DUANE ARNOLD ENERGY CENTER
SAFETY SYSTEM FUNCTIONAL INSPECTION

High Pressnre Coolant Injection System

Prepared for:

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DUANE ARNOLD ENERGY CENTER

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DUANE ARNOLD ENERGY CENTER

SAFETY SYSTEM FUNCTIONAL INSPECTION

HIGH PRESSURE COOLANT INJECTION SYSTEM

1.0 BACKGROUND

On June 10, 1988, the Iowa Electric Light and Power Company contracted with ERCI/WESTEC Power Engineering Division to develop and implement a self-initiated Safety System Functional Inspection (SSFI) of the High Pressure Coolant Injection (HPCI) system at the Duane Arnold Energy Center (DAEC). The inspection team was comprised of both Iowa Electric and contractor (mixed team) personnel.

The scope of the inspection included certain safety-related systems which support HPCI operations, such as the HPCI room cooling, the 480-volt and 120-volt ac systems, the 250-volt and 125-volt dc systems, and the HPCI oil sub-systems, and also the instrument air system. Iowa Electric directed ERCI/WESTEC to utilize U.S. Nuclear Regulatory Commission (NRC) SSFI techniques, criteria, and schedule of activities to determine:

1. The capability of the systems to perform their safety functions as required by their design bases.

2. If the as-built configuration of the systems is consistent with their current design/licensing basis requirements.

3. If current testing is adequate to demonstrate that the systems will perform required safety functions.

4. If current maintenance practices are adequate to ensure operability under postulated accident conditions.

5. If operations, maintenance, surveillance, and test documentation completely and accurately support a determination of functionality.

6. If the training of personnel is adequate to ensure proper operation and maintenance of the systems.

7. If human factors considerations and procedures are adequate to ensure proper system operation under accident conditions.

8. If management controls are adequate to ensure that the systems will fulfill their safety functions.

2.0 METHODOLOGY

An SSFI is an interactive inspection in which a team of highly qualified and experienced inspectors focus on a sample system or systems over a 10- to 11-week period. The team, consisting of five Iowa Electric inspectors, supplemented by four ERCI/WESTEC engineers, examined plant activities in essentially three areas: design, operations, and management. The inspection methodology relies upon two basic principles:

1. Through the interaction (at daily team meetings) of a relatively small number of senior, experienced inspectors, deficiencies can be identified which otherwise have remained undetected.

2. By conducting a detailed review of a sample system (also called a deep vertical review), conclusions can be drawn as to the overall plant design process, operations, and management controls.

Prior to commencing the inspection, both a project management plan and an inspection plan (Attachment 1) were prepared. The intent of the inspection plan was to provide a framework to answer the following questions:

1. How is the system operated compared with how it was designed to operate?

2. Have modifications since the licensing of the plant altered the design in a manner such that it may not function as expected?

3. Are system components and components of essential support systems properly maintained?

4. Does post-modification testing confirm the readiness of the system if called upon?

5. Does surveillance testing confirm the readiness of the system if called upon? Do the acceptance criteria accurately reflect the design basis?

6. Have the operators been properly trained to operate the system? Are modifications accurately reflected in training documents?

7. Are management control programs effective to insure that the system will function on demand?

8. Have modifications to essential support systems altered the likelihood that the safety system will function as expected?

The inspection plan was provided as guidance to the reviewers, not as a rigid checklist but as a starting point for the various directions that the inspection might take. Where weaknesses were identified, the inspection was intensified in the areas of weakness, including reviews outside the sample system to determine the extent of potential weakness. In addition, the review was not limited to the licensing basis of the plant, but was often extended beyond the original licensing basis in order to determine the functionality of the system.

3.0 TEAM COMPOSITION

The inspection team was composed of the following members:

Position	Inspector	Organization
Team Leader	G. Morris	ERCI/WESTEC
Assistant Team Leaders	G. Hawkins/B. Klotz	Iowa Electric
Electrical Design	W. Drummond	ERCI/WESTEC
Mechanical Design	K. Peveler	Iowa Electric
I&C Design	W. Aldrich	Iowa Electric
Operations	R. Fowler	Iowa Electric
Management	G. Tenenbaum	ERCI/WESTEC
Maintenance	D. Prevatte	ERCI/WESTEC
Surveillance Testing	(Joint Team Effort)	

The ERCI/WESTEC team members represented a total of 82 staff-years of engineering experience, 57 staff-years of which represent nuclear plant engineering experience. Prior to this inspection, team members have participated in a total of 27 utility-sponsored and NRC-sponsored design inspections since 1982, including Integrated Design Inspections, Independent Design Verification Programs, Safety System Functional Inspections, and Safety System Outage Modification Inspections. Some of the nuclear units involved in these inspections include:

Shearon Harris	Beaver Valley 2	Turkey Point	Indian Point 2
Perry	Nine Mile Pt. 2	Pilgrim	Point Beach
Seabrook	Millstone 3	Trojan	Ft. Calhoun
Vogtle	So. Texas Project	Robinson	Indian Point 3

The Iowa Electric team members represented a total of 67 staff-years of engineering and/or operations experience, 51 staff-years of which represent nuclear experience.

4.0 SCHEDULE OF ACTIVITIES

The schedule of activities included three weeks of actual onsite inspection, two additional weeks of inspection conducted at ERCI/WESTEC's offices (or at the site for the Iowa Electric team members), and several weeks of final evaluation and report writing. The actual schedule follows:

<u>Week of June 13, 1988</u>

Site-specific training and badging.
Engineering inspection team (ERCI/WESTEC and Iowa Electric) at DAEC.
Team meeting to review objectives and the program plan.
Walkdown of sample system.
Obtain key documents (FSAR, P&IDs, system descriptions, etc.).
Commence the review.

<u>Week of June 20, 1988</u>

Continue review in ERCI/WESTEC's offices and at DAEC, using information gathered in previous week.

<u>Week of June 27, 1988</u>

Entire inspection team (ERCI/WESTEC and Iowa Electric) at DAEC. Conduct interactive review using SSFI techniques.

<u>Week of July 5, 1988</u>

Entire inspection team (ERCI/WESTEC and Iowa Electric) continue review using information gathered in previous week.

<u>Week of July 11, 1988</u>

Entire inspection team (ERCI/WESTEC and Iowa Electric) continue interactive review at DAEC. Exit meeting with Iowa Electric Management on July 15, 1988.

<u>Weeks of July 18 and 25, 1988</u>

Complete technical review and finalize observations. Prepare draft report and submit to Iowa Electric.

<u>Weeks of September 26 and October 3, 1988</u>

Discuss draft report with Iowa Electric. Complete and submit final report.

5.0 GENERAL CONCLUSIONS

During the 5-week period from June 13, 1988 to July 15, 1988, the Iowa Electric and ERCI/WESTEC inspection team performed a detailed technical inspection of the HPCI system at DAEC as outlined in the foregoing paragraphs. Based upon the inspection observations, as set forth in this report, and the specific discipline area summaries of Section 6.0, the following general conclusions are offered:

1. The HPCI system at DAEC was found to be functional in that there were no inspection observations to conclude that the system would fail to perform its design basis safety function.

2. In view of the potential impact on the performance of the system, certain specific observations should be technically evaluated and resolved as soon as possible. These observations are:

   a. The adequacy of the voltage supplied to the HPCI (and RCIC) valves under degraded voltage conditions as described in Observations 2.3 (Battery Sizing) and 2.6 (D.C. Voltage Drop).

   b. Adequacy of the electrical protection of motor-operated valves (a generic industry concern as well as a generic concern at DAEC) is questioned in Observation 2.1.

   c. Lack of control of drawing revisions at Technical Support center (a "controlled" location) is described in Observations 1.3 and 3.14. (Similar deficiencies had also been noted by Iowa Electric internal audits.)

   d. Operator response may be eroded because of inappropriate selection of alarm setpoints, as described in Observations 3.7 (HPCI room temperature), 4.1 (turbine lube oil temperature), 4.15 (turbine vibration monitoring) and 5.1 (turbine oil filter pressure). In addition, Observation 4.11 identifies a Human Factors problem with control panel labels, and Observation 4.10, which identifies valve labeling, is not in agreement with the HPCI P&ID.

   e. Overpressure of the HPCI suction pressure gauge appears to be a recurrent problem (see Observations 3.2 and 3.9).

   In response to these items, Iowa Electric has performed or initiated the following actions:

   a. An engineering evaluation and calculation for each of the RCIC and HPCI DC MOVs is being prepared. For valves where inadequate voltage was found to exist, design change activities will be performed during the 1988 refueling outage to recable with larger power cables.

b. An Iowa Electric task force has been established to evaluate all aspects of DC MOVs. This task force will evaluate adequacy of thermal overload protection as one aspect of its work scope. The issue of breaker coordination is also acknowledged and will be evaluated and resolved during 1989.

c. A Document Control Center has been established to improve control over documentation and document issuance. A task force, previously established in response to an internal audit, is charged with advising and implementing broad corrective action related to document control.

d. Corrective action has been taken to resolve the noted deficiencies as discussed in the respective sections.

e. Corrective action has been taken to resolve the noted deficiencies as discussed in the respective sections.

3. Certain programmatic concerns were identified which indicate that a number of technical areas are weak and require upgrading or improvement. Although the plant is extremely clean, is operated in a professional manner by a highly skilled staff, and has a history of excellent performance and availability, the team felt that improvements are needed in the following areas:

a. The document control process is weak. Different revisions of drawings may be obtained from different locations on site with the "controlled" locations not always having the latest revision.

b. The application and depth of 10CFR50.59 evaluations is inconsistent. 50.59 determinations must also be performed for temporary plant modifications. Similar internal and NRC findings also identified problems in this area. Iowa Electric has responded that a program to improve this process has been defined and initiated.

c. There is an inadequate application of root cause analysis of maintenance problems (which have not been elevated to an LER), resulting in repeated corrective maintenance.

d. Incorporation of vendor recommendations (including operating limits, required maintenance and testing) is inconsistent. Where vendor recommendations are not performed, technical justification for nonperformance should be provided. In addition, some items of weakness were identified on the scope of post-modification and maintenance testing and the controls to ensure that testing is implemented on all necessary or prudent requirements.

e. Consistency of information in controlled technical documents is weak. Information available from databases such as CHAMPS is incomplete or inaccurate in many instances.

In response to these items, Iowa Electric has taken or initiated the following actions:

a. Discussed above.

b. As noted in this item, internal and NRC findings have focused on this area. Actions initiated and completed encompass the concerns identified in this SSFI.

c. Iowa Electric acknowledges these concerns and is currently evaluating appropriate actions.

d. Iowa Electric acknowledges these concerns and is currently evaluating appropriate actions.

e. As discrepancies are identified, staff resources are being applied to correct the discrepancies. Configuration management is a generic industry problem for which substantial resources will be devoted for ultimate resolutions.

6.0 SPECIFIC DISCIPLINE SUMMARIES

6.1 MECHANICAL DESIGN

6.1.1 Review and Approach

The mechanical design portion of the inspection consisted of a review of documentation including the updated FSAR, the Technical Specifications, the High Pressure Coolant Injection system (HPCI) description, associated NSSS and A/E drawings and specifications, calculations, and design change packages.

Although the subject system for this inspection was the HPCI system, support systems such as the HPCI room ventilation and cooling systems were also included. The systems were also the subject of team walkdowns.

6.1.2 Summary of Significant Observations

The following weaknesses were observed by the team in the area of mechanical design.

6.1.2.1 HPCI Room Cooler Design Not Per the Updated FSAR

The maximum normal room temperature for the engineered safeguards rooms is 104°F per Table 9.4-1 of the updated FSAR. Section 9.4.6.3 states that the engineered safeguards rooms are provided with safety-related HVAC systems that ensure the protection of equipment during normal and accident conditions.

Table 9.4-2 states that the ventilation system will turn on when the room temperature rises to the setpoint. Indeed, the fans in the HPCI room coolers will automatically start when the room temperature reaches 90°F. However, there are no provisions in the design to turn on the cooling water for this condition. This water is provided by the ESW system which is actuated automatically only on a LOCA signal. It may also be started manually by an operator at 130°F in accordance with procedures.

