OFFICE OF INSPECTION AND ENFORCEMENT
DIVISION OF INSPECTION PROGRAMS

Report Nos.: 50-250/85-32 and 50-251/85-32

Licensee: Florida Power and Light Company
9250 West Flagler Street
Miami, FL 33101

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Facility Name: Turkey Point 3 and 4

Inspection Conducted: August 26 - September 13, 1985

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SCOPE: This special announced team inspection involved 637 inspection hours assessing the operational readiness of the auxiliary feedwater system.

RESULTS: The licensee's operational readiness and management controls as they relate to the auxiliary feedwater system were reviewed in six functional areas. The functional areas reviewed were:

- Maintenance
- Operations
- Surveillance
- Quality Assurance
- Training
- Design Changes and Modification

Additionally, 10 potential enforcement findings were presented to the NRC Region II office as Unresolved Items for followup.

I. Inspection Objective

The objective of the team inspection at Turkey Point was to assess the operational readiness of the auxiliary feedwater (AFW) system. This assessment included a determination of the following:

- capability of the system to perform the safety functions required by its design basis;
- adequacy of testing to demonstrate that the system would perform all of the safety functions required;
- adequacy of system maintenance (with emphasis on pumps and valves) to ensure system operability under postulated accident conditions;
- adequacy of operator and maintenance technician training to ensure proper operations and maintenance of the system;
- adequacy of human factors considerations relative to the AFW system (e.g., accessibility and labelling of valves) and the system's supporting procedures to ensure proper system operation under normal and accident conditions.

II. Summary of Significant Inspection Findings

Section III of this report provides the detailed inspection findings pertaining to each functional area evaluated. The safety effects of the more significant findings on the operational readiness of Turkey Point's auxiliary feedwater (AFW) system are summarized below.

Safety Effects on the Auxiliary Feedwater System

A. The NRC inspection team identified safety concerns regarding the ability of the AFW system to perform its safety function in the event of a loss of non-safety grade instrument air. Loss of the instrument air supply to the air-operated AFW flow control valves is an assumption in the AFW system design basis for most analyzed accidents involving AFW. To ensure that the flow control valves, and thereby the entire AFW system, continue to operate in such events, a safety-grade nitrogen backup system is provided. The team determined that this backup nitrogen system had never been functionally tested, even though this system had been substantially modified as recently as early 1984. The licensee had based its procedures and operator training on the assumption that 15-20 minutes were available for operators to take necessary action to establish additional nitrogen capacity upon depletion of the first nitrogen bottle. This would be accomplished by valving in additional nitrogen bottles in the event of a loss of instrument air to the flow control valves (FCVs). Control room operators would be alerted to take action by annunciator alarms in the control room that indicate that the on-line nitrogen bottles for each of four trains (two trains per unit) had reached a low pressure condition of 500 psig. As a result of NRC concern during this inspection, the licensee tested all four trains of the nitrogen backup supply to the AFW FCVs. This test demonstrated that from the time the low nitrogen pressure annunciator alarmed, only 6 to 7 minutes (instead of the expected 15-20 minutes) would be available in the most limiting case (FCVs remaining in automatic mode). The team further determined that correct operator response to a low nitrogen pressure annunciator for train 1 would have been hampered by the incorrect information in the annunciator response procedure, Procedure 0208.11, which directed the operator to ignore tbe alarm if all three train 1 nitrogen bottles were in service. Additionally, a review of recent design changes to the AFW system indicated that the low nitrogen pressure annunciator alarm setpoint had been reduced in March 1984 from its original setpoint of 1000 psig to the current 500 psig. This resulted in a significant reduction in the available time for operator response. The design change was also performed without an adequate safety evaluation.

The team concluded that the weaknesses identified above in operator training, inadequate procedures, the failure to functionally test the nitrogen backup system, and the apparent non-conservative setpoint for the low nitrogen pressure alarm could have all contributed to a significant risk of a loss of AFW flow. Specifically, the team concluded that there was inadequate assurance that the control room operators would take the required actions to maintain AFW flow within the 6 or 7 minutes that would potentially be available once the nitrogen low pressure annunciator alarm was received. The team noted that the operators' training and procedural guidance could have provided a false assurance that at least 15-20 minutes were available. The team was also concerned that, even if operators had been correctly trained and had adequate procedures, the existing low nitrogen pressure setpoint of 500 psig might be too low to allow for a reasonable response time for operators to valve in standby nitrogen bottles. Several operators expressed the consensus that at least 10-15 minutes should be available to ensure necessary actions could be taken.

B. The team identified a safety concern regarding the ability of the AFW system to perform its safety function in the event of certain two-unit trip scenarios. The AFW system design description and design basis required that 286 gpm be supplied to each unit within 3 minutes in the event of a two-unit trip and stated that operator action would likely be required to assure correct flow distribution to each unit if only one AFW pump were available. Specifically, the AFW system is arranged into two trains, and any one train is required by the design criteria to supply both units. Train 2 contains only one of the three AFW pumps. Consequently, on the loss of train 1, the single pump in train 2 is required to supply both units. The team determined that the control room operators had not been trained for this eventuality. In addition, the applicable emergency operating procedures, such as EOP 20004, "Loss of Offsite Power," and EOP 20007, "Total Loss of AC," made no mention of the need to provide a minimum of 286 gpm to each unit within three minutes. Without the requisite training and procedural support, the team lacked confidence that correct operator action would be taken to ensure adequate AFW flow to each unit in the event of a two-unit trip with only train 2 of AFW available. This becomes particularly important if one of the units provided less flow resistance to AFW, such as would be the case if steam generator pressures of one unit were lower than the other unit.

C. The inspection team identified a safety concern regarding the ability of the on-shift operators to isolate steam flow paths to the environment from the affected steam generator in the event of a steam generator tube rupture. Emergency Operating Procedure 20003, "Steam Generator Tube Rupture," directed the control room operators to isolate the steam supply from the affected steam generator to the AFW turbines by shutting the associated motor-operated isolation valves using the hand switches in the control room. The inspection team determined that the AFW turbine steam supply isolation valves could not be remotely shut from the control room if there was an AFW actuation signal present. The team identified that the steam supply isolation valves were designed to cycle open if an AFW actuation signal were present, even if the control room handswitches were held in the "close" position. The licensee had not recognized this design feature. Therefore, the licensee had not provided operator training or adequate procedures to ensure that alternate means were taken to isolate the AFW steam supply from the affected steam generator. The team concluded that the lack of operator awareness that the steam flowpaths in question could not be isolated remotely from the control room could have resulted in an unnecessary and potentially significant radioactive release to the environment following a steam generator tube rupture. A significant amount of time could have been required for the control room operators to first identify that the steam supply isolation valve would not remain shut and then take appropriate compensatory actions.

Effects on Other Safety Systems

In addition to the specific safety concerns discussed above that relate directly to the operational readiness of the AFW systems the team also identified several general concerns that have the potential to affect the proper operation of other safety systems.

A. Problems were noted in the Turkey Point maintenance program. Programmatic weaknesses affecting quality of corrective and preventive maintenance performed on Turkey Point safety systems included:

- The maintenance department had experienced a high turnover rate among maintenance technicians which resulted in a shortage of experienced personnel. The Instrumentation and Controls (I&C) section was the hardest hit: at the time of the inspection over half (15 of 27) of the I&C technicians performing surveillance testing had and average of less than 6½ months experience at Turkey Point.

- Maintenance technician training had not been conducted since August 1984.

- Management controls did not exist to ensure that safety-related maintenance activities were performed by qualified personnel. On-the-job training (OJT) records or other forms of qualification documentation were not used by maintenance supervisors as a basis for work assignments.

- Maintenance procedures generally lacked detail. Complex safety-related maintenance activities were often considered to be within the scope of the "skill of the trade", and therefore not requiring procedures. The shortage of experienced technicians and lack of training referred to above do not appear to justify the widespread use of "skill of the trade" as a substitute for detailed procedures.

- Post-maintenance testing requirements were typically not included as part of electrical and I&C Plant Work Orders. Further, documentation of completed post-maintenance tests for electrical and I&C maintenance were typically not part of the retained maintenance records.

