U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Docket/Report: 50-317/85-13 License: DPR-53
50-318/85-11 DPR-69

Licensee: Baltimore Gas and Electric Company

Facility: Calvert Cliffs Nuclear Power Plant, Units 1 and 2

Inspection At: Lusby, Maryland

Dates: May 6, 1985 - June 17, 1985

Inspectors: for T. Foley, Senior Resident Inspector — 7/5/85 Date

for D. C. Trimble, Resident Inspector — 7/5/85 Date

Approved: T. C. Elsasser, Chief, Reactor Projects Section 3C — 7/5/85 Date

Summary: May 5-June 17, 1985, Inspection Report 50-317/85-13, 50-318/85-11.

Areas Inspected: Routine resident inspection of the Control Room, accessible parts of plant structures, plant operations, radiation protection, physical security, fire protection, plant operating records, maintenance, surveillance, open items, and reports to the NRC. Total Inspection Hours 120.

Results: A significant portion of this inspection was dedicated to followup inspection of licensee actions with regard to diesel generator (DG) interpolar connecting bar and pressurizer spray valve fastener problems. In both cases, the licensee demonstrated strong initiative and took conservative actions in resolving safety concerns. Some weaknesses were, however noted in the identification of cracks in and incomplete removal of DG interpolar connecting bar stubs. A licensee Quality Assurance audit is in progress which should better define these weaknesses. The spray valve fastener problem showed inadequacies in maintenance personnel training in bolting practices and in administrative controls of bolt tensioning evolutions.

One violation was identified regarding unnecessary initiation of automatic plant protective systems (Recirculation Actuation Signal on Unit 2 and loss of shutdown cooling on Unit 1 due to closure of a return isolation valve) due to personnel errors.

DETAILS

1. Persons Contacted

Within this report period, interviews and discussions were conducted with various licensee personnel, including reactor operators, maintenance and surveillance technicians and the licensee's management staff.

2. Summary of Facility Activities

Unit 1 remained shutdown throughout the inspection period in an extended refueling outage. Startup, originally scheduled for the first week in June, was delayed due to the discovery on May 22 of low resistance readings on the main generator A-phase stator windings. The projected startup date is August 15, 1985.

Unit 2 began the period operating at full power. The unit was shutdown from May 17 to May 22 to inspect and replace pressurizer spray valve fasteners. On May 23, with the unit at 100% power, an inadvertent Recirculation Actuation Signal (RAS) was generated due to technician error on performance of a surveillance test. The actuation did not induce any transients of a safety or operational concern.

On May 14 an interpolar connecting bar in the generator of #11 Diesel Generator (DG) broke free within the generator and caused significant damage to the stator windings. Further investigation revealed a large number of fatigue induced cracks in the interpolar connecting bars of all three DG's. An engineering evaluation showed that the connecting bars were unnecessary and all bars were removed from #12 and #21 diesel generators. The generator for #11 DG was replaced with a new generator with connecting bars installed. Those bars will be removed at a later date.

Three inspections were conducted by regional specialists in the following subject areas: Integrated Leak Rate Testing (Unit 1), environmental monitoring, and DG interpolar connecting bar fatigue cracking.

3. Licensee Action on Previous Inspection Findings

(Closed) Inspector Follow Item (317/84-18-02) Install Signs on Safety Related Outside Tanks Warning That Vents Should Not Be Obstructed. The inspector confirmed that the subject signs had been installed.

(Closed) Unresolved Item (317/84-23-01) Review of Temporary Plant Modifications for Unreviewed Safety Questions. As discussed in Inspection Report 50-317/85-09, 50-318/85-09, Section 3 (Item 317/84-18-01) on April 4, 1985 the licensee made a major revision to CCI 117, "Temporary Mechanical Device, Electrical Jumper, and Lifted Wire Control", requiring appropriate review/evaluation of temporary modifications. This item is closed.