The result is that the HPCI room is frequently and for long periods at temperatures above the maximum normal temperature specified in the updated FSAR. The actual normal operating design temperature for equipment in the room could not be verified during the inspection. However, original plant design documents specified accident condition temperature qualification in the 140°F to 148°F range. The team was concerned that the repeated electrical equipment failures in this area may be related to this condition.

During the walkdown, the team noticed that the control room annunciators were in alarm, indicating that the room was above its alarm setpoint of 100°F. The team also noted that the temperature indicators in the control room were indicating temperatures considerably below the alarm setpoint (one indicator was reading 86°F), apparently out of calibration. The team acknowledges that Iowa Electric has taken steps to install air-conditioning in the HPCI room. However, the team recommends that Iowa

Electric assess the degradation of the existing equipment over the past years while it has been exposed to temperatures above the designed normal ambient temperature. Iowa Electric has agreed to this action.

The relatively high normal ambient temperature of the HPCI room was recognized by Iowa Electric prior to the SSFI, and Iowa Electric plans to modify the room's cooling by the upcoming (1988) refueling outage.

6.1.2.2 Configuration and Document Control Problems

During the course of the inspection, various document discrepancies were noted. In addition, out-of-date microfiche drawings were obtained at different locations which receive drawings, including the Technical Support Center (TSC). This location is designated as a source of "controlled" documents onsite. Among the discrepancies noted are the following:

1. General Electric design documents are not being systematically revised and therefore their current status is in question.

   a. A recent design change package removed the flow orifice from the HPCI full-flow test return line to the CSTs. The original design documentation from General Electric were not revised to show this device had been removed and that the function previously performed by the flow orifice is now performed by drag valve.

   b. The relief valve on the barometric condenser is specified in the General Electric design documentation as having one setpoint, while the drawing for the barometric condenser and the valve data sheet indicates a higher setpoint. The design documentation is not clear as to what the setpoint should be. The turbine manual does not indicate what the design rating should be. The turbine manual does not indicate what the design rating of the condenser is nor does the condenser drawing. CHAMPS indicates the design pressure is 65 psig, but since the relief is identified as a safety relief, with a maximum working pressure of 20 psig, the design pressure of the condenser is questioned.

   c. Other General Electric documents found in the files were (a) dated as far back as 1968, (b) stamped "preliminary - not for final design," and (c) contained an Appendix B, but not an Appendix A.

   Iowa Electric has acknowledged the need to designate current design documentation as "controlled" and to train personnel on the use of controlled documentation.

2. Some Environmental Qualification Packages were found to be incomplete or data contained in those packages had not been correctly translated into the EQ database.

a. The steam leak detection temperature elements in the HPCI room are identified with the environmental qualification database as having a required and demonstrated qualification of 156°F. However, these elements perform their function at temperatures at or above 175°F. The actual qualification test appears to support the higher qualification requirements.

b. Within the design change package for the HPCI full-flow test valve, documentation was not found to support the qualification of the solenoid valves. During the source inspection of the full-flow test valve at the manufacturer, Quality Assurance observed that the supplier had the documentation, but it was not provided with the valve.

   Secondly, the installed relays were found to have certification from the supplier. This certification contains references to test reports, as well as a summary report in the Quality Control file which contains three seismic curves. The test reports supporting these curves have been provided to Iowa Electric, and there is some correspondence which supports performance of a review on these test reports, but the test reports are not found within the MDL.

Iowa Electric is evaluating these observations.

3. Several discrepancies were noted in the updated FSAR. This may cause problems in that the design inputs to the design change packages made good use of referencing the updated FSAR but failed to reference other supporting references such as the original General Electric design specifications.

   Iowa Electric will prepare UFSAR revisions to correct UFSAR discrepancies.

6.1.3 <u>Conclusions</u>

No findings indicated that the high pressure coolant injection system was incapable of performing its design function; however, several findings indicate a lack of attention to detail.

6.2 ELECTRICAL SYSTEM DESIGN

6.2.1 <u>Review and Approach</u>

The electrical design portion of the inspection focused on a review of Section 8 of the updated FSAR, system design (training) descriptions, NSSS design and interface requirements, single line diagrams, design modification process, system design calculations, Technical Specifications, and Surveillance and Test records, associated with the electrical equipment and systems which support the HPCI system and auxiliary systems. As weaknesses were identified, the design documentation and basis of the system and its components were examined to assess the adequacy of the design. The electrical inspector reviewed the design analyses for sizing the Class 1E station batteries, DC voltage study, and protective device selection, setting, and coordination.

6.2.2 Summary of Significant Inspection Findings

6.2.2.1 Inadequate Motor Protection During Locked Rotor Conditions

The team requested that Iowa Electric provide documentation (written criteria, calculation, analysis) to demonstrate that Class 1E motor protection sizing and methodology was adequate. Iowa Electric was not able to provide any documentation delineating motor protection sizing and methodology used in the original design during the inspection period.

The team therefore prepared a preliminary motor protection analysis; several protective time-current characteristics were drawn to ascertain the adequacy of motor protection. The team concluded that overload relays for MOVs were selected based on the motor's full load amps; the locked rotor condition had not been analyzed by Iowa Electric. Motor operated valves use motors with limited time duty ratings. Typically, AC MOV motors are rated for a 15-minute duty and DC MOV motors are rated for a 5-minute duty. Therefore, sizing motor overloads based solely on the full load current would not protect short time duty motors. In addition, because of the application which tends to use small motor frame sizes compared to their horsepower and torque output, these units tend to be very sensitive to locked rotor current. The valve actuator manufacturer recommends that locked rotor current be limited to less than 10 seconds for AC motors and 8 seconds for DC motors. The team believes motor damage at DAEC occurred during a locked rotor condition; therefore, it was determined by preliminary analysis that MOV thermal overloads elements are not sized to provide adequate protection during a locked rotor condition. An example of inadequate protection was found in DCR 1381. The motor for MO 1908 was damaged beyond repair during excessive locked rotor torque; if adequate protection had been provided, the motor would not have been damaged. The team is concerned that this condition may exist for other safety-related motors. Inadequate protection could result in undetected degradation or possible malfunction of safety-related equipment required to mitigate the consequences of a design basis accident.

Iowa Electric has established a task force to evaluate these concerns and performed cable sizing calculations on DC MOVs to address these concerns.

6.2.2.2 Inadequate Electrical Coordination Study

A comprehensive coordination study of low voltage systems had not been performed for the complete DAEC electrical system. The existing coordination study, EC 12D, was reviewed and it appears that the following studies had been neglected:

1. 125-volt and 250-Vdc system
2. 120-Vac system
3. Uninterruptible power system

The team is concerned that without a complete low-voltage coordination analysis, additional loads may be added to the system and not be selectively coordinated, as required, to eliminate faults or overload conditions. Iowa Electric had been aware of this discrepancy and has now committed to commence a coordination study of low voltage electrical systems by the end of 1988 and complete it in 1989. This study will include important systems but will exclude minor subsystems such as lighting.

6.2.2.3 Discrepancies in Class 1E Battery Sizing Calculations

1. 250-Volt Battery Sizing

The team reviewed the battery sizing calculation E-87-06, Rev. 0, 1987 and the following discrepancies were found:

a. The load profile, which was included in Attachment C to the calculation could not be duplicated from the battery loads described in the attachment.

b. Documentation supporting the 65°F minimum battery room temperature was not referenced in the calculation and could not be produced by Iowa Electric during the inspection.

c. Cell sizing worksheet - The largest calculated positive plate value was not selected as the basis for selecting the required cell size during the recent battery replacement; the justification for excluding the largest value (first period loading) stated that only a small amount of the battery capacity is used up during this time period. This statement does not substantiate the exclusion of this value; the battery voltage must also be analyzed for this loading period; technical justification must verify that the battery voltage remains at an acceptable value during this period.

The team prepared a preliminary sizing calculation that found a lower battery capacity than indicated in the Iowa Electric calculation. This analysis demonstrated that, based upon a new battery at 100% of rated capacity and at the battery's rated temperature of 77°F, the initial battery voltage will drop to approximately 211 volts (116 cells x 1.82 volt/cell = 211 volts); this is 1 volt above the minimum system voltage requirement. This large voltage dip is an indication that the battery was not sized to meet the intended load requirement. Iowa Electric has agreed to revise the calculation to show the correct battery capacity. It is noted by the team that the battery is sized for an aged condition of 80% rated capacity and a reduced operating temperature of 65°F. This total margin in sizing amounts to 35%. This margin was demonstrated in a recent (1987) factory performance test. Therefore, a technical concern over the battery's ability to perform under actual conditions does not exist at this time in the battery's life.

2. 125-Volt Battery Sizing

A review of the 125-volt system was performed by the team, and it was found that the new 125-volt battery was purchased based on the old (original plant design) calculated load profile. The calculation was not revised to show the present plant loading requirement.

Battery sizing requirements from an updatd load profile and the minimum number of cells required must be calculated to assure that the correct battery size is purchased.

Without a load profile, the team cannot determine if the battery is sized to meet the intended duty cycle. Iowa Electric has agreed to revise the 125-volt calculation and to maintain calculations current to assure that the batteries maintain adequate capacity to support the load profile.

Iowa Electric has completed revision of the subject calculations for 125- and 250-Vdc batteries to address the team's concerns following performance of the onsite SSFI.

6.2.2.4 Insufficient Voltage at RCIC and HPCI Motor Terminals

The team requested a copy of the DC voltage analysis to ensure that sufficient voltage would be provided to the HPCI loads. Iowa Electric stated that none was available. The team prepared a preliminary DC voltage analysis, which indicated that the voltages at several of the motor and MOV terminals were below the minimum required motor starting voltage of 80%. It appears as though the cables were not sized to limit the maximum voltage drop during the lowest battery voltage. This discrepancy seems to be generic for the DC system. In response, Iowa Electric commenced a review of DC MOVs that will include an evaluation of power cable sizing.

The team is concerned that the wrong cable size will be selected for modifications to the DC system, increasing the possibility of less than 80% voltage being supplied to terminals of safety class DC motors. Iowa Electric acknowledged this concern and committed to develop a design guide for DC MOV power cable sizing and to perform calculations for the DC MOVs as noted above.

6.2.2.5 Inadequate Safety Evaluation for 125-Vdc Battery Installation

The team reviewed modifications MM-183 and 184 and did not find a revised battery calculation to support the purchase of the new battery with two cells less than the original batteries. The new battery was purchased and installed, based upon manufacturer's catalog information, without a revised load profile or positive plate calculation. The team is concerned that the Safety Evaluation for these modifications was not based on sufficient data to assure that an unreviewed Safety Question was not involved. Without an updated calculation, there is no assurance that the battery will perform as required; an increased cell capacity does not assure that the battery will meet the requirement of the new load profile, because the new batteries contain fewer cells than the original battery. Therefore, the unreviewed Safety Question had not been adequately addressed. The 125-Vdc calculation must be updated to assure that the new battery will meet the new load profile. Barring any increase in load requirements, the team did not consider this a hardware problem because the relatively large increase in cell size should compensate for the loss of two cells. Iowa Electric has revised the battery calculation since the performance of the onsite SSFI.

6.2.3 Conclusion

The team identified several observations which indicate a weakness in two areas of engineering activities. They are (1) missing or inadequate design analyses caused by weak control of design calculations and (2) breakdown in design modification process and design verification activities.

6.3 INSTRUMENTATION AND CONTROL DESIGN

6.3.1 Review and Approach

In the area of Instrumentation and Control (I&C), the team observed, by a walkdown, the instruments and controls associated with the HPCI system in the control room, at the motor control centers, in the essential switchgear room, and in the HPCI room. The equipment was observed for accessibility, ambient temperature, notice of calibration, operability, and physical separation of redundant equipment.

The inspection team reviewed maintenance history on HPCI equipment to determine any common-mode failures and repetitive failures. Calibration cards were reviewed for accuracy and last calibration dates. Procedures used were checked for appropriateness.

The team reviewed the associated alarms for HPCI. Setpoints for the alarms were reviewed against the Technical Specifications, the updated FSAR, the System Description manuals, and original design specifications. Operator response was reviewed by the team to determine if the action taken is consistent with the design requirements.

General Electric service information letters (SILs) and licensee event reports (LERs) were reviewed for implementation of recommendations and commitments.

Design Change Packages were reviewed for scope and acceptance testing criteria. Calculations were reviewed for technique and accuracy.