Interviews with maintenance department supervisory personnel indicated that the above maintenance problems could have contributed to the large backlog of safety-related Plant Work Orders (PWOs) throughout both units. This backlog was of particular concern to the team as it applied to degraded and malfunctioning control room instrumentation. For example:

- The ability of the control room operators to diagnose a steam generator tube leak was degraded by the fact that the steam jet air ejector process radiation monitors had been out of service for about six months.

- The Unit 4 containment sump high level annunciator had been out of service since December 1984 due to a failed level switch.

- Two of the four post-accident monitors for containment sump level for Unit 4 had been out of service since February 1985.

- A Unit 3 safety injection accumulator Hi/Lo pressure and Hi/Lo level annunciators were in an alarmed condition although the associated pressure and level instruments read within their normal bands.

- Several area radiation monitors on both units were out of service. Some of the monitors had been out of service for greater than six months.

- AFW system nitrogen backup supply low pressure annunciators for nitrogen station No. 2 were alarmed on both units. Nitrogen station No. 2 had been removed from service since January 1985 as a result of a design change. The team considers this a concern because the alarmed nitrogen low pressure annunciators were located adjacent to the low nitrogen pressure annunciators for stations 1 and 4 and thereby could degrade the operator's reaction time to a valid low nitrogen pressure alarm. Since very little reaction time may be available (as little as 6 to 7 minutes) to take action to maintain AFW flow once the low nitrogen pressure alarm is received, the potential for confusion caused by the spurious alarms is considered significant.

- Both units had leaking power operated relief valves (PORVs). In addition, the isolation valves (block valves) for the Unit 4 PORVs leaked and this resulted in elevated temperatures downstream of the Unit 4 pressurizer safety relief valves (which share common discharge piping with the PORVs). As a result, control room annunciators were alarmed for all three Unit 4 pressurizer safety relief valves downstream temperature elements. This condition is significant because it could degrade the control room operators' ability to identify a lifted safety relief valve or the failure of a PORV to reseat.

B. Problems were noted in the Turkey Point design change process. Programmatic weaknesses identified by the team that affect the adequacy of the design changes and modifications to safety-related systems include:

- The engineering group often did not provide post-modification testing requirements to confirm the adequacy of the installation to the design basis.

- The team identified instances where modifications were installed without a detailed design analysis. The licensee was found to frequently base design changes on engineering judgement that the new design was bounded by the original design analysis. Documentation justifying the engineering judgement typically did not exist.

- Design bases for safety-related systems were difficult to retrieve. In the absence of readily available design bases for many safety-related systems, the team is concerned that excessive reliance could be placed on engineering judgement for implementing design changes and for performing safety evaluations required by 10 CFR 50.59.

The team concluded that the above programmatic weaknesses in the design change process potentially contributed to the following examples of inadequate design analysis and design change implementation:

- Four of six AFW system steam supply isolation valve motor operators were changed from AC to DC motors without adequate design analysis. Motor overload protection for the new DC motors was not properly sized. Further, the new power cables were not properly sized to ensure adequate operating voltage for the motor operators in the event of a loss of offsite power. The licensee had not performed any cable sizing calculations to support this design change.

- The design change to the AFW system to provide redundant Train A and Train B flow control introduced the potential for common mode failure due to control circuits from both trains coming to common limit switches and common relays.

- The design change to provide redundant nitrogen backup systems to supply Train A and Train B AFW system flow control valves introduced a potential for common mode failure in the redundant control room annunciator circuits. As discussed later in this report, the loss of these redundant annunciators could lead to a loss of AFW.

- Several problems were identified with the modification involving the replacement of the Unit 3 and Unit 4 safety-related station batteries: no calculation was available to substantiate the one hour battery discharge profile contained in the design specification; the factory acceptance test failed to adequately demonstrate the batteries could meet the design basis profile; and plant procedures and Technical Specifications surveillance requirements failed to recognize the existence of the new battery requirements required by the substitution of GNB lead-calcium batteries for the old C&D lead-acid batteries.

- The AFW system was modified to install a redundant solenoid operated steam vent valve. Design analysis does not exist to document the selection of 150 psig setpoint selection for the pressure switches that are used to control operation of the valves. The team is concerned that the 150 psig setpoint would permit the valve to open automatically before plant cooldown could be transferred to the residual heat removal system.

- The design change to install a redundant safety-related condensate storage tank low level alarm introduced a potential for an undetected common mode failure. This failure would have been caused by closing a normally open manual isolation valve. In addition, this valve was not administratively controlled. The design calculation to establish the setpoint for the low level alarm did not identify all the assumptions and design inputs used to perform the calculation. In particular, there was no evidence that the calculation considered the net positive suction head (NPSH) required to maintain AFW pump operation.

- A design analysis did not exist to document the setpoint selection (500 psig) for the AFW system nitrogen backup supply pressure switches. Engineering did not provide post-modification testing requirements, and, as a result, the nitrogen backup system was never adequately tested. The electrical and I&C equipment associated with the nitrogen system were not identified as safety-related in the Turkey Point Q-List, and as a consequence were not being treated as safety-related by the electrical and I&C maintenance technicians.

III. Detailed Inspection Findings

A. MAINTENANCE

1. A significant weakness noted in the Turkey Point maintenance program was the consistent failure to evaluate the root cause of equipment malfunctions and to trend these failures to provide input to the preventive maintenance program. The Plant Work

Order (PWO) form was used to document the performance of maintenance. A section of this form was provided to describe the cause or reason for the trouble found. A review of several hundred completed PWO forms revealed that the cause of the associated equipment failure was not described in most cases. Interviews with maintenance supervisory personnel revealed that the cause of equipment failures and the consideration of the recurrent nature of failures are tracked informally by relying upon the memory of maintenance supervisors. The equipment history records were not being kept current in the electrical and mechanical areas. Specific examples of failures to evaluate root causes of equipment failures are discussed below:

- A review of the maintenance history records, including PWOs and Licensee Event Reports (LERs) for the auxiliary feedwater (AFW) system, revealed several component failures of a recurrent nature. These included seven separate examples, since January 1984, of failure of an air-operated AFW flow control valve to properly function due to water or foreign material in the instrument air system.

- In 1983, on two separate occasions, two of the six AFW steam supply motor operated valves (MOVs) failed to open because of carbon build-up on the motor operator limit switches. A review of the maintenance records for the remaining four AFW steam supply MOVs revealed that, despite the recent failures described above, one MOV (MOV 3-1404) had not been electrically cleaned and inspected since 1979. Additional weaknesses associated with maintenance on MOVs are discussed in Maintenance Observations 2 and 3.

2. A review of the maintenance activities performed on MOVs indicated weaknesses in training for repair of these valves. Interviews with supervisory maintenance personnel revealed that no training had been conducted in either the mechanical or electrical areas covering repair of MOVs with the exception of undocumented, on-the-job training and pre-maintenance briefings. A mock-up of a Limitorque valve operator was available in the training department offices but apparently had not been used to train maintenance personnel.

3. Mechanical maintenance personnel were uncertain regarding the type of grease to be used in MOV gearboxes. This was considered a problem for two reasons. First, the mixing of different types of grease in the gearbox could cause hardening or separation of the lubricant. The potential for this exists at Turkey Point because its preventive maintenance instructions for Limitorque gearboxes specify the use of Texaco Marfac, while these same Limitorques have been supplied with either Exxon Nebula EPO or EPI or Sun 50 EP lubricants. Secondly, the only Limitorque lubricant that meets the environmental qualification requirements of 10 CFR 50.49 at Turkey Point is Exxon Nebula EPO or EPI. A program to address these concerns was in progress and scheduled for completion by December 1986. The progress of this

effort will remain an inspector followup item (50-250/8532-1; 50-251/8532-1).

4. The licensee has recently taken steps to improve MOV reliability. Temporary Operating Procedure 166 was issued in May 1985 and provide detailed instructions for troubleshooting and repair of MOVs, including limit switches, torque switches, and post-maintenance testing. This procedure provides specific torque switch settings for safety-related motor-operated valves and required that, during maintenance, proper torque switch settings be verified by an electrical quality control inspector. Discussions with management representatives revealed that the licensee was in the process of purchasing new MOV test equipment to use in improving the reliability of the MOVs.

