U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 50-423/88-12

Docket No. 50-423

License No. NPF-49

Licensee: Northeast Nuclear Energy Company
P.O. Box 270
Hartford, CT 06101-0270

Facility Name: Millstone Nuclear Power Station, Unit 3

Inspection At Waterford, Connecticut

Inspection Conducted: July 6 - August 15, 1988

Reporting Inspector: G. S. Barber, Resident Inspector

Inspectors: W. J. Raymond, Senior Resident Inspector
G. S. Barber, Resident Inspector

Approved by: [signature] for E. C. McCabe, Chief, Reactor Projects Section 1B — 8/31/88 Date

Inspection Summary: Inspection Report 50-423/88-12 (7/6/88 - 8/15/88)

Areas Inspected: Routine onsite inspection of: Plant Operations; Root Cause of FWLI Solenoid Valve Failure; Lack of Thermal Overload Bypass Feature for Service Water Pump; Plant Operational Status; Plant Incident Reports (PIRs); Physical Security; Storage Battery Adequacy; NRC Bulletin 88-05, Nonconforming Materials Supplied by Piping Supplies Inc. (PSI) and West Jersey Manufacturing Co. (WJM); Auxiliary Feedwater Pump Center Sleeve Cracking; Licensee Event Reports; Maintenance; Surveillance Testing; and Committee Activities.

Results: No violations or deviations were identified. An unresolved item (UNR 88-12-01) was opened on the lack of a required freshening charge if the battery is open circuited for extended periods. A licensee identified item was documented on the failure to take auxiliary sample rig flowrates within the Technical Specification action statement frequency.

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DETAILS

1.0 Persons Contacted

Inspection findings were discussed periodically with the supervisory and management personnel identified below:

S. Scace, Station Superintendent
C. Clement, Unit Superintendent, Unit 3
M. Gentry, Engineering Supervisor
R. Rothgeb, Maintenance Supervisor
K. Burton, Staff Assistant to Unit Superintendent
J. Harris, Operations Supervisor
D. McDaniel, Reactor Engineer
R. Satchatello, Health Physics Supervisor
M. Pearson, Operations Assistant

2.0 Summary of Facility Activities

The unit operated at full power throughout the period except for two minor power reductions (2%) on July 19 and July 28. These power reductions were of short duration (<12 hrs.) and were necessary to perform required surveillances. The plant ended the inspection period at full power.

3.0 Status of Previous Inspection Findings

3.1 (Closed UNR 87-21-01) Root Cause Determination of FWLI Solenoid Valve Failure

Inspection Report 50-423/87-21 Detail 4.1 documented the licensee's failure to establish a root cause for the open circuiting of a normally energized FWLI solenoid (SOV 41A1) valve, which resulted in a reactor trip. It was the second such failure in 7 months. During the first failure, the normally energized solenoid operated valve (SOV41D1) for CTV41D failed in the same manner, causing a reactor trip on SG "D" low-low level. (See Inspection Report 50-423/87-05.) Since this was the second failure, the licensee had their Reliability Engineering Department evaluate the failure mechanism. Reliability engineering contacted the valve vendor (Anchor Darling) and the solenoid vendor (Skinner) to determine if other plants had experienced similar failures. Anchor-Darling stated that a Westinghouse, Taiwanese plant had similar problems. That plant replaced their solenoids with a newer, low wattage design and have not had a solenoid failure for over two years. The licensee has 12 low wattage solenoids on order (PO#913785) with an estimated delivery date of November 11, 1988. They are scheduled to be installed at the next refueling outage. This unresolved item is closed.

4.0 Review of Facility Activ'ties

4.1 Lack of Thermal Overload Bypass Feature for Service Water Pump Discharge Valves

On August 4, the licensee identified a potential concern with bypassing thermal overloads for two service water pump (SWP) discharge valves (3SWP*MOV102A,C) during certain accident conditions. The Engineering Review Group identified an unincorporated Engineering and Design Change Request (E&DCR) (N-EC-00859) which was to have added thermal overload bypass circuitry to 3SWP*MOV102A,C. The E&DCR was referred to corporate Electrical Engineering (EE) for cancellation because Technical Specifications (TS) did not require the valves to have overload bypass capability. Corporate EE review of these valves indicated a potential problem in that, according to an electrical one-line drawing (EE-1DB), 3SWP*MOV102A,C were active valves and, to conform to NRC Reg Guide (RG) 1.106, they should have been included on the Technical Specification listing of valves requiring overload bypass.

Motor-operated valves with thermal overload protection devices are used in safety systems and in their auxiliary supporting systems. Operating experience has shown that indiscriminate application of thermal overload protection devices to these valve motors could result in needless hindrance to successful completion of safety functions. RG 1.106 specifies that thermal overloads be bypassed or set sufficiently above the worst case postulated trip setpoint to prevent hindrance during "active" repositioning for accident situations.

TS 3.8.4.2.1. and TS Table 3.8-2a specifies the valves that are actively repositioned during accident situations. The thermal overloads (OL) for these valves are required to be bypassed when accident signals (e.g., SIS), are generated. The bypass is typically accomplished by a parallel contact around the OL contacts and that closing on an accident signal. TS 3.8.4.2.2 and Table 3.8-2b specify the valves whose thermal overloads do not need to be bypassed during accident situations. Implic n this TS is that the valves are already in their accident position (..., open or closed for cooling or injection). 3SWP*102A, C are in Table 3.8-2b since they are interlocked to open when their respective SWP starts and at least one of them is open because its service water pump is running. They also close when their SWP stops.

The licensee postulated an accident scenario where the service water (SW) valves would fail to reach their accident position. For this scenario, the SWPs trip on a Loss of Power (LOP) and are started 30 seconds later when the emergency diesel generator (EDG) sequencer initiates that action. The SW discharge valves stroke shut immediately upon diesel loading since the valves' Motor Control Center (MCC) is not stripped during accident conditions and the pumps are stopped. The SWP will start after its time delay (TD) and cause the valve to reverse direction.

Valve design is such that it will return to full open within 40 seconds, supplying cooling water to the charging and HPSI pumps within the 60 seconds specified in the EDG Load Study. If the thermal overload relay would actuate when the MOV was 6% open (approximately 25 seconds after EDG start), a pump trip signal would not be generated, Train "A" service water flow could not be guaranteed (probably resulting in at least three low flow alarms), and the valve would indicate mid-position. The only protection for this event would be operator action. Hence, the licensee took prompt action to remedy this situation.

The licensee held a PORC meeting to evaluate installation of a bypass/jumper to bypass the thermal overloads for 3SWP*102A, C. PORC completed their safety evaluation and bypass/jumper 3-88-57 was installed on valves 3SWP*102A, B, C, D. The inspector questioned the bypass/jumper installation on 3SWP*102B, D since these valves' thermal overloads are bypassed during accident conditions. The licensee explained that, although controlled one-line drawings showed the required bypasses, further evaluation of the values' circuitry was necessary prior to final resolution of this issue. Corporate EE calculation showed on August 8 that the thermal overload setpoint was sufficiently above the worst case trip setpoint per RG 1.106. The licensee subsequently removed the bypass jumpers.