P&IDs, logic diagrams, and control drawings were compared for consistency. FSKs were reviewed for conformance to actual installation.

The inspection team reviewed design specifications for HPCI instruments and controls for quality level, temperature limitations, and instrument accuracy. Ambient temperature limits and possible exclusions were explored.

6.3.2 Summary of Significant Inspection Findings

6.3.2.1 Design Deficiencies

1. Overpressurized Instrument

A pressure indicator was found reading high as a result of exceeding the maximum indicating range on the gauge. The line has repeatedly been pressurized due to back-leakage through a check valve from reactor pressure. Maintenance history shows that this pressure indicator has been repaired several times due to excessive pressure. To correct this condition, three options exist: (1) the indicator should be replaced by one rated for the pressure it has to see; (2) the back-leakage should be corrected; or (3) this condition could be avoided by procedural change. Iowa Electric committed to revise the routine surveillance procedure.

2. Ambient Condition for Governor Controls (MM 187)

HPCI governor controls were moved from the turbine skid to the HPCI room wall to avoid turbine heat and vibration. The original enclosure for this equipment consisted of a ventilated box. The new installation encloses this equipment in an unventilated box. One component of the controls is a dropping resistor mounted on a heat sink. This dropping resistor runs very hot and generates considerable heat. By not being ventilated, the new box may be containing heat and subjecting the controls to even higher temperatures than before. Further evaluation by Iowa Electric will be conducted on this item.

6.3.2.2 Inconsistencies of Design Documents and Engineering Databases

1. General

During a review of the design documents, inconsistencies and errors were found. No guidance could be found as to which original design documents were maintained as historical records and which were maintained as controlled design documents.

2. Errors and Disagreements

The following documents yielded contradictory or erroneous information.

a. CHAMPS contained errors in quality level, manufacturer, and model number.

b. The updated FSAR was in conflict with itself.

c. The GE APED equipment specifications show errors in manufacturer and model numbers in relationship to the current plant configuration.

d. The Technical Support Center (TSC) files contained film cards not of current revision.

e. Disagreement was found between GE specifications, the updated FSAR, and other documents for torus water level limits and maximum ambient temperature in HPCI room.

As noted above, guidelines will be developed and documentation revised by Iowa Electric to resolve these issues.

3. Setpoint Calculation Anomaly

Design Document Change DDC1197, which contains calculations of analytic limits for instrument setpoints, appears inadequate to ensure there is sufficient margin between safety limits and operating limits. The safety limits were not defined for the setpoints. Not all the variables were addressed in the calculations, the team felt that the method used was not correct and that the calculations do not verify safety margins or justify setpoints.

Iowa Electric notes that a primary purpose of DDC 1197 and the underlying calculations is to make design basis information available on instrument setpoints that are included in Technical Specifications. In order to complete this task, information is being sought of the NSSS vendor (GE) on the original analytical and safety limits. Inhouse calculations are being performed to demonstrate that the inplant settings will support safety, analytical, operational, and Technical Specification limits, and that adequate conservatism is provided by these instruments and their settings. Each of the concerns raised by the SSFI inspector will be evaluated and addressed during the review and finalization of these calculations. Iowa Electric notes that no significant safety concerns have been identified as a result of either the inhouse work or the SSFI. Rather, the SSFI concerns generally focus on the proper methodology to be applied and administrative aspects of the documentation.

6.3.3 Conclusion

A substantial review of the instrumentation and control for HPCI revealed two minor design anomalies, neither of which is considered a threat to the availability of the HPCI system. In general, the application and maintenance of I&C equipment was satisfactory and no generic weakness was found. Of greater concern is the lack of definition of design criteria. Since some disagreement among documents was found, and the controlled design documents cannot be identified, the possibility of misspecifying and misapplying equipment exists.

6.4 OPERATIONS

6.4.1 Review and Approach

The review and approach used in the operation portion of the inspection consisted of an evaluation focused on how operating procedures, control of ongoing operation activities, abnormal procedures, alarm response procedures, administrative procedures, operator familiarity with physical location of electrical and mechanical equipment interfaced with the HPCI system under normal and abnormal conditions. The operation inspector reviewed the documents to ascertain the adequacy of the operation department and personnel.

6.4.2 Summary of Significant Inspection Findings

6.4.2.1 Failure to Follow Operating Procedures

The plant operating instructions and the manufacturer's recommendations require that the vibration monitoring system on the Terry turbine be in service whenever the turbine is operating.

The HPCI turbine vibration monitoring instrumentation has not been used by the operators for many years even though it was being maintained under the Preventative Maintenance program and the HPCI system Operating Instruction required its use. The disuse has proceeded to the point that the Detailed Control Room Design Review Group recommended that the instrumentation be removed and a Design Change Package has been written to do that. Apparently, more than 10 years ago, operators stopped using the monitor, regardless of the requirements by the plant Operating Instructions and the manufacturer's recommendation to use the system.

6.4.2.2 Inconsistencies Between Operating Instructions and Vendor Recommendations

HPCI operation instruction (OI-152) does not agree with the vendor recommended required setpoints for lube oil temperature and turbine vibration (GEK16646). The team reviewed Iowa Electric OI-152, Rev. 6. and the following discrepancies were found:

1. The turbine lube oil temperature upper limit is set to alarm at 180°F. The vendor-recommended setting is 160°F.

2. The turbine normal operation vibration upper limit setpoint is referenced as 2.0 mils; the vendor-recommended setting is 0.5 mils. The team is concerned that operating outside of the recommended setpoint limits could cause damage to the system and cause it to be inoperable when required to operate.

In response to item 2, Iowa Electric used this instrument in the next surveillance test. The instrument response appeared satisfactory. Iowa Electric is evaluating means to implement turbine vibration monitoring consistent with the original design and the vendor's recommendation separate from the use of the control room panel instrumentation.

6.4.2.2 Equipment Found in Nonconforming Condition

The team made a walkdown of the main control room and found numerous retaining bolts missing from the annunciator panel doors located over the main console. The bolts were omitted to facilitate the frequent resetting of alarms in the annunciator panel. It appears that the doors have remained unbolted over a period of time. The team is concerned that the occurrence of a seismic event could dislodge the panel door and allow it to strike the main console and render a system inoperable. In response, Iowa Electric immediately secured the open annunciator doors with the bolts available, ordered suitable bolts to replace those that were missing, and informed operators of the need to maintain annunciator doors in a bolted condition.

The drain piping on the RHR service water system downstream of manual drain valve V-13-71 is considered to be Quality Level IV; but due to its proximity to the HPCI Governor control mechanism, the piping is seismically mounted. At some time in the past, the drain line plugged up and was disconnected at an elbow downstream of the drain valve. To perform this, one of the two drain line seismic mounts had to be disconnected, leaving the pipe in a condition that could compromise the seismic qualifications of the HPCI governor control panel. Iowa Electric responded by securing the disconnected pipe sections. The major concern is that it is hard to judge an item's potential impact on a safety system by looking at it from the standpoint of its quality level.

Programmatically, Iowa Electric is developing and implementing improved administrative controls over temporary modifications that utilize INPO guidance.

6.4.2.4 Drawing Discrepancies

During a walkdown of the HPCI system, the team found six drawing discrepancies. The piping and instrumentation drawings did not agree with the as-built piping drawing. There is no safety significance involved in this finding. Iowa Electric is revising, by the design document change process, the affected drawings to reflect the present plant configuration.

6.4.3 Conclusion

A review of plant operations and the HPCI system indicated some procedure and drawing discrepancies which need to be rectified. The operation of the plant seems to be satisfactory with the exception of the weaknesses noted above.

6.5 MAINTENANCE

6.5.1 Review and Approach

The maintenance inspection of the HPCI system was conducted by reviewing the applicable system documents, by interviewing personnel, by personal inspection of the system and supporting systems, and by observation of maintenance activities.

The documents reviewed included both specific and general maintenance procedures, the Maintenance Action Requests (MARs) with particular emphasis on the last two years, vendor manuals and other vendor supplied information, the updated FSAR and Technical Specifications, and the P&IDs and system descriptions.

Walkdown inspections of the HPCI system and supporting and interfacing systems were performed, and interviews were conducted with personnel from the Maintenance Department and other supporting and interfacing departments.

Two maintenance activities were observed by the team: replacement of relief valves on the HPCI turbine lube oil system and removal of an emergency service water system river water intake screen wash pump for repair of the seals.

Areas investigated included equipment histories, maintenance procedures, interactions between Maintenance and other departments, the MAR process, root cause determination for equipment failures, MOV maintenance practices, maintenance training, staffing levels and qualifications, post-maintenance testing, control and utilization of vendor-supplied information, control of replacement parts, maintenance planning, and maintenance scheduling and backlog management.

6.5.2 Summary of Significant Observation Findings

The following are observations made by the team of both strengths and weaknesses in the area of maintenance.

6.5.2.1 Need for Updated Equipment Histories

In general, the equipment histories appeared to be well documented and readily retrievable from the CHAMPS database. More detailed information was available on the microfilm records of the Maintenance Action Requests. However, due to a microfilming backlog, the MARs for approximately the last year were not available in the microfilm records, making retrieval more difficult. This is particularly significant since these microfilm records are the records located in the Technical Support Center and are earmarked for use if the center is activated.

6.5.2.2 Maintenance Procedures Problems

Overall, the maintenance procedures appeared to be very good, particularly with respect to level of detail. A very good balance appeared to have been achieved between not placing too much reliance on "skill of the trade" while, at the same time, not being so detailed as to inhibit such skills. It was obvious that a great deal of effort had been spent on this aspect of the procedures.

Additionally, the procedures appear to contain the proper QC hold points at the critical activities to assure that the maintenance activities are being carried out properly.

Offsetting these positive points were problems discovered in several procedures with respect to coordination of acceptance criteria with design or operational limits, inadequate acceptance criteria, improper direction, and lack of attention to detail. The following paragraphs describe specific cases where such problems were discovered:

1. Coordination of Acceptance Criteria with Design/Operational Limits

   Per the annunciator response procedure for HPCI oil filter high differential pressure, the alarm occurs at 11 psid increasing. The HPCI turbine inspection procedure requires that the filter be changed if the differential pressure exceeds 20 psid. The vendor manual for the filter states that at 20 psid the filter is clogged and should be changed.

   To ensure that the filter will not be clogged when it is required, it must be changed out at a differential pressure less than that which indicates clogging, with enough margin to allow some additional loading. The high differential pressure setpoint of the annunciator procedure would appear to include such a margin, whereas the inspection procedure does not. Using this maintenance inspection procedure, it is possible for the filters to be discovered in a high differential pressure, nearly clogged condition without being changed out, leaving the system vulnerable. In this condition, a high differential pressure alarm would occur upon starting of the turbine for a LOCA response, but it may be impossible to properly respond due to the LOCA being in progress. This could lead to oil starvation and possible failure of the turbine. Iowa Electric believes that good coordination exists between operations and maintenance personnel which would make it unlikely that this condition would remain uncorrected, particularly in light of the operators' desire to maintain minimal annunciators in an alarm condition. However, they agreed that the inconsistency in the documentation would be resolved.

2. Improper Maintenance Direction

The repair procedure for the HPCI barometric condenser vacuum pump instructs the mechanic to "Exercise care in handling the gaskets to avoid having to replace them with new ones" and to "Remove the gasket carefully and set it aside to prevent it from being damaged."

Reuse of gaskets is generally considered to be a poor maintenance practice likely to result in leakage. Leakage of the vacuum pump gasket, if it were gross, could result in failure of the barometric condenser to properly perform, causing release of steam to the HPCI room. This could result in trip of the HPCI system due to high area temperature, degradation of temperature-sensitive equipment such as the turbine speed controller, and/or increased reactor building airborne contamination. If this practice were also to be used in other maintenance activities, it could result in other safety significant failures. Iowa Electric agreed with the team's concern and committed to revise their repair procedure to specify replacing used gaskets.

3. Inadequate Acceptance Criteria

The plant repair procedures for the HPCI turbine lube oil flush and the HPCI turbine oil filtration contain acceptance criterion for determining that the flush/filtration is satisfactorily completed. The acceptance criterion is that the amount of residue from the sample does not decrease appreciably from the previous sample. This is determined by the Maintenance Supervisor or his designee passing samples through a 0.45-micron filter paper,

This acceptance criterion is not satisfactory in that it gives no indication of what is an acceptable quantity and type of particulate contamination. It also gives no direction with regard to the acceptable quantity and type of other contaminates in the system.