5. A review of calibration records revealed that the low pressure alarms for the AFW nitrogen system were not routinely calibrated (see Design Changes and Modifications Observation 5.c for further discussion). A search of calibration records with the assistance of an I&C supervisor revealed that the most recent calibration records for two of the nitrogen supply low pressure alarm pressure switches (PS 2322 and PS 2323) were dated June 14, 1978. In addition, no procedure was available for the calibration of these alarms. The apparent failure to establish and implement procedures for the calibration of the AFW nitrogen system low pressure alarms was discussed with the licensee and will remain unresolved pending followup by the NRC Region II Office (50-250/8532-2; 50-251/8532-2).

   Due to this identified concern, the licensee issued PWOs 8349 and 8350 to calibrate all four nitrogen system pressure switches. These calibrations were performed on September 9, 1985.

6. The control and documentation of sampled post-maintenance testing was found to be weak. In many cases, neither the post-maintenance testing instructions nor the results of the testing were documented on the PWO. This was particularly evident for I&C and electrical maintenance activities. However, for mechanical maintenance activities, Administrative Procedure (AP) 0190.28, "Post Maintenance Test Control," was specified on the PWO in most cases. This procedure described most of the testing considered adequate by the licensee to return mechanical systems to an operable status and also provided a form to document the test results as an attachment to the PWO.

   The apparent failure to provide adequate instructions for post-maintenance testing on some PWOs appears to be contrary to AP 0190.19, "Conduct of Maintenance on Nuclear Safety Related and Fire Protection Systems," was discussed with the licensee, and will remain unresolved pending followup by the NRC Region II Office (50-250/8532-3; 50-251/8532-3).

7. A weakness was noted in the program to return instruments properly to service following maintenance or calibration while

the plant was operating. The licensee had a program for providing general assurance that instruments inside and outside the containment were properly aligned when the plant was returned to operation from an outage condition. The procedures describing the instruments to be checked, 0-SMI-059.1 and 0-SMI-059.2, were considered adequate, providing a place for first and second check verification for each applicable instrument. However, interviews with I&C supervisory personnel revealed that these procedures would normally be used only to verify instrument alignment at the end of an outage condition. Instrument line-ups were not required by the licensee to be independently verified following maintenance or calibration while the plant is in an operating status.

8. A sample of maintenance procedures indicated that many complex maintenance activities were accomplished without detailed, step-by-step procedures. Instead, these complex activities were considered to be "skill of the trade". The team considers the licensee's frequent reliance on individual skills of maintenance technicians as a substitute for detailed procedures to be unjustified in view of the limited training provided to maintenance technicians and the high turnover rate among maintenance personnel. (See Maintenance Observations 10 and 11.)

9. A backlog of approximately 900 PWOs existed in the I&C section. Included in this backlog of PWOs were a number affecting control room instruments. The team considers that any degraded condition of these instruments could hamper the operators' ability to diagnose and respond to abnormal plant conditions. Examples of instruments that fit into this category were:

   - Unit 3 Steam Jet Air Ejector (SJAE) Process Monitor had been out-of-service (OOS) since February 13, 1985, and the Unit 4 SJAE Process Monitor Cabinet had been pulled from the control room for maintenance for approximately 6 months. The SJAE Process Monitors are used to monitor radioactivity in the steam exhausted to the main condenser and are an important diagnostic tool for identifying a primary-to-secondary leak. At the time of the inspection, the SJAE exhaust gas radioactivity was being recorded by a backup (SPING) system that had no control room indications or alarms. The readout of the SPING system was checked by the chemistry department every 8 hours.

   - The Unit 4 Containment Sump High Level Annunciator had been OOS since December 6, 1984. The cause was determined to be an inoperable level switch, LS-1538.

   - The containment sump pump handswitches (labelled "Off-Auto-Run") were in the "Off" position for both units. This was done because the pumps would not cut off automatically when sump level was pumped down if the switches were left in "Auto" as designed.

- Two of the four accident monitors for Unit 4 containment sump level indication, which are used to determine the level during a Loss-of-Coolant Accident (LOCA), had been OOS since February 7, 1985.

- The Hi/Low Pressure Annunciator and Hi/Low Level Annunciator for one of three Unit 3 Safety Injection Accumulators were in an alarmed condition.

- Area Radiation Monitors on both units had many PWO tags which had been in place for extended periods. Some of these monitors were in degraded conditions for greater than 6 months. This reduced the operators' ability to diagnose abnormal plant conditions and also increased the possibility of personnel exposure.

- The AFW nitrogen supply station number 2 low pressure annunciators were alarmed on both units. These annunciators were used to indicate low nitrogen supply to the AFW differential pressure transmitters, which had been disconnected since January 1985. Further, these annunciators were located beside the AFW nitrogen system station 1 and station 4 low pressure annunciators, and therefore could potentially degrade the control room operators' ability to distinguish a valid low nitrogen supply pressure condition (see Operations and Surveillance Observation 1.a and 1.b for further discussion).

10. Interviews with maintenance supervisors and training personnel indicated that formal classroom training sessions for maintenance technicians had been discontinued in August 1984. Licensee management stated that maintenance training had been discontinued to dedicate training resources to developing training materials required to support Institute of Nuclear Power Operations (INPO) accreditation of the maintenance training program. The licensee stated that this decision was necessary in order to meet the INPO accreditation Self Evaluation Report submittal date of February 1986.

    Additionally, a review of maintenance training records indicated that a very limited amount of on-the-job (OJT) training and vendor supplied training had been conducted since the decision to discontinue classroom training.

    The team concluded that maintenance training being conducted did not appear adequate to maintain staff proficiency and to train new personnel, particularly in view of the high turnover rates experienced by the maintenance staff (see Maintenance Observation 11 of this section).

11. Review of training records and interviews with training and maintenance supervisors raised the following concerns:

    - Over half of the I&C technicians that conduct surveillance tests (15 of 27 at the time of the inspection) had an average of less than 6.5 months of experience at Turkey Point. The electrical and mechanical maintenance groups had also recently experienced high turnover rates among their technicians, but not to the degree of the I&C group.

- The licensee's management controls for safety-related maintenance work assignments were considered weak. Maintenance supervisors relied on their knowledge of each technician's abilities and experience for work assignments. OJT records or other forms of qualification documentation were not used to assure that only properly qualified personnel were assigned safety-related maintenance activities.

B. Operations and Surveillance

1. The procedures for normal and emergency operation of the auxiliary feedwater system were evaluated as weak, with numerous instances of incorrect information that could result in degraded AFW system operation. For example:

   a. Procedure 0208.11, "Off-Normal Operating Procedure," stated that in the event of a low nitrogen pressure annunciator alarm the standby nitrogen bottle should be valved in. However, in the case of the train 1 nitrogen system, the procedure states that if all three available nitrogen bottles are valved in, the operators were to ignore the alarm. To ignore the annunciator alarm in that instance could quickly lead to a loss of sufficient nitrogen pressure to operate the train 1 AFW flow. The licensee informed the team that this procedural inadequacy would be corrected on a priority basis. This item will remain an inspector followup item pending confirmation of the licensee's corrective actions (50-250/8532-4; 50-251/-8532-4). Additionally, this procedure did not alert the operator to the fact that very limited time might be available to take corrective action, nor did the procedure advise the operators to conserve nitrogen pressure by shifting AFW flow control valve operation from automatic to manual.

   b. The team determined that confusing and incorrect information was available to control room operators regarding the capacity of the AFW nitrogen backup system. Procedure 7300.2, "AFW System Flow Control Valves Instrument Air/Nitrogen Backup System Operation," states the operators have 15 minutes to valve in standby nitrogen bottles after the low nitrogen pressure annunciator alarms. However, licensed operators were trained in their ongoing requalification training program that they have 20 minutes to take action (reference: Training Brief #9, dated March 1, 1984). The AFW system description and design basis states that only 10 minutes are available for the operators to take action. At the request of the NRC, the licensee performed a functional test of the nitrogen backup system during this inspection period. The test results indicated that, in fact, operators had as little as six minutes (with the flow control valves in auto) to take action to avoid the loss of AFW due to a loss of nitrogen pressure.