(Closed) Violation (317/84-23-02) Failure to Follow the Requirements of CCI 117D, "Temporary Mechanical Device, Electrical Jumper and Lifted Wire Control". The subject event was the improper installation of a blank flange on the letdown line and subsequent overpressurization of a section of that piping. The requirements of CCI 117 and importance of good communications between the maintenance and operations groups were discussed with maintenance and operations personnel. Additionally, improvements were made to CCI 117D to require inclusion of a sketch or marked up drawing showing proposed locations of any blank flanges. This item is closed.

(Closed) PAS Item (317/82-01-05) No Designation of Corrective Action and Other Records to be Reviewed by the Off Site Safety Review Committee (OSSRC). The inspector reviewed the OSSRC Manual, Technical Specifications 6.5.2.7 (required OSSRC reviews) and 6.5.2.8.1 (required OSSRC audits). The committee has broad review responsibilities which include corrective actions (e.g. Nonconformance Reports). A large number of other records are required to be reviewed (safety evaluations, LERs, Technical Specification Changes, violations, POSRC minutes, audit reports, etc.). Various audits conducted under the cognizance of the OSSRC encompass review of records applicable to the subject area. This item is closed.

(Closed) Violation (317/83-26-03) Failure to Fully Implement a Surveillance Test Procedure (STP). This item concerned an error in STP O-7-1, "Engineered Safety Features, Logic and Performance Test", in that direction was not given to return the service water inlet valve to #11 Spent Fuel Pool heat exchanger to its pretest condition. STP O-7 has been revised to correct the problem. All operational STP's were reviewed by senior licensed personnel to ensure that similar conditions did not exist. The violation also concerned a failure of an operator to carry out a step of STP O-7. The individual was counseled by the General Supervisor, Operations on the need for proper procedure implementation. The individual was required to draft an incident report which was distributed as required reading for all operations personnel. This item is closed.

(Closed) Unresolved Item (318/82-27-04) Confirm Number of Letdown Isolation Cycles Do Not Exceed Maximum Allowable. The licensee completed an engineering evaluation to determine the number of thermal transient cycles allowable for the CVCS (Chemical and Volume Control System) nonregenerative heat exchanger, charging piping and charging nozzles. Of these, the most restrictive components were found to be the charging nozzles (180 cycles allowable). The inspector confirmed with the licensee that the numbers of actual cycles experienced were less than the allowable. This item is closed.

4. Review of Plant Operations

a. Daily Inspection

During routine facility tours, the following were checked: manning, access control, adherence to procedures and LCO's, instrumentation, recorder traces, protective systems, control rod positions, Containment tem-

perature and pressure, control room annunciators, radiation monitors, radiation monitoring, emergency power source operability, control room logs, shift supervisor logs, tagout logs, and operating orders.

No violations were identified.

b. System Alignment Inspection

Operating confirmation was made of selected piping system trains. Accessible valve positions and status were examined. Power supply and breaker alignment was checked. Visual inspection of major components were performed. Operability of instruments essential to system performance was assessed. The following systems were checked:

-- Unit 1 Shutdown Cooling checked on May 30, 1985.
-- Service Water Alignment to #11 Diesel Generator checked on May 31, 1985.
-- Unit 1 Service Water in Service Water Pump Room checked on June 11, 1985.

No violations were identified.

c. Biweekly and Other Inspections

During plant tours, the inspector observed shift turnovers; boric acid tank samples and tank levels were compared to the Technical Specifications; and the use of radiation work permits and Health Physics procedures were reviewed. Plant housekeeping and cleanliness were evaluated. Verification of the following tagout indicated the action was properly conducted.

-- Tagout 166691, SRW to #12 Diesel Generator checked on May 31, 1985.

No violations were identified.

d. Other Checks

On May 14, 1985, Diesel Generator (DG) #11 was damaged when an interpolar connecting bar on the generator rotor broke free at one end, rubbed and abraded the stator winding and then completely separated by fracture. The insulation on one stator winding was substantially damaged. The DG was undergoing over speed testing at the time of failure. The DG engine is manufactured by Colt Industries, Fairbanks Morse Power Systems Division, Model 38TD8-1/8. The generator is a Fairbanks Morse, Type TGZDJ.