In addition to the stated acceptance criterion, the procedures should specify the sample size to be used, acceptable particle size, particle type, number of particles per unit area, and other limitations on the sample such as water content and chemical contaminates. Lack of specificity in this area could result in the system not being properly flushed or the oil not being properly filtered, which could lead to accelerated wear or failure of components lubricated and cooled by the system. This could result in failure of the HPCI system to perform its safety function.

4. Lack of Attention to Detail

Cases were identified where errors or omissions existed in the procedures, thus indicating a lack of attention to detail in their generation and review. The following are examples:

a. The current repair procedure for the HPCI turbine trip solenoid valve is written for a model valve that does not exist in the plant.

b. The HPCI turbine oil flushing procedure does not specify the oil to be used for the flushing.

Iowa Electric is instituting procedural changes to resolve the maintenance problems noted by the SSFI team.

6.5.2.3 Inconsistent Root Cause Analysis of Failures

10CFR50, Appendix B requires that, for significant conditions adverse to quality, the cause of the condition be determined and corrective action taken to preclude repetition.

HPCI equipment failures, sometimes repetitive, which have had the potential to render the system incapable of performing its design safety function, have occurred with no root cause analysis being performed. In general, these analyses have only been performed when the failures were required to be reported to the NRC. The following are examples:

1. Failures in HPCI Turbine and Pump

In May 1987, in the performance of the monthly HPCI oil inspection under inspection procedure IP-4, a large amount of bearing material was found in the oil. Water was also found. Further investigation revealed that a bearing in pump P216 was wiped, the journal bearing locator pin was adrift in the sump, the thrust oil orifice was missing, and the oil seals locating screws were sheared off. No root cause for these failures was determined. A recurrence during a LOCA could prevent the HPCI system from performing its safety function.

2. HPCI Steam Line Drain Valve Solenoid Valve Failures

In July 1986, in the performance of the HPCI annual surveillance test, STP 45D001-A, the HPCI steam line drain pot bypass valve would not open without tapping on the solenoid valve, SV2206. Although Deviation Report 86-131 was generated and the solenoid valve was replaced with an identical valve, the root cause of the failure was not determined.

In September 1983, the same valve had failed to open upon demand, and the root cause had not been determined at that time either. This valve had been replaced in 1981 as a part of the EQ equipment upgrade program.

The evaluation of the deviation report for the 1986 case contended that failure of this valve to open when required would not cause impairment or damage to the HPCI turbine because the amount of water that would collect in the line would be minimal since the condensate would still be draining through its normal path. The team does not concur with this evaluation. If the water has collected to the point of initiating an attempted opening of the bypass valve, it would continue to collect. Just because the normal drain path would still be open would not preclude this continued accumulation, which could ultimately become large enough to have the potential of causing turbine failure or impairment upon initiation.

Iowa Electric acknowledges this SSFI team concern regarding root cause analysis of failures. Action to strengthen root cause analysis for maintenance-related failures is being investigated.

6.5.2.4 Inadequate Control of Safety-Related Spare Parts

10CFR50, Appendix B requires that measures be established to prevent the use of incorrect material, parts, and components. Although it appeared that the control of materials, parts, and components was good in the warehouse, cases were found where the control was less than adequate in the other steps in the process of getting the right part to the required application. The following are examples:

1. Use of Incorrect Gaskets

During the inspection, MARs were performed to replace the two pressure relief valves that perform the critical function of controlling lube oil pressure in the HPCI turbine lube oil system.

The gaskets originally installed in the system were of a composition material. The replacement gaskets specified with the first issue of the CMAR were incorrectly designated as red rubber material. Because they were also the wrong size, it became obvious to the mechanic that they were not correct. With this realization, the mechanic conferred with the maintenance planner, and the gaskets were changed to flexitalic, which was also incorrect. These were installed with one of the valves and, because of the thickness difference between the original composition gaskets and the flexitalic gaskets, the piping connections to the valve were misaligned and the pipe was sprung. The second valve was installed using the correct composition gaskets.

This maintenance activity was planned by an experienced maintenance planner, performed by an experienced mechanic, and witnessed by an experienced QC inspector. Yet the wrong gaskets were ultimately installed.

There were several indicators that should have alerted those involved that the installation was incorrect:

a. Both of the incorrect types of gaskets were not the same as the gaskets that came out of the system.

b. The misalignment of the piping to the valve using the flexitalic gaskets was very obvious.

c. The gaskets used for the two identical valves installed at the same time were not the same.

The significance of using the wrong gaskets in this and other applications can be profound. In this case, misalignment of the piping could potentially cause unreliable valve operation, excessive pipe stress, and higher probability of subsequent leakage. Additionally, had a gasket been used of a material incompatible with the application, it may have deteriorated, causing potential contamination of the system, which may have led to lubrication failure at critical points, such as the bearings.

2. Misidentification of HPCI Turbine Stop Valve Seals

In November 1979, General Electric issued Service Information Letter (SIL) No. 306 describing failure of a HPCI turbine stop valve to open due to deterioration of the hydraulic actuator piston seals. It recommended that the original leather and Teflon seals be replaced with Buna-N seals.

In 1984, the seals were replaced, and in 1987 they were required to be replaced again. There were no seals in the warehouse at that time. Therefore, they had to be ordered. The part numbers that were used for the order were for the old style seals, and the error was not discovered until the mechanic received the parts from the warehouse and saw that they were of a different material than the seals being taken out. They were returned to the manufacturer, and the correct seals were ordered, delivered, and installed.

Currently there are no spare seals in the plant warehouse. Although the repair procedure for replacement of the seals specifies the correct part numbers, other plant records still show the incorrect part numbers. Were reorder to be required at this time, there is a reasonable probability that the wrong parts would be ordered again.

6.5.2.5 Inadequate Post-Maintenance Testing of Containment Isolation Valves

10CFR50, Appendix J requires that any major modification or replacement of a component which is part of the primary reactor containment shall be followed by the appropriate leak rate test to determine that the combined leakage rate is less than 0.60 La. The plant Technical Specifications are written to reflect this requirement.

Current plant guidelines and/or practice allow valves to remain untested after maintenance activities which have the potential to increase their leakage rates. The activities of concern are as follows:

1. Removal and replacement of motor operated valve operators. Not performing testing is inappropriate in that even when the setup of the new operator is identical to that of the old operator, the closing thrust may be less and, hence, the leakage rate may be greater.

2. Repacking, adding packing rings, or tightening of valve packing if the valve is inside the primary containment. Not testing in these cases is inappropriate in that any of these activities can increase the drag on the valve stem, thereby decreasing the thrust available to seat the valve, and potentially increasing the leakage rate through the valve. Additionally, repacking of a valve would not necessarily decrease the leakage rate through the packing as implied by the current guidelines. This could only be determined by testing.

The engineers concerned have maintained that even though leak rate retesting is not performed in these cases, the MOVATS testing that is performed would show if the stem thrust had been increased. Such testing is inadequate for the following reasons:

a. Currently, MOVATS testing is only performed on HPCI and RCIC valves. Other containment isolation valves are not tested.

b. MOVATS testing does not specifically address the seating thrust produced on a valve, and the changes in thrust allowable for MOVATS testing are not acceptable for determining if a valve's leakage rate has increased.

c. The closing thrust, which is the concern with regard to the valves' leak tightness, is not measured directly but rather is estimated by extrapolation from measured opening thrust values. This method may produce significant inaccuracy.

The engineers concerned also maintained that the increase in drag due to packing tightening is insignificant compared to the total thrust available, and therefore the decrease in seating thrust is insignificant. This is contrary to the inspector's experience which shows that where the valve stem or the packing is damaged, it can be tightened to the point of stalling the valve without stopping the leak. If the valve stalls, the problem is recognized and corrected. However, if it does not stall, the seating thrust could be significantly reduced with no recognition of the problem without leakage rate testing.

Iowa Electric takes notice of the SSFI team concern regarding this item. Our past practice, and experience, has been not to specifically perform LLRT tests following minor packing adjustments and this practice at DAEC is not known to have caused leak rate problems. We note that both industry and NRC attention is being focused on this area. Iowa Electric will actively follow the development on this issue and will revise plant practices as deemed prudent or necessary.

6.5.2.6 Deviation from Vendor-Recommended Maintenance

Vendor information supplied to utilities in the form of manuals and information notices provides recommendations for specific maintenance activities. The recommendations of the equipment manufacturers are generally based on specific knowledge of the limitations of the equipment. To not perform these recommended actions without careful consideration is to invite unreliability and potential failure. Per Appendix B, this is not acceptable in equipment that is required to perform a safety function.

The following are examples where suppliers of safety-related equipment have made specific maintenance recommendations that have not been incorporated in the plant procedures or, if incorporated, are prescribed less frequently than recommended and for which no documentation is available to explain or justify the deviation:

1. Limitorque manual, Bulletin SMBI-82C, recommends that the following maintenance not currently included in plant procedures be performed on MOV operators:

   a. Cleaning of electrical contacts with solvent similar to CRC Lectra Clean.

   b. Checking of terminals for tightness.

   c. Clean and grease gaskets.

   d. Megger motor. (Note: This is particularly important in view of Section 6.2.2.1 of this report concerning the incorrect sizing of MOV overload protection and the failure of MOV motors that have occurred due to winding deterioration.)

   e. Clean and lubricate valve stem.

   Additionally, it is recommended that "A minimum inspection period [for these activities] of eighteen months should be used as a base until experience indicates otherwise." The current procedure requirement is for inspections to be performed less often, every second refueling outage. There is no documentation that these activities have ever been routinely done, thereby providing an experience base, and no documentation of the decision to deviate from the recommended interval.

2. The Terry Turbine manual requires that, "All new oil added to the oil tank prior to flushing and/or operating must be done through a filter press or temporary 5 micron filter." The plant maintenance procedures for the HPCI turbine oil flush and turbine oil filtration both address the addition of oil to the system. Neither procedure requires that the oil be filtered.

3. General Electric Service Information Letter (SIL) No. 353 recommends inspections that should be performed on the HPCI turbine overspeed trip assembly. Although there is a plant maintenance procedure that addresses inspection of the overspeed trip assembly, it does not incorporate the following GE recommendations:

a. Verify the operability of the reset circuit.

b. Verify the operability of the overspeed trip assembly at each refueling outage.

c. Inspect the overspeed trip assembly to verify that the trip and reset piston are uniform in color (amber to black) and free of scratches and wear marks, that the valve body is free from scratches, wear marks and dirt accumulation, and that the tip of the emergency trip weight is smooth, free from scratches, and accumulation of foreign matter.

4. The Terry Turbine manual recommends that "The non-metallic head of the tappet assembly [for the mechanical-hydraulic overspeed trip] must be inspected a minimum of once per year...." Maintenance procedure IP-4, requires that the inspection be performed at a longer interval, every refueling outage.

5. SIL No. 306 recommends that inspection of the HPCI stop valve hydraulic cylinder be performed annually. Currently, instead, this inspection is performed less frequently, at refueling outages. This discrepancy was noted in the HPCI/RCIC Reliability Task Force letter, DAEC-86-0059, dated January 28, 1986, with a statement that a DCF was being initiated to make the inspections annual.

In response to these items, Iowa Electric has committed to revise procedural requirements or to formally evaluate and document deviations from vendor recommendations on these items.

6.5.2.7 Quality Classification of Plant Equipment

The quality classifications of plant equipment have been removed from the plant databases to facilitate the changeover from the old classification program to the current program. Current practice is to reclassify items as they are needed to perform plant activities rather than to predetermine their classification.

The team was concerned that using this approach rather than classifying the equipment before it is needed could increase the probability of error; however, no cases were discovered where safety-related equipment has been incorrectly classified.

6.5.2.8 Training and Qualification of Maintenance Personnel

The training in the Maintenance Department appears to be very good, and work assignments in the shops are made based on the qualifications of the individuals as determined by their demonstrated knowledge and experience, by qualification testing, by their level of completion of the plant apprentice program, or by a combination of these.