Because of the inadequate operator training and incorrect procedural information available, the team lacked assurance that appropriate operator action would be taken in the event of a low nitrogen pressure annunciator alarm following a loss of instrument air.

c. Emergency operating procedures did not provide adequate guidance to control room operators to assure that adequate AFW flow (286 gpm) would be provided to each unit within 3 minutes, as required by the AFW design basis, in the event of a two-unit trip with only one AFW pump available. EOP 20004, "Loss of Offsite Power," and EOP 20007, "Total Loss of AC," made no mention of the need for timely operator action to balance flow between the units in this instance.

d. EOP 20003 (E-3), "Steam Generator Tube Rupture," dated December 20, 1984, provided incorrect information to the control room operators regarding how to isolate the steam supply to the AFW turbines from the affected steam generator. Specifically, EOP 20003 directed the control room operators to isolate the steam supply from the affected steam generator by shutting the associated motor-operated isolation valve using the handswitch in the control room. However, the inspection team determined that these AFW isolation valves could not be remotely shut from the control room if there was an AFW actuation signal present (see Design Changes and Modifications Observation 5.c for further details). The licensee had not recognized this design feature and therefore had not provided operator training or procedures to ensure that alternate methods were available to isolate the AFW steam supply from the affected steam generator in the event of a tube rupture.

   The licensee stated that the affected EOPs would be corrected on a priority basis. Further, the licensee provided training to all on-coming control room operators regarding this matter. This item will remain an inspector followup item (50-250/8532-5; 50-251/8532-5).

2. During a system walkdown of the auxiliary feedwater supply and the auxiliary feedwater steam systems, as described in piping and instrument drawings 5610-T-E-4062, Rev. 33, and 5610-T-E-4061, Rev. 6, the following observations were noted:

   - turbine casing and exhaust silencer drain valves 328, 329, 331 and 332 were missing their associated handwheels;

   - local pressure instruments (PI) 1416, 1417, and 1418 had an additional isolation valve not shown on the drawing;

- feed flow transmitter 3-1401B was marked 4-1401B and one isolation valve, 3-002, was not tagged; feed flow transmitter 3-1457B had an isolation valve, 3-003, not tagged;

- the following valves had no identification tags: 3-012, RV-6401A, AFWU-010, 70-102, AFWU-011, 70-103, AFWU-012, 70-104, and isolation valves on PI-1430, PI-1431;

- a flexible hose was supplied from the backup service water system through Aeroquip quick disconnect fittings to supply backup AFW pump cooling water. Debris was noted in the hose for the "A" pump. There was no control for either the male or female fittings;

- all the valves for nitrogen station No. 4 were mislabelled as station No. 1 valves;

- three nitrogen bottles in each nitrogen station (No. 1 and No. 4) had "empty" tags on them. When questioned by the inspector, the licensee determined that the bottles were, in fact, full;

- the licensee had not established contingency measures to ensure that replacement nitrogen bottles could be made available on backshifts. This issue was significant because only about 3 hours of nitrogen is available at the nitrogen stations, so several replacement nitrogen bottles would be required to operate the AFW system long enough to cool down the units to allow for residual heat removal operation. The AFW system walkdown revealed that replacement nitrogen bottles were not readily available.

3. A review of "Auxiliary Feedwater Train 1 Operability Verification," Procedure 3-OSP-075.1, dated August 7, 1985, identified that it did not adequately verify the operability of AFW steam supply MOVs 3-1404 and 3-1405. Limit switches located in these valves are used to control associated flow control valves in the feedwater lines. When either of the MOVs opens, all flow control valves in trains 1 and 2 open to assure a feedwater flow path. However, procedure 3-OSP-075.1 required opening both of these steam supply valves together. Therefore, each of the MOVs was not independently verified capable of opening all the flow control valves as designed.

4. The team considers local control of train 2 AFW valves to be virtually impossible. Off-Normal Operating Procedure 0208.17, "Control Room Inaccessibility," dated May 24, 1985, would be used to take local feedwater control in the event of a control room evacuation. This procedure has no guidance for local control of train 2 AFW valves. Additionally, it appeared that operation of this train would be difficult because the valves are located under the feedwater platforms and all indications for train 2 are located on the platform area.

The team's concern regarding the ability of the licensee to safely shut down the plant in the event of control room inaccessibility was reinforced by the observation that the licensed operator requalification program did not include drills or plant walkthroughs to simulate local control of essential safety systems. This is considered a weakness at Turkey Point for two reasons. First, Turkey Point does not have a safe shutdown panel outside the control room that would provide a central location for essential instrumentation and control. Second, less than a quarter of the licensed control room operators had previously been a watchstander outside the control room; therefore, the majority were not as familiar with local equipment operation.

5. The team noted the following concerns with the condition of the auxiliary feed pump turbines and their associated steam supply system.

   a. During a system walkdown, the drain lines on the turbine casings and the exhaust silencers were noted to be hot. Water was flowing from the drains on the A and C turbines. The steam supply isolation valves for the A and C turbines were leaking and allowing steam to reach the turbines even though the valves were closed (MOV-3-1404, MOV-3-1405). A review of the valves' maintenance history revealed that these valves had been reworked several times. However, it did not appear that the problem had been resolved. The associated steam supply valves on Unit 4 also appeared to be leaking. It should be noted that the B turbine did not appear to have any leakage from its steam supply valves (MOV-3-1403 and MOV-4-1403). During this inspection period, no current PWOs were noted on the leaking steam supply valves.

   b. The steam supply vent system did not appear to be functioning properly in that the vent valves were open but only a small amount of steam was being vented. Further, a substantial amount of steam appeared to be reaching the AFW turbines based on the condensate flow from the casing and silencer drains and the elevated temperature of the exhaust stack. The team identified that one of the vent valves on Unit 3 was failed shut on September 11, 1985. The licensee promptly corrected this problem.

6. It was noted during walkdowns of the auxiliary feedwater system that the seismic qualification of portions of the system was not being properly maintained. The following observations were noted: control air lines going to CV-3-2816 were attached to their tubing tray but the tray was not attached to the floor for several feet; nitrogen instrument lines were noted to go underground to transit from one location to another; and nitrogen bottles stored at nitrogen station No. 1 were not adequately restrained.

It was noted also that temporary scaffolding was in place above all four instrument racks for Unit 3 and 4 auxiliary feedwater flow transmitters. In addition, a leg of one of these scaffolds was installed adjacent to the Unit 3 train 2 auxiliary feedwater instrument rack right between two of the flow transmitters. The failure of non-seismic components (scaffolding) could cause the failure of safety-related AFW components with the resultant common mode failure of all auxiliary feedwater flow to both units.

This item will remain unresolved pending followup by the Region II Office (50-250/8532-6; 50-251/8532-6).

7. Procedure 4-OSP-075.3, "AFW Nitrogen Backup System Operability Verification," was reviewed by the team. This procedure did not appear adequate to functionally test the nitrogen backup system as it only tested the operability of the system during static conditions. The test did not demonstrate that the nitrogen backup system would function properly in its design basis mode of supplying the AFW flow control valves with the valves in automatic.

8. The differential pressure transmitters on the discharge of each AFW pump were disconnected in January 1985 in accordance with Procedure 0103.3, "Control and Use of Temporary System Alterations." This procedure required that a 10 CFR 50.59 safety evaluation be written and the alteration be reviewed and approved by the Plant Nuclear Safety Committee (PNSC). The Temporary System Alteration for disconnecting these differential pressure transmitters included neither a 10 CFR 50.59 safety evaluation nor PNSC approval. This item will remain unresolved pending followup by the Region II Office (50-250/8532-7; 50-251/8532-7).

C. Design Changes and Modifications

1. Plant Change/Modification (PC/M) 80-77 was reviewed by the team. This modification package installed redundant instrument strings to provide safety related condensate storage tank level indication and an alarm 20 minutes prior to needing another source of water for the auxiliary feedwater pumps. The team determined that the implementation of this design change failed to ensure that it met the single failure criteria.

   Specifically, an operator error to close one manual isolation valve (isolation valve 428) could have caused an undetected common mode failure of safety-related condensate storage tank level indication and alarm functions. The level transmitters for redundant level indication are connected to a common instrument tap from the condensate storage tank. The common instrument tap has a normally open isolation valve which could be mistakenly closed by an operator causing common mode failure of the level instruments. No valve position indication was provided to alert the operator of incorrect valve position and no administrative controls (such as locking the valve open) were applied to ensure that the valve remained open.

