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Facility Name: Oyster Creek Nuclear Generating Station

Inspection At: Forked River and Parsippany, New Jersey

Inspection Conducted: August 14 to September 15, 1989

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Inspection Summary: Inspection conducted on August 14 - September 15, 1989 (Report No. 50-219/89-80)

Areas Inspected: An announced safety systems functional inspection (SSFI) of the emergency service water (ESW) and containment spray (CS) systems was performed. The interface between corporate engineering and the site also was examined.

Results: Refer to the Executive Summary in the report.

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## EXECUTIVE SUMMARY

A team of NRC and contractor personnel inspected the containment spray (CS) and emergency service water (ESW) systems. The ESW/CS systems are the containment heat removal system with CS drawing water from the torus and exchanging heat to the salt water ESW system via the containment spray heat exchangers.

The objective of this inspection was to verify that the ESW/CS system will function as intended under normal and postulated accident conditions. The inspection was divided into the areas of mechanical (section 2.1.1), electrical (section 2.1.2), instruments and controls (I&C) (section 2.1.3), operations (section 2.1.4), maintenance (section 2.1.5), and surveillance and testing (section 2.1.6). In addition, the team evaluated engineering support and involvement (section 2.2) and management support and QA involvement (section 2.3) in site activities related to the ESW/CS systems. The major findings in each of these areas are summarized below.

In the mechanical area it was determined that prior to the inspection, a valid calculation demonstrating the ability of the ESW/CS systems to effectively remove heat from the containment did not exist for all reasonably postulated conditions. Prior to the end of the inspection the licensee completed such calculations and demonstrated that the system can perform its intended function providing the ESW flow rate is not reduced to less than 3000 gallons per minute through the containment spray heat exchanger by throttling the ESW system discharge valve during periods of elevated canal temperature. However, additional calculations were still needed at the end of the inspection to determine if the system had been previously operated in a condition that would inhibit its ability to function as intended or if the system was operated in an unanalyzed condition.

A potential violation was identified regarding the failure to have a design calculation demonstrating ESW/CS operability under throttled ESW flow conditions. This issue and the topic of timely follow-up to identified issues will be the subjects of an enforcement conference. A violation also was identified with regard to the deletion of Section XI, required upper and lower alert range limits and raising of the upper action limit associated with pump inservice testing.

In the electrical area no conditions were identified that would challenge the ability of the ESW and CS systems to perform their function. However, it was identified that the EDG loading could exceed 90% of its 30 minute rating. This is a deviation from the FSAR commitment to meet the AEC Safety Guide 9 (now Reg. Guide 1.9). Also, some areas where improvements could be made to increase reliability were identified. These include automatic non-safety load shedding on EDG startup, and addition of breakers to prevent loss of a bus following some postulated faults.

In the I&C area, several potential single failure susceptibilities were identified. These could result in failure of the CS pump to automatically shutdown, possibly leading to over cooling of the containment and subsequent operation of the vacuum breakers with introduction of oxygen to the containment.

In the areas of operations, maintenance, and surveillance and testing, problems were identified with having procedures properly established, implemented and maintained. Specifically, electrical jumpers, a revised procedure and operator training of jumper use were the initial solution of the problem of how to provide for torus cooling after a containment spray initiation if an accident occurred during a dynamic test. This was superseded by a Temporary Change on 7/14/89 which substituted lifting leads in place of jumper use. Operators were not trained on this change, the change was not on their reading list and jumpers were not removed from the holding area until these conditions were observed by the team. Also, CS spray pumps were not lubricated in accordance with the applicable procedure and containment spray system heat exchanger relief valves did not have lockwires and nameplates as required by the ASME Code.

With regard to engineering, management and quality assurance support and involvement, several weaknesses were identified where licensee performance could be improved. The primary area is the follow-up on previously identified concerns as discussed in Sections 2.2 and 2.3. This issue will be a subject of discussion at the planned enforcement conference. Other observed weaknesses are listed in Appendix I.

TABLE 1

Violations, deviations and unresolved items identified during the inspection are summarized below.


Violations — Page

| | | |
|---|---|---|
| 89-80-03 | FSAR not adequately updated | 9 |
| 89-80-06 | Establish, implement, maintain procedures<br>Three examples: | |
| | B-1; Procedure changed but not implemented by adequate training | 22 |
| | B-2; Procedure not implemented | 28 |
| | B-3; Relief from Section XI not requested per procedure | 30 |
| 89-80-10 | Lack of ASME Code required lockwires and nameplates on containment spray heat exchanger relief valves | 24 |

Deviations

| | | |
|---|---|---|
| 89-80-04 | EDG loading greater than FSAR and Safety Guide 9 | 14 |
| 89-80-05 | CS control circuits not single failure proof | 20 |

Unresolved Items

| | | |
|---|---|---|
| 89-80-01 | Stress isometric drawings not prepared for safety related piping | 10 |
| 89-80-07 | CS Hx relief valves, chlorine line boundary valves not included in IST program | 30 |
| 89-80-08 | Potential clogging of CS strainers in torus | 26 |
| 89-80-09 | Procedure change and preparation of jumpers for containment spray system - diagnostic and restoration actions | 23 |


The potential violation (89-80-02) regarding inadequate ESW and CS calculations will be the subject of an enforcement conference scheduled at the Region I office. This is discussed on page 8 of the report.

## 1.0 INTRODUCTION

The objective of this Safety System Functional Inspection (SSFI) at the Oyster Creek plant was to assess the operational readiness and design basis for the emergency service water (ESW) and containment spray (CS) systems. This was accomplished by determining whether:

a. The CS and ESW systems are capable of performing the safety functions required by the design bases.

b. Testing is adequate to demonstrate that CS and ESW systems would perform all required safety functions.

c. Maintenance is adequate to ensure reliable system availability.

d. Human factors considerations related to CS and ESW (e.g., accessibility and labeling of valves), the system's supporting procedures, and operator training are adequate to ensure proper system operation.

e. Quality program activities related to CS and ESW are effective in identifying safety issues and in assuring their resolution.

f. Engineering support including calculations provide assurance that the systems, as operated, meet the design bases.

The team reviewed the FSAR, Plant Technical Specifications, modification packages and reference documentation and examined the available calculations which support design and operation of the systems. System operating procedures were evaluated to assess the detail, accuracy and adequacy of direction provided to operators. The team observed control room activities during the course of the inspection, and reviewed maintenance procedures and programs related to the ESW and CS systems. Additionally, the team performed system walkdowns to verify that the system configuration is in accordance with design documents. Finally, the Team assessed the overall design control program as applied to the CS and ESW systems. This included inspection at the GPU Engineering offices at Parsippany, N.J. The principal findings pertain to the operational readiness of these systems and auxiliary support systems, the effectiveness of programs to ensure continued safe operation and engineering calculations. These are summarized in the Executive Summary. The following sections provide detailed findings, including both strengths and weaknesses, in each of the functional areas inspected.

## 2.0 DETAILS OF INSPECTION

### 2.1 Emergency Service Water System (ESW) and Containment Spray System (CS)

#### 2.1.1 Mechanical

Engineering - Mechanical Systems

The SSFI team reviewed and evaluated the adequacy of licensee engineering in maintaining and updating the design bases, translating the design bases into operating procedures and controlling design changes. The team also evaluated engineering support and involvement in licensing, corrective action programs, and plant operations activities related to the ESW and CS systems. The emergency service water (ESW) system and the containment spray (CS) system were the primary systems subject to the inspection, with inclusion of interfaces with the chlorination system and service water system.

The team's review included system walkdown and review of licensing, engineering and plant operations documents, including the following:

- Updated FSAR and Technical Specifications.
- Selected modifications and safety evaluations.
- Calculations, including system pressure drop and pressure profile, net positive suction head (NPSH) limits, ESW and CS system thermal hydraulic performance, heat exchanger fouling, torus temperature response, and ESW System loss of flow due to postulated nonseismic pipe breaks.
- Engineering procedures for design analysis, design verification, modifications, and safety evaluations, including the Procedures Update Program.
- ESW and CS system flow diagrams and IST flow diagrams.
- Procurement specifications for ESW and CS pumps and CS heat exchangers.
- Technical data reports (TDRs) applicable to ESW and CS systems.
- Plant test and operability procedures for proper inclusion and adequacy of design basis criteria/limits.
- Plant pump IST program for proper inclusion and adequacy of design basis codes and standards and engineering criteria.
- Interviews applicable to these team inspection attributes were conducted with corporate engineering personnel at both licensee headquarters offices and at the site and with plant engineering, IST, and other operations personnel at the site

The team's review identified strengths in the following areas:

- The ISI Program's incorporation of the Nuclear Repair (NR) form, with its required third party review of the licensee Repair and Replacement Program, applicable to Class 1 components.

- The ISI Program's incorporation of the NIS-2 Form, with its required review and concurrence by third party ANII, for ASME Section XI Repair and Replacement documentation of safety related components.

- The development and issue of a Codes and Standards Reconciliation document by Licensee Corporate Engineering.

- The incorporation of an Engineering Procedures Update Program, with commitment for continued, scheduled review and update of Corporate Engineering procedures.

- The corporate commitment to the development of a design basis document program and internally performed SSFIs for safety related systems, with work scheduled through 1992.

The team's review and evaluation identified the following weaknesses, applicable to the mechanical systems discipline.

1. The inspectors reviewed the licensee's calculations performed to demonstrate the ability of the containment spray and emergency service water systems to maintain adequate containment cooling in the event of a postulated design basis accident condition. Several non conservative assumptions were identified in these calculations. Specifically, "runout" flow was assumed for the core spray pumps as opposed to a more realistic flow rate based on inservice tests, an ultimate heat sink (canal) temperature lower than actual was assumed, no allowance was made for heat exchanger fouling, and inappropriate application of the NPSH limit curve for CS pumps taking suction from the containment torus. In addition, the licensee's calculations did not address operation with the ESW system discharge valves partially closed. The ESW discharge valves have been operated in this throttled position at least since startup from the 11R outage. This mode of operation was adopted in order to maintain the ESW system pressure higher than the CS system pressure to prevent potentially radioactively contaminated water from leaking into the ESW system in the event of a tube leak. The licensee's evaluation of this change in operating procedure did not assess the impact of reduced ESW system flow on the ability to transfer heat from the containment under design basis accident conditions.

   Subsequent to the identification of this concern, the licensee performed additional calculations to demonstrate that the ESW/CS system would function within the design basis. These calculations were presented to the NRC on September 13, 1989. The calculations assumed design values for CS system pump flow (3200 gpm for each pump) and heat exchanger fouling (65% heat exchanger efficiency), a canal temperature of 90°F which exceeds the maximum temperature observed to date and a CS pump operability limit of 3800 gpm as measured in "test mode" for additional margin. These calculations also assumed an ESW system flow of 3000 gpm which included seismic failure of ESW branch lines, conservative piping friction losses and heat exchanger blockage with margin added to establish an ESW pump operability limit of 3300 gpm. These calculations demonstrated for these conditions that the ESW/CS systems could effectively control containment temperature in the event of the postulated design basis accident. The team concluded, based on these calculations, that adequate assurance existed that the ESW/CS system can perform their design basis function, and that continued plant operation was acceptable. However, it remains to be determined if the ESW/CS system could have effectively performed within the design basis when operated with the ESW system discharge valves in the present throttled position as they have been at least from plant startup from the end of the 11R outage. This issue is very similar to two previous events identified in inspection reports 89-16 and 88-23 in which the plant was operated in an unanalyzed condition when the canal temperature exceeded 85°F. The licensee's use of non conservative calculational assumptions, failure to effectively evaluate operation of the ESW/CS systems with the ESW discharge valves throttled and the failure to recognize these deficiencies given the identification of similar, related problems is a potential violation (50-219/89-02).

2. There is no corporate engineering commitment for a Calculation Update Program for voiding, superseding, or revising calculations which no longer reflect the Design Basis or where assumptions and/or conclusions are no longer valid.