The apprentice program provided by the Training Department appears to be very detailed and thorough, requiring individuals to complete approximately 1900 classroom hours for I&C and 800 hours each for the mechanical and electrical areas, plus a similar number of hours outside the classroom.

6.5.2.9 Staffing Levels, Scheduling, and Backlog Management

The staffing levels in the shops appear to be a bit light as indicated by the significant increase in the CMAR backlog in the last year. This backlog, however, does appear to be well managed in that it is closely monitored, and there are plans to bring contract personnel on site before the upcoming refueling outage to clear backlog and to become acquainted with the plant and procedures before the outage starts.

6.6 SURVEILLANCE AND TESTING

6.6.1 Review and Approach

The surveillance and test portion of the inspection included a review of surveillance tests specified in plant Technical Specifications, vendor testing recommendations, and operating procedures. The HPCI section of the updated FSAR was also reviewed to identify surveillance commitments.

6.6.2 Summary of Significant Inspection Findings

6.6.2.1 Incomplete Functional Testing

The team reviewed the updated FSAR and manufacturer testing requirement and found that tests referenced in these documents are not the responsibility of any single group and therefore are performed randomly. Examples are the HPCI pressure turbine trip and the high exhaust diaphragm's pressure turbine trip. It was also found that surveillance testing is only done per the Technical Specification required testing. The team is concerned that equipment required to mitigate an accident will not be tested as required to ensure its reliability.

Iowa Electric notes that periodic testing of equipment functions necessary to mitigate accidents, as specified in the Technical Specifications, is not questioned by this SSFI observation. Iowa Electric acknowledges, however, the need for improved programmatic controls on certain diagnostic and vendor recommendation type of testing.

6.6.2.2 Inadequate Battery Temperature Surveillance

The team reviewed the weekly battery room recorded temperature and found that no limits are given for the room temperature. Since low temperature decreases battery capacity and high temperature decreases the battery life expectancy and no alarms are associated with the room, then limits should be included with the operator rounds to assure continued operability of the battery system.

6.6.2.3 Inadequate Construction Acceptance Test (Post-Modification)

The team observed that construction acceptance testing may not always address the design requirements of the modification. For example, the acceptance test for the new 125- and 250-volt batteries was to prove that they would have sufficient capacity to supply their load profile without the voltage dropping below a minimum acceptance value. The test acceptance criteria did not address the design requirements of cell aging or cell minimum temperature, both of which affect battery capacity. The 250-volt battery factory test demonstrated the new battery could provide greater than 100% capacity. The battery was at 79°F when tested on site. This combination gave the battery an effective total of 40% increase in capacity over the design basis, which was based on an aged battery (with only 80% of rated capacity remaining) and a minimum operating temperature of 65°F. In spite of this additional capacity, the battery barely passed the test with only a 3-volt margin. The team feels that unacceptable installations may occur without appropriately comprehensive acceptance test criteria.

6.6.2.4 Failure to Incorporate Vendor-Recommended Test Acceptance Limits

In 1982, SIL No. 352 was issued by General Electric describing a problem with erratic opening of Terry HPCI turbine stop valves. The valves had opened too fast at two plants, resulting in damage to the seat, the stem, and the hydraulic cylinder seals. The erratic opening was attributed to improper balance chamber pressure adjustment. The SIL also pointed out that improper adjustment in the opposite direction could result in the stop valve failing to open. It was recommended that owners monitor the opening transient of the turbine stop valve during surveillance testing of the HPCI system by obtaining stop valve position and balance chamber pressure. To date, the recommendation of the SIL has not been fully incorporated in the plant routine testing.

In January 1986, a report was issued by the HPCI/RCIC Reliability Task Force in which it was stated that EWR 86-17 had been initiated to study the advisability of performing such a transient recording. To date, that EWR has not been performed.

The team noted that steam balance chamber pressure adjustment has been incorporated into repair procedure RP 52/ie-10, but that this adjustment is done only after corrective or preventative maintenance, not as a regular maintenance activity. It is important to note that obstruction of the adjustment valve flow path by corrosion or foreign matter can increase valve speed. Iowa Electric believes that this condition probably would be detected by current surveillance testing and trending.

Currently the upper limit of the valve speed is monitored as a part of the IST program, but no lower limit had been established that would be indicative of a too fast closing problem, which could result in damage to the valve.

6.6.3 <u>Conclusion</u>

Based on the documents reviewed, the team concluded that weaknesses exist in certain aspects of testing or routine maintenance of the HPCI system. The team is concerned that random testing of equipment will not adequately test all equipment required to mitigate an accident.

Of greater concern, however, is the potential generic problem of not having adequate programmatic control for overall testing. Two groups perform testing, surveillance, and maintenance. However, vendor-recommended testing that is not required by Technical Specifications or maintenance is sometimes not controlled or implemented by either group.

6.7 MANAGEMENT

6.7.1 Review and Approach

Because of the broad scope of this topic, the review of management support programs was topically narrowed to four categories. The areas of concentration were in 10CFR50.59 Reviews and Safety Evaluations, configuration control, impact of the modification process on training, and management support programs.

With respect to 10CFR50.59 reviews and safety evaluations, the following documents were reviewed: procedures, non-conformance reports, letter documents, clearance forms, design change packages, design document change packages, and corrective maintenance action requests. These documents were reviewed to determine if the facility/procedure changes, tests, experiments, or temporary modifications involved a change in the technical specifications or provoked an unreviewed safety question.

The inspection of the configuration control consisted of a review of the HPCI system drawings available at various distribution and/or reference centers, and a review of the following: the electronic database, the design document control procedures, a comparison of HPCI system drawings, temporary modifications, the quality level of parts replacements, modification packages and technical specification change control.

With respect to training, the HPCI training courses for operators and maintenance personnel were compared to the latest modification packages for consistency and incorporation into the training programs, the training procedures were reviewed for requirements and responsibilities, the training records of several site personnel were reviewed, and interviews were conducted to reveal perceptions of additional training required. Design change packages were reviewed for incorporation of the design guides, design basis documents, and continuation of the design basis analysis.

In the area of management support programs, procedures were reviewed for the types of programs available and design change packages were reviewed for the application of these programs and the levels of support provided for incorporation, verification, and closure.

6.7.2 Summary of Significant Observation Findings

6.7.2.1 Change Control Programmatic Concerns

The team found that 10CFR50.59 reviews and safety evaluations had not received a consistent depth of review, especially those for temporary modifications (or the emphasis through training that is required) to ensure that the changes in plant configuration do not result in an unreviewed safety question or reduce the margin of safety.

Letters authorizing changes often contain safety evaluations. The use of safety evaluations with these letters, however, is inconsistent. For example, NG 85-2123 replaced a safety-related pressure switch with a safety evaluation, and a subsequent letter NG 87-2228 removed two of the safety-related switches without a safety evaluation.

Safety evaluations should be issued prior to commencement of the associated work. One example of when this did not happen occurred when the diesel generator differential relay 1G31 was de-energized two days prior to the release of NG 87-2874 containing the safety review.

An example of a contradictory use of a safety evaluation occurred when the differential relay protection for a single DG 1G21 was disconnected based on the remaining DG 1G31 being in service (per MAR 082099 and Clearance 87-1358 and NG 87-2969). A similar justification was used when the second DG 1G31 differential relay protection was also disconnected several days later even though the first safety evaluation had never been revised to provide further justification eliminating the differential protection on both units simultaneously (per MAR 0-82099 and 87-1367 and NG 87-2974).

Iowa Electric notes that additional administrative controls and guidance regarding safety evaluations is being implemented in response to internal Iowa Electric and NRC commments in this area.

6.7.2.2 Inadequate Configuration Control

It appears that although DAEC has good access to most original design documents, they are not being adequately controlled or updated. The team is concerned that this could result in incorrect data being used to operate or modify the plant in the future.

The team found that the process of revising documents and the completeness of its treatment in the design change process was ambitiously being handled through an extensive procedure rewrite program. However, several areas surfaced where increased attention and commitment should be exerted.

For example, the control of current information and the availability of only current information at the location where the prescribed activity is performed needs to be reinforced. There are six onsite areas that receive microfilm cards and a recent sample by Iowa Electric (CAR 88-001) showed a disparity of revision levels.

The team found several discrepancies in the CHAMPS database regarding the quality level classification and missing information (for example, ZS2315A/B). In response, Iowa Electric has made a commitment to correct the database. However, more attention should be addressed to training on database updating during DCP closure.

The team found that the FSM type drawings in the Iowa Electric document system were not consistently being maintained or identified for limited use. The purpose of the FSM is to be an engineering tool to aid the designer in finding related FSKs. Iowa Electric has committed to provide guidance on what types of information are controlling on design documents. The team found that changes to these drawings are batched via a general updating design document changes and not changed during the design change package process.

A review of temporary plant modifications to equipment has revealed that the procedures do not limit or provide for timely restorations of the effects of temporary changes. The Operations Procedure OP-014 requires an engineering review and evaluation for the permanent resolution of the temporary jumper at the end of 6 months. A review of OP-14 monthly jumper and lifted lead audit for April 9, 1988 shows only 14 temporary changes in place for periods greater than 6 months. However, one "temporary" has been in existence since 1977. Iowa Electric is in the process of upgrading administrative control of temporary modifications.

A review of non-conformance reports by Iowa Electric revealed several quality level IV parts used in safety-related applications, i.e., NCR 87-116 and NCR 87-123, with a disposition to rework (replace with a qualified part). The team found that this status has remained for greater than 6 months without a conditional release for operation being performed or approved as required in the Quality Assurance Manual, Section 12.6.2.

The team reviewed DDC1197, which was used to document field survey results that found equipment changes, setpoint changes, accuracy changes and equipment model changes. This review revealed the use of the DDC process to finalize document changes without the review and evaluation of a non-conforming plant installation.

As noted earlier, Iowa Electric is conducting a full review of SSFI team concerns regarding DDC 1197.

6.7.2.3 Neglect of Design Basis in Modification Process Training

There are two types of training programs at the Duane Arnold Energy Center: the formalized training given at the training center and the training given by the appropriate department regarding their department procedures and other related topics. Both are tracked and maintained in the individual's training profiles.

The team found that the original design basis documents are not always referenced as inputs to the modification. General Electric and Bechtel design basis documents contain many design inputs that form the basis of the updated FSAR and the licensing of the plant. A review of the contents and uses of these documents should be incorporated into the training program.

Iowa Electric has initiated training and guidance to improve the use of design inputs for modification.

6.7.2.4 Weak Assignment of Design Responsibility

A second level of review procedure NGD 103.175 has been in effect for the past 20 months and it provides a review of safety-related work performed by design organizations external to Iowa Electric. This procedure contains elements of a good review and would assure adequate Iowa Electric attention. However, this procedure has not been invoked yet, since its implementation is discretionary. The team recommends (and Iowa Electric concurs) that formal use of this second-level review procedure be implemented.

6.7.3 <u>Conclusions</u>

Based upon the areas reviewed in this inspection, the team concluded that the following weaknesses exist:

1. The emphasis on safety evaluations and reviews does not extend to temporary modifications and evaluations of non-conformances.

2. Lack of control of revisions to drawings available at the site from six different locations may lead to future design errors.

ATTACHMENT 2

OBSERVATION CLASSIFICATION MATRIX

OBSERVATION CATEGORY	1 Mech.	2 El.	3 I&C	4 Ops.	5 Maint.	6 S&T	7 Manag.	Total
SIGNIFICANCE								
Major	1	3	4	2	3	2	3	18
Minor	21	3	14	13	9	2	16	78
DESIGN PROCESS								
Input	5	3	3					11
Assumption	2	1	1					4
Methodology		2	3					5
Verification	2	2	1			2	1	8
Interface	1		1	1				3
Output	3	1	1	1				6
PROCEDURE								
Preparation				1	4	2	1	8
Implementation	1		3	4	3		5	16
COMMUNICATIONS, Including Safety Evaluations and Root Cause Analyses			1		2		7	10
CONFIGURATION CONTROL	9		7	9	3	1	7	36

NOTE: Totals may not necessarily agree because some observations may have covered more than one area.