The inspector reviewed the licensee's actions and noted no inadequacies.

5.0 Plant Operational Status Reviews

The inspector reviewed plant operations from the control room and reviewed the operational status of plant safety systems. Actions taken to meet technical specification requirements when equipment was inoperable were reviewed to determine whether the limiting conditions for operations were met. Plant logs and control room indicators were reviewed to identify changes in plant operational status since the last review and to determine whether changes in the status of plant equipment was properly communicated in the logs and records. Control room instruments were observed for correlation between channels, proper functioning and conformance with technical specifications. Alarm conditions in effect were reviewed with control room operators for proper response to off-normal conditions and to determine whether operators were knowledgeable of plant status. Operators were found to be cognizant of control room indications and plant status. Control room manning and shift staffing were reviewed and compared to technical specification requirements. No inadequacies were identified. The following specific activities were also addressed.

5.1 Review of Plant Incident Reports

The plant incident reports (PIRs) listed below were reviewed during the inspection period to (i) determine the significance of the events; (ii) review the licensee's evaluation of the events; (iii) verify the licensee's response and corrective actions were proper; and, (iv) verify that the licensee reported th. vents in accordance with applicable requirements, if required. The F.Rs reviewed were: 93-88 dated 5/2/88, 95-88 dated 5/4/88, 96-88 dated 5/11/88, 97-88 dated 5/11/88, 99-88 dated 5/13/88, 100-88 dated 5/15/88, 102-88 dated 5/13/88, 103-88 dated 5/6/88, 106-88 dated 6/6/88, 107-88 dated 6/9/88, 108-88 dated 6/6/88, 110-88 dated 6/11/88, 111-88 dated 6/13/88, 112-88 dated 6/13/88, 113-88 dated 6/15/88, 117-88 dated 6/20/88, 119-88 dated 6/21/88, 121-88 dated 6/22/88, 122-88 dated 6/23/88, 123-88 dated 6/23/88, 124-88 dated 6/27/88, 125-88 dated 6/30/88. No inadequacies were noted.

6.0 Physical Security

Selected aspects of site security were verified to be proper during inspection tours, including site access controls, personnel and vehicle searches, personnel monitoring, placement of physical barriers, compensatory measures, guard force staffing, and response to alarms and degraded conditions.

7.0 Storage Battery Adequacy Audit (RI TI 87-07)

An inspection was performed to determine the adequacy of storage batteries. Millstone 3 vital batteries were designed to be operable during accident conditions. Strict adherence to their maintenance and surveillance requirements will ensure their availability when needed. A Temporary Instruction was written to verify battery operability.

The Temporary Instruction (TI) provided specific questions regarding storage batteries. In addition, during the review of licensee documentation provided for the TI, other questions arose and were addressed by the licensee. They are specified in this detail. Attachment 2 of this TI was provided to the licensee, and is attached to this report for reference.

There are six batteries in use at Millstone 3, with four providing safety-related Class 1E functions. The safety-related batteries are addressed as batteries 1, 2, 3, 4, or 301A-1, 301B-1, 301A-2, and 301B-2, respectively. The non-safety-related batteries are addressed as batteries 5 and 6 or 301C-1 and 301D-1, respectively. Batteries 1 and 2 and 3 and 4 are rated at 1650 and 750 amp-hr (8 hr rate), respectively. Batteries 5 and 6 are rated at 2550 amp-hr (8 hr rate). Batteries 1 through 4 supply their respective vital busses. Batteries 1 and 2 supply additional DC loads beside their vital busses. Batteries 3 and 4 supply only their vital busses. Independent battery chargers are provided power by safety-related 480 volt busses to float their respective batteries and supply DC loads. The following is a synopsis of information requested by the TI. See Attachment 2 for details.

7.1 General Battery Information

The licensee specified the requirements for the battery in Specification No. 2445.100-259 (Spec 259) dated May 10, 1982. Spec 259 requires a service life of 40 years and that the cells be seismically tested and racks be evaluated by static analysis at Safe Shutdown Earthquake (SSE) and one-half SSE levels. The environmentally qualified (EQ) life of the batteries is 20 years. The station batteries were certified to meet all seismic and environmental qualifications in a July 16, 1985 memorandum from GNB Batteries to Stone and Webster. Startup testing was completed and the batteries were placed in service in August, 1983. The licensee plans to operate these batteries until the end of their EQ life or until they no longer meet their Technical Specification (TS) acceptance criteria. No inadequacies were noted.

7.2 Previous Licensee Actions

The following IE Information Notices along with the licensee's responses was used as an input to the evaluations specified in this TI:

-- 83-11, Possible Seismic Vulnerability of Old Lead Storage Batteries;
-- 84-83, Various Battery Problems;
-- 85-74, Station Battery Problems; and,
-- 86-37, Degradation of Station Batteries.

The inspector reviewed the licensee's response to each Information Notice and noted no inadequacies.

7.3 Seismic Lifetime and Qualification

For batteries supplying vital loads, the following was evaluated for acceptability:

-- Licensee and/or manufacturer's establishment of seismic lifetime. This may be through documentation allowing verification by competent personnel other than the qualifiers and containing design specifications, the qualification method, results, and justifications.

-- Seismic qualification maintenance. The criteria for assuring that the battery and rack will maintain seismic qualification should be defined, available, and used for periodic inspections and cell replacements. The licensee should specifically establish criteria for determination of the seismic end-of-life based upon the inservice condition of the battery.

Spec 259 provides specific details regarding battery seismic qualification. It also specified that the vendor provide the necessary replacement parts for the 40-year lifetime which may include defective or aged battery cells. SP 3712NA, Battery Surveillance Testing, and MP 3780AA specify the testing requirements and acceptance criteria for safety-related and non-safety-related batteries. These procedures specify the required seismic qualification maintenance along with other maintenance requirements.

SP 3712NA, Step 2.3 requires that cells, cell plates and battery racks be free of physical damage or abnormal deterioration, in addition, Step 7.2 requires checking each cell for cracking or leaky electrolyte with a flashlight and the corners for surface cracks and the sides and top for signs of fatigue or damage. Cell plates are flashlight checked for flaking or peeling and the bottom of the cell jar is inspected for foreign material. Electrolyte is verified to be clear and not hazy or discolored in any way.

No inadequacies were noted.

7.4 Electrical Sizing and Qualification

For batteries supplying vital loads, evaluate the acceptability of the following:

-- Licensee confirmation that the battery size is sufficient to handle the DC load profile with a suitable margin.

-- Licensee tracking and control of battery loads such that the batteries and replacements will have sufficient capacity throughout design life, if worst case electrolyte temperature and other worst case conditions exist when the battery is called upon to perform its design function.

-- Licensee consideration of the effect of jumpered out cells upon the ability of a battery to perform under worst case conditions.