As a result of the inspection concern, the licensee checked open isolation valve 428 and installed a locking device. Revision of appropriate valve lineup sheets and plant drawings will also be required. This item will remain an inspector followup item (50-250/8532-8; 50-251/8532-8).

2. PC/M 80-117 was reviewed. This modification added redundant steam supplies to the auxiliary feedwater turbines. The modification also replaced the auxiliary feedwater flow control valves. Upon auxiliary feedwater initiation, six pneumatic flow control valves per unit are automatically opened and controlled to supply 125 gpm through each valve. The three auxiliary feedwater pumps are aligned in a two train arrangement with turbine pumps A and C assigned to train 1 and turbine pump B to train 2. Three flow control valves are assigned to each train to provide auxiliary feedwater flow to each of three steam generators. Flow transmitters immediately downstream of the flow control valves monitor feedwater flow and provide feedback to I/P converters to alter control air pressure to flow control valve positioners. Upon loss of instrument air these valves are designed to fail shut. To prevent this from occurring the flow control valves are provided with a safety-related source of bottled nitrogen to restore the sources of motive and control power for the flow control valves.

   PC/M 80-117 also added six new flow control valves (three valves per unit) and replaced the actuators on the six installed valves (three actuators per unit). To accommodate redundancy in the nitrogen system, the existing nitrogen cylinders (five cylinders per unit) were divided into two trains per unit. This division resulted in assigning three nitrogen cylinders to train 1 and two cylinders to train 2. In each train, only one cylinder was valved on-line. During the team's review of PC/M 80-117, the design of the nitrogen system was examined. The following observations were made during the review of the modification package.

   a. The implementation of the design control process for this modification did not produce a documented analysis substantiating the design adequacy of the nitrogen system. The team found that a design analysis was not performed by Bechtel to confirm that the design change was acceptable. The team was informed that Bechtel reviewed the original design analysis and confirmed that the new design was bounded by that calculation in lieu of a new design analysis. No evidence existed documenting this engineering judgment. The team was informed that the existing calculation was considered bounding because the new components had a lower nitrogen consumption rate. The original design analysis was performed in 1972 and had consumption rates for components which existed in the original control scheme and which were subsequently replaced with new components by

PC/M 80-117. The calculation had no indication of a check or verification. Likewise, the sources and nature of the consumption rates were not identified. During the inspection, Bechtel could not determine if the values in the 1972 calculation represented steady-state conditions or consumption rates reflecting some assumption for valve modulation and component leakages. Bechtel cited information from a vendor technical manual which indicated that the-new valve actuators have a lower steady-state air usage value of 0.26 scfm per valve, rather than the 1.0 scfm per valve used in the existing calculation. The valve actuators are diaphragm actuators with a balance positioner constantly exhausting air through a detecting nozzle. Bechtel pointed out that only three actuators are being supplied by the one nitrogen cylinder on line instead of six per the original design. Thus, Bechtel concluded that the original design analysis bounded the new design. By inspection, the team could not arrive at the same conclusion for the following reasons:

° The team determined that the steady-state air usage value of 0.26 scfm was based upon a vendor test of a similar, but not identical valve positioner. The vendor test was conducted with an air supply pressure of 60 psi instead of the minimum nitrogen supply pressure of 80 psi furnished by the installed nitrogen system regulators at Turkey Point. As a consequence, the steady-state air usage value can be expected to increase. During the inspection, Bechtel indicated that a linear extrapolation was a reasonable assumption. Therefore, the steady-state consumption rate approaches 0.36 scfm (i.e., increased by a factor of 80 psi/60 psi).

° The assumption of instantaneous steady-state operations does not appear to be consistent with the as-designed valve response (i.e., upon actuation the valve cycles full open and then closes towards the 125 gpm flow setpoint). The vendor's technical literature indicates that high operating speed is achieved with virtually no overshoot when approaching the final plug position. Although a designer might choose to assume a leak tight system with periodic testing to confirm this assumption, it appears unreasonable to conclude that no valve modulation is required and that a steady-state condition is reached immediately. The team was informed that the operators typically take the flow control valves out of automatic control and place them in remote manual control immediately after an auxiliary feedwater flow to maintain steam generator level. The team was informed that this operator action results in elimination of control valve modulation except for the initial valve cycle. However, the team determined that the operators were not required by procedure to take remote manual control nor were the operators directed to do so by existing management guidelines or training. Consequently, the team concluded that the licensee's assumption that operators would immediately take remote manual control of the flow control valves (and thereby reduce the valves' air usage rate) was unjustified. In addition, the team found no periodic testing performed on the nitrogen system to confirm its leak tightness and instead observed a system with significant leakage rates.

- The minimum available volume of nitrogen is higher in the original design analysis than prescribed in the system design description. Specifically, the original design calculation uses a minimum volume based upon 1005 psig in the cylinder, and the system description indicates a minimum volume based upon 500 psig. This reduction can, in part, be explained by the reduction in the assumed time the operator has available to valve in a new nitrogen cylinder. The original analysis was performed with a design basis of operator action within 15 minutes of receiving a low nitrogen pressure alarm, whereas, the current system description specifies 10 minutes. This time reduction does not appear to be based on a documented analysis of the actions required of the operator to recognize the alarm, analyze the appropriate response, send another plant operator to the nitrogen cylinder and valve in a second nitrogen cylinder. (See Operations and Surveillance Observation 1 for further discussion.)

- The original nitrogen system design bases included a requirement that the stored volume of nitrogen be able to permit system operation for 2 hours assuming that all five nitrogen cylinders were full. A similar requirement for the current system does not appear to be addressed. This does not appear to be consistent with the licensee's commitment to have at least one AFW system pump and its associated flow path and essential instrumentation capable of being operated independent of any AC power source for at least two hours (SER related to Amendment No. 75 to operating license No. DPR-31 and Amendment No. 69 to facility operating license No. DPR-41).

b. The team found that a design analysis did not exist to document the setpoint selection for pressure switches used to alert the operator via control room annunciation that ten minutes of nitrogen remained before loss of motive and control power to the AFW flow control valves. Instead the team was informed that the setpoint reduction from 1005 psig to 500 psig for the pressure switches was established by testing performed under Temporary Procedure 085 on March 1, 1984. This test appeared to have been performed prior to the splitting of nitrogen system into two redundant trains but after addition of the new flow control valves and actuators. The test was performed with one nitrogen control cylinder supplying all six flow control valves with the valves in a full open position. Placing the valves in a full open position causes the air usage to be in a steady-state condition. Because the nitrogen pressure decayed the last 500 psig in 15 minutes, the low-pressure alarm was set at 500 psig. This setpoint was selected based upon a steady-state test without consideration of instrument error and without compensation for that pressure at which the flow control valve can no longer modulate (approximately 30 psig per manufacturer information). The issue is safety significant because incorrect setpoint selection could result in the premature loss of nitrogen pressure and closure of all auxiliary flow control valves.

c. The design verification process failed to ensure that appropriate quality assurance requirements were specified for nitrogen system components. Electrical and I&C equipment associated with the nitrogen system were not identified as safety-related in FP&L's Q-List. As a consequence, the pressure switches used to alert the control room operator of low nitrogen pressure and the need for immediate operator action were not being treated as safety-related by the site I&C group.

The AFW system design description identifies the AFW system as an emergency safeguards system to prevent core damage in the event of transients such as a loss of normal feedwater or a main steam line break. The nitrogen system is essential to operation of the auxiliary feedwater flow control valves and, as such, the nitrogen system serves a safety-related function. FP&L Quality Instruction JPE-QI-2.3A, "Classification Of Structures, Systems and Components," indicated that the mechanical equipment but not the electrical and instrumentation and control equipment associated with the nitrogen system were safety-related. The team was informed that a more detailed component level Q-List was being developed and that this list indicated the pressure switches were safety-related; however, this list had not been issued from engineering at the time of the inspection, and the I&C group was unaware that the safety classification for the pressure switches had changed.