The interconnecting bars are copper and are a part of the amortisseur, or damping, winding. They are attached between rotor poles. The winding serves as a speed and voltage stabilizer and would be most useful in situations where a DG is required to run in parallel with other machines to dampen speed changes or if the generator is required to carry single phase loads that can cause the three phases to become imbalanced.

Calvert Cliffs has three (3) EDG's (#11, #12 and #21). Each generator has sixteen (16) interpolar connecting bars; eight (8) bars on each end. The seven bars remaining on the damaged end of #11 EDG were radiographed and six were found to contain cracks. All sixteen bars on #21 EDG were radiographed. Eleven bars had cracks and six bars were cracked completely through. A visual inspection of #12 EDG bars also revealed cracks.

Metallurgical analysis of the failed bar determined the predominant cause of failure was high stress due to cyclic centrifugal loading. This problem appeared to be of a design nature and not due to a material defect. The licensee estimated that it took approximately 400-500 start cycles for the cracks in the failed connecting bar to initiate and an additional 500 cycles for failure. The licensee replaced the generator for DG #11 with a new generator (with similar interconnecting bars). The connecting bars were removed from DGs #12 and #21. The licensee plans to remove the bars from DG #11 on an, as yet, undetermined schedule.

During a followup inspection on June 6, 1985, a region-based NRC inspector noted that several connecting bar stubs had been left attached to rotor poles on #12 and #21 DG's during bar removal. That inspector also noted, in a review of existing radiographs, indications of cracks near rotor poles. He expressed concern to the Plant Superintendent that cracks may be present in connecting bar stubs still attached to generator poles. The licensee did further radiographic examinations of the stubs and confirmed that several cracks were present. All remaining stubs were removed from the generators of #12 and #21 DG's.

The Facility Change Request, FCR 85-1025, which was used to remove the interpolar connecting bars specified that the cutting should be done "as close to pole face as possible". If this instruction had been closely followed, the later stub problem would never have arisen. The inspector questioned the General Supervisor, Operations Quality Assurance (GS-OQA) why several stubs had been left in the generator during the initial cutting, particularly given the above instruction. The GS-OQA stated he also had several questions about the planning and conduct of the bar removal and that he would initiate a special audit of this job. The inspector will review this audit when completed.

10 CFR 21 reports were submitted to the NRC on May 29, and May 21, 1985 by Louis Allis Co. (current manufacturer of these generators) and June 5, 1985 by Colt Industries (former owner of the generator manufacturing firm). The June 5 report recommended removal of the interpolar connectors.

In general, the licensee's actions in response to this issue were prompt and conservative.

e. Checks for Fatigue Cracking in the Salt Water System

During the period, the inspector noted two potential sources of corrosion fatigue problems in the Salt Water (SW) system and asked the Acting Plant Superintendent and Principle Engineer, Plant Engineering Nuclear, to evaluate whether or not periodic checks for fatigue cracking should be conducted for the subject components. The endurance limits of ferrous materials can be lower in salt water environments. Therefore, the possibility of fatigue problems may be greater in the SW system.

The disc in each butterfly valve of the SW system is fastened to its operating stem with a tapered pin. The plant has experienced a failure of one of those pins and a rapid closure of the valve ensued. The internals of butterfly valves located in headers shared by both SW loops, where a single valve failure could interrupt both trains of salt water flow, were later removed. However, the possibility of pin failures in remaining butterfly valves still exists, particularly in those valves that are exposed to greater turbulent flow due to their normally throttled position. No periodic check of the pins is presently conducted.

The inspector noted the presence of general corrosion and apparent pitting on exposed portions (outside the pump casing) on the carbon steel shaft on #23 SW pump. It is possible that similar corrosion is present on the shaft internal to the pump casing. Since (1) pits can act a surface stress concentrators and sites for initiation of cracks under cyclic stress and (2) these pump shafts have two additional stress concentrators (shaft diameter change and a keyway) inside the pump casing, the inspector felt the need for a periodic check of SW pump shafts for fatigue cracks should be evaluated. No such checks are conducted at this time.