Licensee calculation (calc) 118E was used to specify the battery and charger sizes in FSAR Table 8.3.1. Calc 188E dated 10/7/85 updated the battery duty cycles and sized the battery in accordance with IEEE 485-1978. The duty cycle loading for each battery specified in Calc 188E showed that the minimum Individual Cell Voltage (ICV) of 1.75 volts/cell (v/c) was not reached for the 2 hour accident load duty cycle. The minimum ICVs reached were 1.85 v/c and 1.81 v/c for batteries 1, 2 and 3 and 4, respectively. In addition, the maximum design rating of the inverter (163 amps) was assumed in the duty cycle to allow for load growth instead of the actual vital bus loads.

The inspector noted that the battery size was established by a DC load profile of 986 ampere-hours, a 10% margin for temperature variation, and a 25% margin for aging. This produces a minimum rating requirement of 1368 ampere-hours. The batteries selected are rated at 1650 ampere-hours, and the inspector identified no inadequacy in battery sizing.

If loads are to be added to a given battery, a plant design change request (PDCR) must be written and Calc 188E rerun. Corporate engineering (NUSCO) retains cognizance over this "living" calculation and ensures that any PDCRs filed against this calculation are within the ratings of the batteries. This loading calculation assumed a low temperature of 60 degrees F, the same as the battery's minimum temperature.

SP 3712NA step 2.1.4 specifies a minimum battery voltage of 129 volts (normal is 132 volts), and step 6.2.6 requires subtracting 2.2 volts for each jumpered cell and establishing a float charge at the corrected voltage.

No inadequacies were noted.

7.5 Battery Ventilation and Protection from Ignition Hazards

For batteries supplying vital loads, the following were evaluated for acceptability:

-- Provisions for assuring adequate battery ventilation during normal operation, outages, charging, and discharge.

-- Licensee checks of battery ventilation flow.

-- Controls over battery ventilation obstructions such as by enclosing the battery space or impeding ventilation with plastic sheeting or any other barrier during outages and other periods.

-- Adequacy of hydrogen detection equipment and its calibration and use, or of the technical justification for not using such equipment.

-- Knowledge of the hydrogen hazard on the part of plant management, operating shifts' management, and personnel who access battery spaces.

-- Prohibition of hot work and smoking in battery spaces, including checking the spaces for the residue of such activity.

-- Assuring that battery cells are properly secured. Post-to-case and top-to-jar seals should be tight. Thermometers should not be left in cells after temperatures are measured. Caps on the filler openings in individual cell flash arresters should be properly secured on the flash arresters when not required to be off. (Cells should be vented only through their flash arresters because hydrogen concentrations in the cell jars can be substantially higher than in the battery space.)

-- Elimination of water-carrying pipes (e.g., HVAC lines) from battery spaces, especially those which may carry salt water.

A 125 volt DC operating procedure (OP 3345C) specifies the normal and casualty procedures for station batteries. OP 3345C Step 6.2 requires battery ventilation to be operating at all times to prevent the formation of an explosive hydrogen (H_2) mixture. Controls for battery exhaust fans exist in the Millstone 3 control room and system alignments are reviewed during panel walkdowns at shift turnover. Abnormal ventilation lineups are noted on the shift turnover log. The inspector verified that ventilation supplies to the battery room were free of obstruction. A filtering media is provided on the supply, and the exhaust fans in each battery room were observed running with their outlet dampers throttled during this inspection. Hydrogen detection equipment is provided outside of the battery rooms and concentrations greater than 1% prohibit entry. Observed concentrations were less than 0.1% during battery float. OP 3345 Step 5.2 requires the hydrogen monitoring system to be in service and it must be properly calibrated to provide accurate indications. Operators questioned were aware of the hydrogen limit and noted the no smoking signs on the battery room doors.

SP 3712NA specifies the requirements for battery cell general condition such as ensuring service tube caps and flash arresters are properly installed, thermometer removal after temperature measurement, and cell post and post seals are free of cracking and other damage. A spot check of a number of cells showed that their service tube covers and flash arresters were properly installed and that the battery rooms were free of debris. In addition, there is no piping of any sort in any of the battery rooms. Chemistry provides demineralized (DI) water to maintenance, if DI water must be added to a given cell. Water is not stored in the battery rooms. No inadequacies were noted.

7.6 Electrolyte Temperature Control

For batteries supplying vital loads, check the adequacy of the following:

-- Avoidance of localized heat sources such as direct sunlight, radiators, steam pipes, and space heaters.

-- Whether the location/arrangement provides for no more than a 5 degree F difference in cell temperature, as confirmed by measurements representative of operating conditions. If this is not the case, than the licensee and manufacturer should have identified the consequent impact on expected battery and individual cell capacity and life, and surveillance procedures should reflect the additional allowable temperature variation.

Vital station batteries are located at the 4 ft. elevation (below grade) of the control building and in their own separate, independent battery rooms. There are no pipes or heaters in the rooms and the rooms are not exposed to sunlight. Sixty cells are divided on each side of the battery room and the rooms are small and not subject to large temperature gradients within each room.

The battery rooms reside in the east and west switchgear room, which is environmentally controlled as a part of the control building envelope. Cell temperature in six connected cells is verified to be above 60 degrees F on a quarterly basis by SP 3712NA. No inadequacies were noted.

7.7 Charging

For batteries carrying vital loads, check the adequacy of the following:

-- Provision for a freshening charge after more than 3 months of being on open circuit (this sometimes occurs with a newly delivered battery and is much less likely after installation) unless determined by the manufacturer to be unnecessary to assure rated capacity throughout life.

-- Accomplishment of equalizing charges at 18-month intervals, and when the corrected specific gravity (SG) of an individual cell is more than 10 points (0.010) below the average of all the cells, and when the average corrected SG of all cells drops more than 10 points below the average installation value, and if any cell voltage is below 2.13V. (Specific manufacturer's provisions and assessments may allow the non-performance of some of these recommended charges, or may provide different criteria.)

-- Control over battery water quality such that specified purity is confirmed before addition, that water added just prior to charging is added only to bring the electrolyte up to the prescribed minimum (to prevent overflow during charging), and that water added after and between charges does not bring the level above the prescribed maximum (unless manufacturer's instructions provides for other water addition measures).

-- That routine float and final end of charge SGs not be taken before 72 hours of float operation after completion of the charge and the last water addition, unless the manufacturer's instructions provide otherwise. (The need is for measurement of representative cell SGs. An alternative means is to measure SGs at different cell levels and average them.)

-- Establishment and maintenance of float voltage on accordance with the manufacturer's instructions.

-- That single-cell charger use does not violate Class 1E independence from non-class IE equipment (ref: IEEE-389).

OP3345C Step 7.10 and 7.11 specify the instructions for open circuiting and reenergizing the DC busses from the respective batteries. However, cautions do not exist to preclude restoring vital batteries from extended periods an open circuit. TSs only require one battery and charger to be operable in Modes 5 & 6 and, since TS surveillance requirements do not have to be performed on inoperable equipment, three vital batteries could be open circuited for extended periods. OP3345C does not specify a freshening charge prior to returning the batteries to service.