It appears that, contrary to the requirements of ANSI N45.2.11 Section 6.3, the design verification process for the Q-List and the design modification did not ensure that equipment performing a safety-related function were designed, specified, and maintained commensurate with that function. This item will remain unresolved pending followup by the Region II Office (50-250/8532-9; 50-251/8532-9).

d. Implementation of the design change process for this modification did not produce a design analyses to confirm that non-safety components of a system do not adversely affect the safety function of the system. Although not identified in the system design description and design bases document for the auxiliary system, steam vent valves were provided to vent steam when the system is not operating. The valves are signaled to close on increasing steam pressure (increasing steam pressure indicates that auxiliary feedwater system has initiated) and to open upon decreasing pressure to vent the steam lines between the steam admission valves and the auxiliary feedwater pump turbines. The steam vent valves are outside of the seismic boundary and are treated as non-safety-related. In reviewing PC/M 80-117 this design feature was examined and the following observations were made.

- Design analysis does not exist to document the consequence of a failure of the vent valves to shut and the ability of the auxiliary feedwater pump to supply sufficient feedwater flow at reduced steam generator pressures to reach the point of Residual Heat Removal System operation.

- Design analysis does not exist to document the setpoint selection for pressure switches and the error band used to control the operation of solenoid-operated steam vent valves. The setpoint was verified to be at 150 psig which would permit the valve to open automatically before the cooldown has been transferred to the Residual Heat Removal System.

The lack of a design analysis in the cases cited above in subparagraphs a, b, and c appears to be contrary to the requirements of ANSI N45.2.11 Sections 4.1 and 4.2 which requires that design analyses be performed in a planned, controlled and correct manner and that there exist traceability from design input through to design output. This item will remain unresolved pending followup by the Region II Office (50-250/8532-10; 50-251/8532-10).

3. During the review of PC/M 80-117, the team observed nitrogen system tubing which did not appear to be seismically supported and instances of broken supports. This tubing was routed from the nitrogen cylinder racks to the flow control valves and included original tubing as well as new tubing. The team was informed that this lack of adequate seismic supports was known by the licensee as documented in REA No. TPN 85-30. In a March 7, 1985 letter, the licensee directed Bechtel to walk down the system in the field and determine if the tubing was actually supported in accordance with Bechtel's design specification for seismic Class I tubing supports or in accordance with the original seismic design specification. On July 19, 1985, in response to this request, Bechtel reported that most of the 3/8-inch tubing was installed in accordance with Bechtel

specifications but with two tube spans greater than that allowed. These deviations were evaluated and found to be acceptable as installed. With respect to the old tubing in the rest of the system, Bechtel identified that the configuration was different than originally accepted by Project Engineering. Bechtel evaluated the configuration using the functionality criteria developed to justify continued operation in response to IE Bulletin 79-014. The Bechtel analysis determined that the tubing must be supported at 27 inch maximum intervals-to meet final design requirements for long term operation. The licensee informed the team that correction of this nonconforming condition will be performed during the next refueling outage. This item will remain an inspector followup item (50-250/8532-11; 50-251/8532-11).

4. The team found that design calculations were not being updated by FP&L to reflect current modifications. The team was informed that design inputs were maintained so that, if required, the calculations could be recreated. The team found that design criteria documents did not exist and that design bases were, in many instances, difficult to retrieve. This condition was further complicated by the controls Bechtel maintains over calculations performed by Bechtel. The team found that Bechtel had a set of original project design calculations which were used for reference purposes but not updated. For current design activities, Bechtel maintained design calculations and updated those calculations as plant modifications were assigned to their design responsibility by FP&L. As a consequence, it was difficult for a Bechtel or FP&L engineer to know where applicable design analyses were to be found. Further, the team observed a lack of attention to documenting assumptions, justification for their use, and confirmation that the assumptions were accurate after the design had proceeded. Likewise, the team found that the source of input data was not consistently design documents but the FSAR or uncontrolled Plant Data Books.

   During the inspection the team observed errors in design documents (e.g., calculations, drawing and specifications) which do not represent, in themselves, inadequate designs but reflect a need for more attention to design traceability. For example:

   a. Bechtel calculation (M-08-093-02, Auxiliary Feedwater System Control Valve Sizing, Rev. 1, July 31, 1981) did not identify the source of assumptions and input data such as main steam safety valve setpoints, relief valve accumulation, auxiliary feedwater pump flow, and pump discharge pressure. The calculation made a general reference to FP&L's Turkey Point Unit 3 and 4 Plant Data Book, Volume 1. Although this document is not a design document, it appears that it was used as a source document for design input.

   b. Bechtel drawing 5610-P-151, Piping Isometric Auxiliary Feedwater System Pump Discharge, Rev. 0, November 1, 1981, had incorrect valve weights shown for AFW valves CV-3-2818, CV-3-2816, and CV-2-2817. The team confirmed that the valve weights identified on the vendor valve drawing were on Bechtel Drawing 5177-162-P-325, Rev. 1, dated May 16, 1983, and that these weights were used in the piping stress analysis. During the inspection, FP&L initiated an External Request for As-Built Verification and Document Review to correct the identified discrepancies in the Bechtel isometric drawings.

c. Bechtel calculation M-08-093-03, Auxiliary Feedwater Flow At Minimum Steam Conditions, Rev. 0, May 4, 1982, references FP&L Plant Data Book, Sections 5.6 and 5.7, for pump performance ratings. As stated above (subparagraph a), the Plant Data Book is an uncontrolled document and is not considered a suitable source for design input.

d. FP&L Calculation, Low Level Alarm on Condensate Storage Tank, November 15, 1979, does not identify all of the assumptions and design inputs used to perform the calculation. The calculation was performed to establish the alarm setpoint alerting the operator in the control room of the need to provide makeup water or transfer to an alternate water supply in order to prevent a low pump suction pressure condition from occurring. The team found no evidence in the calculation that the preparer considered the NPSH required to maintain AFW pump operation. Instead, the preparer appeared to have assumed that the minimum NPSH would be below the instrument tap, because the analysis calculated the height above the instrument tap which corresponds to 20 minutes of water at a usage rate of 600 gpm with a 10% factor for conservatism. The team independently confirmed that the NPSH is well below the instrument tap and the design is not deficient. However, the calculation did not document assumptions nor identified those assumptions that required verification as the design proceeded. The calculation did not define the design bases and their sources. FP&L procedures in place at the time this calculation was performed required a design analysis to contain this information (Quality Instruction EPP-QI-3.1, "Control of EPP Design," Rev. 2, October 9, 1979).

e. Bechtel Drawing 5610-M-339 Sheet 1 of 1, Rev. 15, incorrectly shows that the nitrogen system pressure control valves PC-3-1706, PC-3-1708, PC-4-1705, and PC-4-1709 were set to provide 55 psig. These pressure control valves were set for 80 psig.

f. The AFW System Description and Design Bases document dated January 31, 1985 had the following errors.

- The system description stated that an air signal is supplied by a differential pressure controller which is set to maintain a minimum pump discharge pressure approximately 125 psi higher than the steam supply pressure. As observed during the inspection, this design feature had been disconnected (see Operations and Surveillance Observation 8).

- The system description incorrectly stated that when instrument air pressure drops below 55 psig (nitrogen regulator valve outlet pressure), check valves open to automatically supply backup nitrogen. As stated previously, the pressure control valves were set at 80 psig.

- The system description incorrectly stated that the low pressure nitrogen alarm will allow about 10 minutes for the operator to get to the station, close off the first bottle and cut in bottles 2, 3, and 4, which will each provide about a 30 minute supply to the flow control valves. This description appeared to refer to the intended operation of the nitrogen station before the station was divided into two trains with three bottles in train 1 and two bottles in train 2. The described action would violate the single failure criterion.

5. PC/M Numbers 80-78 and 80-79 were reviewed. These PC/Ms addressed the diversity of the power supplies to the steam admission valves of the auxiliary feedwater system. The steam supply for the auxiliary feedwater pump turbines is developed in the steam generators and fed to the station common auxiliary feedwater turbine pumps through six steam lines associated with the six steam generators (three steam generators per unit). Each steam generator is isolated from the steam header with a normally closed motor-operated gate valve. These valves are powered from a safety-related power supply (two motor-operators per unit are DC powered and one is AC powered) and will automatically open upon an auxiliary feedwater initiation signal. Downstream of these steam admission valves, steam vents are provided to vent off steam that may leak past the isolation valves. The following observations were made during the review of the modification package:

   a. The modification of the motor-operators on the steam supply valves involved the purchase of new DC motor starters. These motor starters were specified and purchased by material requisition No. 5177-B6-E-818-4. These starters were to be supplied complete with motor overload heaters compatible with Limitorque operators. The team reviewed the motor starter vendor's drawings to determine the overload heater size supplied and to verify that the type of overload heater installed agreed with the drawing.