3. The Plant Operating, surveillance and test procedures do not reflect adequate transfer of design basis information, including CS pump flow limits under "Dynamic Test Mode", and instructions for use of NPSH limit curves.

4. Safety Evaluations are difficult to perform properly, due to inadequate FSAR updates and unclear Technical Specifications, unless the qualified reviewer performs additional research into design and licensing bases, pending FSAR Amendments, and plant operability procedures.

5. Engineering Procurement Specifications do not appear to be included in an update program. Specifically, the CS heat exchanger procurement specification has not been revised to include titanium tubes and a change in percent clean.

6. Modifications do not include requirements for identifying applicable previous calculations, with the exception of those calculations affecting system operability, or assurance that initial calculations have been reviewed, voided, superseded, or revised as applicable. The scope of the systems operability calculations is inadequately defined. This may have contributed to the deficiency identified in the ESW/CS system calculation discussed in item 1, above.

<u>FSAR - Adequacy of Updating</u>

The following are examples of inadequacies and lack of timely FSAR update for Section 6.2.2 identified by the team during the inspection period:

- The present FSAR does not reflect the latest net positive suction head (NPSH) limits, ESW and CS pump flow requirements for the accident condition, and updated CS heat exchanger heat transfer analysis for the accident condition. In addition the ultimate heat sink limits, ESW/CS interface differential pressure requirements to preclude radioactive effluents beyond allowable limits, and CS Heat Exchanger ESW differential pressure limit for baffle plate design are not included in the FSAR.

- Section 6.2.2.2, system design, contains numerous errors including: identifying each loop CS heat exchanger as 100% duty, instead of 50%; lack of clarification of the automatic sequence for ESW/CS "A" and "C" vs. manual operation for the "B" and "D" pumps; incorrect identification of total containment spray pump flow as "about 4000 gpm", when analysis identifies this flow significantly lower (3815 gpm); lack of adequate clarification for CS heat exchanger design vs. accident conditon heat transfer; incorrect identification of ESW pump flow as 4000 gpm, when analysis and system throttling significantly reduce this flow (i.e., 2370 gpm minimum flow for accident condition and actual throttled flow at approximately 3500 gpm).

- Other subsections (6.2.2.2.1, 6.2.2.2.4, and 6.2.2.3.1) and Tables (6.2-3 and 6.2-14) have similar errors and inconsistencies applicable to ESW/CS flows and CS heat exchanger design vs. accident condition design basis criteria and analyses for heat transfer each heat exchanger and for each loop.

This is a violation of 10CFR 50, Paragraph 50.71(e) that requires revision of the FSAR to contain the latest material developed (50-219/89-80-03).

Pipe Stress and Pipe Supports

The team performed a visual examination of the containment spray and the emergency service water piping systems (ESW) components and supports to assess the general condition of the equipment and verify that the configuration of the systems is consistent with the FSAR, plant drawings and specifications.

Plant Piping and Instrumentation Diagrams (P&IDs) and isometric drawings were reviewed for consistency with the installed hardware. Stress analysis and design packages for pipe supports selected during the walkdown were reviewed to verify that:

- the as-built condition was properly reflected in the analytical model used to design the pipe supports;
- the proper loads and load combinations were used and;
- the calculated stresses were within code allowables.

The team also observed the response of the containment spray system's piping and pipe supports during a surveillance test conducted on August 17, 1989.

The condition of the system as observed was acceptable. The piping appears to be properly supported, guided and anchored, no leaks were detected and insulation is in acceptable condition. The team determined, based on the system walkdown that the general configuration of the systems matched the FSAR description. However, an error was detected on Isometric Drawing Number ECP-19436, Rev. 2, Sheet 5 of 11, in that valve V-21-4 is shown as a gate valve instead of a check valve, as installed. The licensee acknowledged the error and initiated a drawing correction.

The team found that the stress analysis and design packages reviewed were acceptable. Calculated stresses were within code allowable limits using both the HOUSNER and BLUME response spectra.

The licensee could not provide the piping stress isometric drawings for the ESW system in a timely manner. Although the licensee committed to prepare stress isometric drawings for safety related systems in the November 7, 1985 IEB 79-14 response letter to the NRC, this activity is incomplete. The November 7 letter did not specify a schedule for completing these drawings. This is an unresolved item pending the licensee's scheduling of this initiative (50-210/89-80-01).

Check Valve Program

The team reviewed the licensee's check valve reliability program, both in general and for the specific actions taken to assure reliability of check valves in the Containment Spray and Emergency Service Water (ESW) systems.

The licensee's check valve reliability program is described in the document titled "Oyster Creek Significant Operation Experience Report (SOER) 86-03 Check Valve Program". The program includes all valves that are three inches or greater and classified as "Important to Safety". The program relies on an EPRI monograph to provide technical information which is used to satisfy the Institute of Nuclear Power Operation (INPO) SOER 86-03. The EPRI monograph is titled "Application Guidelines for Check Valves in Nuclear Power Plants". This monograph presents minimum velocities required for full disk lift for different valve manufacturers and for swing check, tilting disk and lift check types. The team concluded that the licensee's program includes appropriate acceptance criteria including criteria to determine if a valve is a potential candidate for detailed design review and surveillance, including disassembly as required.

The Wafer Duo check valves used in the ESW system are not covered in the EPRI monograph and the licensee, therefore, used vendor recommended flow velocities to assess the reliability of these types of valves. The licensee identified ESW Wafer Duo check valves Numbers V-3-65, 66, 67 and 68 as potential candidates for further review since their actual flow velocities are less than the minimum flow velocity recommended by the vendor. Attempts to ultrasonically test ESW Check Valve Numbers V-3-65, 66, 67 and 68 were unsuccessful due to internal coating of Belzona Type anti-corrosion material. Therefore, the licensee plans to disassemble these valves every outage to monitor their operability, until an alternate way to determine the position of the valve disk is developed.

Containment Spray System swing check valves Numbers V-21-2, 4, 8 and 10 were determined to be potential candidates for further review, based on the geometric configuration of the lines in which the valves are located close to elbows, which could alter the flow conditions and operation. These valves will be monitored during the next maintenance cycle.

The team concluded that the licensee's program includes appropriate criteria and that adequate surveillance techniques and frequencies are being used to monitor check valve reliability.

Throttling of Butterfly Valves

The team observed the ESW heat exchanger butterfly valves to be positioned 30-40% open. The licensee had performed an evaluation indicating this position is acceptable for these valves; however, vendor approval for use of these valves in 30-40% throttle position was not obtained and the vendor manual for these valves was not available. The team considered the lack of communication with this valve vendor or a similar valve manufacturer to be a weakness. The new ESW/CS flow calculations presented on 9/14/89 indicated that the ESW system would not be operated with throttled valves during periods of elevated canal temperature to assure that adequate heat removal capacity would be available by the ESW system.

Conclusions

The following conclusions were identified by the team for the Mechanical Systems discipline, resulting from the detailed inspection of the ESW and CS Systems, but excluding Engineering support and involvement with plant organizations.

- Most significant were the deficiencies identified in the calculations performed to demonstrate ESW/CS system functionality and the failure to evaluate the ability of the systems to perform their design bases function with the ESW discharge valve throttled. The potential exists that the plant was operated in an unanalyzed condition. In addition, no assurance is provided that calculations are identified, reviewed, updated, or generated for plant modifications. Engineering Calculations do not appear to be adequately updated, including voiding, superseding, and revising existing calculations where necessary. No formalized Calculations Update Program is provided.

- The FSAR does not appear to be updated in an adequate and timely manner to reflect the present Design Basis analyses for the ESW and CS systems.

### 2.1.2 Electrical

In the electrical portion of the inspection the team focused on the capacity and capability of the Class 1E electrical systems to support the safety related functions of the containment spray (CS) system and the emergency service water (ESW) system. Particular attention was directed at those portions of the electrical systems and equipment which serve the electrical loads associated with the containment spray and emergency service water systems.

Documentation reviewed by the team included FSAR Chapter 8, electrical diagrams, electrical calculations, procedures, procurement specifications and station electrical modifications. Two licensee self-audits, one dealing with the containment heat removal systems and the other, the onsite AC emergency power system, were also reviewed. The team performed a walkdown of one of the redundant trains of the Class 1E electrical system which serves the containment spray and emergency service water systems including the 4160 V switchgear bus 1D, 480 V unit substation 1B2, 480 V motor control center 1B21B and station battery "C". The team also inspected the emergency diesel generators of both the redundant Class 1E systems.

A summary of the inspection team's findings relating to the Class 1E electrical systems is given in the following paragraphs.

System Protection

The inspection team's evaluation of the licensee's calculation C-1302-700-5350-003 and C-1302-723-5350-005 indicates that protective device coordination, when using the results developed, will provide satisfactory protection for the 4160 V and 480 V systems Class 1E buses, conductors and loads. Further, considering the time-current characteristics of the various protective devices used, unnecessary interruption of unfaulted buses and loads can be minimized by the isolation of a short circuit or overload. The various protective device settings observed during the electrical equipment walkdown were found to agree with those developed by the calculations.

The system protection reliability and coordination were enhanced by the recent plant modification which replaced existing electromechanical trip devices in the 480 V unit substation main, tie and feeder breakers with solid state type trip units. Also, the recent modification which replaced thermal overload/instantaneous relays (Device 49/50) on the emergency service water pump motor feeders with instantaneous/time overcurrent/high-dropout instantaneous relays (Device 50/51/83) provides more reliable and predictable operating characteristics.

Motor Terminal Voltages

The licensee provided the results of a study performed by their design contractor which assesses the adequacy of starting and running terminal voltages for safety related pump motors and motor operators for safety related valves. The study considered the worst case degraded voltage condition as the minimum trip point of 3635 V associated with the 416 kV Class 1E buses.

The values were found acceptable and they exceed the specified starting and running voltages for the pump motors. Also the valve motor operators exceed the industry standard of 90% minimum voltage for valve operation.

Electrical Load Control

The licensee's engineering and design department has issued E&D Guidline 4 for the control of electrical loads added to the station's electrical distribution system. Load changes on the various preferred and standby power sources are addressed. The guideline is intended to standardize methodology and data format for load changes and assure that entries are verified by a second party. Also, guidelines are established as to when load changes should be incorporated into the various electrical system calculations and studies.

The timely analysis of the auxiliary electrical systems will be enhanced by the above discussed guideline and the initiation of the licensee's planned computer program "Distribution Analysis for Power Planning, Evaluation and Reporting" (DAPPER). The computer program is reported to have the capability of performing load flow, fault duty and voltage profile analyses when system modifications and load changes are made. The licensee contact advised that they hope to have the DAPPER program operational by February of 1990.

Emergency Diesel Generators

Review of Table 8.3-2 of the Oyster Creek FSAR Update led to the recognition of a condition which could lead to emergency diesel generator overload. The condition could occur following a loss of off-site power (LOOP) followed by a loss of coolant accident (LOCA). Following the LOOP, the operator could manually load the machine(s) with non-essential loads, such that in the event of a subsequent LOCA, the addition of the automatically started safety related loads would result in overload and potential damage to the machine. The non-safety related loads are not automatically stripped from the buses following a LOCA.

As a result of the licensee's review of the situation, the stations operating procedures have been revised to give guidance for limiting non-essential loading of the units during a LOOP which will then allow safety related loading if a subsequent LOCA were to occur. Further, the licensee is investigating automatic tripping of non-essential loads from the emergency diesel generators in the event of LOCA. The team feels that the revision of the station procedures to attempt to prevent overloading is an acceptable interim fix, however, the investigation of the possibility of providng automatic stripping of non-essential loads should be evaluated by the licensee.