The Principle Engineer, Plant Engineering Nuclear, indicated that conduct of these checks would be considered and could perhaps be done during routine preventative maintenance of the SW pumps and when SW valves are removed from the system for other maintenance actions.

f. Precautions to Prevent AFW Pump Steam Binding

During the period, the inspector reviewed licensee controls to prevent steam binding of Auxiliary Feedwater (AFW) Pumps. Calvert Cliffs had previously experienced back-leakage from the steam generators. In response they added an additional check valve in the steam driven and motor driven pump discharge lines. These check valves are of a "tilted" disc design which provides for seating under low differential pressure conditions. The licensee has had no recent check valve back-leakage problems. As a precautionary measure, weekly pyrometer readings are taken of AFW pump casings (PM 2-36-4-0-W). If temperatures exceed 10 degrees F above ambient conditions, an investigation for back-leakage is initiated. Operating Instruction OI-32, AFW System (Revision 22 for Unit 1 and Revision 20 for Unit 2), contains a general precaution to "ensure AFW pump is vented properly if steam binding of the pump is evident before running the pump". No unacceptable conditions were identified by the inspector.

5. Events Requiring Prompt Notification

The circumstances surrounding the following events requiring prompt NRC notification pursuant to 10 CFR 50.72 were reviewed.

Inadvertent Recirculation Actuation System (RAS) Actuation and Loss Of Shutdown Cooling

On May 23, 1985, during performance of Surveillance Test Procedure (STP) M-220-2, ESFAS Functional Test, on Unit 2, instrument technicians encountered difficulty in testing a Refueling Water Tank (RWT) level switch. At the time, the channel under test was in a trip or actuation state. The technicians then, without first conferring with their acting supervisor, removed the cover from a second level switch to make a physical comparison between switches. Removal of the cover caused the actuation of the second channel resulting in RAS actuation. The unit was at power operation at the time. No significant problems resulted from the actuation (i.e., Containment sump valves opened but due to the presence of in-line check valves, no water flowed to the sump from the RWT; Low Pressure Safety Injection Pumps were not in operation and the trip signal sent by RAS, therefore, had no effect on them). The test was later repeated by more senior technicians and all level switches (2-LS-4142A-D) were found to be working properly. The inspector discussed the event with the technicians' Assistant General Supervisor. The technicians failed to follow instructions given by their acting supervisor, regarding notifying him so he could be present for the test, and did not follow the directions and two general precautions in the STP.

Section V of the STP requires removal of each RWT level switch channel, one at a time, for testing. General Precaution B emphasizes that only one channel is to be affected by the test ("be in a test mode") at any one time. General Precaution A directs technicians to "Proceed through each section of this (procedure) in sequential steps." If expected results are not obtained in a step, do not proceed with the testing of the affected channel until the required test results are obtained by applicable corrective action.

At 10:45 a.m. on June 2, 1985, with Unit 1 in Mode 5, shutdown cooling was lost due to operator error. Reactor Coolant System (RCS) pressure was allowed to increase to about 280 psia and as designed, automatic closure of a shutdown cooling suction isolation valve (1-MOV-652) occurred. The second pump used for shutdown cooling (Low Pressure Safety Injection Pump) was out of service for maintenance. RCS pressure was quickly reduced by charging pump auxiliary spray to the pressurizer, and shutdown cooling was restored at 11:08 a.m.

Coincident with this event, the plant computer, which normally provides additional pressure indication and an alarm to warn operators that RCS pressure is approaching the 280 pound range, was inoperable (had failed earlier that day). Additionally, an annunciator warning of low shutdown cooling pump suction pressure did not properly alarm after the suction valve closed. The plant was operating under Operating Procedure OP-1, Plant Startup from Cold Shutdown, Revision 26, at the time. That procedure includes two precautions,

under General Precaution IE and Initial Condition IIA.4, stating that whenever the shutdown cooling system is in operation, RCS pressure shall not exceed 270 psia.

The licensee could not explain why the annunciator had not functioned. Its pressure switch was later bled down and annunciation occurred in the expected range of pressure (as measured by an indicator associated with the switch). The inspector recommended that the switch's calibration be checked. The licensee stated this would be done.