      In response to a team request for criteria and the calculation used to determine the size of the motor overload heater needed to protect the steam supply valve motors, the licensee produced a preliminary calculation, No. 5177-462-E-02, prepared on September 6, 1985 (i.e., prepared during the inspection), to demonstrate that the as-installed motor overload protection would not trip the valve motor for continuous currents below 9.19 amperes. From inspection of the motor nameplate data, the team determined that these DC motors are 5 minute duty rated motors and the full load current is 6.5 amperes. This results in a trip point 140 percent of full load-current. The team independently determined that the setting of the overload devices provided inadequate overload or stall protection for the motor-operators. The team also confirmed this conclusion with the motor-operator vendor's engineering department.

The team's concern was that the motor insulation could be damaged during normal plant operations or periodic testing because of inadequate overload protection. This could result in the inability of the DC motor-operated valves to perform their safety function during a design basis event.

In an attempt to determine the generic implications of this issue, the team requested the Bechtel criteria used to determine the overload protection for the existing AC motor-operated valve on the third steam supply line. No basis for selection of the overload protection on these motor-operated valves at Turkey Point was provided during the inspection.

The failure of the design organization to verify the adequacy of the overload protection specified for the DC motor-operated valves is contrary to ANSI N45.2.11-1974 Section 6.3 which requires that specified parts and equipment be suitable for the required application. This item will remain unresolved pending following by the Region II Office (50-250/8532-12 ; 50-251/8532-12).

b. Implementation of the design change process failed to verify that the design change did not violate the original design function.

The proposed cable routing for motor cable 4D0128Q from motor starter 3N1403 to steam valve MOV-3-1403, as shown in the cable and raceway schedule, was 78 feet of 5 conductor AWG No. 12 wire. The team requested the sizing criteria and supporting calculations that would indicate that the conductor size was sufficient. During the second week of the inspection the licensee produced a calculation, dated September 10, 1985, with no calculation number or file identification. The calculation was prepared during the inspection and appears to have been performed in response to the team's concerns about the adequacy of the wire size. No earlier calculation could be located at Bechtel's offices either on site or in Gaithersburg, Maryland. The calculation used as-installed cable lengths obtained from Bechtel's 5177-E-45C Electrical Circuit Schedule and motor data from the Limitorque data sheet. Although this motor data did not agree with the motor nameplate full load current, its application in this calculation was judged to be conservative by the team. The calculation demonstrated that the cable's ampacity and short circuit withstand capability were adequate. However, the calculation stated that the cable resistance was sufficiently low so that the voltage drop was not a concern because voltage at the worst case valve (MOV-4-1403) would remain above 96 volts DC. The team questioned this conclusion because Bechtel had failed to consider starting current.

The team contacted the actuator manufacturer directly and confirmed that starting current and the resulting voltage drop to the motor must be considered because the valve was tested with only 90 volts DC as the minimum starting voltage. To assess the effect of starting current, the team substituted the published 53 amperes locked rotor current obtained from the Limitorque data sheet for the 8 Amperes full load current used in the Bechtel calculation. The team determined that the voltage would be less than the required minimum starting voltage of 90 volts for MOV-4-1403.

The team is concerned that during a loss of offsite power and the resulting DC system voltage drop, inadequate voltage would be available at the motor terminals resulting in a stall condition and a failure of the DC motor-operated valves to perform their safety function.

The failure to adequately understand the requirements of the original design and to confirm that those requirements were met with the new design is contrary to ANSI N45.2.11 Section 6.3 and 8.2. This item will remain unresolved pending followup by the Region II Office (50-250/8532-13; 50-251/8532-13).

c. The control circuit schematic for the DC and AC motor-operated steam isolation valves shows that the control switch used in the circuit is a momentary open/closed return to normal control switch. As a consequence, this switch will not stop the valve from automatically reopening following an operator's attempt to shut the valve as long as an auxiliary feedwater initiation signal is present. The licensee had not recognized this design feature (see Operations and Surveillance Observation 1.d for further discussion).

d. PC/M 80-117 added a second steam vent valve between the steam admission valves and the auxiliary feedwater pump turbines. The original header design contained an air-operated, DC solenoid controlled steam vent valve whose purpose was to vent steam that may leak by the normally closed steam admission valves. The vent valve is normally open and closes when the DC solenoid is energized through a pressure interlock. When the steam supply header was separated into two headers, an additional vent valve was added. The solenoid for this new valve must be energized to close the valve; however, the valve was powered from an AC source. The team is concerned that on a loss of AC power the open vent on the train 2 steam header will result in a path for steam loss.

6. The design of the nitrogen system failed to provide the required separation in the low nitrogen pressure alarm circuit. Alarms are provided on the redundant nitrogen system to warn the operator that he must take action to maintain the nitrogen system's ability to position the auxiliary feedwater flow control valves. The team determined that the low pressure signals from pressure switches PS-3-2322 (nitrogen train No. 1) and PS-3-2323 (nitrogen train No. 2) feed adjacent control room annunciator windows. Associated pressure switch contacts must close to alarm. The team determined that the two signals share a common field wire (cable 3R38/3C05-TB3414/1 is a 3 conductor cable with wire AN38 common to both alarm circuits).

   The team is concerned that a single failure, such as a loose or disconnected wire could result in the common mode failure of all low pressure alarms for the redundant nitrogen system. Further, this design appears to be contrary to the redundancy and separation requirements of ANSI N45.2.11, Section 3.2. This item will remain unresolved pending followup by the Region II Office (50-250/8532-14; 50-251/8532-14).

7. The team reviewed PC/M 83-05 concerning replacement of the safety-related station batteries. The auxiliary feedwater system uses direct current motor-operated valves and control systems whose power is derived from the station batteries. Turkey Point Units 3 and 4 share safety-related batteries such that the DC power for some of the Unit 3 auxiliary feedwater components is derived from the Unit 4 batteries. The converse is true for Unit 4 auxiliary feedwater components. The following observations were made during the review of this modification package.

   a. The safety-related battery system which existed before PC/M 83-05 consisted of four batteries, two per unit. Unit 3 had one C&D battery rated at 1885 ampere-hours and an EXIDE battery rated at 648 ampere-hours. Unit 4 had one C&D battery rated at 2175 ampere-hours and an EXIDE battery rated at 648 ampere hours. With PC/M 83-05, the 1885 ampere-hour and 2175 ampere-hour C&D batteries were replaced with smaller Gould-GNB 1800 ampere-hour cells. The 648 ampere-hour EXIDE batteries were replaced with larger Gould-GNB 1200 ampere-hour cells. These new batteries were purchased using Bechtel specification 5177-272-E-850.1, Rev. 0, dated January 18, 1983. This document contained a one-hour battery load profile and required corrections for a minimum electrolyte temperature of 55° F and an 80 percent end-of-life compensation in accordance with IEEE Standard 485. This specified load profile did not agree with that given in FSAR Table 8.2.4. The team noted that the DC loads listed in this table did not include the auxiliary feedwater DC motor-operated valves. In an attempt to determine if all DC loads were accounted for in the sizing of the new replacement batteries, the team requested the battery sizing calculations.

The licensee was unable to produce an analysis of calculation which was used to develop the load profile used in the procurement specification. However, the licensee did exhibit a DC system capability study, calculation 5177-399-E-01, which was performed by Bechtel during the first half of 1985. The purpose of this study was to determine the capability of the DC system to respond to the unavailability of selected batteries under different operating conditions. In case I of this study, each battery was checked with its own emergency loads. This calculation did include loads for the auxiliary feedwater DC motor-operated valves; however, it assumed data based upon a preliminary 1980 calculation and not on manufacturer's data or the equipment nameplate data. This calculation included inappropriate assumptions for the steady-state load by basing this load on battery charger readings under normal operating plant conditions. The calculation did not identify these as assumptions requiring verification. This calculation also did not include design margin correction factors for temperature or inadequate maintenance as required by IEEE Standard 485.

b. The design modification process failed to include adequate acceptance criteria and verification testing for the new batteries. The purchasing documents specified required testing by the battery manufacturer. Gould-GNB performed a standard eight hour capacity test which showed that the batteries would deliver at least their eight hour rated capacity. This test stopped short of determining any margin above rating (Inspection Report 83779 dated May 5, 1983). The manufacturer also performed a load duty cycle test on selected cells in accordance with the specified load profile but failed to correct the discharge rates for the specified minimum temperature condition. The post-modification testing performed on the Unit 3 B battery (Plant Work Order 358353) tested the new battery using the FSAR half hour profile, not the one hour duty cycle of the specification. Again, no temperature correction was made to the discharge rate as indicated on the July 12, 1985 data sheets.