All lead acid batteries lose a certain amount of charge when removed from a voltage source that is higher than the open circuit potential of the battery. As this charge is lost, the electro-chemical process produces lead sulfate in both the positive and negative plates of each cell in the battery. If left uncharged for a significant period of time, large crystals of lead sulfate will form. These large crystals may be difficult to reduce through normal charging and may inhibit the complete electro-chemical process desirable to sustain a healthy lead acid battery. Higher than normal charging potentials or more sophisticated remedial approaches may be necessary to recover the affected battery. With very severe sulfation cases battery replacement may be the only solution. It is important that batteries be given prompt initial charging and, if required to remain out of service after initial charging, that the process be repeated at least every three months up to a maximum of one year from date of initial shipment.

Procedures should address the need for a freshening or equalizing charge when the battery is open circuited for an extended period of time. This is an unresolved item. (UNR 88-12-01)

SP 3712 NA Step 6.2.7 requires an equalizing battery charge for low ICVs, low SGs, after 18 months, and following a test discharge. SP 3712NA also cautions that only DI water be added, when water level is at the minimum level, and that the cell only be filled to 1/4 inch below the maximum level to prevent splattering during charging. The caution following SP 3712NA step 7.1.10 requires that the addition of DI water occur only after SG readings are taken. Float voltage is set at 132 volts plus or minus 2 volts for all batteries per step 7.12.5 of OP 3345C. Single cell chargers are not used at Millstone 3.

No inadequacies were noted.

7.8 Performance Tests and Replacement Criteria

For batteries carrying vital loads, check acceptability of the following:

-- Initial acceptance testing which demonstrates the ability of the battery to meet the manufacturer's rating.

-- Service testing which demonstrates the ability to carry the load profile with an appropriate margin for worst case conditions, including end of life loss of capacity under the worst case electrolyte temperature.

-- Accomplishment of a performance test (capacity test discharge) within the first two years of service and at 5 year intervals until signs of degradation are evident or 85% of the qualified service life is reached.

-- Annual performance testing of batteries which show signs of degradation or which have reached 85% of their qualified service life.

-- End of electrical life criteria which consider the possible sharp end of life drop-off in capacity, worst case state of charge during float service, worst case electrolyte temperature, current DC loads, and the time needed to replace the battery while it can still handle worst case conditions.

The inspector reviewed the 125 VDC Channel 1,2,3,4 startup tests (T3345CP001, T3345CP002, T3345CP003, T3345CP004) to determine the scope and completion dates of the required testing. These startup tests required the licensee to perform a battery performance test to ensure they met their rated capacity. The tests, along with their subsequent equalizing charges were completed on July 29, 1983 and accepted by the licensee in PORC mtg 3-83-7. Minor deficiencies in the test were noted and corrected by the licensee's deficiency correction systems. TS 3.8.2.1 requires performance of a battery service test every 18 months. Battery capacity performance/discharge tests are performed once per 60 months to verify greater than 80% of rated capacity. Performance discharge tests are performed every 18 months when 85% of service life is reached or when the battery shows signs of degradation. Battery replacement is required 1 year after 80% capacity is reached.

No inadequacies were noted.

7.9 Other Safety-Significant Wet Cell Batteries

For safety-significant wet cell batteries not used for vital loads, check on whether the maintenance program periodically determines the ability to perform the design function and provides for timely replacement of batteries and associated equipment (e.g., chargers).

Preventive Maintenance (PM) Procedure (MP 3780AA) specifies the instructions for general maintenance and inspection of batteries 5 & 6. It also delineates the requirements for cell jumpering and equalizing battery charges on the vital batteries. The PM acceptance criteria of this procedure are the same as SP 3712NA. No inadequacies were noted.

8.0 NRC Bulletin 88-05, "Nonconforming Materials Supplied by Piping Supplies Inc. (PSI) and West Jersey Manufacturing Company (WJM)

On May 6, 1988, the NRC staff issued Bulletin 88-05, "Nonconforming Materials Supplied by PSI and WJM." Certified material test reports (CMTRs) for material supplied by PSI and WJM contained false information on material supplied to the nuclear industry. The NRC requested licensees to review purchasing records to determine if any American Society of Mechanical Engineer (ASME) or American Society of Test Materials (ASTM) materials have been supplied by PSI since January 1, 1985, or from WJM since January 1, 1976. The licensee was also requested to review the location of installed components in safety-related systems, the suitability for intended service, and conformance with code and procurement specifications.

On June 15, the NRC staff issued Supplement 1 of NRC Bulletin 88-05 in response to test data for two flanges supplied by WJM to Carolina Power & Light's Shearon-Harris nuclear power plant. The flange test results demonstrated that they did not comply with, and had material properties significantly below, the ASME and ASTM specifications. The supplement to Bulletin 88-05 requested licensees to test installed flanges and fittings, within 30 days of receipt of the supplement (July 15), for conformance to ASME and ASTM specifications and, if deviations were present, to prepare an analysis of the justification for continued operation of the facility.

The inspector reviewed the licensee's activities in response to Bulletin 88-05 and associated Supplement 1. The licensee's Quality Services, Purchasing, and Engineering departments reviewed purchase orders and work orders to determine the number of flanges and fittings supplied by WJM or PSI. The review identified the number of spare flanges and those currently installed in safety-related systems. The licensee's review identified the following vendors that supplied WJM and PSI fittings to the Millstone Station: Radnor, Tyler-Dawson, Guyon, Cunningham Supply, and Pullman Power. The licensee's corporate Generation Engineering department coordinated activities at the facility and developed conformance testing on installed flanges on safety-related systems. The results of testing of installed flanges were compared with the CMTRs supplied by the vendor, and the applicable ASME and ASTM code standards.

The licensee tested the potential nonconforming materials using an Echo-tip instrument. The instrument tests flanges for their Brinnell hardness values. The examination takes five readings on the flange surface. The highest and lowest values are deleted; the three remaining readings are averaged together to determine a hardness value. The licensee reported to the inspector that the hardness technique was found to be acceptable by the Electric Power Research Institute (EPRI). The inspector discussed EPRI's position with NRC Nuclear Reactor Regulations (NRR) staff, and learned that it was acceptable to the NRC staff for testing installed flanges.

The inspector reviewed licensee documentation to identify flanges supplied from either PSI or WJM manufacturers. On the following page is a tabulation of affected flanges and location at Millstone Unit 3.

Number of Flanges and Size	Manufacturer	Location	ASME/ASTM Specification
6 (3")	PSI	Steam Generator wet layup skid	SA 105
2 (3")	WJM	Component Cooling Water to "D" RCP LO Cooler	SA 105

Initial licensee investigation into installed plant flanges manufactured by either WJM or PSI resulted in the above list. The inspector independently reviewed licensee documentation to achieve the above conclusion. No inadequacies were noted.