Safety Guide 9 (Regulatory Guide 1.9) referenced in Section 8.2.1.2.4 of the FSAR Update states that the predicted loads on an emergency diesel generator should not exceed the smaller of the unit's 2000-hour rating or 90% of the 30-minute rating. The units installed at Oyster Creek are rated by the manufacturer at 2500 kW (continuous), 2750 kW (2000 hours per year) and 2950 kW (30 minutes per year). The licensee's diesel generator loading calculation C-1302-741-5350-001 indicates a maximum loading of 2703 KW on Unit No. 2 which is 98.3% of its 2000-hour rating but contrary to Safety Guide 9 exceeds 90% of its 30-minute rating (2655 kW). However, since the predicted loadings on the machines are within their 2000-hour rating the inspection team feels that the situation does not pose an immediate safety concern but should be shown to be acceptable. The licensee should re-address compliance with Safety Guide 9, in response to this deviation from the FSAR, reference Appendix B, Item A (50-219/89-80-04).

In addition to the above, the inspection team feels that the design wherein the Oyster Creek emergency diesel generators are cable connected to their respective buses with circuit breakers located at the machines rather than at the buses is a design weakness. A cable fault will result in the temporary loss of the associated safety related bus. The team has included this condition in this report as an observation of a design weakness. The condition has been found to be well documented in the Augmented Inspection Team Report No. 50-219/88-80. The lack of a resolution to this problem is another example of ineffective follow-up to an identified issue as noted in Part 2.3 of this report.

4.16 kV System Fault Level

The licensee's study, TDR-630, indicates that the worst case fault analyzed considers, at the time of the fault, all four of the stations's 4.16 KV buses, are being fed from the start-up transformers during a LOCA condition. In this condition, the reactor recirculation pump motor-generator sets are automatically tripped but all other normal load motors and the automatically started emergency load motors are considered operating and thus contribute to the fault level. The team feels that the licensee has not demonstrated that the worst case has been analyzed because the analysis did not include motor loads including those of the reactor recirculation pump motor generator sets and emergency loads motors during a non-LOCA condition. However, in the event that the worst case fault, considering all possible conditions, has not been analyzed, an uncleared fault on the 4.16 kV system could result in the loss of only one train of safety related equipment. The redundant safety related buses and equipment would remain unaffected by the single fault and the design basis would still be satisfied.

Automatic Fast Bus Transfer

The 4.16 kV buses, including Class 1E safety related buses 1C and 1D are subjected to automatically initiated, fast dead bus (open circuit) transfers from the auxiliary transformer supply to the start-up transformer supply. Motors and driven loads can be subjected to transient torques resulting from a phase angle difference between the motor residual voltage and the incoming source voltage. The magnitude of the transient torque is dependent on the phase angle difference and magnitude of these voltages. Severe transient torques that exceed design stresses can result in damage to motors and driven equipment.

The licensee acknowledged that it is possible but not normal to have the two power sources involved in the automatic fast transfer out-of-phase. In spite of this, the inspection team found that the automatic transfer logic scheme does not include a sychro-check feature. Thus, an out-of-phase transfer is possible which could subject motors and driven equipment to severe transient torques.

The foregoing automatic fast transfer situation is not contrary to the General Design Criteria. However, the team considers the finding a design weakness worthy of licensee review and re-evaluation. An out-of-phase transfer could result in equipment degradation with common mode failure being possible.

Class 1E Station Battery Rack

During the walkdown the team noted that several corner brackets on the battery rack protrude inside the rack's side rails such that during a seismic event the brackets could contact and damage the battery jars. The team also noted that clearance between jars and side rails, in a few cases, exceeded the reported vendors specified clearance.

As a result of this finding the licensee issued work orders to correct the condition. This observed condition applies only to battery "C" and its rack. The redundant safety related battery "B" and its rack were supplied by a different vendor.

Licensee's Self-SSFI Report

Near the end of the inspection period, the licensee provided the team with a copy of TDR-986 for their self-initiated safety system functional inspection of the emergency electrical power system. The team was unable to review this document during the site inspection period. However, at a later date, a cursory review by the team revealed two concerns based on statements in Section 3.3.4 of the report. These statements are:

- "The inability to supply power to all four 4160 VAC buses, results in a loss of the emergency core cooling systems and possible core or fuel damage."
- "A loss of power to USS 1A2, 1B2, 1A3 or 1B3 requires plant shutdown and may result in a loss of emergency core cooling systems."

The licensee was contacted by telephone on September 14, 1989 to discuss the bases of the statements. After their review the licensee advised that the existing statements are incorrect and should and will be reworded to read as follows:

- "The inability to supply power to both emergency 4160 VAC buses, results in a loss of the emergency core cooling systems and possible core or fuel damage."
- "A loss of power to USS 1A2, 1B2, 1A3 or 1B3 requires plant shutdown. A loss of any one of these buses may result in a loss of one division of emergency core cooling system."

Based on the licensee response and their rewording of the statements, there is not a safety concern. However, the situation is an example of inadequate licensee "in-house" review and attention to detail.

Conclusion

Based on the documents reviewed and conditions observed during walkdowns the inspection team feels that the Class 1E electrical systems will provide for the acceptable operation of the station's containment spray and essential service water systems.

2.1.3 Instrumentation and Control

The instrumentation and control design audit trail was traced from the original design specifications through the existing as-built configuration. The existing instruments were inspected to confirm that individual instrument accuracy conformed to design specifications. Instrument loop and associated setpoint calculations were examined to verify calculation methodology and accuracy. Components and cabling were inspected to verify that the design separation criteria was maintained; and various reports, engineering documents and procedures were reviewed.

The team found that the licensee's failure modes & effects analysis for the containment spray system, designed to identify single failures in the containment spray system automatic/manual controls and supporting power supply system that have the potential of disabling both the system trains or spurious activation of either train, was a strength.

The team found that the licensee's instrument loop accuracy and setpoint calculations represented an area of weakness. Specifically, five calculations were examined in detail, with the following errors or problems identified:

1. Calculation C-1302-622-5350-029 - IP-15 - Reset Calculation Containment Spray System

   - A technically invalid reason for omitting response time considerations was listed in the assumptions and basic data in paragraph 4.3. The stated reason addressed an initiation time limit, but the calculation pertained to the instrument reset setpoint,

   - The assumptions and basic data paragraph 4.3 did not specifically identify or justify errors that were or were not included in the calculation. For example, the test instrument error of 0.1 psig used in the calculation, was neither clearly identified as the test instrument error nor justified as a valid value,

   - The calculation identifies a "Safety Limit" of 0 psig, but does not identify the requirement for the safety limit or the accuracy associated with the limit, and

   - During review of Safety/Environmental Determination and 50.59 Review (EP-016), SE No. 315403-013, EOPs Modification For Containment Spray System Valve Logic, dated 6/27/89, page 7, it was noted that setpoint values of 0.23 psig to 0.97 psig were used instead of the 0.312 psig value from calculation C-1302-622-5350-029. The source of the 0.23 psig to 0.97 psig values was not identified in SE NO. 315403-013.

2. Calculation C-1320-5350-023, OC - Barton Model 288A Pressure Switch Loop Accuracies

   - The calculation identified references attached to the document as the source of the data used in the calculation; however, the data that should have been contained in the references was not there.

   - The calculation incorrectly determined that the instrument error was +10.5% and -14.5% of full span; however, the calculation should have determined that the low switch error was +10.5% and -7.5% and the high switch was +3.5% and -14.5%, and

- The calculation was verified on licensee verification form V-1302-622-024, dated 11/20/87. The team found errors that the verifier had failed to find. It also found that the following statements on the verification form were not valid or accurate:

  - "...verified that listing of references was clear and complete and that data and information was accurately transposed in calculation..."

  - "...this included verification that environmental effects were properly identified and considered in their calculation..."

  - "Reviewed calculations method to verify appropriate and properly executed."

  - "Performed 100% math check."

  - "Performed general overview for completeness, clarity of presentation, and reasonableness of results."

3. The following calculations were found to lack documentation or justification for how the data should be applied [+ or - convention] in the calculation:

   - Calculation C-1302-622-5350-022, OC - Containment Spray Water Temperature Loop Accuracy,

   - Calculation C-1302-622-5350-019, OC Containment Spray Flow Pump Interlock Loop Error 1P03A/B, and

   - Calculation C-1302-622-5350-012, OC RPS EQ Upgrade - Accident Error Calcs.

The calculation errors and problems identified above indicate less than full attention to detail in performance and verification of the calculation. The errors were not considered to adversely affect system operability.

The team found that the containment spray logic and control circuit's susceptibility to single failures represented an area of weakness. The licensee's failure modes and effects analysis for the containment spray system identified the following components as being subject to single failure modes that defeated automatic initiation of containment spray: 125 VDC Panels D or F, mode selector switch CS16S15, permissive and test override relays 16K1A or B, and normal/emergency power relays NK1, NK2, EK1, or EK2. The licensee has also determined that during a containment spray dynamic test, also referred to as the torus cooling mode of operation, a low low reactor level, without a coincident high drywell pressure, will initiate an inadvertent containment spray.

Prior to the inspection, the licensee had implemented procedural actions directing operator manual actions to initiate containment spray if automatic initiation of containment spray fails; and the licensee has also implemented procedure cautions directing operators to stop the operating containment spray pumps in the event of an inadvertent containment spray actuation. The team found the procedure actions and cautions to be an acceptable interim corrective action pending implementation of long term corrective action. To date, long term corrective actions have not been initiated. Resolution of this issue is dependent on the decision to eliminate or retain the automatic initiation feature of containment spray.

The team's analysis of the containment spray control circuits identified the following components as being susceptible to single failures:

a. The single failure of the following components may permit the introduction of oxygen into containment by defeating the automatic containment spray pump trip on low drywell pressure:

   - Start pump relays, 16K2A or B,

   - Dynamic test permissive relays, 16K21A or B, and

   - Auto start relays, 16K25A or B and/or 16K26A or B.

   The licensee's procedures direct the operators to manually stop the operating containment spray pumps if the pumps fail to trip at the drywell low pressure reset point. The team found this manual action to be acceptable interim corrective action pending implementation of long term corrective action. The licensee initiated potential safety concern (PSC) 89-013 after the team identified the single failures that prevented automatic tripping of the containment spray pumps on low drywell pressure. PSC 89-013 proposes providing sufficient redundancy to enable automatic pump trip to occur independent of single failure action.

b. The single failure of the following components may initiate inadvertent containment spray during containment spray dynamic testing [also referred to and known as the torus cooling mode of operation]:

   - Low low reactor level relays 16K110A, B, C or D,

   - Test override relays 16K7A or B and/or 16K9A or B,

   - Dynamic test permissive relay 16K21A or B, and

   - Mode selector switch CS16S15.

   The licensee's procedures direct the operators to manually stop the operating containment spray pumps in the event of an inadvertent containment spray. The team found this manual action to be an acceptable interim corrective action pending implementation of long term corrective action. The licensee has not determined a long term corrective action for these failures.

c. The licensee has also determined that an automatic trip of the containment spray pumps may not occur for some operating configurations. Specifically, manually started containment spray pumps will not trip automatically on a low drywell pressure if the automatically started pumps are not running. The emergency operating procedures provide instruction to the operators to manually trip the pumps if a valid automatic trip does not occur. The team found the manual actions to be acceptable interim corrective action; however, the licensee's representatives stated that additional long term corrective action, such as circuit modification, is not contemplated.

The susceptibility of containment spray control circuits to single component failures is contrary to the FSAR Update, Section 6.2.2.1.b and is a deviation, reference Appendix B, Part B (50-219/89-80-05).

Conclusions

The team found the containment spray and emergency service water systems to be functionally capable of performing their design requirements from an instrument and control perspective. This evaluation included the following considerations:

a. Although errors were identified in the five calculations reviewed, the calculations did not yield nonconservative accuracy or setpoints values, and

b. The licensee has implemented procedural actions to manually correct the identified single component failures.

2.1.4 Operations

An indepth review of activities which have an effect on the capability of the containment spray/emergency cooling water CS/ESW system was performed.

System Walkdowns

A 100% walkdown of accessible portions of the CS/ESW system was performed. The systems had for the most part been recently painted. In general the physical equipment appears to be well maintained, motor vents were reasonably clean, no significant leakage was noted during pump operation, and components and flow directions were clearly marked. Some motor lubrication oil sight glasses were painted over, however, this was promptly corrected. Valve stems and packing glands were also identified as having been painted. The appearance of the equipment at the intake structure shows some evidence of deterioration due to weather, but, no safety significant deficiencies were noted. Redirecting some packing leakoff lines would be an improvement.