Because of the lack of an acceptable load analysis combined with inadequate testing, the team was unable to determine the degree of margin existing in the new batteries.

c. The plant operating procedures for the DC System failed to reference the specific periodic testing requirements for the new Gould-GNB batteries. Plant Operating Procedure 96041.1, dated June 19, 1985, specified the requirements for the monthly equalizing charge. However, the new Gould-GNB batteries are composed of lead calcium cells, and this type of battery cell should not be given monthly equalizing charges. Instead, they should only be given an equalizing charge when required in accordance with the manufacturer's recommendation. Further, this operating procedure references the instruction manuals for the old batteries and does not reference the new Gould-GNB instruction manuals. Also this procedure calls for different float and equalizing voltages for the two new Unit 3 batteries. These batteries are both made up of Gould-GNB NCX type cells and should have the same charging voltages.

Plant operating Procedures 9654.1 and 9654.2, dated November 8, 1984, describe the load test procedures for all four safety-related batteries. Again, these procedures only refer to the C&D Batteries Instruction Manual (even though batteries 3B and 4A were originally EXIDE batteries) and do not reference the new Gould-GNB instructions. Additionally, the description of the battery load test profile used in these procedures use the 30 minute FSAR profile also without compensation for minimum electrolyte temperature requirements.

The team could not find plant operating procedures describing a battery performance test to determine actual battery capacity compared to rated capacity (as recommended by IEEE Standard 450).

The apparent failure to establish and implement technically adequate procedures for the new station batteries will remain unresolved pending followup by the Region II Office (50-250/8532-15; 50-251/8532-15).

8. The team had a significant concern that excessive reliance was placed on operator action instead of design features to ensure the proper functioning of the auxiliary feedwater system. Specifically, the team was concerned that immediate operator action may be required upon initiation of the auxiliary feedwater system following a loss of main feedwater and reactor trip with a concomitant loss of the non-safety-related instrument air supply. Although the auxiliary feedwater system is designed to automatically initiate, design calculations do not exist which demonstrate that the system will continue to run for a period of time without immediate operator action. This concern is, in part, based upon the lack of design analyses to support nitrogen system design details and the need for immediate operator action inherent in the design of the nitrogen system. This concern is based upon the following observations:

   - Lack of design analysis based upon the as-installed system to document the setpoint selection for pressure switches used to alert the operator that ten minutes of nitrogen remain before loss of motive and control pressure (i.e., closure of flow control valves and loss of all feedwater).

- Lack of design criterion to define how long the auxiliary feedwater system has to operate without operation action. Consequently, no guidance was provided to establish operating limits on available nitrogen supply before reaching the low level setpoint.

- Lack of engineering direction with respect to post-modification testing requirements to confirm the adequacy of the installation to design bases.

D. Quality Assurance

A review of the corporate and site quality assurance auditing activities revealed that these audits, as implemented, neither had identified nor were capable of identifying quality concerns of a technical and operational nature similar to those concerns identified during this NRC inspection. Both the corporate vendor audit and the plant audit programs were designed to assure that QA programs met NRC requirements and licensee commitments from a programmatic basis only. The following are examples of audits conducted by corporate and site QA staffs that failed to identify any of the significant weaknesses identified during this inspection.

Audit Numbers	Activity Audited
08.01.DTLMD.84.1	QA program including design control (BPCO)
QAS-EPP-83-1 QAS-JPE-84-1	Power Plant Engineering
QAO-PTP-84-549 QAO-PTN-85-657	Training
QAO-PTP-82-10-421 QAO-PTP-84-584	Plant Change-Modification

The lack of an implemented corporate and site audit program providing for technical and operational reviews of vendor and plant activities meant that FP&L management was not receiving important feedback on the quality of activities affecting the safe operation of the plant. The team noted that recent Performance Enhancement Program initiatives were being implemented and Quality Improvement Program efforts were underway to address some aspects of these QA weaknesses. The progress of this effort will be tracked by the NRC Region II Office as part of their routine followup to the licensee's Performance Enhancement Program.

IV. MANAGEMENT EXIT MEETINGS

An exit meeting was conducted on September 13, 1985, at the Turkey Point plant. The licensee's representatives are identified in the Appendix.

The scope of the inspection was discussed, and the licensee was informed that the inspection would continue with further in-office data review and analysis by team members. The licensee was informed that some of the observations could become potential enforcement findings. The team members presented their observations for each area inspected and responded to questions from licensee's representatives.

APPENDIX

Persons Contacted

The following lists the persons who attended the exit interview. Some of these persons were contacted during this inspection and other technical and administrative personnel were also contacted.

C. O. Woody, Vice President, Nuclear Operations
J. W. Dickey, Assistant to the Vice President, Nuclear Operations
C. M. Wethy, Vice President, Turkey Point
C. J. Baker, Plant Manager, Nuclear
H. T. Young, Site Project Manager and Acting Plant Manager
D. D. Grandage, Operations Superintendent
T. A. Finn, Operations Supervisor
J. E. Price, Corporate Engineer
R. J. Acosta, Quality Assurance Superintendent
L. W. Bladow, Quality Assurance Supervisor
T. P. Coste, Project Quality Assurance Engineer
J. W. Kappes, Maintenance Superintendent
W. C. Miller, Training Supervisor
E. F. Hayes, I&C Department Supervisor
S. G. Brain, Turkey Point Project Engineer
K. L. Jones, Technical Department Supervisor
J. Arias, Jr., Regulatory and Compliance Supervisor
D. E. Boger, ANI Inspector
J. K. Hayes, Manager, Licensing and Quality Assurance
E. H. O'Neal, Systems Engineer, AFWS
J. M. Donis, Site Resident Engineering Supervisor
H. E. Hartman, In-Service Inspection Supervisor
R. Gouldy, Corporate, Licensing
D. W. Haase, Safety Engineering, Group Chairman
M. J. Crisler, Quality Control Supervisor
G. M. Vaux, Safety Engineer
J. Rosenfeker, Corporate Engineer
F. H. Southworth, Corporate Engineer
R. A. Longtemps, Assistant Superintendent, Maintenance

Enclosure 2

Suggested Addition

The following insert would update the draft report. This insert could be placed after the first full paragraph on page 35:

The NRC's Office for Analysis and Evaluation of Operational Data collects, assesses, and distributes data, including statisical measures of licensee performance. Recent activities in this regard include:

- o The Licensee Event Report System was modified through adoption of a new rule, 50.73, which was effective January 1, 1984. The new LER rule, for the first time, places uniform reporting requirements on all nuclear power plants and assures that events of interest, such as actuations of all engineered safety features, will be reported to the NRC. Thus data, which was not previously readily available, now exists to track the operational experience of each plant on a defined and consistent base.

- o AEOD analyzes the trends and patterns of individual plant performance as well as that of the industry. Included in this activity are performance indicators based upon operational data. Two major studies in this regard have been produced; one study covers the scram history of all plants during 1984, and the other study covers the actuation of Engineered Safety Features (ESF) equipment for the first six months of 1984. These studies have been distributed to the staff and are intended for use as input into the SALP Program. These studies are the first in a series of reports on scrams and ESF actuations. Subsequent reports will also consider the trends in these measures of licensee performance. AEOD also has in progress studies which will provide statistical measures associated with safety system availability and technical specification violations.

- o As another specific measure of plant performance, AEOD is implementing a quantitative program to assess the quality of Licensee Event Reports prepared by licensees. This program provides a summary of the strengths and.weaknesses of LERs from individual plants and then provides a summary of all plants. This data is also being routinely provided to each region as input to SALP determinations.