On July 25 at 9:00 a.m., the licensee reported that NRC Bulletin 88-05 followup identified two installed Component Cooling Water (CCW) flanges to the "D" RCP upper motor bearing cooler that were manufactured by WJM. The licensee could not conduct in-plant testing of the listed flanges since they were inside containment. The bulletin requires the licensee to notify the NRC if any deviation from ASME/ASTME occurs in safety-related flanges or if any inaccessible flanges or fittings are identified in safety-related equipment or systems. The licensee must provide a justification for continued operation (JCO) to the NRC.

The inspector reviewed the licensee's JCO. The JCO concluded the flanges were acceptable based on the following:

1) The allowable stress levels used to qualify the CCW piping was based on a 60,000 psi tensile strength for the piping, not the flanges. Licensee review of the stress analyses of record showed all stress levels at the flange locations are well below code allowables for all loading conditions. (Maximum stress <2000 psi.)

2) In order to withstand the maximum stress levels, the minimum ultimate tensile strength of the flange material must be greater than or equal to 10,000 psi. In all the testing to date, a minimum ultimate tensile stress of 40,000 psi has been found for SA 105 flange material.

3) Actual moment loadings on the subject flanges are qualified for the worst case load combination to the yield strength of the flange material. In all cases, flange loadings do not exceed 25% of their allowables. These allowables are based on a yield strength of 30,000 psi. In all testing to date, a minimum yield stress of 25,000 psi has been found for SA 105 flange material.

The inspector reviewed the licensee's JCO and identified no inadequacies. In addition to the flanges identified above, there are eight isolated flanges for the blowdown system. These flanges are isolated by locked closed manual valves and are not subject to steam generator blowdown system pressure. The inspector reviewed the system configuration and had no further questions.

9.0 Auxiliary Feedwater Pump Center Sleeve Cracking (10 CFR 21)

Bingham International, Inc. (BI) notified the NRC on May 4, 1988 of a 10 CFR Part 21 report concerning stress corrosion cracking/hydrogen embrittlement observed on center and throttle sleeves in auxiliary feedwater (AFW) pumps at various U.S. power plants. BI notified the licensee in a memorandum dated May 19, 1988 of their pumps' potential susceptibility to this problem. BI first learned of the problem in February and March, 1988 when AFW pumps at South Texas Project (STP) and Palo Verde Nuclear Generating Station (PVNGS) failed while in service. The failures noted were:

-- On February 28, 1988, STP Unit 1 turbine-driven, 11-stage, AFW pump developed a crack in the throttle bushing.

-- On March 25, 1988, PVNGS Unit 1 Seismic Train B, 8-stage, motor-driven AFW pump 1M-AFB-P01 also developed a crack in the center shaft sleeve.

-- On June 1, 1987, PVNGS Unit 1 non-seismic, motor-driven, 8-stage AFW pump 1M-AFN-P01 developed an axial crack in the center shaft sleeve.

For the PVNGS pumps, the damage resulted in the loss of flow from the 4th stage impeller and a reduction in discharge pressure. For the STP pumps, the damage caused the pump shaft to seize. The inspector noted that the PVNGS draft report dated 4/22/88 characterized the motor-driven pump failure in detail. The 8-stage pump has a single suction, double volute with a horizontal split casing. The rotating element is supported with sleeve journal bearings at both ends outboard of the stuffing box and the pump has an oil-lubricated ball thrust bearing assembly located opposite of the driver end. The configuration of the impellers on the pump shaft is commonly called the opposed impeller arrangement. The purpose of this arrangement is to reduce axial thrust loading. In this arrangement, the first four impellers are arranged on the pump shaft facing in one direction with the remaining four impellers facing in the opposite direction. This design requires a center shaft sleeve assembly to separate the opposed impellers at the pump center between impellers four and eight. The normal differential pressure (DP) across the 4th and 8th stage impellers is 800 psid, which tends to drive the center shaft sleeve into the base metal of the fourth stage impeller. The 4th stage impeller and center shaft sleeve share a common keyway with the center sleeve being interference fit (2 mils) onto the shaft. The interference fit prevents center stage slippage along the keyway. The sleeve is also surrounded and supported by a center stage piece forming a hydrodynamic bearing. There is a groove within the center stage piece that spirals around the center stage sleeve for pumped fluid flow. While the pump is at rest, the center shaft sleeve is resting on the center stage piece. Upon startup, the rotating shaft is then supported by a film of pumped fluid that is forced through the annulus region between the center stage piece and the sleeve by the pressure differential between the eighth and fourth stages. Thus, upon startup, there is usually contact between the center stage shaft sleeve and the center stage piece.

During the March 25, 1988 monthly routine surveillance on PVNGS Unit 1 B-Train motor-driven AFW pump, it was observed that the total delivered head was below the allowable value of 1682.2 psid. The actual total delivered head was 1538.5 psid. This value was approximately 210 psid below the value of 1748 psid which was obtained in the previous surveillance test for this pump. The pump was declared inoperable and disassembly was initiated. The System Engineer, who was present for the pump disassembly, made the following observations during the visual inspection of the pump's rotating assembly. First, the fourth state impeller hub was no longer keyed to the shaft and the center stage sleeve was found underneath the fourth stage impeller. The fourth state impeller hub was observed to be capable of rotating freely around the stationary pump shaft. There was also evidence of grinding on the center stage piece side of the fourth stage impeller hub. Secondly, the center stage shaft sleeve was also free to rotate about the pump shaft. By design, the center stage shaft sleeve is shrunk fit onto the shaft and also keyed to the shaft. Visual observation showed a crack on the outside surface of the center stage shaft sleeve that went axially along the entire length of the shaft sleeve at the keyway location. Additionally, the key for the center stage shaft sleeve and fourth stage impeller hub could not be found during visual inspections.

After PVNGS visual inspection of the damaged AFW pump, the following failure scenario was developed. The initiating event was the crack in the center stage shaft sleeve. The existence of the crack allowed the shaft sleeve to expand which eventually resulted in the shearing of the key due to the frictional forces between the sleeve and the center stage piece. The differential pressure that is normally developed across the shaft sleeve is approximately 800 psid. This is the pressure differential between the eighth stage and the fourth stage pressures. This large differential pressure forced the center stage shaft sleeve into the fourth stage impeller hub. The shaft sleeve ground into the impeller hub removing hub and key material. Finally, the sleeve reduced the key in the impeller to such a dimension that the impeller torque sheared the remaining length of the key. The fourth stage impeller was then free from the rotation of the shaft and the developed head of the pump was reduced.

PVNGS evaluation of the failure scenario led to the development of the two potential root caused identified below:

Suction Transients: The galling of the center stage shaft sleeve to the center stage piece could occur as a result of suction transients on the AFW pumps. Suction transients can be caused by either plant operation or plant design. Fast starts of the motor-driven AFW pumps can lead to a condition where the pressure at the suction nozzle of the pump drops below the vapor pressure of the water in the suction line. This is due to the inertia of the water in the suction line preventing the water from moving into the eye of the first stage impeller at the same rate that the pump is attempting to remove water from the case. This condition can result in galling of the center stage sleeve by either causing an imbalance of the pump shaft or by reducing the hydrodynamic lift effect at the center sleeve location. Another plant operating problem that can lead to galling occurred when the non-seismic AFW pump PVNGS IM-AFN-P01 was started with at least one of its two motor-operated suction isolation valves closed. This led to an inadequate suction water supply for the pump and in galling of the shaft sleeve due to loss of the hydrodynamic lift effect at the center stage shaft sleeve. One possible plant design problem that could lead to galling is long horizontal runs of suction piping. If the piping is not adequately vented following system maintenance, then air could be ingested at the pump suction, leading to galling of the center stage shaft sleeve.