On three occasions during tours of the reactor building an alarm was sounding which indicates the containment spray compartment doors are not closed as required. This occurred even though there is a 5 minute time delay on the alarm. The door was verified closed on each occasion. This indicates increased personnel training or attention to the limit switch is warranted.

The correct connection of selected instrumentation to the system as indicated on P&ID's was verified. Also, in conjunction with the Resident Inspectors, an independent valve check off in accordance with Station Procedure 310, containment spray system operation was performed. No deficiencies were noted. The control room copies of the P&ID's associated with the CS/ESW system were verified to be current.

Procedure Review

Various procedures associated with the operation and testing of the CS and ESW system were reviewed. Detailed reviews were conducted of portions of Procedure 310, Containment Spray System Operation and Procedure 607.4.005, Containment Spray and Emergency Service Water Pump System 2 Operability and Inservice Test. Where possible, portions of the procedure were walked through or their implementation observed. The procedures were discussed in detail with numerous operators to assess both the procedures technical adequacy as well as the operators knowledge of the procedures and the systems. Without exception the operators knowledge of both the procedures and the operation of the system were excellent. In instances where operators understanding of procedural steps was unclear it was the fault of the procedure. These procedural deficiencies were discussed with the licensee and six procedure changes to Procedure 310 were promptly prepared. The deficiencies identified indicate a need for improved periodic procedure reviews and better coordination between the reviewers and the procedural users.

Several other matters related to procedures were discussed with the licensee. These matters were:

- Currently there is no procedural requirement to monitor heat exchanger differential pressure during prolonged ESW system operation as occurred during the inspection.

- The contemplated performance of CS/ESW monthly operational surveillance with IST performed only quarterly would significantly reduce the amount of data available for system performance evaluation (Note: during the inspection two ESW pumps were declared inoperable based on IST data which would have passed an operability surveillance alone).

- The heat exchanger shell to tube delta pressure requirement is currently not a system operability acceptance criteria.

The licensee indicated these matters would be addressed.

Prior to the startup from the last refueling outage as a result of a review of preliminary safety concerns, the need for bypassing containment spray system valve control logic during emergency conditions was identified. A procedure describing the lifting of leads and the installation of jumpers to accomplish this was prepared, and personnel were specifically trained in how to accomplish the procedure. On a number of occasions during the inspection operators referred to the installation of jumpers in establishing torus cooling. During an attempted walkthrough on August 17, 1989, of Procedure 312.1, Bypassing Isolation Interlocks and Automatic Scram During Emergency Condition, the operators on shift became aware for the first time that a temporary procedure change had been issued on July 14, 1989, which eliminated the need for installing the jumpers they had all been specifically trained to install.

Additional follow-up showed the temporary change had been placed with the 312.1 procedure. However, marked up pages were evidently pulled when a subsequent new revision to the procedure was issued. Also, the madeup jumpers, identified by procedure and step number were still in the emergency equipment locker.

Shift management indicated that significant changes of this type are normally brought to the attention of the operators by a "Required Reading" mechanism. Operations management makes the determination of what becomes "Required Reading". No guidance exists which identifies what should become "Required Reading". Failure to notify shift personnel of a significant change to a procedure they had recently been specifically trained on had the potential to create confusion should an emergency require use of the procedure. A policy was initiated to review all changes during the pre-shift briefing.

As a follow-up to the temporary change to Procedure 312.1, additional posting of temporary procedure changes were reviewed. Of three additional changes reviewed, one change, 8.18.89.2 was found to be improperly posted to Step 2.2.5 of Procedure 310, Containment Spray System Operation. Also, a package of jumpers labeled for Emergency Procedure 3200.2, Primary Containment Control - Torus Water Temperature, Section 13.0, Containment Spray Valve Control Lock Bypass/ Unbypass were found. Procedure 3200.2 has no Section 13.0 and no one could identify where the jumpers would or should be installed. Operations management removed the bag of jumpers. The failure to establish and properly control temporary procedure changes is a violation, reference Appendix A, Item B-1 (50-219/89-80-06).

There are radiation monitors installed at the service water discharge from the containment spray heat exchangers. These monitors are incapable of leak detection due to a design deficiency. They would alarm due to high background. This deficiency was reported in LER 88-20. As a follow-up to the LER in NRC Inspection Report 50-219/88-38, inspectors noted the alarm response procedures associated with these monitors did not indicate to the operators that these monitors were subject to high background radiation and may alarm without a leak being present. During this inspection the alarm response procedures still did not provide this information to the operators.

The heat exchanger differential pressure instrumentation modification states, "after each inservice test the differential pressure instrumentation should be flushed with demineralized water to avoid any problem from the use of sea water". This instrument flushing was not specified in the inservice test procedure. Personnel indicated the flushing was done as a refueling preventive maintenance activity.

Procedure 2000-OPS-3024.05, Containment Spray System - Diagnostic and Restoration Actions, written for a containment spray system line break specified the lifting of leads and the installation of jumpers. The procedure requires the installation of the jumpers is to be controlled using Procedure 108, Equipment Control. Discussions with personnel indicate that installing jumpers in accordance with Procedure 108 would take several hours. Also, the jumpers have not been madeup. These time consuming activities defeat the purpose of the procedure. The licensee indicated the procedure would be written to stand alone as far as installing jumpers is concerned, the jumpers would be madeup, and that a review would be conducted for other procedures which may require the installation of jumpers. This item is unresolved pending issue of the procedure changes, preparation of the jumpers and completion of the procedure review (50-219/89-80-08).

A review of the Technical Specifications limiting conditions for operation shows operation for 15 days is permitted with either one CS or one ESW pump inoperable in each system. If the inoperable pump were the "A" in one system and the "C" in the other system the automatic initiation of the CS/ESW system would not occur. This condition, although permitted by the Technical Specifications, would defeat the design bases of automatic initiation for the system. The licensee, to correct this condition, issued a memo dated August 31, 1989, which requires that if either the "A" or "C" CS or ESW pump is inoperable, the associated system must be considered inoperable. In this way the licensee recognizes that the loss of both an "A" and a "C" pump makes the CS/ESW system inoperable.

With the exception of the items noted above, changes resulting from modifications, information in modification design descriptions, and FSAR changes were generally found to be reflected in procedures.

Operator Training

The licensee's training provided to the operators relating to the CS/ESW system was reviewed. The lesson plans associated with both the equipment operator and operator requalification training were reviewed. A detailed review of the lesson plans was not performed, however, it appears the training which is provided is adequate to describe the functions and the operation of the system.

Operator training on the CS/ESW system was given in June 1987. It was scheduled to be given again during October-November 1988. It was not given at that time because of consideration being given to changing the system from automatic initiation to manual initiation. A strike also affected training schedules at that time. The system training is now scheduled to be provided during November 1989. This is within the two year requalification cycle and does not result in nonconformance with the training program guidelines.

Usage of the system was partially covered in the EOP training which was given in February 1989. Also, simulator training given in May and June 1989 covered operation of the system.

Training on setpoint changes and the installation of jumpers to bypass certain logics was provided in February 1989. Training on system modifications has also been provided.

Equipment operators (non-licensed) were trained on the CS/ESW system in March 1989.

The training department has no input into the "Required Reading" program. This program is primarily used by operations to keep operators current with important changes.

Conclusion

The material condition of the CS and ESW systems appear to be good, no excessive leakage or vibration was noted during operation. The operators knowledge of procedures and the systems was excellent. The operators appear to be committed to adherence to procedures. More attention is needed to improve procedures and in making operators aware of significant temporary changes.

2.1.5 Maintenance

The team performed walkdowns of the ESW and CS systems to assess the condition of the mechanical components in these systems and the maintenance effectiveness on the components. Verification was made that the components were properly installed and matched the equipment shown on the drawings and equipment data listings. Maintenance documentation was reviewed and included general maintenance procedures, history records, maintenance scheduling, specific work job orders, discrepancy reports, LER commitments and vendor data. The review of documentation provided general information regarding the overall conduct of maintenance and direction for further team review of specific component maintenance.

Containment Spray Heat Exchangers

The CS heat exchangers were observed during several walkdowns and subsequent review was made of the heat exchanger maintenance history. The team identified several findings relating to heat exchanger maintenance.

a. Relief Valves

The relief valves (RV) on the heat exchangers were identified by the team to have broken or missing lockwires (valves V-3-83 and 85 and V-21-24). Also vendor nameplates were missing on several valves (V-3-82 and 83). Lockwires of relief valve adjustments are necessary to assure proper operation and pressure relieving function. Missing lockwires and nameplates do not provide assurance that the adjustments are intact or that relieving capacity is appropriate and could result in loss of heat exchanger flow. Nameplates and lockwires are required by the ASME Section VIII Code to which these valves were purchased. Based on the team's findings, the licensee issued short form work request 56734 to replace all eight heat exchanger RVs. The team concluded that missing nameplates and lockwires is a violation of 10CFR 50, Appendix B requirements for identification and control of components (89-80-10).

b. Repetitive Maintenance

The team reviewed the licensee's documentation related to ESW system corrosion and fouling problems and NRC Inspection Report Nos. 50-219/85-23 and 50-219/89-04. The ESW System was declared to be inoperable due to blockage of the containment heat exchangers by fragments of coal tar enamel which dislodged from inside surface of the ESW piping on July 22, 1985. The potential for further blockage has been minimized by hydrolazing the affected areas of the pipe. Non-Destructive Examination (ultrasonic test) established that piping has sufficient wall thickness to ensure safe operation for at least 9 years.

During the 11 and 12 outages, portions of the ESW piping was monitored by UT measurements and video camera. Both surveillance methods revealed, that the pipe wall thickness remains equal to or greater than the minimum required thickness. The video camera revealed no coal tar degradation in the observed lined areas. Some recently formed barnacle deposits were hydrolazed from the bare pipe.

Based on a review of maintenance history records, the team determined there were numerous repetitive maintenance activities to open and clean the heat exchangers. The maintenance frequency, excluding outage time, was eight months at the longest interval generally through the winters, and much shorter times during the summer. At several times, the heat exchangers were cleaned just days apart. The team was concerned about the constant heat exchanger maintenance because each maintenance removes one of the two redundant loops from service and the plant is in an LCO condition. The repetitive maintenance has been due in part because the heat exchangers are performing a strainer function which is not their primary purpose. In addition to pipe lining pieces and other debris in the tubes and on the tube sheet, the marine life biofouling reflects a possible ineffective chlorination process.

Past licensee considerations of upstream strainer installation and chlorination entry point relocation were rejected. MCF has recently submitted a Technical Functions Work Request, dated 7/20/89, to install duplex strainers for use during surveillance and bypassed at other times. This request has not yet been acted on, but plant engineering stated the plan may be effective and that a chlorination relocation into the keep-full piping would be beneficial.

The CS heat exchanger performance for flow rate is measureable by pressure change but fouling progression is not measurable with the present system instrumentation. Heat exchanger temperature changes are not taken, nor has an alternate means of measuring fouling (i.e. by visual inspection and correlation of fouling thickness to performance) been included in Plant Surveillance or Maintenance procedures.

The team concluded that the licensee's delay in resolving the repetitive heat exchanger maintenance and the inability to access the degree of heat exchanger fouling based on measured temperatures and flows are weaknesses. Nonetheless, the team concluded that the maintenance performed by the licensee provides reasonable assurance that the heat exchangers will perform with adequate efficiency to satisfy functional requirements.

Torus Strainer Maintenance

The containment spray system takes suction from the torus through three strainers located inside the torus. These strainers were determined to be 2' diameter x 3' long, 12 ga. sheet, 304L stainless steel with 0.187" diameter holes on 0.250" centers. The team was concerned that the strainers could be vulnerable to clogging and was interested in the maintenance requirements of these strainers. The licensee had no preventive maintenance requirements for these strainers and it could not be verified that the 10 year IST included inspection of the strainers. The team also questioned the quantity of debris that would be deposited on the strainers during an accident involving containment spray and torus cooling. The potential for debris clogging torus suction strainers and the lack of any maintenance requirement for torus strainers is an unresolved item.