ATTACHMENT 3

PERSONNEL CONTACTED

Name	Position	Meeting
Aldrich, Wendell	I&C Inspector	1, 3
Aldridge, Arden	PMAR Coordinator	1
Anderson, Rob	Operations	3
Baldyga, R.	Supv. Engr., Response Engineering	3
Bell, P.	Licensing Engineer	
Bjorseth, John	Maintenance Engineering Supervisor	
Brown, Russ	Warehouse Foreman	
Browning, Tony	Group Leader-Licensing	3
Chess, R.		
Chrystal, Janice	Admin. Support	1, 3
Dvorsky, J.	Engineer	
Ellis, Gary	Plant Services Supt.	3
Fowler, Dick	Operations	1, 3
Fritz, Fred	Electrical Engineer	
Hahle, Paul	Training Supervisor	
Hannen, Rick	Plant Supt.	1, 2, 3
Hawkins, Gary	Systems Engineering	1, 3
Howard, Ann	Surveillance Performance Coordinator	
Hunemuller, Maureen	Plant Performance Supv.	1
Klotz, Bruce	Quality Assurance Supv.	
Kozman, Joseph	Supv. Engr., Systems Engineering	1, 3
Lacy, Bruce	Maintenance Supt.	3
Leach, G.		
Leimkuehler, Brian	HPCI Systems Engr.	1, 3
Lessly, Roger	Manager Design Engineering	1, 2, 3
Levan, Kent	Nuclear Station Mechanic	
Loehrlein, Jim	Supv. Engr., Modifications Engineering	1, 3
Matthews, Ernest G.	Mgr. QA	3
McCracken, Robert	Q.C. Supervisor	1, 3
McDermott, Mike	Supv. Engr., Project Engineering	1
McGough, J.	Electrical Engineer	
Medulan, K.	Systems Engr. (ASME)	
Miller, Bill	SSFI Response Team Manager	1, 2, 3
Moeller, A.	Engineer	
Parker, Mike	Senior NRC Resident Inspector	3
Peden, Bill	Systems Engineer	1
Peterson, Norm	Licensing Engr.	
Powers, J.		
Probst, J.	Engr., Tech. Support	
Roby, Russ	Electrical Engineer	1
Rockhill, Dick	Electrical Maintenance Supervisor	
Roderick, A.	Design Engr.	

Meetings:
1. Entrance
2. Mid-inspection management briefing
3. Exit

MAJOR OBSERVATIONS

1.3	Outdated microfiche drawings in EOF
2.1	Inadequate MOV protection
2.3	Inadequate battery sizing
2.6	Inadequate voltage at DC MOVs
3.2	Instrumentation repeatedly out of range
3.7	Inadequate operator response to annunciator
3.14	Out of date documents in TSC
3.17	Incomplete setpoint analysis
4.1	Operating Instruction conflicts with vendor recommendations
4.15	Repeated failure to comply with operating procedures
5.1	Conflict between annunciator procedure and vendor recommendations
5.4	Inconsistent root cause analysis on CMARS
5.12	Inadequate control of safety-related spare parts
6.2	Incomplete HPCI trips functional testing
6.4	Battery temperature not included in surveillances
7.1	Unjustified use of QLIV parts in safety-related applications
7.2	Unjustified use of QLIV parts in safety-related applications
7.4	Inadequate control of working drawings

Note: Observations categorized as major significance are those items that the team feels could lead to future design or operating problems.

Observations categorized as minor significance include items such as UFSAR discrepancies, drawing and data base errors, and other documentation type problems that are examples of lack of attention to detail, but would not normally be expected to be significant to plant or personnel safety.

ATTACHMENT 3 (Cont.)

PERSONNEL CONTACTED

Name	Position	Meeting
Rothert, Bill	Manager, Nuclear Generation Division	3
Salmon, R. F.	Tech. Services Supt.	1, 3
Scott, Jim	Nuclear Station & Sub Elec. Foreman	
Severson, Russ	Reactor Engineer	
Shearer, H.	Systems Engr. (EQ)	
Shubatt, C.		
Shuffield, J.	Maintenance Planning	
Sikka, Narindra	Design Engineering - Supv. Engr.	1, 3
Sorensen, Eric	Maintenance Engr.	1
Sparano, Jim	Outage Planner	
Sueper, L.	Systems Engr.	
Sweiger, J.	Electrical Maintenance	
Thorsteinson, Jeff	Technical Support Supervisor	1, 3
Tran, Bav	Systems Engr.	
Tucker, Bob	Staff Tech	
Van Etton, Frank	Instructor	
Van Middlesworth, Gary	Assist Plant Super. Operations	1
Vavra, Leigh A.	Supv. Engr., Engineering Support	1, 3
Votroubeck, L.	Assistant Supervisor - Mech. Maint.	
Wilson, Dave	Manager, Training	

Meetings:
1. Entrance
2. Mid-inspection management briefing
3. Exit

ATTACHMENT 4

DOCUMENTS REVIEWED

Document Number	Revision/ Date	Title/Description
Drawings		
APED-B21-017	Rev. 11	Steam Leak Detection System Elementary Diagram
APED-B21-017(2)-11	Rev. 11	Steam Leak Detection System Elementary Diagram
APED-B21-037(1)-1	Rev. 6	Temperature Monitor for Leak Detection System
APED-B21-037(2)-1	Rev. 6	Temperature Monitor for Leak Detection System
APED-B21-037(3)-1	Rev. 6	Temperature Monitor for Leak Detection System
APED-E41-006(1)-26	Rev. 26	HPCI System Elementary Diagram
APED-E41-006(1)	Rev. 25D	HPCI System Elementary Diagram
APED-E41-006(2)-22	Rev. 22	HPCI System Elementary Diagram
APED-E41-006(2)	Rev. 22C	HPCI System Elementary Diagram
APED-E41-006(3)-16	Rev. 16	HPCI System Elementary Diagram
APED-E41-006(3)	Rev. 16A	HPCI System Elementary Diagram
APED-E41-006(4)-22	Rev. 22	HPCI System Elementary Diagram
APED-E41-006(4)	Rev. 21B	HPCI System Elementary Diagram
APED-E41-006(5)-8	Rev. 15	HPCI System Elementary Diagram
APED-E41-006(6)-18	Rev. 18	HPCI System Elementary Diagram
APED-E41-006(6)	Rev. 18A	HPCI System Elementary Diagram
APED-E41-006(7)-10	Rev. 10	HPCI System Elementary Diagram
APED-E41-006(7)	Rev. 9A	HPCI System Elementary Diagram
APED-E41-006(8)-11	Rev. 18	HPCI System Elementary Diagram
APED-E41-012(1)	Rev. 6	HPCI Functional Control Diagram
APED-E41-012(2)	Rev. 4	HPCI Functional Control Diagram
APED-E41-012(3)	Rev. 5	HPCI Functional Control Diagram
7784-BECH-E-001-1	Rev. 12	One Line Diagram
BECH-E-005	Rev. 8A	One Line Diagram
BECH-E-0065	Rev. 12F	One Line Diagram
BECH-E-27	Rev. 12	Single Line Meter & Relay Diagram - 125 Vdc System
BECH-E-27	Rev. 12D	Single Line Meter & Relay Diagram - 125 Vdc System
BECH-E-28	Rev. 4	Single Line Meter & Relay Diagram - 250 Vdc and 24 Vdc Systems
BECH-E-28	Rev. 4D	Single Line Meter & Relay Diagram - 250 Vdc and 24 Vdc Systems

Document Number	Revision/ Date	Title/Description
BECH-E-108, Sheet 18	Rev. 5	CST Level Control
BECH-E-124, Sheet 6	Rev. 4	Reactor Instrumentation and Radiation Monitoring System
BECH-E-124, Sheet 7	Rev. 4	Reactor Instrumentation and Radiation Monitoring System
BECH-FSM-122, Sheet 1	Rev. 1	High Pressure Coolant Injection System (HPCI) Steam Side
BECH-FSM-123, Sheet 2	Rev. 1	High Pressure Coolant Injection System (HPCI) Steam Side
BECH-M-109	Rev. 28	Condensate and Demineralized Water Systems
BECH-M-109	Rev. 28C	Condensate and Demineralized Water Systems
BECH-M-113	Rev. 27	RHR Service Water and Emergency Service Water Systems
BECH-M-113	Rev. 27A	RHR Service Water and Emergency Service Water Systems
BECH-M-114	Rev. 24	Nuclear Boiler System
BECH-M-114	Rev. 24D	Nuclear Boiler System
BECH-M-119, Sheet 1	Rev. 28	Residual Heat Removal System
BECH-M-119, Sheet 1	Rev. 28F	Residual Heat Removal System
BECH-M-122, Sheet 1	Rev. 19	High Pressure Coolant Injection System (HPCI) Steam Side
BECH-M-123, Sheet 2	Rev. 13	High Pressure Coolant Injection System (HPCI) Steam Side
BECH-M-125, Sheet 2	Rev. 19	Reactor Core Isolation System (RCIC) System (Water Side)
BECH-M-125, Sheet 2	Rev. 19B	Reactor Core Isolation System (RCIC) System (Water Side)
BECH-M-177-1-5	Rev. 5	CST Level Control
BECH-M-171	Rev. 12	Reactor Building HVAC Cooling Systems
BECH-M-400	Rev. 2	Instrument Index
BECH-M-660	Rev. 9	Heating Ventilating and Air Conditioning Reactor Building Area No. 5 Plan Below El. 757'-6"
BECH-M-661	Rev. 10	Heating Ventilating and Air Conditioning Reactor Building Area No. 5 Plan Below El. 734'-0"
BECH-E-121L0197	6/	HPCI Test Bypass to CST
BECH-E-121L019A7	0/	Reactor Core Cooling Systems
BECH-E-121L01987	NI-A/	Reactor Core Cooling Systems
BECH-E-121L0207	4/	HPCI Sys Red Shutoff to CST
BECH-E-861L57		Connection Diag Misc Junct. Box
BECH-E-861L5T7	T/	

Document Number	Revision/ Date	Title/Description
M165-4-2	0/ 10-15-71	HPCI Rupture disc
M495, Sheet 1	4/ 3-20-76	HPCI Rupture disc Data sheet
M144A-129-1	A/ 12-1-71	Drwg for PCV-2232
M453-2	0/6-1-71	Data Sheet for PCV-2232
M146-43	0/ 6-29-72	Drwg for PSV-2228
M457-4	2/ 3-19-73	Data Sheet for PSV-2228
M146-35	B/ 6-30-72	Drwg for PSV-2223
M457, Sheet 4	2/ 3-19-73	Data Sheet for PV-2223
APED-E41-2763-211	F/1972	Barometric Condenser
M159-2, Sheet 6	9/8/70	Orifices, FO-2203, 04, 05; FO-2254A/B
M141-056	11/ 11-9-87	Drwg for MOV-2290A/B
Bech M152	17D/ 5-2-88	Reactor Bldg. Air Flow Diagram
Bech M171	12/ 8-20-87	P&ID, HVAC Cooling Systems
Bech M113	27/ 8-11-87	P&ID, Emergency Service Water
M095-26-1	1/ 4-27-77	Material List - HPCI Room Cooler
M095-59-2	0/ 5-23-74	Motor Data Sheet
M095-97-1	0/ 8-28-73	Fan Curve - IV-AC-14 A/B
M095-20-	0/ 1-13-72	Material List for IV-AC-14 A/B
M095-21-	0/ 1-13-72	Material List for IV-AV-14 A/B
Bech-E 200-03	4/87	MOV Data Sheets
Bech-E 200-05	2/87	MOV Data Sheets
Bech-E 200-06	3/87	MOV Data Sheets
Bech-E 200-07	2/87	MOV Data Sheets
Bech-E 200-08	3/87	MOV Data Sheets
Bech-E 200-09	1/87	MOV Data Sheets
Bech-E 200-12	0/87	MOV Data Sheets
Bech-E 200-13	0/87	MOV Data Sheets
Bech-E 200-13H	0/87	MOV Data Sheets
7784-E121-11	2/76	Schematic Diagrams
7784-E121-12	3/72	Schematic Diagrams
7784-E121-13	6/76	Schematic Diagrams