Stress Corrosion Cracking/Hydrogen Embrittlement: The galling of the center stage shaft sleeve could have been initiated by the observed axial crack in the shaft sleeve. Specifically, the crack in the shaft sleeve was initiated by intergranular attack. When the crack propagated, it reduced the diametral clearance between the center stage piece and the shaft sleeve. This led to inadequate cooling flow to the shaft sleeve and resulted in galling.

PVNGS Conclusion: The recommendation from the root cause analysis section of the report was that any design changes should consider both postulated root causes. BI and PVNGS are conducting a comprehensive review of the center stage design. The objective of this effort is to incorporate design changes which will eliminate the possibility of a failure due to the two root causes identified. A separate review of other rotating elements will also be performed to assess if any changes are desirable. The selection of the final modifications to the center stage piece and shaft sleeve is to be done to accommodate the following considerations:

i) A new material will be selected for the shaft sleeve to maximize the material's resistance to the hydrogen embrittlement phenomena and to reduce the brittleness of the component.

ii) A new center stage piece material will be selected to lower the susceptibility to galling and, therefore, produce a more forgiving design.

iii) The shaft sleeve and keyway design will be optimized to reduce residual stresses from shrink fitting and operating stresses inherent to the keyway.

The evaluation for material selection is underway.

One of the identified contributing causes of the AFW pump degradation is full flow starts of the AFW pumps. Presently, full flow starts of the PVNGS Train B AFW pump occur only during performance of Integrated Safeguards (ISG) testing. To eliminate this potential cause of degradation to the pump, the PVNGS ISG test procedure will be revised to eliminate the full flow pump start. The PVNGS B-train AFW pump will now be started on minimum flow recirculation. The minimum flow start is also closer to the conditions that the pump will see post-accident due to the fact that the AFW pump discharge valves open slowly in relation to the acceleration of the pump.

The Millstone 3 licensee stated that, except for the number of stages, Millstone 3 AFW pumps are identical in design to those of STP and PVNGS, including the use of AISI 420 wrought material for the center and throttle sleeves. Unit 3 Engineering has reviewed the PVNGS draft report and conferred with both Bingham-Willamette (BW) (a division of BI) and corporate Piping Systems Engineering on the 10 CFR Part 21 report. In addition, Unit 3 Engineering has reviewed the AFW pump operation/surveillance procedures and the work order history for all pumps since January, 1985. The following summarizes the licensee's discussions/reviews as they affect the Unit 3 AFW pumps.

-- According to BW, there should be no reason to expect stress corrosion/hydrogen embrittlement cracking considering only demineralized water is used as the water source. However, BW could not explain why such corrosion/embrittlement occurred in PVNGS and STP.

-- There is no adverse work history on any of the AFW pumps with regard to any of the sleeves. In fact, the material for wear rings and sleeves was changed from AISI 440A to AISI 420 on the recommendation of BW during the NTOL phase.

-- The licensee performs all its pump surveillance under minimum flow conditions. The only significant operational problems were motor-driven AFW pump trips due to low suction pressure. These events occurred in January 1987, and were discussed in LER 3-87-004. In support of the LER, testing was performed under IST 3-87-004. This IST identified the cause and corrective action for the trips. The inspector reviewed all 8 AFW surveillance procedures (SP3622.1 through SP3622.8) and the AFW operational procedure (OP 3322) and noted that in all cases the AFW pumps were started in the recirculation mode. The inspector noted that the PVNGS AFW pump that failed was started a total of 227 times with 27 of those starts being under full flow conditions. The licensee performed less than 5 full flow starts during NTOL.

Based on the information presently available, the licensee does not intend to modify pump operation or take any action to inspect the sleeves. The Unit 3 AFW pumps, with the exception of the pump trips identified in LER 3-87-004, have performed well in surveillances. However, the licensee did issue a Plant Modification Request (PMR 3-88-062) for NUSCo Engineering to evaluate the final recommendations of BW, PVNGS, and STP with regard to the use of different material, and to recommend a further course of action based on these recommendations. Furthermore, the licensee will consider increasing the priority for a PMR issued to NUSCo Engineering for evaluation of AFW pump pressure oscillations discovered during testing per IST 3-87-004.

The licensee feels justified in postponing pump inspections not only because of the satisfactory pump operation experienced thus far, but also based on PVNGS own probabilistic risk assessment (PRA) on the subject, whereby they recommend continued operation of their own plant until their next major outage. Millstone Unit 3 has two motor-driven AFW pumps and one turbine-driven AFW pump. This combination provides the redundancy required to assure necessary cooling is available for a safety event should a problem occur in one of the pumps. The inspector reviewed the licensee's evaluation of the 10 CFR 21 report's applicability to the Unit 3 AFW pumps and identified no inadequacies.

10.0 Former Security Guard Allegation (RI-87-A-137)

This allegation addresses concerns raised by a former guard in the licensee's contract security force. The issues were initially identified to the NRC in a telephone conversation in November, 1987.

Some of the issues were also identified by the alleger to the contractor guard force in separate meetings on November 9, 1987. The items were referred for utility management for followup in January 1988. Licensee followup on some of the issues required long term review. Licensee determinations were summarized in a March 7, 1988 memorandum from the security supervisor to the Station Services Superintendent. NRC followup and verification of the licensee's actions and dispositioning for the issues occurred in the May-August 1988 time period. The issues and the NRC findings for each are summarized below.

The security concerns were raised by a former employee of Burns International, who provides the contract security force at the site. The individual had attained the rank of sergeant and was employed at the site from May 1985 until October 1987 when terminated under Burn's progressive disciplinary policy.

10.1 Personnel Leaving Site with Security Badges

This item was a general concern about workers leaving the site with their security badges, but no specifics were given for dates or names of individuals. The inspector was unable to confirm the allegation because of the lack of specific information. However, previous NRC inspection (Region I Inspection Report 50-336/87-20) identified guard checks of badge turn-ins to be inadequate in the case of NRC personnel leaving the site. Corrective actions were taken by the licensee to better control badge turn-in. Subsequent routine checks by the inspector confirmed the badge retrieval process was performed satisfactorily. This issue is considered a poor practice that was corrected by the licensee as a result of NRC inspection. This item is closed.

10.2 Security Checks Not Made But Entered As Made On Round Sheet

This item concerned an incident on 10/22/87 involving the failure to make a routine check of a security key ring as required. When the alleger informed Guard Sergeant "A" that the required check had not been made, that guard reportedly insisted the alleger had made the check and entered the check as completed satisfactorily on the round sheet. When the alleger went to report the incident to the security captain, Guard "A" reportedly used white-out to revise the round sheet. Inspector review of the security form Daily Shift Report for 10/22/87 confirmed an entry had been made for a key check, whited-out, and a new entry was made to reference an incident report the same day. This matter was referred to the licensee for review.