Service Water Intake Area

Portions of the service water intake area structural steel support beams, angle iron, and electrical conduit were highly corroded. This had been identified by the licensee as an area in need of repair. Budget proposals have been made which address the team concerns, however, the budget has not yet been approved. The team considered the material condition of the intake area to be a weakness.

Excessive Paint

During plant walkdowns, excessive paint was noted on CS valves (MOVs V-21-13, 15, 17, 18 and manual valves V-21-1, 3, 7 and 9). Packing glands, gland followers, adjusting nuts and threads were covered with paint. Several valve nameplates, CS pump 21-1D motor lubrication sight glasses and all CS pump vibration marks were painted over. Based on the team findings, the licensee issued a memorandum describing painting cautions to be taken. The covered sight glasses were immediately corrected and the manager of plant engineering stated that, "vibration locations would be in place prior to the next surveillance." The team finding of excessive paint is considered to be a maintenance weakness indicating a lack of procedural control and supervisory oversight.

Chlorination Pump Room

Chlorination pumps for ESW were observed to have corrosive buildup. The licensee was having problems with chlorination pump operation during the inspection. A budget proposal has been made for pump and piping repairs but is not yet approved. In view of the heat exchanger maintenance and the need to reduce biofouling, the team considered the non resolution of chlorination improvements a weakness.

Follow-up on Licensee Event Report (LER) Commitment

The team reviewed LER 85-18 pertaining to heat exchanger tube plugging due to pieces of ESW pipe coating and dead marine debris. The licensee committed to monthly preventive maintenance (PM) inspection of the intake screen wash nozzles and flappers as part of the LER corrective action. The team verified that nozzle inspections and flapper cleaning are performed weekly June through September and monthly October through May under PM Task 012390. Additionally, inspection for flapper damage is performed on a three week interval under PM Task 838M. The team concluded the licensee's commitment was conservative and being met.

Review of Valve Deviation Reports

The team reviewed several selected valve deviation reports. These deviations were; 89-021 and 89-022 for valves found without grease in the limitorque gear box, 89-076 for valve V-3-131 that was leaking, and 87-127 for a relief valve found open. For each deviation, there was no requirement for root cause determination or actions to prevent recurrence. Further review by the team determined that the licensee had self identified this concern and has revised Procedure 104 (revision 12 on 5/23/89), Control of Nonconformances and Corrective Actions, to include root cause determination and actions to prevent recurrence as an integral part of the deviation report format. The self identification and correction of the problem by the licensee was considered appropriate.

In-Process Maintenance

The replacement of the "B" ESW pump and keep full check valve V-3-131 was performed during the inspection. The pump work was done under Job Order (JO) 18889 and the valve under J.O. 18780. In both cases, the work was correctly performed in accordance with the J.O. requirements and system operational surveillance upon completion satisfied the post maintenance operability requirements.

During the inspection, CS and ESW System 1 failed the inservice test due to inadequate emergency service water flow. Subsequently, instrument and control technicians were observed performing corrective maintenance on emergency service water flow instrument, DPI-532-5. The observed corrective maintenance included: back flushing the annubar detector with demineralized water, instrument calibration in the shop, and detector removal and cleaning. The technicians performing the work were knowledgeable, properly supervised, and used the correct tools, procedures and calibrated test equipment. The team found the instrument and control maintenance practices to be satisfactory.

Predictive Maintenance and Valve Program

The team determined that a pump lubrication oil sampling program has been used for over seven years for predictive maintenance. A review of the lube oil sampling records by the team noted that the lube oil samples identified several pumps needing repair during the past outage.

A valve program to centralize valve activities is also in process. The valve program has been involved with live load packing and selected valves have been modified to this concept. The licensee has also been involved with the use of ultrasonics to determine check valve disc stability.

Conclusions

The team conclusion was that the material condition of the ESW and CS system components was being effectively maintained. Several maintenance activities need to be addressed and resolved by management. These include the downtime and unavailability of the heat exchangers which are important components needed for accident conditions, the need for chlorination and intake structure improvements, and the lack of any preventive maintenance on the torus stainers.

Those maintenance activities observed by the team were effectively planned and the use of the computerized work order control system has improved maintenance effectiveness. Predictive maintenance utilizing pump lubrication oil, the use of ultrasonic for check valve disc stability and involvement in live loading of valve packing is viewed as progressive maintenance management practices.

2.1.6 Surveillance and Testing

Observation of Surveillance Testing

The team witnessed the performance of Procedure 607.4.005, Containment Spray and Emergency Service Water Pump System 2 Operability and Inservice Test (IST). The test was performed to verify the operability of system two CS and ESW pumps. Also, IST data for the CS and ESW pumps were recorded. System Nos. 1 and 2 testing were performed over several days and portions of the testing were witnessed.

During observations of system No. 2 testing beginning on August 16, 1989, operators adherence to procedure precautions and limitations and the performance of test prerequisites were observed.

The grease cup cap on pump 21-1D was all the way down indicating it was not capable of supplying grease on demand. Based on the review of the procedural requirements (Step 6.6 of Procedure 607.4.005) and discussion with maintenance personnel, there appears to be some confusion on how to adjust the grease cup cap. This indicates a need for training or more explicit instructions in the procedure. The team considered the need for procedural clarity or training to be a weakness.

The procedure prerequisites require the operator to verify that the grease cups on the bearing housings of the CS pumps contain grease. The procedure provides instructions for adding grease and also requires that if a grease cup is depleted, grease should be added to the cup. During the performance of the test prerequisites the operator noted the grease cups had been fully turned down which made them effectively empty. Since the prerequisite step could not be completed, the surveillance test was suspended. It was obvious that during the previous performance of the surveillance, the test procedure was not fully adhered to because depleted grease cups were not refilled. Since proper greasing of the pump bearings is vital to proper pump operation this failure to implement this procedure is a violation, reference Appendix A, Item B-2 (50-219/89-80-06).

The pump grease cups could not be immediately filled because the only spare grease on site had exceeded its shelf life. The shelf life date was extended, the grease cups filled and the test was performed on the following day. Operators completed a deviation report describing the matter and operations management issued a memorandum to operators describing proper greasing of the CS pump bearings.

The actual running of the pumps was witnessed by the NRC inspector on August 18, 1989. Control room activities were observed, the heat exchanger area monitored for vibration during pump starts, and the pumps and system observed for leakage. No vibration or unacceptable leakage was observed. The operators understanding of the procedure and conduct of the test was excellent. As problems were experienced during the conduct of the test the group shift supervisor monitored test activities while still maintaining overall cognizance of plant conditions.

The system passed the monthly operability test, but failed the inservice test (IST) because of low ESW pump flow. Upon failure of the inservice test, the operators declared the system inoperable, entered the technical specification action statement and initiated corrective action. While conducting the test, in addition to low flow, inadequate ESW to CS differential pressure was observed. The system engineer and the IST coordinator were present in the control room to observe the test performance. Due to problems encountered during the test, the control room operators received frequent and repeated requests from Engineering to deviate from the ongoing test procedure to perform diagnostic evaluations. The control room operators correctly followed the test procedure in progress through to completion without deviation. The team considered the repeated engineering requests to deviate from the approved procedure to be a weakness. The requests to deviate from the test procedure were intended by engineering to yield test data beyond that required by the approved test procedure for diagnostic purposes. Present site interface procedures do not describe the controls on interactions between engineering and operations in modifying an ongoing test to obtain supplementary data.

Further evaluation after the surveillance test failed its pump IST action limit determined that a keep full system check valve was the cause, not pump degradation.

Inservice Testing (IST) of Valves

Observation of ESW and CS system valves during walkdown were compared against the licensee's IST program listing of valves. The team determined that the heat exchanger relief valves and the chlorination code class boundary valves are not included in the program and there was not a relief request submitted for their omission. During walkdown, the team noted that the chlorination piping code class boundary valves V-33-35 and 37 shown on UFSAR drawing, Figure 3.2-11 are manual valves whereas valves V-33-11 and 12 upstream of the manual valves are diaphragm air actuated valves. The air actuated valves are positioned as part of the pump surveillance test.

The manager of plant engineering committed to include the HX relief valves in the program and the issue of the chlorination boundary valves is being reviewed further by the licensee. The team determined that this is an unresolved item pending the licensee's inclusion of the HX relief valves in the program and acceptable resolution of the chlorination piping boundary valves in the program (50-219/89-80-07).

Observation of Pump Lube Level

The team review of pump test procedures (607.4.004 and 005) noted that there is no requirement for proper lubrication oil level to be observed as required in IST Table IWP-3100-1. The team walkdown verified that all ESW and CS pump oil levels were satisfactory. Further, team review determined that CS pump motor lubricant level is checked on a monthly frequency by electrical maintenance under PM task 09600E, and ESW pump oil levels are checked each shift on the operations tour sheet. The team concluded that a lubricant oil level check as part of the pump test prerequisite requirements would improve the pump test and IST procedure.

Inservice Pump Testing

The licensees IST of the CS and ESW pumps was reviewed, as was the surveillance procedure for performing pump testing. Procedure 125.1, Inservice Test Program Administration, is the procedure which provides direction for the administration and implementation of the IST program. A brief review of the procedure and subsequent discussion with personnel indicated that the pump test portion of the procedure no longer accurately describes the pump test program. The principal area where it was noted that the procedure had become obsolete was in data analysis. It was noted, however, that the current data analysis termed ESW supplemental analysis which is being performed is far superior to that specified by the procedure. Station Procedure 125.1 requires a relief request to be submitted when ASME Code Section XI requirements for IST are not being met. The ASME pump test code was not followed by the elimination of the ESW pump high and low IST alert ranges and the increase in the high action range above the ASME Code value for the ESW pumps. The alert ranges are performance values that when reached are possible indicators of pump degradation and initiate more frequent testing to better quantify the magnitude and significance of the changes. The failure to maintain the required alert and action ranges without obtaining approval of a relief request from the ASME Code Section XI requirement is a violation, reference Appendix A, Item B-3 (50-219/89-80-06).

Installation of improved instrumentation and the establishment of a fixed reference ESW flow rate has made the current IST data the best accumulated and has eliminated many of the past difficulties in obtaining data. The supplemental analysis which is performed using surveillance test specified data, although not specified by the IST procedure, is extremely useful in analyzing system performance.

The test data for the CS pumps are relatively stable and are useful for evaluating pump performance. The ESW IST data are less stable and while useful for evaluating system performance are less useful for determining pump performance. A significant number of factors exist (valve leakage, instrument error) which appear to have a significant affect on the ESW IST Data.

IST data has been recorded essentially monthly although the ASME Code Section XI requirement is quarterly during the performance of the pumps functional testing. The licensee is considering gathering IST data quarterly. This change would limit the amount of data available for ESW system diagnostics, but meets regulatory requirements.

The CS/ESW operability and IST procedures are adequate for determining both the minimum required system flow rate as well as establishing constant flow conditions for IST data recording. The procedure does not provide for recording ESW system as-left flow with the discharge valve throttled but a review of test data does not identify this being a problem.

Conclusion

Surveillance testing was observed to have been conducted in accordance with procedures excluding the noted exceptions. Much improved recording and analysis of pump IST data are currently being performed, however, the improved IST data recording and analysis has not been reflected in the IST program procedure. The elimination of the alert range for ESW pumps without a relief request is contrary to requirements. The ESW system IST data are better for detecting system problems rather than pump degradation. The proposed gathering of IST data quarterly instead of monthly as is currently being performed will limit the amount of data available for system diagnostics. Heat exchanger relief valves and the chlorination class boundary valves have not been included in the valve IST program and require further licensee evaluation. The team conclusion was that the overall system surveillance is adequate to verify system operability with the exception of heat removal capacity as discussed in Section 2.1.5.b.