The failure to follow procedural guidance was the principal cause of the above events (RAS actuation and loss of shutdown cooling). Failure to follow appropriate procedures is a violation (317/85-13-01).

Control Room Ventilation HEPA Filters

During a surveillance test of both trains of the post accident Control Room (Loss of Cooling Incident) ventilation system, both trains of HEPA filters failed pressure drop, flow rate and D.O.P. tests. The filters were replaced and a Licensee Event Report (LER) was submitted. The filters were replaced which corrected the efficiency and pressure drop problems. The flow rate problem was resolved by a damper adjustment. The licensee attributed the inability to pass the D.O.P. and pressure drop tests to the accumulation of dust/dirt of the filters due to large scale building renovation activities in the room. The flow rate will be checked monthly for two months and again six months later to assure the damper adjustments were adequate.

6. Observations of Physical Security

Checks were made to determine whether security conditions met regulatory requirements, the physical security plan, and approved procedures. Those checks included security staffing, protected and vital area barriers, vehicle searches and personnel identification, access control, badging, and compensatory measures when required.

No violations were identified.

7. Review of Licensee Event Reports (LER's)

a. LERs submitted to RI were reviewed to verify that the details were clearly reported, including accuracy of the description of cause and adequacy of corrective action. The inspector determined whether further information was required from the licensee, whether generic implications were indicated, and whether the event warranted onsite followup. The following LER's were reviewed.

LER No.	Event Date	Report Date	Subject
Unit 1			
85-03	04/06/85	05/03/85	Shutdown for Refueling Outage
85-04	04/06/85	05/02/85	ESFAS Occurred During Surveillance Testing
85-05	04/06/85	04/29/85	Inadvertent Initiation of Steam Generator Isolation
85-06	04/18/85	05/16/85	UGS Removal Without Fuel Handling Supervisor Present
85-07	04/15/85	05/15/85	HPSI Injection Legs' Flow Imbalanced
Unit 2			
85-01	04/25/85	05/23/85	Manual Trip Caused by Degradation of 21A Reactor Coolant Pump Shaft Seal
85-04*	05/18/85	06/13/86	Control Room Post LOCI Filter System Inoperable
85-07	04/15/85	05/15/85	HPSI Injection Legs' Flow Imbalanced

*See Section 5 for further details.

8. Plant Maintenance

The inspector observed and reviewed maintenance and problem investigation activities to verify compliance with regulations, administrative and maintenance procedures, codes and standards, proper QA/QC involvement, safety tag use, equipment alignment, jumper use, personnel qualifications, radiological controls for worker protection, fire protection, retest requirements, and reportability per Technical Specifications. The following activities were included.

-- MO 205-151-300A, #12 Diesel Generator MCC Bus Bar Inspection observed on May 31, 1985.

-- MO 203-003-257A, Tack weld of bolts to lube oil flange for #12 Diesel Generator observed on May 31, 1985.

-- PM 1-24-F-R-12, #12 Diesel Generator Control Relays observed on May 31, 1985.

-- Inspection of #21 LPSI pump coupling performed on June 11, 1985.

No violations were identified.

9. Surveillance Testing

The inspector observed parts of one test to assess performance in accordance with approved procedures and LCO's, test results (if completed), removal and restoration of equipment, and deficiency review and resolution. The following test was observed:

-- STP O-5, Unit 2 Auxiliary Feedwater Pumps test observed on June 13, 1985.

The inspector reviewed documentation for the following completed Surveillance Tests:

-- STP M-2-1, Pressurizer Safety Valve setpoint check for 1-RV-200 and 201 reviewed on June 12, 1985.

-- STP M-8-1, Component Cooling Relief Valve RV-3827 setpoint checked reviewed on June 12, 1985.

-- STP M-11-1, Unit 1 Snubber Functional Test reviewed on June 12, 1985.

No violations were identified.

10. Radiological Controls

Radiological controls were observed on a routine basis during the reporting period. Standard industry radiological work practices, conformance to radiological control procedures and 10CFR Part 20 requirements were observed.

