenge the ability of the diesel to accept and recover from the load changes.

SIGNIFICANCE / RESOLUTION:

The load is considered to be bounded by existing analysis. Electrical load calculations will be completed to confirm the current high level of confidence, based on qualitative engineering assessment, that the USAR accident loading analysis conservatively bounds the fire safe shutdown loading. When completed, those calculations will be included as references in the compliance document. The action is expected to be completed by the end of the third quarter of 1998.

5.4.9 Raceway Routing Information

Cable tray routing information is maintained in "FACTS" (Fort Calhoun Automatic Cable Tracking System) a QA software database. It is maintained and updated in accordance with requirements for QA software. Conduit routing is documented by drawing. Because conduits are field routed within rooms, separation within fire areas must be demonstrated by walkdown. Only one case

of conduit separation within a fire area is credited and sketches are included in the Safe Shutdown Analysis (FC-89-055 attachment 4).

No scale is stated on the sketch. The sketch calls out several dimensions such as height of ceiling, location of conduit near ceiling etc. It is not clear from the sketch however that 20 feet of horizontal separation exists between the redundant raceways free of intervening combustibles and with suppression and detection. If the sketch is the basis for demonstrating separation, it should be a QA (two party) document.

RECOMMENDATION:

Provide traceability to the preparer and verifier of field walkdown data. Review the installation and document that the separation between the redundant cables is horizontal (not vertical or diagonal) and with no intervening combustibles and document these facts on the sketch.

SIGNIFICANCE / RESOLUTION:

The sketch in question is a markup of drawing 11405-E-73, Sh. 3 showing the cables/conduits associated with NE-002 and NE-003. These markups show 20' separation horizontal and 12' separation vertically. Although this drawing is a scaled drawing, the markups are made on a "less than full size" copy. FCS will create a special drawing for this purpose depicting the fire area drawn to scale, equipment and the cables/conduit for NE-002 and NE-003. The cables/conduits will be dimensionally located within the room to demonstrate the 20' horizontal separation. The action is expected to be completed by the end of the third quarter of 1998.

5.4.10 Pre-fire Plans

- Standing Order SO-G-28 provides the means for responding to and extinguishing fires.

- The station fire plan as defined in SO-G-28 can be improved by adding the following instructions to Incident Commander Strategy Sheet:

  - Electrical hazards in the area
  - Deenergization location for electrical equipment
  - Flammable and pressurized vessels in the area
  - Specialized fire fighting equipment
  - Cautions

The plans will also be enhanced if they are color figured and laminated.

RECOMMENDATION:

Within one year, revise the Pre-fire Plans as recommended above.

SIGNIFICANCE / RESOLUTION:

FCS will evaluate current industry standards for fire area pre-plan information as a basis for determining whether enhancements are appropriate. The action is expected to be completed by the end of the fourth quarter of 1998.

5.4.11 Manual Hose Stations with Less Than 100 ft. Hoses

- Table 9.11-1 of the USAR (Section 9.11) states that there are 59 hose stations throughout the plant with a minimum of 75 feet of lightweight 1 ½" hose. Review of the August 23, 1978 SER sections 3.1.5 (Page 3-2) and 4.3.1.4 (Page 4-8) revealed that FCS had agreed to replace several 75-foot hoses with 100-foot long hoses. Review of the OP-ST-FP-0001A revealed that with the exception of the intake structure hose cabinet the remaining hoses are 100 foot. It should be noted that field verification was not performed.

RECOMMENDATION:

Revise USAR Section 9.11 to state all hoses are 100 feet with the exception of the Intake Structure.

SIGNIFICANCE / RESOLUTION:

The current USAR description of hose lengths in manual hose stations is correct but will be clarified. Currently, the USAR states that "typically each station includes a minimum of 75 feet of 1-½ inch lightweight rubber lined hose." (Section 9.11 page 6 of Table on page 7.) This statement is correct, but it may not sufficiently alert the reader to the circumstance that certain hoses are required to be 100 feet long. OPPD committed to providing 100 foot long hoses in certain areas where they were needed to assure that "all points in safety-related areas and other areas in which a fire may impact safety related areas can be reached by at least one effective hose stream." (Section 4.3, 1.4 of NRC SER dated August 23, 1978, 78-0104, to accompany license amendment No. 4.) OPPD did not, however, commit to a uniform hose length of 100 feet. OPPD has determined that in all but two (2) locations 100 foot hoses were appropriate. In two areas, 75 foot hoses were found to be adequate.

Under these conditions, the USAR would meet current industry standards and more clearly communicate the actual plant configuration if it noted that typically, hoses in manual hose stations are 100 feet long, except for instances in which shorter hoses have been found to satisfy OPPD's commitment to the NRC as delineated in station procedures. The action is to clarify USAR descriptions, and is expected to be completed by the end of the fourth quarter of 1998.

5.4.12 Penetration Seals

- Appendix A SER dated August 23, 1978 specifically requires the fire resistance of electrical cable penetration seals to be three hour rating. (Sections 3.1.20 and 4.9.3). Also, Section 5.25.6 of the SER specifically requires the electrical cable

penetrations in the cable spreading room to be three-hour fire rating. This became a commitment in the supplemental SER dated November 17, 1980.

- Penetrations 77-F-277, 77-F-307 and 70-W-2 were reviewed. These penetrations were evaluated by EA-FC-92-021 and EA-FC-93-051. The evaluations conclude that a fire in the cable spreading room will not affect the ability to achieve and maintain safe shutdown. However, it does not conclude that these penetrations are three hour rated. Although this contradicts the SER, numerous 86-10 evaluations have been performed (91 total) to address the lack of three-hour penetration seals in approximately 380 penetrations. While the 86-10 process allows performing such evaluations for the penetration seals that cannot be shown as three-hour rated. The assessment team believes that the number of 86-10 evaluations are excessive at FCS compared to the rest of the industry. Our discussions with OPPD engineers revealed that FCS will be reevaluating the 86-10 evaluations for a number of penetration seals.

RECOMMENDATION:

FCS may be able to revise some 86-10 evaluations to conclude that some of the existing penetration seals do have a three-hour rating.

SIGNIFICANCE / RESOLUTION:

Fort Calhoun Station is conducting a program to reduce the number of 86-10 evaluations for penetration seals. The action is expected to be completed by the end of the fourth quarter of 1998.

Attachment 1: List of Individuals Consulted During the Self-Assessment

Name	Title
Richard Acker	QA Auditor
Dick Andrews	Division Manager, Nuclear Assessments
Clarence Brunnert	Manager, QA/QC
Sandy Chomos	Fire Protection Systems Engineer
Ken Erdman	Fire Protection Engineer
Don Flegle	Electrical Systems Engineer
Sudesh Gambhir	Engineering & Operations Support Manager
Alan Hackerott	PRA Manager
Rich Jaworski	Manager, Design Engineering
Sudhir Kalra	Electrical Design
Jim Kecy	Operations Engineering
Tim Leibel	Duke Engineering contractor
Bob Mahaffey	Principal Electrical Engineer
Deb Matthews	Operations Engineer - EOP/AOP Coordinator
Joe McManis	Mechanical Engineering Supervisor
Randy Mueller	Electrical Design
Terry Peterson	Electrical Design
Carl Rennerfeldt	Operator Training
Ron Short	Manager, Operations
Mike Smith	Fire Brigade Training