## 2.2 Engineering Support and Involvement

The team discussed the engineering support and involvement with plant organizations with the Corporate (Headquarters) System Engineers and with the Engineering Technical Functions Department management and supervisory personnel. Items discussed, which are applicable to Engineering Support and involvement included the following:

- Engineering review of plant operability procedures and test results.
- Engineering support and involvement in licensing issues (i.e. USNRC Bulletins, Notices, Generic Letters, LERs)
- Design Basis Document commitment, development, and use by plant organizations.
- Engineering role in Safety Evaluations.
- Engineering involvement in corrective actions.
- Role of the headquarters system engineer and interface with site plant engineering personnel.
- Engineering studies performed to support plant organizations.
- Methodology for written and verbal communication with site plant engineering and other plant organizations.
- Translation of Design Basis criteria into plant operations procedures.
- Pending plant modification status and budgetary commitments.

Engineering support to operations with regard to the CS/ESW systems was clearly evident throughout the inspection. During the conduct of surveillance testing associated with the systems, both the system engineer and the IST coordinator were clearly involved in the conduct of the test, primarily when it became evident that reduced flow was noted in system No. 2. Plant engineering (PE) was also involved in the review of test data.

During a surveillance test conducted on August 16, 1989, a system No. 2 ESW pump failed to meet its IST acceptance criteria. An inspection team member sat in on the engineering evaluation which was performed by members of the site PE staff. The evaluation was detailed and made use of previous IST data and supplemental analysis which had been performed using previous IST and surveillance test results. The results of the PE review were provided to plant operations management. Plant operations personnel did not attend the PE evaluation although this would have been beneficial to operations by providing them with more insight as to why engineering made the recommendations they did.

As a result of an eel grass influx on July 18, 1989 which resulted in a loss of all six traveling screens and caused both turbine building closed cooling water heat exchangers and the main condensers to be fouled, PE wrote a preliminary Safety Concern (PSC). The PSC is still under evaluation. The possibility of a differential pressure increase in the CS/ESW heat exchanger during long term system operation is a matter which merits further engineering evaluation.

Engineering support appears to be adequate in that there are not an unusual number of outstanding Technical Functions Work Requests or Plant Engineering Work Requests associated with the CS/ESW systems.

One area in which support to operations could have been improved was in the five days it took to replace a two inch check valve on the ESW keep-full system. This made it necessary to operate an ESW pump for five days with some resultant increase in heat exchanger differential pressure.

In the area of engineering involvement with the site the team identified four strengths:

1. The ESW/CS Headquarters System Engineer and other systems engineers were knowledgeable of system functions and have regular site presence and interface with site Plant Engineering systems Engineer.

2. The licensee, using headquarters engineering personnel, has generated significant mechanical systems calculations and studies (Technical Data Reports) for ESW/CS Systems.

3. The Design Basis Document for the containment spray system is in final review, with preparation and coordination by the headquarters system engineer.

4. Technical Functions engineering management personnel appear knowledgeable and committed to providing technical support to plant organizations, including plant modifications, corrective actions, licensing response, studies, and response to technical information requests.

In this area the team identified the following three weaknesses in the Headquarters Engineering support and involvement with Plant organizations:

1. Review by headquarters engineering of plant operability procedures is no longer being performed.

2. Translation of design basis criteria and limits into operations and IST procedures is not adequate for CS pump flow, NPSH limits, Ultimate Heat Sink temperature limits, Pump IST Alert Ranges and pump discharge pressure-to-total dynamic head (TDH) conversion information. For example: NPSH limit curves, developed in calculation C-1302-212-5450-010, have incorrect and/or inadequate instructions for their use causing confusion. The calculation states: "If the NPSH limit is significantly violated, the operator will be instructed to reduce the pump flow until the NPSH requirement is again satisfied". For the containment spray pump, the design provides no method for throttling flow. The calculation statement further identifies use of these curves in EOPs, while the present EOPs have deleted NPSH limits for containment spray pumps, but included them in Procedure 310. The latter procedure, step 5.2.6.3 states: "Observe containment spray pump NPSH limits figure 310-11...", but does not provide instructions for action if the limits are exceeded. No calculation update for clarification has been provided by Engineering.

   TDR 369 indicates that fouling can result in the containment spray heat exchanger, with decrease in heat transfer coefficient (U) to as low as 50, rendering the heat transfer inadequate within the present analyzed condition. However, no design modifications have been recommended to allow measurement and evaluation for fouling effects on heat transfer effectiveness, nor were alternate means recommended.

   The ultimate heat sink temperature exceeded the analyzed condition temperature (85°F), as indicated in plant measurements, since 1985. No action was taken on this concern until an NRC violation was issued in Inspection Report 50-219/89-16. The present plant status allows operation at elevated ultimate heat sink temperatures at reduced power (up to 9[illegible]°F @ 75% power) by calculation C-1302-241-5450-035, but no design basis criteria has been established for this temperature at 100% power during the inspection period.

3. The role of the headquarters system engineer is not clearly identified.

Conclusion

The team concluded that Headquarters Engineering support and involvement with Plant organizations needs improvement to fully translate the Design Basis into Plant Operability procedures and to a lesser extent into Plant IST procedures. The team considers that the lack of Design Basis Documents, elimination of Engineering review of Plant operability procedures, lack of a Calculations Update Program to assure operability limits have been analyzed, and the unclear role of the Headquarters System Engineer are contributing factors in this inadequacy.

Plant engineering support to operations was adequate during resolution of the problems which were noted during the inspection. The proper evaluation of the many deviation reports which are prepared should keep PE aware of the problems needing engineering attention. Improved communications between PE, maintenance, and operations would be beneficial.

## 2.3 Management Support and Quality Assurance Involvement

During the inspection, the team noted actions and issues with incomplete resolution. The team found the licensee's follow-up to resolution of problems to be a weakness. Specific examples of the licensee's lack of timely follow-up to resolve issues include:

a. Mechanically disabling the containment spray system static test mode of operation without disabling or retiring the associated control circuits. By not removing or properly retiring the circuits in place, the licensee exposed the system to potential single component failures that could have prevented containment spray automatic initiation.

b. On 12/22/82 an inadvertent containment spray transient occurred. The licensee's investigation of this transient included two long term actions; however, the licensee was unable to demonstrate completion or resolution of the following actions:

   - That the need for testing had been resolved between Technical Functions and Plant Operations. The licensee could not demonstrate completion of this action, and

   - The human factor considerations pertaining to reorientation and labeling of the mode selector switch were not implemented. The team found that:

      - The mode selector switch had not been rotated counter clockwise to provide for a vertical boundary between System 1 and System 2, and

      - The mode selector switch position labels had not been changed to black letters on a white background.

c. Since 1986, removal of containment spray automatic initiation capability has been proposed as the corrective action to resolve identified single failure design deficiencies. The licensee is currently planning to determine, by September 30, 1989, the action that will be taken with regards to removing the containment spray automatic initiation capability or initiating appropriate modifications that would have been made if elimination of automatic initiation had not been proposed.

d. The QA Department performed GPU audit S-OC-86-05 on the containment heat removal system and as a result several recommendations were made, one of which deals with incorporating the 4.16 KV switchgear ammeters into the station's calibration procedure. The recommendation was evaluated but, although required by the licensee's corporate policy, resolution of that recommendation was not documented. During the inspection, the licensee did document the resolution by a memorandum to file. The team feels that this item lacks a timely follow-up on the part of the licensee's QA Department to assure close-out of the recommendation.

e. Open Safety Evaluation Program (SEP) items continue to be identified in the FSAR despite being closed out in 1985, which is an example of the FSAR not being properly updated.

f. The 1982 TDR 369, that included heat exchanger fouling considerations, was not followed up. The team found that the licensee had not included heat exchanger fouling considerations in the calculations to determine heat exchanger operability limits.

g. Although the design analysis had used 85 degrees F as the limit on canal temperature, the plant has been operated at maximum power with the canal temperature over 85 degrees F.

h. LER 88-20 addresses the containment spray high radiation monitor ineffectiveness in the event of area high radiation conditions. The annunciator response procedures do not include cautions or warnings that the containment spray high radiation monitor is unreliable or ineffective during area high radiation conditions.

i. Approximately 3 years ago it was identified that technical specifications permitted continued operation with both the A & C containment spray pumps out of service. Operation with both the A & C pumps out of service is contrary to the design requirement to have containment spray automatic initiation capability. This was clarified by memorandum, dated August 31, 1989, which considers system Nos. 1 or 2 inoperative if the corresponding automatic initiated pump is inoperative.

j. The Oyster Creek SSOMI identified calculation errors as a problem. Calculation errors were identified as a weakness during this inspection. Although the licensee performs independent review and verification of calculations, the team found calculation errors that were not identified by the licensee's calculation reviewers/verifiers.

k. In the licensee's response to Bulletin 79-14, dated November 7, 1985, the licensee committed to preparing stress isometric piping drawings for all safety related systems. The team found that stress isometric drawings had not been prepared for all safety related systems.

l. The team found that the licensee has relied upon administrative or procedural solutions to correct hardware problems. The following are provided as representative examples of administrative resolution of hardware problems:

- If the automatic containment spray pumps [A or C] are not operating, then the operating containment spray pumps must be tripped manually at the low drywell pressure setpoint. Emergency operating procedures direct manual tripping of the operating pumps if automatic tripping does not occur. Licensee representatives reported that action to install a modification to correct the circuit design deficiency is not planned, and

- In the event of a loss of offsite power (LOOP) is followed by a loss of coolant accident (LOCA), the emergency diesel generator(s) may be overloaded. The licensee has implemented procedural controls to manually reduce loads on the safety related buses rather than installing modifications to initiate bus stripping.

m. The team noted several licensee failures to follow-up on the resolution of open items from the special electrical NRC team inspection of November, 1986, as follows:

| ITEM | TITLE |
|---|---|
| 50-214/86-37-01 | Potential seismic interference on safety related motor control center 1B21 extension. |
| 50-219/86-37-02 | Installation deficiency in 125 VDC battery "C". |
| 50-219/86-37-04 | Administrative control for load growth. NOTE: That E & D Guidline 4 discussed in Section 2.1.2 of this report input appears to satisfy this item. |
| 50-219/86-37-05 | Dynamic test to prove increased capacity of diesel generators. |

n. As a result of the augmented inspection (IR 50-219/88-80) in October, 1988, the licensee committed to provide to the USNRC, for review, details of a program for surveillance of normally energized underground cable. In discussions with the licensee contact, the team was advised that a program has yet to be formalized.

## 3.0 CONCLUSION

### Overall Conclusion

The Team found the containment spray and emergency service water systems to be functionally capable of performing their design requirements. This is primarily due to original design redundancy and excess system capacity. However, plant operating procedures must clearly reflect the operating procedures necessary to implement the technical specification and FSAR requirements as analyzed by Engineering.

## 4.0 EXIT INTERVIEW

At the conclusion of the inspection on September 1, 1989, the inspection team met with the licensee representatives, denoted in Appendix II. The team leader summarized the scope and findings of the inspection at the time.

The team gave no written material to the licensee.

# APPENDIX I

## SUMMARY OF WEAKNESSES

A weakness is a condition or potential problem that is presented for licensee review to establish what, if any, corrective actions are required. The following is a summary of weaknesses as noted by the inspection team.

1. The licensee has failed to demonstrate timely responses to USNRC inspection report unresolved and/or open items and to a self-audit per corporate policy.

2. Communication between Operations, Maintenance and Corporate Engineering.

3. A fault on the cables connecting an emergency diesel generator to its bus will result in the temporary loss of that bus.

4. The worst case fault on the 4.16 KV system that was analyzed is not demonstrated by calculations or studies to be the worst case.

5. Impact of automatic fast transfer on motors and driven equipment has not been analyzed.

6. Synchro-check logic is not used in the automatic fast transfer scheme to reduce the potential for out-of phase transfer of motors.