Millstone Security report 87-1198 and a Burns Routine Report, both dated 10/22/87, documented the incident. The licensee concluded that the alleger's name was entered on the Round Sheet as a result of a misunderstanding and there was no deliberate attempt to falsify documentation. Further, the concern about falsification was not corroborated by the statements of others. The use of white-out to correct log entries was not prohibited on Burns internal forms, but is prohibited by licensee procedures and is considered a poor practice by the licensee. Instructions provided in a memorandum dated 2/3/88 to security personnel prohibit the use of white-out.

The inspector noted that the existing entry on the round sheet was correct and was made on the same date that the alleger identified the incorrect entry. The failure to make the key check was not a significant security problem. Licensee corrective actions were evaluated as appropriate. Based on the above, this item is closed.

10.3 Person With Wrong Security Badge

This item involved an unidentified individual who had the wrong badge and key card for about 8 hours while onsite in July or August 1987. The alleger stated Burns management knew of the incident based on a report that was filed, but the matter was not reported to the NRC. No further specific information was available from the alleger.

The inspector noted that no safeguard events report on file with the NRC covered the matter. The inspector also noted that no uncleared personnel access was indicated based on the available information. Inspector checks of badge issue practices during routine inspections showed licensee controls are proper and are used to assure the correct badges are issued to the right people. Additionally, when badge issue problems occasionally occur, the inspector has found that licensee followup and corrective actions were proper (reference Security Event Reports 87-16 and 87-20). In general, licensee reponse actions are appropriate for lost or mis-issued badges: upon discovery, a timely check is made to assure no unauthorized use of the badge. In such cases, the incidents are not reportable to the NRC.

Based on the above, no further action was deemed warranted on this matter. This item is closed.

10.4 Burns Supervisor Reporting To Work Under The Influence Of Alcohol

This item concerned guard supervisors alleged to have routinely reported to work under the influence of alcohol, in general, and about one individual in particular. This condition was reportedly known to and sanctioned by Burns management. This item was referred to the licensee for followup.

In regard to the specific guard, the allegers' concern was not based on personal observations, but on reports by Individual "A," identified by the alleger. Licensee followup with Individual "A" corroborated that the guard was observed to be under the influence offsite, but the concern that he had worked a shift in that condition was not corroborated.

On January 29, 1988 the Security Supervisor issued a directive to NNECO Security Shift Supervisors to monitor all Burns personnel for signs of being under the influence of drugs or alcohol. NNECO Shift Supervisors, in particular, made contact on each shift with each Burns supervisor. The results of these observations were documented in NNECO shift round sheets. Based on checks completed from January-July, 1988, no instances have been identified where Burns personnel were unfit for duty. This finding was confirmed by inspector discussions with the Security Supervisor and a review of the NNECO shift round sheets from January - May 1988, and based on inspector observations of security personnel during routine inspections, including backshift periods. The allegation was not substantiated. Licensee monitoring of Burns personnel for fitness-for-duty continues. Based on the above, this item is closed.

10.5 Safeguards Material Taken Offsite

During an August 24 - September 18 training class, the Burns instructor provided Safeguards information about the Central Alarm Station (CAS) to the alleger and two other students. The other students took the material home for study, which failed to meet the intended controls for the material. The training material was returned and properly controlled at the end of the training session. This matter was referred to the licensee for followup.

Licensee review substantiated the concern as presented. Licensee corrective actions included instructing the Burns Training Department on the licensee's administrative requirements for safeguards material, and to counsel the instructors involved. Licensee review concluded that the temporary loss of control of the material had minimal security significance in that the material was recovered, and it could not be used to the detriment of site security without the prior occurrence of several other security breaches. Licensee followup actions were proper. Based on the minimal security significance of the incident and the licensee's corrective actions, no further NRC action is warranted. This item is closed.

10.6 CAS Mistakes Covered Up

This item involved the concern that mistakes were made in the CAS during routine duties, and the mistakes were not reported to Burns supervisory personnel. No examples or specifics were provided.

No further NRC followup of this item could be made without further specific information. CAS operations received particular attention in recent routine security inspections (Reference Inspection Report 50-245/88-04, 50-336/88-08, and 50-423/88-06), and during NRC pre-licensing reviews for Millstone Unit 3. Very good performance was noted during these inspections. Based on the above, this item is closed.

10.7 Stealing Covered Up

This item involved a guard who was reportedly observed stealing supplies from NNECO. The alleger prepared a routine report on the incident and submitted it to a Burns Supervisor, but the matter was not reported to NNECO. The alleger heard the Burns supervisor tell the guard not to steal when the alleger was around. This matter was referred to the licensee for followup.

Licensee review identified that a specific incident occurred in January 1988. A guard took some pens and stationary from a warehouse for use onsite. While the guard would otherwise be entitled to the supplies, they were not obtained in the expected manner. When the incident was reported to Burns supervision, disciplirary action was taken by the supervisors, but their failure to notify NNECO did not meet the licensee's expectations. The licensee addressed this matter to assure future communications would be adequate. The licensee stated that performance by the Burns Supervisor involved has otherwise been acceptable.

The licensee concluded that the statement made about not stealing while the alleger was around represented an error in judgement by the Burns supervisor, but not a coverup. Based on the above, the inspector concluded that actions by the licensee and Burns to maintain guard force integrity were appropriate. This item is closed.

During an interview with the alleger on August 2, 1988, additional concerns were identified regarding alleged alcohol and drug use by workers at the station. This matter is under further review by the NRC staff, and will be addressed further in a subsequent routine inspection report.

11.0 Licensee Event Reports (LERs)

Licensee Event Reports (LERs) submitted during the report period were reviewed to assess LER accuracy, the adequacy of corrective actions, compliance with 10 CFR 50.73 reporting requirements and to determine if there were generic implications or if further information was required. Selected corrective actions were reviewed for implementation and thoroughness. The LERs reviewed were:

-- LER 88-18-00, Failure to Log Auxiliary Sample Rig Flow Rate (NV4 88-12-01). This licensee-identified item was evaluated as being of low safety significance, appropriately reported and corrected, and not a result of inadequate corrective action on a prior violation. Therefore, no Notice of Violation was issued.

-- LER 86-17-01, Reactor Trip Due to General Warning Due to Faulty Power Supply. The licensee implemented a long term monitoring program to uncover the cause of a spurious reactor trip due to a "B" train General Warning Alarm with the "A" train out-of-service (OOS). On January 3, 1988 after special testing, the cause of the general warning alarm was traced to a momentary sag in a 48 VDC power supply. No inadequacies were noted.