No violations were identified.

11. Pressurizer Spray Valve Fasteners

On May 1, 1985, during a Unit 2 outage, the licensee found that one of eight body to bonnet stud fasteners was broken on pressurizer spray valve 2-CV-100F. The remaining fasteners on that valve were ultrasonically tested (UT) and no indications of cracks were found. The broken fastener was replaced with the specified 17-4 PH (ASTM A564, type 630) stainless steel material. A decision was then made to check the condition of the fasteners on the Unit 1 spray valves 1-CV-100E and 100F. Three bolts in each of these valves were rejected (by UT)) due to cracks or, in one case, due to fracture (a stud on valve 1-CV-100E). The rejected studs for 1-CV-100E were further examined. Two had indications of stress corrosion cracking (SCC) and the fractured bolt was apparently made of the wrong material. On May 17 and 18, the licensee reduced

power on Unit 2 and entered Containment to verify that the Unit 2 spray valve fasteners were made of the correct material (by magnet and eddy current tests). The licensee's decision to do this was also in part based upon a discovery that on May 3, 1985, a mechanic had tightened and very possibly over-torqued the body to bonnet bolts on 2-CV-100E to stop a leak. No torque specification had been provided to the mechanic. The checks on Unit 2 showed that 3 fasteners on each valve were made of the proper material and 5 on each were of improper material (type 316 stainless steel which has a lower yield strength than 17-4 PH). One crack was found in a 17-4 PH fastener on 1-CV-100E.

Due to an unavailability of 17-4 PH material, the licensee replaced the 316 stainless steel bolts and the cracked 17-4 PH bolt with A193 type B7 carbon steel bolts (Facility Change Request 85-28) and resumed power operation. They intend to replace the carbon steel bolts with 17-4 PH bolts at the next refueling outage (Fall 1985). A193 material is used in a number of fasteners in primary system valves.

No indication in plant maintenance history could be found that would indicate that any pressurizer spray valve studs had been replaced. Therefore, the valves could have been received from the vendor (ITT Hameldahl for all four valves) with improper fasteners installed. A review of all other ITT valves was conducted to verify correct stud material. Incorrect material (was supposed to be 17-4 pH) was found on 3 of 4 pressurizer spray bypass valves. These studs were replaced by studs of an approved material. A documentation review was undertaken to determine if valves supplied by two other major vendors specified 17-4 pH studs. No such valves were identified as being installed in either plant in other than non-critical applications.

I&E Bulletin 82-02, Degradation of Threaded Fasteners in the Reactor Coolant Pressure Boundary of PWR Plants, discussed industry problems with SCC and emphasized the need for maintenance crew training on proper bolting practices. In their bulletin response, the licensee indicated administrative and maintenance procedures had been reviewed and updated where necessary to ensure training in proper bolting/stud practices, detensioning and retensioning practices and gasket installation and controls. However, the mechanic who tightened the fasteners on Unit 2 valve 1-CV-100E was apparently not aware of the problems that can result from over-torquing. This coupled with the fact that no torque specifications were given to the mechanic indicates that the licensee's training/controls are weak.

Through discussions with licensee personnel, the inspector learned that torque specifications are not always provided by vendors. An industry group is trying to better define threshold torque valves below which SCC should not occur. The Plant Superintendent stated that he was very concerned about the apparent lack of maintenance personnel knowledge/training on bolting practices and felt a significant weakness was exposed.

The General Supervisor, Maintenance and Modifications, discussed the event with maintenance personnel and instructed them to not torque fasteners in any pressure boundary without first ensuring that appropriate torque specifica-

tions are given (either by Technical Manual or from the engineering group). The licensee is currently scheduling a training program for maintenance personnel on bolting practices.

Identification of proper torque specifications for critical fasteners, establishment of controls to ensure those torque values will be included in maintenance procedures, and completion of proper training for maintenance personnel will be reviewed by the NRC during routine inspection of maintenance activities.

12. Exit Interview

Meetings were periodically held with senior facility management to discuss the inspection scope and findings. A summary of findings was presented to the licensee at the end of the inspection.