7. The Class 1E station battery "C" rack as installed has the potential to damage battery jars during a seismic event.

8. Emergency diesel generator loading on loss of off-site power followed by a loss of coolant accident can result in potential overloads to the machines.

9. The licensee failed to adequately review the accuracy of their self-SSFI report TDR 986 prior to its issue.

10. In the area of calculations, the team identified errors in I&C and Mechanical Engineering calculations that were not found by the calculation verifier.

11. Corporate System Engineers do not have a procedure or formalized listing of their primary responsibilities.

12. Engineering does not have a calculation review and update program.

13. Failure to resolve repetitive heat exchanger maintenance problems including need for chlorination improvements.

14. Corroded condition of steel support beams and electrical conduits at service water intake areas.

15. Observations of heat exchanger relief valves with broken or missing adjustment lockwires and nameplates.

16. Excessive paint on valve packing, lubrication sight glasses and pump vibration marks.

17. Lack of understanding on how to grease pumps with grease cups.

18. Observation of pump lubricant level is not part of the surveillance procedure prerequisites.

19. Engineering requests for operators to deviate from procedures during surveillance testing.

20. There is a need to resolve technical specification vs. design basis conditions such that needed setpoints and values are included in procedures to adequately quantify "operability".

## APPENDIX II

## PERSONS CONTACTED

GPU Nuclear

J. Abramovici, Heat Exchanger and Pressure Vessels Manager
A. Agarwal, Manager, Instrumentation - Corporate
K. Barnes, Licensing
J. Bishop, Senior Job Coordinator
* R. Blouch, MCF Technical Support Manager
M. Bradley, I&C Job Coordinator
D. Brittner, Control Room Operator
W. Brostow, Engineer, Plant Materiel
* G. Busch, Oyster Creek Licensing Manager
A. Cassell, Quality Assurance Engineer
A. Cazaban, Engineer, Inspections
P. Cervenka, Engineer, Plant Engineering
F. Cimino, Maintenance Foreman
* M. Colangelo, Work Authorization Manager, Plant Materiel
* D. Croneberger, Acting Director, Tech. Functions
D. Custodio, Engineer, Plant Engineering
P. Czaya, Licensing
* J. DeBlasio, Manager, Mechanical Engineering
* T. Dempsey, Tech. Functions Plant Systems Manager
A. Dickenson, Supervisor, Electrical Engineering
A. Duffield, Mechanical Maintenance Planner
R. Evers, Engineer, Projects
M. Filippone, Work Authorization Coordinator, Plant Materiel
E. Fitzpatrick, Vice President and Director
* J. Flynn, Manager Engineering Data Conformance Control
T. Gaffney, I&C Supervisor, Plant Materiel
* J. Galanto, Engineer, Plant Engineering
J. Hagan, Instrumentation Engineer
C. Hager, Engineer, Plant Engineering
G. Harttraft, Engineer, Plant Materiel
A. Hawley, Plant IST Coordinator (Pump IST)
G. Hicks, Quality Assurance Engineer
R. Huddy, Program Development & Audits
M. Husain, Plant Engineer, Spare Parts
J. Isch, Plant Maintenance
* D. Jerko, Licensing
D. Jones, Plant Engineering
C. Lefler, Project Engineer, Technical Functions
* J. Logatto, Engineering & Design
S. Narayan, Engineer, Plant Engineering
* R. Markowski, Program Development & Audits
D. McFarlane, OC Site Audits
R. McGarriagle, Design and Drafting
D. Most, I&C Technician
* L. Munzing, Plant Operations
L. Newton, Plant Operations

E. O'Hara, Engineer, Mechanical Compcnents
M. Orlowski, Human Factors Specialist
R. Owstrowski, Staff Consultant (ISI)
D. Pino, Plant Material
P. Procacci, Project Engineer
* D. Ranft, Plant Engineering Manager
G. Rhedrick, Engineer, QA-ISI
H. Robinson, Engineering & Design
* E. Roessler, Manager Nuclear Safety
J. Rogers, Licensing
A. H. Rone, Plant Engineering Director
G. Sadauskas, Engineering & Design
* C. Schilling, Supervisor Mechanical Engineering
* D. Slear, Engineering & Design
J. Smith, Engineering & Design
* P. Smith, Systems Engineer
* J. Solakiewicz, Operations QA Manager
* P. Thompson, Lead QA Auditor
* N. Trikouras, Tech. Functions SAPC Manager
D. Whitley, I&C Technician
R. Zak, Engineer, Engineering Mechanics

* Indicates presence at the exit meeting on 9/1/89

## APPENDIX III

## DOCUMENTS REVIEWED

Portions of the items listed in this Appendix were reviewed as part of the SSFI inspection. The list is not complete but is provided as a background for reference in report follow-up.

### MECHANICAL

1. GPU Nuclear Corporation "Oyster Creek Nuclear Generating Station Docket No. 50-219 IE Inspection Report 85-14". Dated November 7, 1985

2. GPU Nuclear TDR No. 369, Rev. 0, dated December 14, 1982 "Evaluation of Containment Spray/Emergency Service Water System Condition -- August 1982"

3. Casagrande Report - April 21, 1972, Forked River Nuclear Station, Investigation of stability characteristics of soil in the canal banks

4. GPU Nuclear Specification for Oyster Creek Nuclear Generating Station "1985 IE Bulletin 79-02/14 Inspection Program Design Input for Piping Support Analysis". Specification No. SP-1302-12-212, Rev. 1, dated June 9, 1988

5. GPU Nuclear Specification for Oyster Creek Nuclear Generating Station "1985 IE Bulletin 79-02/14 Inspection Program Design Input for Piping Stress Analysis." Specification No. SP-1302-12-208, Rev. 2, dated June 5, 1989

6. GPU Nuclear TDR No. 829, Rev. 0, dated January 20, 1987 "UT and Visual Inspections of OCNGS Emergency Service Water Piping"

   GPU Nuclear TDR No. 723, Rev. 1, dated October 15, 1985 "Evaluation of ESW System Pipe Coating Failure"

7. GPU Nuclear Short Form Specification SP 1302-26-010, Rev. 1, dated January 28, 1986 "UT Inspection of the Intake Structure Non-Immersed Piping"

8. GPU Nuclear Specification SP 1302-26-012, Rev. 2, dated October 12, 1988 "12R Inspection of Intake Structure Non-Immerse ESW Piping"

9. Oyster Creek SOER 86-03 Check Valve Program.

10. EPRI Monograph Titled "Application Guidelines for Check Valves in Nuclear Power Plants", Section 3, Information on Performance Characteristics of Check Valves

11. GPU Nuclear Memo of July 5, 1989, No. 2310-M89-061, "Completion of "Checkmate" Check Valve Monitoring - Phase I"

12. Oyster Creek Nuclear Generating Station Operation Plant Manual - Module 09 Containment Spray and Emergency Service Water Systems, Rev. 1, dated March 7, 1988

13. GPU Nuclear Calculation No. C 1302-241-5320-024, Rev. 02, "Oyster Creek NSR Piping Analysis Containment Spray" (outside drywell), dated November 10, 1988

14. GPU Nuclear Calculation No. C-1320-241-5320-023, Rev. 2, dated May 20, 1988, HGR No. 241-NQ-2-H30-74

15. GPU Nuclear Calculation No. C-1302-532-5320-008, Rev. 02, "Oyster Creek NSR Piping Analysis Emergency Service Water (ESW)", dated October 10, 1988

16. GPU Nuclear Calculation No. C-1302-532-5320-009, Rev. 02, "Oyster Creek Emergency Service Water", dated November 17, 1988, HGR No. 532-SW-SN-5-17

17. GPU Nuclear meeting notes (Memorandum No. C320-89-24), dated August 15, 1989)

18. USNRC Generic Letter 89-13, (dated July 18, 1989)

19. USNRC Inspection report No. 50-219/85-23, dated October 7, 1985

20. USNRC Inspection report No. 50-219/89-04, dated April 28, 1989

21. CS System General Physics Corporation. Drawing Piping Isometric Containment Spray System No. ICP-19436 Sheet 1 to 11, Revision 2, dated September 25, 1979 (Field verification for NRC I&E BLTN 79-14)

22. Burns and Roe Incorporated Emergency Water Service (Reactor and Turbine building) Isometric Piping No. H0102 and H0103, Revision 0

23. Jersey Central Power and Light Company Generation Department; Composite Yard Piping Key Plan No. BR 2192, Revision 12, dated May 1983

24. Burns and Roe, Incorporated Engineers and Contractors "Composite Yard Piping" No. 2193, Revision 8, dated September 1967

25. Burns and Roe, Incorporated Engineers and Contractors "Piping Isometric Chlorination System Upgrade," Revision 0, drawing No. M0225

26. GPU Nuclear Calculation No. C-1302-532-5310-006, Revision 0, "ESW Pipe Support No. ISH-10," dated September 20, 1984.

27. GPU Nuclear Calculation No. C-1302-104-5320-016 ESW Support SW-1-H1A, O.C. dated October 16, 1984

MECHANICAL DESIGN

1. FSAR Sections

   a. Section 3.1, "Conformance With NRC General Design Criteria".
   b. Section 6.2.2, "Containment Heat Removal Systems".
   c. Section 9.2.1.1, "Service Water Systems".
   d. Figure 3.2-4, Rev. 2, dated 6/87, "Containment Spray System InService Diagram".
   e. Figure 3.2-11, Rev. 2, dated 6/87, "Service and Emergency Service Water InService Diagram"
   f. Figure 6.2-14, Rev. 3, dated 2/88, "P&ID-Containment Spray System"
   g. Figure 9.2-1, Rev. 3, dated 2/88, "Flow Diagram-Circulating, HP Screenwash, Service & Emergency Service Water Systems"

2. Technical Specifications

   a. 1.1, "Definitions" (Operable-Operability)
   b. Table 3.1.1, "Protective Instrumentation Requirements"
   c. 3.4/4.4, "Emergency Cooling"

3. Plant Procedures and Data

   a. 607.4.004, Rev. 0, dated 6/11/89, "Containment Spray and Emergency Service Water System 1 Pump Operability and Service Test"
   b. 607.4.005, Rev. 0, dated 6/11/89, "Containment Spray and Emergency Service Water System 2 Pump Operability and Service Test"
   c. TP 200/0.1, Rev. 0, dated 10/15/85, "Emergency Service Water (ESW) Pump Operability Test"
   d. 1000-POL-7220.01, Rev. 1, dated 1/10/89, "GPUN Welding Program Policy"
   e. 6150-ADM-3272.01, Rev. 2, dated 11/15/88, "Special Processes and Programs-Inservice Inspection Program Development and Documentation"
   f. 1504-ADM-3272.02, Rev. 0-00, dated 7/1/85, "Repair and Replacement"
   g. 310, Rev. 33, dated 4/29/89, "Containment Spray System Operation".
   h. 125.1, Rev. 0, dated 1/31/84, "In-Service Test Program Administration" (Pump Test Record sections, 1986-1989)
   i. Standing Order 36, Rev. 4, "Allowable IST Ranges for Pumps"
   j. "ASME XI Oyster Creek Nuclear Generating Station Pump and Valve InService Testing Program", dated 3/12/87.
   k. ESW Pump and Containment Spray Pump Curves (IST Furnished).