12.0 Maintenance

The inspector observed and reviewed selected portions of preventive and corrective maintenance to verify compliance with regulations, use of administrative and maintenance procedures, compliance with codes and standards, proper QA/QC involvement, use of bypass jumpers and safety tags, personnel protection, and equipment alignment and retest. The following activities were included:

-- RCS Gross Activity Sample dated 7/15/88

-- Chlorination Water Booster Pump Repair dated 7/21/88

No inadequacies were identified.

13.0 Surveillance Testing

The inspector observed portions of surveillance tests to assess performance in accordance with approved procedures and Limiting Conditions of Operation, removal and restoration of equipment, and deficiency review and resolution. The following tests were reviewed:

-- RWST Boron Concentration SP 3859-1 dated 7/26/88

-- Monthly Fire Extinguisher and Fire Hose Conditions SP 31502-3 dated August 15, 1988

-- Vital Battery Inspection SP 3712NA dated 8/15/88

No inadequacies were noted.

14.0 Management Meetings

Periodic meetings were held with station management to discuss inspection findings during the inspection period. A summary of findings was also discussed at the conclusion of the inspection. No proprietary information was covered within the scope of the inspection. No written material was given to the licensee during the inspection period except as annotated in Detail 8.0.

ATTACHMENT 2

STORAGE BATTERY INSPECTION SAMPLE

The following identifies the wet cell battery inspection sample. It may be provided to the licensee for more efficient identification of data relevant to assessing compliance with the current licensing basis.

1. General Battery Information

   Document the below information for batteries which carry vital loads.

   (1) Qualified, or design, seismic life.

   (2) Qualified, or design, electrical life.

   (3) Age.

   (4) Time in service.

   (5) Plans for replacement.

2. Previous Licensee Actions

   Identify actions taken on the following IE Information Notices: 83-11, Possible Seismic Vulnerability of Old Lead Storage Batteries; 84-83, Various Battery Problems; 85-74, Station Battery Problems; and 86-37, Degradation of Station Batteries.

3. Seismic Lifetime and Qualification

   For batteries supplying vital loads, identify the following information.

   (1) Licensee and/or manufacturer's establishment of seismic lifetime. This maybe through documentation allowing verification by competent personnel other than the qualifiers and containing design specifications, the qualification method, results, and justifications (ref: IEEE 535-1986).

   (2) Seismic qualification maintenance. Identify how the criteria for assuring that the battery and rack will maintain seismic qualification are defined, available, and used for periodic inspections and cell replacements. Identify the criteria for determination of seismic end of life based upon the in-service condition of the battery.

4. Electrical Sizing and Qualification

For batteries supplying vital loads, identify the following information.

(1) Confirmation that the battery size is sufficient to handle the load profile with a suitable margin.

(2) The means of tracking and control of battery loads such that the batteries and their replacements will have sufficient capacity throughout design life, if worst case electrolyte temperature and other worst case conditions exist when the battery is called upon to perform its design function.

(3) The provisions for consideration of the effect of jumpered out cells upon the ability of a battery to perform under worst case conditions.

5. Battery Ventilation and Protection From Ignition Hazards

For batteries carrying vital loads, identify the following.

(1) The provisions for assuring adequacy battery ventilation during normal operation, outages, charging, and discharge.

(2) Adequacy of checks of battery ventilation flow.

(3) Adequacy of controls over battery ventilation impediments such as enclosing the battery space or its ventilation with plastic sheeting, or any other ventilation obstructions, during outages and other periods.

(4) Adequacy of hydrogen detection equipment and its calibration and use, or of the technical justification for not using such equipment.

(5) Knowledge of the hydrogen hazard on the part of plant management, operating shift management, and personnel who access the battery spaces.

(6) Prohibition of hot work and smoking in battery spaces, including checking the spaces for the residue of such activity.

(7) Assurance that battery cells are secured, with post-to-case and top-to-jar seals tight. Thermometers should not be left in cells after temperatures are measured. Caps on the filler openings should be properly secured when not required to be off. (Cells should be vented only through the flash arrestors.)

(8) The means of assuring proper elimination of water-carrying pipes (e.g., HVAC lines) from battery spaces, especially those which may carry salt water.

(9) The means of positive control over the quality of water added to the batteries to assure that the manufacturer's recommendations or an appropriate licensee standard are met or exceeded.

(10) The assurance of elimination of combustibles, and loose equipment and conductors, from battery spaces.

6. Electrolyte Temperature Control

For batteries supplying vital loads, identify the adequacy of the following.

(1) Avoidance of localized heat sources such as direct sunlight, radiators, steam pipes, and space heaters.

(2) That the location/arrangement provides for no more than a 5F difference in cell temperature, as confirmed by measurements representative of operating conditions. If this is not the case, then the licensee and manufacturer should have identified the consequent impact on expected battery and individual cell capacity and life, and surveillance procedures should reflect the additional allowable temperature variation.

7. Charging

For batteries carrying vital loads, identify the adequacy of the following.

(1) Provision for a freshening charge after more than 3 months of being on open circuit, unless determined by the manufacturer to be unnecessary to assure rated capacity throughout life.

(2) Accomplishment of equalizing charges at 18 month intervals, and when the corrected specified gravity (SG) of an individual cell is more than 10 point (0.010) below the average of all the cells, and when the average corrected SG of all cells drop more than 10 points below the average installation value, and if any cell voltage is below 2.13V. (Specific manufacturer's provisions and assessment may allow the non-performance of some of these recommended charges, or may provide different criteria.)

(3) Control over battery water quality such that specified purify is confirmed before addition, that water added just prior to charging is added only to bring the electrolyte up to the prescribed minimum (to prevent overflow during charging), and that water added after and between charges not bring the level above the prescribed maximum (unless manufacturer's instructions provide for other water addition measures).

(4) That routine float and final end of charge SGs not be taken before 72 hours of float operation after completion of the charge and the last water addition, unless the manufacturer's instructions provided otherwise. (The need is for measurement of representative cell levels and average them.)

(5) Establishment and maintenance of float voltage on accordance with the manufacturer's instructions.

(6) Assurance that single-cell charger use does not violate Class 1E independence from non-class 1E equipment.

8. Performance Tests and Replacement Criteria

For batteries carrying vital loads, identify the following.

(1) Initial acceptance testing which demonstrates the ability of the batteries to meet the manufacturer's rating.

(2) Service testing which demonstrates the ability to carry the load profile with an appropriate margin for worst case conditions, including end of life loss of capacity under the worst case electrolyte temperature.

(3) Accomplishment of a performance test (capacity test discharge) within the first two years of service and at 5 year intervals until signs of degradation are evident or 85% of the qualified service life is reached.

(4) Annual performance testing of batteries which show signs of degradation or which have reached 85% of the qualified service life is reached.

(5) End of electrical life criteria which consider the rapid end of life drop-off in capacity, worst case state of charge during float service, worst case electrolyte temperature, current DC loads, and the time needed to replace the battery while it can still handle worst case conditions.

9. Other Safety-Significant Wet Cell Batteries

For safety-significant wet cell batteries not used for vital loads, show how the maintenance program periodically determines the ability to perform the design function and provides for timely replacement of batteries and for maintaining associated equipment (e.g., chargers).