Document Number	Revision/ Date	Title/Description
7784-E121-14	7/87	Schematic Diagrams
7784-E121-15	7/87	Schematic Diagrams
7784-E121-16	9/87	Schematic Diagrams
7784-E121-16A	2/88	Schematic Diagrams
7784-E121-17	5/87	Schematic Diagrams
7784-E121-18	6/87	Schematic Diagrams
7784-E121-19	6/87	Schematic Diagrams
7784-E121-19A	0/	Schematic Diagrams
7784-E121-19B	0/	Schematic Diagrams
7784-E121-20	5/	Schematic Diagrams
7784-E121-21	4/	Schematic Diagrams
7784-E121-22	5/	Schematic Diagrams
7784-E121-23	6/	Schematic Diagrams
7784-E121-23A	2/	Schematic Diagrams
7884-E-105-12	13/84	1B32 - 480 V MCC Schedules
7884-E-105-16	13/84	1B42 - 480 V MCC Schedules
7884-E-105-14	15/85	1B34 - 480 V MCC Schedules
7884-E-105-16A	8/	1B42 - 480 V MCC Schedules
7884-E-105-12A	7/85	1B32 - 480 V MCC Schedules
7884-Bech-E105<3>	8/86	480 V MCC Schedules
Bech-E105-015	15A/87	1B34 - 480 V MCC Schedules
E27-F D	0/72	Functional Description 125 Vdc System
Bech-E027	12/87	Single Line Meter & Relay Diagram 125 Vdc System
Bech-E028	4C/87	Single Line Meter & Relay Diagram 250 Vdc & 24 Vdc System
E-28-FD	0/72	Functional Description 250 Volt DC & +24 V Systems
E107-009	5/	
E9-100	11/84	480 V MCC 1B32 Front View Dwg
E010-001-09	7/87	1D41 MCC Schedule Sheet 1
E010-001-11	5/87	1D41 MCC Nameplate Schedule
E010-001-10	1/74	1D41 MCC Schedule Sheet 2
E-29-2	4/83	D.C. Description Panels
E-10-1-22	4/	MCC Wiring Diagram "G"
E-10-1-21	5/73	MCC Wiring Diagram "F"
E-10-1-19	4/73	MCC Wiring Diagram "D"
E-10-1-20	7/74	MCC Wiring Diagram "E"
E-10-1-17	5/	MCC Wiring Diagram "B"
E-10-1-18	5/73	MCC Wiring Diagram "C"
E-10-1-16	5/	MCC Wiring Diagram "A"
E-9-85	6/	Size 1 - Fur Comb Starter Wiring Diagram
FSK-3559	Rev. 9	
FSK-4074	Rev. 5	
FSK-4075	Rev. 5	

Document Number	Revision/ Date	Title/Description
FSK-4076	Rev. 4	
FSK-4079	Rev. 5	
FSK-4085	Rev. 10	
FSK-4087	Rev. 4	
FSK-4088	Rev. 3	
FSK-4093	Rev. 4	
FSK-4094	Rev. 7	
FSK-4095	Rev. 2	
FSK-4096	Rev. 6	
FSK-4097	REv. 2	
FSK-4098	Rev. 3	
FSK-4099	Rev. 3	
FSK-4100	Rev. 5	
FSK-4104	Rev. 3	
FSK-4106	Rev. 3	
FSK-4108	Rev. 4	
FSK-4113	Rev. 5	
FSK-4114	Rev. 3	
FSK-4117	Rev. 2	
FSK-4118	Rev. 3	
FSK-4119	Rev. 7	
FSK-4140	Rev. 5	
FSK-4140-B	Rev. 1	
FSK-4159	Rev. 7	
FSK-4162	Rev. 4	
FSK-4163	Rev. 2	
FSK-4164	Rev. 2	
FSK-4176	Rev. 6	
FSK-4177	Rev. 6	
FSK-4346	Rev. 4	
FSK-4394	Rev. 3	
FSK-4482	Rev. 2	
FSK-4483	Rev. 1	
FSK-4488	Rev. 1	
FSK-4539	Rev. 1	
FSK-4580	Rev. 1	
FSK-4813	Rev. 3	
FSK-4900	Rev. 4	
FSK-5074	Rev. 4	
FSK-5075	Rev. 4	
FSK-5077	Rev. 2	
FSK-5078	Rev. 2	
FSK-5080	Rev. 3	
FSK-5081	Rev. 2	
FSK-5082	Rev. 2	
FSK-5087	Rev. 2	

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FSK-5088	Rev. 2	
FSK-5089	Rev. 2	
FSK-5090	Rev. 2	
FSK-5092	REv. 3	
FSK-5263	Rev. 2	
FSK-5581	Rev. 4	
FSK-5583	Rev. 3	
FSK-5584	Rev. 3	
FSK-5631	Rev. 2	
FSK-5681	Rev. 1	
FSK-5683	Rev. 2	
FSK-5684	Rev. 1	
FSK-8055	Rev. 3	
FSK-8056	Rev. 4	
FSK-8057	Rev. 4	
FSK-8105	Rev. 2	
ISO-DBA-003-001	Rev. 3	
ISO-DLA-001-001	Rev. 3	
ISO-DLA-002-001	Rev. 2	
ISO-DLA-0002-002	Rev. 2	
ISO-DLA-002-003	Rev. 6	
ISO-DLA-002-004	Rev. 7	
ISO-DLA-003-001	Rev. 3	
ISO-DLA-003-002	Rev. 0	
ISO-EBB-004-001	Rev. 0	
ISO-EBB-005-001	Rev. 0	
ISO-EBB-006-001	Rev. 0	
ISO-EBB-007-001	Rev. 0	
ISO-EBB-014-001	Rev. 0	
ISO-EBB-016-001	Rev. 0	
ISO-EBB-016-002	Rev. 0	
ISO-EBD-003-001	Rev. 5	
ISO-EBD-003-002	Rev. 4	
ISO-EBD-003-003	Rev. 2	
ISO-EBD-003-004	Rev. 3	
ISO-GBD-029-001	Rev. 4	
ISO-GBD-029-002	Rev. 1	
ISO-HBB-006-001	Rev. 0	
ISO-HBB-006-002	Rev. 0	
ISO-HBB-008-001	Rev. 0	
ISO-HBB-009-001	Rev. 0	
ISO-HBD-009-001	Rev. 5	
ISO-HBD-009-002	Rev. 4	
ISO-HBD-009-003	Rev. 4	
ISO-HBD-009-004	Rev. 4	
ISO-HCC-006-001	Rev. 2	

Document Number	Revision/ Date	Title/Description
ISO-HCC-006-002	Rev. 3	
ISO-HCC-006-003	Rev. 2	
ISO-HCD-003-001	Rev. 5	
ISO-HCD-003-002	Rev. 3	
ISO-HCD-023-001	Rev. 3	
ISO-HCD-023-002	Rev. 4	
ISO-HLE-001-001	Rev. 0	
ISO-HLE-005-001	Rev. 0	
ISO-HLE-006-001	Rev. 0	
ISO-HLE-013-001	Rev. 3	
ISO-HLE-013-002	Rev. 0	
ISO-HLE-019-001	Rev. 0	

UFSAR Chapters/Tables/ Figures/Sections		Title/Description
Table 3.2-1	-	Seismic Structures Systems and Equipment
Tables 3.2-3 and 4	-	RCPB and Classifications of Other Systems Beyond RCPB
3.1.2.13	-	Fire Protection - Criterion 3
3.1.2	-	Criterion 35 - ECCS
3.6.2.2.4.7	-	Design - Separation
3.6.1	-	Postulated Piping Failures in Fluid Systems Outside Containment
6.2.4	-	Instrument Line Isolation
6.3	-	ECCS Design Basis
9.5	-	Fire Protection
9.4	-	Engineered Safety Feature Ventilation
9.2.3	-	Water Supply Systems
7.3	-	
7.4	-	
6.5.3.3	-	
1.2.5.6.6	-	Electrical
8.3	-	
Chapter 15	-	(All)

Technical Specifications

Section 1.0	Rev. 149	Definitions
Section 3.1/4.1	Rev. 149	Reactor Protection System
Section 3.2/4.2	Rev. 149	Protective Instrumentation
Section 3.5/4.5	Rev. 149	Core and Containment Cooling System
Section 3.7/4.7	Rev. 149	Containment Systems
Section 3.8/4.8	Rev. 149	Auxiliary Electrical Systems

Calculations

EC4H	1970	Voltage Drop Study - Aux. Syst.
EC8C	1970	Plant D.C. System
EC-8D	1970	D.C. System S.C. Study
EC-8E	1971	D.C. System Battery Sizing

Document Number	Revision/ Date	Title/Description
EC-8F		D.C. System Interrupting Cap
EC-9B		
EC-9Q	1974	Cond Ampacities Hot Areas
M104 A-016	0	Seismic Calc, HPCI Deluge
CAL-BECH-VCI-6	0/ 12-1-72	HPCI Room Cooling Units
BLIEG 80-0443	-	Room Cooling NUREG 0737
CAL-BECH-VC6-1	-	Cooling Loads
CAL-BECH-MC-42A	-	HPCI NPSH
CALC M22-21-3	-	
CAL-BECH-082-605A	-	HPCI Steam Line Failure HBB-14-H-8
CALC-M87-46	0	Battery Rack Anchor Bolting
BEC-01-17	-	HPCI Steam Supply ANSI B31.7 Stress Analysis
CALC-IELP-E87-04		Setpoint Calculations
E-87-06		250 Volt Battery Sizing

Operating Procedures

OI-152	Rev. 6	HPCI Operating Instruction
EOP-1	Rev. 3/ 5-30-87	RPV Control

Annunciator Response Procedures (ARPs)

1C-03C	Rev. 6	Control Panel 1C-03C
1C-24A	Rev. 4	Control Panel 1C-24A
1C-24B	Rev. 4	Control Panel 1C-24B

Maintenance Procedures

IP-2		Western Gear Reducer
IP-3		Barometric Condenser
IP-4	Rev. 4	HPCI Turbine
RP52/ie-1		HPCI Turbine
RP52/ie-2		Barometric Condenser Alternator Float
RP52/ie-3		Vacuum Pump
RP52/ie-4		Inspection and Replacement of HPCI Turbine Shaft Seals
RP52/ie-5		HPCI Overspeed Trip
RP52/ie-6		IMO Pump
RP52/ie-7		HPCI Main and Booster Pump
RP52/ie-8		HPCI Turbine
RP52/ie-9		HPCI Turbine Oil Flush
RP52/ie-10		
RP52/ie-11		Vertical Mounted Centrifugal Pump
RP52/ie-12		Internal Gear Pump

Document Number	Revision/ Date	Title/Description
RP52/ie-13		HPCI Turbine Stop Valve
RP52/ie-14		Solenoid Valve
RP52/ie-15		HPCI Turbine Oil Filtration
SMP-87-001		MOVATS 2100/2150 Signature Analysis System for Testing Limitorque Motor
VALVOP-L200-006		Limitorque Valve Operator Type SMB-00
VALVOP-L200-007		Limitorque Motor Operator Lubrication
VALVOP-L200-009		Limitorque Valve Operator Inspection and Lubrication (draft)
VALVOP-L200-011		Limitorque Motor Operator Lubrication
GMP-TEST-011	Rev. 0	Limitorque Valve Operator Testing

Surveillance Test Procedures (STPs)

STPBS-5	Rev. 35	Control Room Panel Shift Check List
STPBS-8	Rev. 7	Valve Position Indicator Verification
STPBS-42	Rev. 1	RHR, CS, HPCI, RCIC, Room Cooler Checks
STP41A003	Rev. 19	Reactor High and Low Water Level (HPCI, RCIC, RPS, PCIS) Instrument Functional Test/Calibration
STP42A001	Rev. 82	Daily and Shift Instrument Checks
STP42B001	Rev. 24	Reactor Low Low Low Water Level (HPCI, RHR, CS, ADS, RCIC) Instrument Functional Test/Calibration
STP42B006	Rev. 14	Drywell High Pressure (CS, RHR, HPCI) Instrument Functional Test/Calibration
STP42B015	Rev. 16	CSCS Trip System Bus Power Monitors Functional Test
STP42B019	Rev. 17	Condensate Storage Tank Low Water Level Instrument Functional Test/Calibration
STP42B020	Rev. 9	Suppression Chamber High Water Level Instrument Functional Test/Calibration
STP42B025-M	Rev. 0	HPCI Steam Line High DP Instrument Functional Test
STP42B025-Q	Rev. 0	HPCI Steam Line High DP Instrument Functional Test/Calibration
STP42B026	Rev. 12	Suppression Chamber Steam Leak Detection Temperature Monitoring System Functional Test/Calibration
STP42B028-M	Rev. 0	HPCI Steam Supply Low Pressure Functional Test
STP42B028-Q	Rev. 0	HPCI Steam Supply Low Pressure Functional Test/Calibration
STP42B029	Rev. 12	HPCI Steam Leak Detection Temperature Monitoring System Functional Test/Calibration
STP42B035	Rev. 10	HPCI Actuation Logic System Functional Test