4. Engineering Procedures (Technical Functions Division)

   a. ES-001, Rev. 1, dated 3/15/89, "GPUN Engineering Classifications"
   b. 5000-ADM-7311.01 (EP-006), Rev. 3-00, dated 2/13/89, "Calculations"
   c. 5000-ADM-1291.01 (EP-016), Rev. 3-07, dated 6/1/89, "Nuclear Safety/Environmental Impact Determinations and Evaluations"
   d. 5000-ADM-7313.01 (EP-005), Rev. 3-03, dated 6/1/89, "Modification and System Descriptions"
   e. 5000-ADM-7311.02 (EP-009), Rev. 3-00, dated 4/18/88, "Design Verifications"

5. Engineering Specifications

   a. S-2299-40, "Containment Spray Pumps", dated 1/19/66 (Burns & Roe)
   b. 21A5410, Rev. 0, dated 4/30/65, "Containment Spray System Pumps" (G.E.)
   c. Purchase Specification #141-75-2, Rev. 4, dated 5/1/78, "Containment Spray Heat Exchangers"
   d. S-2299-43 and Addendum 1, dated 10/22/65, "Emergency Service Water Pumps" (Burns & Roe)
   e. 22A1018, Rev. 2, dated 1/19/66, "Design Specification for Primary Containment Spray System" (G.E.)
   f. Design Criteria No. 466-79-4, Rev. 0, dated 2/5/80, "Replacement of Containment Spray Heat Exchanger Emergency Service Water Connections"
   g. Installation Specification No. OC-IS-315302-001, Rev. 1, dated 8/27/82, "Modification To The Containment Spray Heat Exchangers"
   h. Installation Specification No. OC-MM-402871-001, Rev. 1, dated 9/1/87, "Containment Spray Heat Exchanger Delta Pressure Gages - Oyster Creek"
   i. Installation Specification No. OC-MM-402742-005, Rev. 0, dated 1/13/88, "Addition of Tell-Tale Drain to Service Water System - Oyster Creek"

6. Safety Evaluations

   a. SE No. OC-000241-001, Rev. 2, dated 2/16/87, "Containment Spray Heat Exchanger Tube/Shell Differential Pressure"
   b. SE No. 402672-001, Rev. 0, dated 1/9/84, "Containment Spray Pumps Suction Pressure Gauges"
   c. SE No. 000532-007, Rev. 0, dated 12/9/88, "ESW Weephole Modification, MNCR 880394"
   d. SE No. 00532-003, Rev. 0, dated 2/2/88, "Tell-Tale Drain Service Water System"
   e. SE No. 000532-002, Rev. 1, dated 8/2/85, "ESW System Return to Service-ESW Pipe Cleaning-Oyster Creek"

7. Technical Data Reports (TDRs)

   a. TDR 165, Rev. 0, dated 6/19/80, "Performance Evaluation of the Oyster Creek Containment Spray Heat Exchangers"
   b. TDR 369, Rev. 0, dated 12/14/82, "Evaluation of Containment Spray/ Emergency Service Water System -- August, 1982"
   c. TDR 532, Rev. 0, dated 5/3/84, "Torus Water Chloride Mixing Time and Containment Spray Heat Exchanger Leakage Analysis"
   d. TDR 701, Rev. 0, dated 12/12/85, "Evaluation of Emergency Service Water System"
   e. TDR 716, Rev. 3, dated 5/1/86, "Best Estimate Analysis of Oyster Creek DBA LOCA Containment Analysis"
   f. TDR 723, Rev. 1, dated 8/23/85, "Evaluation of ESW Pipe Coating Failure"
   g. TDR 777, Rev. 1, dated 9/4/86, "Evaluation to Increase High Drywell Pressure Setpoint Limit"
   h. TDR 808, Rev. 0, dated 1/7/87, "Evaluation to Eliminate Containment Spray Automatic Start Logic"
   i. TDR 829, Rev. 0, "UT and Visual Inspections of OCNGS Emergency Service Water Piping"

8. Audits

a. Audit Report S-OC-86-05, dated 9/17/86, "System Functional Audit-Containment Heat Removal"

9. Calculations

a. 13432.15-01, Rev. 0, dated 11/18/81, "Adequacy of Containment Spray System to Preclude Operation of Pumps at Runout Flow" (Stone & Webster)
b. 13432.15-07, Rev. 0, dated 12/25/81, "Available NPSH For Containment Spray Pumps" (Stone & Webster)
c. C-1302-241-5360-004, dated 10/7/83, "Containment Spray/Emergency Service Water System Performance"
d. C-1302-532-5360-002, dated 11/8/83, "CS/ESW System Pressure Profile"
e. C-1302-241-5360-006, dated 12/28/83, "Containment Spray System Pressure Profile"
f. C-1302-532-53220-004, dated 2/22/84, "OC ESW Flow Analysis"
g. C-1302-532-5360-007, Rev. 0, dated 9/24/85, "Loss of Flow From ESW System Through Chlorination Branch Connections & Hx Relief Lines"
h. C-1302-212-5450-010, Rev. 1, dated 8/8/86, "O.C. EOPs: Core and Containment Pump NPSH Limit Curves"
i. C-1302-241-5450-012, Rev. 1, dated 6/10/86, "OC EOPs: Torus Spray Initiation Pressure"
j. C-1302-241-5360-031, Rev. 0, dated 6/22/88, OCNGS- Cont. Spray Hx Area Reduction"
k. C-1302-243-5450-044, Rev. 0, dated 6/23/88, "OC DBA LOCA Containment Response With Reduced Containment Spray Heat Exchanger Area"
l. C1302-241-5450-035, Rev. 0, dated 8/7/89, "Torus Temperature Response To ESW Temperature of 95F and 75% Reactor Power"

ELECTRICAL

FSAR

OCNGS FSAR Update, Rev. 3, dated 2/88, Chapter 8, Electric Power

Amendment 32 to Construction Permit, Response to Question 3, dated 1/9/68.

Diagrams

BR3001, Rev. 14, dated 7/19/89 - Main One Line Diagram

BR3002, Rev. 26, dated 7/19/89 - Auxiliary One Line Diagram

BR3031, Rev. 5, dated 3/27/87 - Synchronizing Diagram

GE-157B6350, Sheet 20, Rev. 7 - Motor Control Center 1B21B

SK-861-W-1002, Rev. 1, dated 5/19/86 - 16GH-4STG, VTP (Byron Jackson - ESW Pump outline.

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21A0100, Rev 0, dated 8/20/62 - Electric Motors

21A5410, Rev. 0, dated 4/30/65 - Containment Spray Pumps

21A1018, Rev. 2, dated 1/19/66 - Primary Containment Spray System

S-2299-40, Rev 0, dated 1/66 - Containment Spray Pumps

S-2299-43, Rev 0, (not dated) - Emergency Service Water Pumps

S-2299-61, Rev. 0, (not dated) - Standard Valves

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OC-MM-328184-003, Rev. 2, dated 10/20/87 - Installation Specification for Changout of 49/50 Relays on Emergency Service Water (ESW) and Core Spray Maine (CSM) Pumps

OC-MM-328206-001, Rev. 0, dated 8/12/88 - Installation Specification for Diking Required for Removal of PCB Fluids from Transformers

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C-1302-700-5350-005, Rev. 1, dated 9/8/87 - OCNGS - Class 1E Solid State Trip Device Settings for 480 V USS Circuit Breakers

C-1302-741-5350-001, Rev. 1, dated 6/27/88 - OC, Loading of Diesel Generators and Associated Buses

EAGB-80-383, dated 8/11/88 - (Letter to USNRC) Docket No. 50-219, Grid Undervoltage Protection

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S-OC-86-05, dated 9/17/86 - System Functional Report - Containment Heat Removal

S-OC-87-19, dated 8/4/88 - Onsite AC Emergency Power System

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341, Rev. 29, dated 3/30/89 - Oyster Creek Nuclear Generating Station Procedure - Emergency Diesel Generator Operation

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056731, dated 8/29/89 - Main Station Battery "C"

056732, dated 8/29/89 - Main Station Battery "C"

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LAI No. 87139.01 and No. 87139.02, dated 8/9/88, Licensing Action Item, PSC 87-006 Evaluation

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PSC 87-006, dated 5/14/87 - Preliminary Safey Concern and Potential Licensee Event Evaluation - Diesel Generator Response to LOOP with Subsequent LOCA

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TDR 777, Rev. 1, dated 5/13/86, Evaluation To Increase High Drywell Pressure Setpoint Limit

TDR 808, Rev. 0, dated 1/7/87, Evaluation to Eliminate Containment Spray Automatic Start Logic

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PSC 86-021, dated 1/12/87, Containment Spray Auto-Start Logic

PSC 86-020, dated 10/27/86, Automatic Initiation Of Containment Spray

PSC 86-019, dated 3/2/87, Containment Spray System

PSC 86-016, dated 12/11/86, Normal Containment Spray Flow

PSC 85-023, dated 12/5/85, Emergency Service Water Piping

PSC 85-007, dated 2/7/85, ESW Overboard Radiation Monitors

PSC 84-014, dated 5/8/85, Containment Spray Relief Line

PSC 84-002, dated 11/18/85, Emergency Service Water Line Break

PSC 83-002, dated 9/28/83, Delta Pressure On The Emergency Service Water Heat Exchanger

PSC 83-005, dated 5/3/83, Emergency Service Water System Damage From Natural Phenomena, Inadequate Fire Protection, etc.

PSC 83-008, Rev. 2, dated 4/26/84, Emergency Service Water System Pipe Hangers

LER 85-018, dated 8/23/85, Emergency Service Water Pipe Coating Failure

LER 86-002, dated 2/21/86, Inoperative Containment Spray Snubber Caused By Personnel Error

LER 86-014, dated 7/25/86, Containment Spray System Seismic Concerns

LER 86-023, dated 12/1/86, Single Failure Of Containment Spray Automatic Initiation Logic

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A100-ADM-3053.01, Rev. 1, dated 2/22/88, Calibration of Maintenance Test and Inspection Tools, Gauges, and Instrument

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C-1302-241-5450-012, Rev. 1, dated 7/15/86, OC EOPs: Torus Spray Initiation Pressure

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C-1302-622-5350-019, Rev. 0, dated 10/2/87, OC Containment Spray Flow Pump Interlock Loop Error IP 03 A/B

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VM-OC-0248, Rev. 0, dated 9/18/87, Technical Manual - Type 560 Alarm Unit (4532K20-001D)

VM-OC-0265, Rev. 0, dated 11/15/88, Technical Manual - Rosemount Model 3051 Pressure Transmitter User's Manual

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607.3.002, Rev. 31, dated 6/22/89, Containment Spray System Automatic Actuation Test Data Sheet

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DPI-532-0006, System 2 ESW Flow Indicator Instrument Data Record/Calibration Data/Maintenance History

067505, dated 1/5/88, Emergency SW System Field Questionnaire Change Request/Change Notice/Design Change Notice

053140, dated 9/16/87, Document Release Form - Containment Spray Heat Exchanger Delta Pressure Gauges

OC-MM-402571-001, Rev. 0, dated 9/17/87, Installation Specification for Containment Spray Heat Exchanger Delta Pressure Gauges

OC-MM-402571-001, dated 9/17/87, Construction Release Checklist for B/A #402871 (Containment Spray Heat Exchanger Delta Pressure Gauges)

2000-OPS-3024.05, Rev. 3, dated 4/22/89, Containment Spray System, Diagnostic and Restoration Actions

5000-ADM-7350.05, Rev. 1-01, dated 10/2/86, Mini-Mods

5000-ADM-7313.01, Rev. 3-03, dated 6/1/89, Modification and System Design Descriptions

5000-ADM-7311.02, Rev 3-00, dated 4/18/88, Design Verification

## APPENDIX IV

## NRC INSPECTION MODULES

Portions of the following NRC inspection modules were used in the conduct of the SSFI.

30703 - Entrance and Exit Meetings
35701 - QA Program Annual Review
37700 - Design, Design Changes and Modifications
37701 - Facility Modifications
37702 - Design Changes and Modifications Program
41701 - Licensed Operator Training
42700 - Plant Procedures
61700 - Surveillance Procedures and Records
61725 - Surveillance Testing and Calibration Control Program
61726 - Monthly Surveillance Observations
62702 - Maintenance Program
62703 - Monthly Maintenance Observations
62704 - Instrument Maintenance (Components and Systems) Observation of Work, Work Activities, and Review of Quality Records
62705 - Electrical Maintenance (Components and Systems) Observation of Work, Work Activities, and Review of Quality Records
71707 - Operational Safety Verification
71710 - ESF System Walk Down
72701 - Modification Testing
73051 - Inservice Inspection - Review of Program
73755 - Inservice Inspection - Data Review and Evaluation