Document Number	Revision/ Date	Title/Description
STP42B035	Rev. 0	HPCI Actuation Logic System Functional Test (STEEP Draft)
STP42B036	Rev. 8	HPCI System Isolation Logic Functional Test
STP45D001.1-SP	Rev. 0	Alternate HPCI Operability Test
STP45D001-CY	Rev. 2	HPCI System Cycle Operability Test
STP45D001-M	Rev. 34	HPCI System Monthly Operability Test
STP45D001-PM	Rev. 3	HPCI System Operability Tests Following Pump Maintenance
STP45D001-Q	Rev. 15	HPCI System Operability Tests
STP45D001-Q, Appendix 1	Rev. 26	HPCI System General Inspection for Visible Leakage
STP47A003	Rev. 6	Containment Leak Tightness Test - Type B Penetrations
STP47A005	Rev. 28	Containment Isolation Valve Leak Tightness Test - Type C Penetrations
STP685001	Rev. 7	Cycle Leakage Measurement Program
STP48005	Rev. 14/ 4-7-88	Weekly/Quarterly Battery Checks
STP48A006	Rev. 15/ 3-16-88	Battery Testing
STP48A006	Rev. 12/ 4-30-87	Battery Test Results

Administrative Procedures

102.10	Rev. 1A/ 11-12-87	Preparation Review and Processing of UFSAR Change Requests
102.11	Rev. 1/ 11-12-87	Preparation, Review and Processing of Technical Specification/Operating License Change Requests
103.000	Rev. 1A/ 4-1-88	Design Control Process
103.001	Rev. 2/ 3-11-88	Engineering Work Requests (EWR)
103.004	Rev. 1/ 10-21-85	10CFR50.59 Safety Evaluation for Design Change Packages
103.008	Rev. 2/ 6-30-87	Emergency Design Changes
103.100	Rev. 1A/ 3-11-88	Detailed Design Activities
103.120	Rev. 1/ 11-14-86	External Design Interfaces
103.121	Rev. 0/ 11-14-86	Internal Design Interfaces
103.160	Rev. 0/ 10-21-85	Final Safety Evaluation
103.170	Rev. 1/ 11-14-86	Design Verification

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103.175	Rev. 0A/ 12-31-86	Second Level Review
103.180	Rev. 1A/ 3-11-88	Design Change Package Assemble, Review, and Approval
103.400	Rev. 2A/ 3-11-88	Field Variance
103.420	Rev. 1C/ 1-31-87	Design Change Package Closure Activities
103.430	Rev. 2A/ 3-11-88	Field Change Notice
106.4	Rev. 2A/ 7-11-86	Distribution and Document Control
106.5	Rev. 4/ 6-19-86	Document Control - Advanced Information Drawings
106.7	Rev. 1/ 1-31-87	Control of Design Document Changes (DDC)
106.12	Rev. 0/ 12-31-84	Vendor Manual Document Control
106.13	Rev. 1/ 5-24-88	Equipment Data Base
109.1	Rev. 1B/ 3-11-88	Minor Modifications
111.2	Rev. 0/ 3-7-86	Post-Installation/Modification Test Program
112.1	Rev. 2/ 11-14-86	Nonconformance Reporting and Dispositioning
113.1	Rev. 1B/ 11-12-87	Personnel Training on New and Permanently Revised Procedures
113.2	Rev. 0/ 3-7-86	Records of Training
114.3	Rev. 0/ 4-22-88	Root Cause Analysis
1202.1	Rev. 0/ 7-1-83	Design Engineering Review of Industry-Related Experience
1204.01	Rev. 0/ 5-13-88	Design Engineering Procurement
1410.1	Rev. 2	Shift Organization, Operation and Turnover
1410.5	Rev. 4	Tagout Procedure
1410.6	Rev. 4	Jumper and Lifted Lead Control
1410.9	Rev. 0	Locked Valve Program

Training Documents

500-007	1/4-19-88	Reactor Operator Instructor Guide C3 HPCI System
500-007	1/2-5-88	Reactor Operator System Description C3 HPCI System

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APED-A61-18-1	Rev. 3	22A1295, Design Specification for Pressure Integrity of Piping and Equipment Pressure Parts)
	2-27-70	Preliminary, not for Final Design Data Sheets for "33"
APED-A61-19-1	Rev. 2 2-17-72	(22A1295AD)
APED-A61-32-1		(22A1300EB) BWR Plant Requirements for Duane Arnold Project
APED-B21-89-1	8-1-68	(22A1304A) Design Recommendations for Standard BWR Plants
7884-E-27	Rev. 1/ 3-15-71	Valve Motor Operators
DGC-G104		Design Guide - Setpoints
APED-E41-015		
APED-E41-016		
NEDO 10139		HPCI Subsystem Containment Isolation Valve Testing Criteria

GE Service Information Letters (SILs)

91	Topaz Inverter Cover Clearance
233	HPCI Turbine - Control Valve Lift Rod Bending
274	HPCI Solid Wheel Turbine - Reversing Chamber
306	HPCI Turbiner - Stop Valve Hydraulic Cylinder Seal
319	HPCI and RCIC Turbines Drive Gear Assembly
336	Surveillance Testing Recommendations for HPCI and RCIC Systems
351	HPCI and RCIC Turbine control System Calibration
392	Hydralic Trip Tappet Modification
353	HPCI Turbine Mechanical Overspeed Trip
358	Replacement Diaphragms for Robertshaw Valve
405	Failures of Anchor Darling Globe Valve Anti-rotation Devices
2	PEECO Paddle Wheels - N/A
30	Vacuum Breakers - Steam Exhaust
94	Turbine Controls
129	Graham Gland Condense Gaskets - N/A
416	Riley Pan Alarm Switches - Inadvertent Trips
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SIL-442	

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500-001	1/11-23-87	Second Assistant Instructor Guide 2.8 HPCI
500-001	1/11-25-87	Second Assistant Student Guide 2.8 HPCI
500-007	0/2-13-86	Reactor Operator Student Guide S/D C-3 HPCI System
500-005	0/5-6-88	Mechanical Maintenance Student Guide 11.3 Globe Valves
500-005	0/9-22-87	Mechanical Maintenance Instructor Guide 11.3 Globe Valves
500-005		11.8 Lab Sheet: Repair Limitorque Valve Operator; Lab Sheet: Inspect and Repair Pneumatic Actuator
500-005	0/3-31-88	Mechanical Maintenance Student Guide 20.2 Repair HPCI and RCIC Turbines
500-005		Mechanical Maintenance 11.3 Lab Sheet: Repair Scram Valve; Lab Sheet: Replace Seat in Scram Inlet Valve; Lab Sheet: Replace Outlet Scram Valve Seat; Lab Sheet: Repair N_2 Inerting Valve
500-005	0/3-24-88	Mechanical Maintenance 20.1 Turbine Inspection
500-005	0/3-24-88	Mechanical Maintenance 20.1 Turbine Inspections
500-005	0/5-22-86	Mechanical Maintenance 11.8 Valve Operators
500-005	0/5-22-86	Mechanical Maintenance Instructors Guide 11.8 Valve Operators
500-005	0/3-31-88	Mechanical Maintenance Instructor Guide: 20.2 Repair HPCI and RCIC Turbines
IEL&P	6/1-1-88	Training Center Course Catalog
Trng. Records		S.S. #496661649 S.S. #480542315

Technical Instructions and Manuals

T147	Rev. 3	Terry Turbine Manuals Miller Fluid Power (Stop Valve) W. W. Nugent (Lube Oil Filters)
GEK-16646	Rev. 8/ 8-23-74	GE HPCI Operations and Maintenance
GEK-34714	Rev. 8/ 8-23-74	HPCI Process Instrumentation

Design Specifications

Bech MRS-M44		CST Design Specification
22A1362	Rev. 5	HPCI System Design Specification
NEDC-20115		Engineering Documentation Systems

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31		Warming of Steam Lines T. Walter
418		
418	Rev. 1	
080904		M02298-0

Corrective Maintenance Action Requests (CMAR)

080904	M02298-0
081087	V22-0018
081028	V22-0041
081972	IS201 Rotor Shaft
081973	IS201 Oil Relay
081978	1S201 Oil Filter Valve
082006	CV2206
082912	M02321-0
083279	M02290A-0
083280	M02290B-0
083282	M02321-0
085503	HV2200
085608	TI2279
086226	M02247
086227	M02311
086231	PSV2288
086232	PSV2289
086360	M02312-0
086361	M02311-0
086362	M02202-0
086369	1D4104
086502	SUS52.00 HPCI-1-10 Whip Restraint
086615	EBD003
086671	SUS52.00 Air Supply Header
087141	LS2206
087305	V22-0079
087306	V22-0081
087895	CV2212
087973	SUS52.00 Flange
088079	V22-0084
088280	M02311
088433	DT2209
088435	HV2201-0
088600	M02300-0
088601	M02321
088668	PS2233A
088669	PS2233B
088859	V13-0071 Downstream Piping
088861	1C035 Annunciator Panel Fasteners
089074	1S201 EGR Speed Control
089081	PSE2214

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079196		
073065		
074924		
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073374		
071181		
076774		
084186		
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083280		
088876		
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069955		
082457		
063219		
075271A		
075445		
080499		
073804		
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075443A		
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072903		
088327		
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087306		
083282		
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070754		
080904A		
080959A		
073804A		
075472		
073445		
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079196A		
060658		
086232		
085608		

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081972		
088600		
086615A		

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1026220		1E202
1026276		1P216
1026277		1P216A
1026278		1P216A-G
1026281		1P233
1026302		1S201
1027032		E41-K603-1C003
1027146		LITS4540
1027193		LS2206
1027194		LS2219
1027195		LS2222A
1027196		LS2222B
1027272		PCV2232
1027293		PD2272
1027369		PS2215A
1027370		PS2215B
1027371		PS2215C
1027372		PS2215D
1027454		TCV2255
1027512		TI2279
1027911		LITS4540
1027913		PCV2292
1027914		PCV2293
1027971		M02202-M
1028414		1P218-M
1028415		1P219-M
1028422		1P233-M
1028428		1S201
1028591		M02202-0
1028592		M02238-0
1029891		1S201
1029992		DLA-003-SS-001
1029994		EBB-014-SS-013
1029995		EBB-014-SS014
1029996		EBB-014-SS-015
1029997		EBB-014-SS-016A
1030245		1B3233
1030315		1B3453

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089245		IC003 Annunciator B-3
074353		
080391A		
080687		
071729		
062494		
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070725		
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081963		
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Design Change Packages (DCPs)		
1331A		HPCI Test Valve
1331B		HPCI Control Power Plant Supply
1297		
1401		
Design Change Request (DCRs)		
1277	1984	Upgrade Motorized Valve Actuators to Class 1E Qualification
1378	1987	250 Volt Battery Installation
1381	1986	Valve MD-1908 Motor Replacement
0716		Torus Level Instrumentation
0954		Addition of Level Switch LS4363
1099		
0150		
Deviation Requests (DRs)		
85-110		
85-147		
85-151		
86-566		
86-758		
86-760		
87-107		
87-235		
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87-239		
Miscellaneous Documents		
PO S27766		Purchase Order; CV2315
PO S30388	2/86	Purchase Orders; Batteries
QUAL-SC100		CALC VCI 32 HPCI Steam Line Break
QUAL-SC101		HPCI Environmental Conditions (p. 211)
C&D Work Order 03210	2-19-87	250 Volt Battery Factory Capacity Discharge Characteristics
C&D Curve D-841	5-5-86	LC Cell Discharge Characteristics
Letter Memo	10-10-86	Movats to IE (R. Roby)
DAEC-87-1037	10-2-87	Response to INPO O&MR-308
DAEC-85-0059	1-28-86	HPCI/RCIC Reliability Task Force
DAEC-87-0142		HPCI/RCIC Realibility Study, Task Force Report