U.S. NUCLEAR REGULATORY COMMISSION
REGION I

REPORT/DOCKET NOS. 50-317/92-28
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LICENSE NOS. DPR-53
DPR-69

LICENSEE: Baltimore Gas and Electric Company

FACILITY NAME: Calvert Cliffs Units 1 and 2

INSPECTION AT: Lusby, Maryland

INSPECTION DATES: November 3-6, 1992

INSPECTORS: H J Kaplan — 11-22-92
H. J. Kaplan, Sr. Reactor Engineer, Materials Section, EB, DRS — Date

Robert A. McBrearty — November 24, 1992
R. A. McBrearty, Reactor Engineer, Materials Section, EB, DRS — Date

APPROVED BY: E H. Gray — 11/30/92
E. Harold Gray, Chief, Materials Section, Engineering Branch, DRS — Date

Areas Inspected: An inspection was conducted of the licensee's erosion/corrosion (E/C) monitoring program, plant water chemistry and the inservice inspection program. The inspection was conducted to ascertain whether the program conformed to applicable code and regulatory requirements, and whether the activities were performed in a way that confirms the plant's acceptability to continue operation.

Results: The E/C program is generally good. Previous inspection results confirm that the program is effective in finding defective components and performing its intended function. The ISI program conforms with code and regulatory requirements. The chemistry control for the primary water in the RCS system was found to be effective and conform to Technical Specification requirements. For normal operating modes the key parameters were consistently well below the specified limits. The chemistry control of the steam generator secondary side was also found to be effective and the chemistry results compared favorably with other utilities using industry standards.

1.0 EROSION/CORROSION (E/C) PROGRAM (Inspection Procedure IP 49001)

1.1 Background

Concern regarding erosion and corrosion in balance of plant piping systems has been heightened as a result of the December 9, 1986, feedwater line rupture that occurred at Surry Unit 2. That event was the subject of NRC Information Notice 86-17, Bulletin 87-01 and Generic Letter (GL) 89-08. The GL specifies that all licensees provide assurances that a program, consisting of systematic measures to ensure that erosion/corrosion does not lead to degradation of single and two phase high energy carbon steel piping systems, has been implemented.

A formal inspection program was established at Calvert Cliffs in 1984. Inspection locations were established and prioritized using plant and industry experience and plant characteristics including piping geometry and material, flow velocities, system pressure and temperature. Originally, water chemistry characteristics were not used, but were included in the process after implementation of Materials Engineering and Analysis Implementing Procedure ME&AIP 5.05, "Secondary System Piping Erosion/Corrosion Inspection Procedure." When the present program was established, as discussed in the licensee's response to Bulletin 87-01 and Generic Letter 89-08, plant historical data, E/C rates and previous piping replacement information was available from the 1984 program. No computer based program such as the EPRI generated "CHECMATE" for system selection and prioritization was used at that time. The large accumulation of plant historical data, measurements from 1984 to the present, permits accurate wear rate predictions. Current plans are to initiate the use of "CHECMATE" by the middle of 1993.

1.2 Response to Bulletin 87-01 and Generic Letter (GL) 89-08

Bulletin 87-01 was issued on July 9, 1987, to provide information to licensees regarding erosion/corrosion problems at nuclear plants and requested licensee responses to specific actions defined by the Bulletin.

The response to Bulletin 87-01 to the NRC was by letter dated September 9, 1987, addressing the actions as requested by the Bulletin.

Generic Letter 89-08 was issued on May 2, 1989, and requested licensees to provide assurances that an erosion/corrosion program has been implemented. The licensee responded to the GL by letter dated July 19, 1989, and stated that a procedure would be in place by December 31, 1989, to control the E/C program. A followup response, dated February 26, 1990, in reply to the NRC 9/15/89 letter requesting written notification that the program has been fully implemented confirmed that the E/C program controlling procedure ME&AIP 5.05 was fully implemented on December 29, 1989.

1.3 Responsibilities

The supervisor of Nuclear Inspection Services Unit (NISU) is responsible for implementing the E/C program at Calvert Cliffs. A description of program responsibilities is found in ME&AIP 5.05. Nuclear Inspection Services is responsible for selecting and prioritizing systems and components for the E/C program. Inspections, ultrasonic thickness measurements, are performed by the licensee's inservice inspection contractor and the results are evaluated by the E/C engineer using pre-established acceptance criteria. The establishment of the acceptance criteria is the responsibility of the E/C engineer. Items requiring further evaluation are identified on an Issue Report generated by the E/C engineer and submitted to the appropriate system engineer who is responsible for performing the evaluation and disposition. The Issue Report is the mechanism by which E/C items are tracked through the licensee's tracking system.

No time constraint regarding the transfer of inspection results from the contractor to the E/C engineer and subsequently to the system engineer, and the evaluation and disposition of questionable results by the system engineer, was included in the controlling procedure. That apparent programmatic weakness was discussed with licensee representatives during the inspection and at the exit meeting. The licensee acknowledged the inspector's concern.

1.4 Program Implementation

Procedure ME&AIP 5.05 controls the E/C program. The procedure identifies the systems included in the program, acceptance criteria, inspection frequency, inspection techniques, prioritization of inspection points and the attributes used for inspection point selection.

Thickness measurements are taken at the intersecting points of a grid pattern that is marked on the pipe section under inspection. The procedure identifies the appropriate grid size which is based on pipe diameter. The procedure, additionally, requires that zero reference points be permanently marked on each inspection point.

Some exceptions to the controlled program were identified:

> The NRC inspector noted that the E/C program requires that inspection point EB-01-1005-05 be examined during each Unit 1 refueling outage to monitor a thin wall area resulting from weld fit-up during the construction of Unit 1. Inspection of the area since 1985 has produced confusing results, and data show that the inspections were not all performed the same way with similar equipment. Additionally, it is unclear from the data that the measurements were taken from the same reference point in each case.

Baseline thickness measurements of replacement piping are performed by the licensee in some cases. The procedure does not address baseline inspections and that was discussed with licensee representatives as a way to improve the overall E/C program.

In 1993, when the use of "CHECMATE" is initiated by the licensee, it would be beneficial if plant characteristics such as water chemistry be available to the E/C engineer for inclusion in the "CHECMATE" analysis. There is presently no procedure or mechanism that assures that the E/C engineer is made aware of that information.

The use of baseline inspections and the importance of plant operating characteristics with regard to the accuracy of "CHECMATE" analyses were discussed with licensee representatives during the inspection and at the exit meeting.

During the 1992 Unit 1 refueling outage, 240 component areas were subjected to E/C examination which resulted in the replacement of 21 components. In addition to that, 198 were replaced based on predicted wall loss.

Conclusions

The erosion/corrosion (E/C) program at Calvert Cliffs is generally good. A formal E/C monitoring program was initiated at the facility in 1984 and has resulted in a large library of wall thickness data to aid in predicting wear rates and selecting components for the monitoring program. When the use of "CHECMATE" is initiated for system selection, prioritization, and wear rate prediction, the effectiveness of the program will be enhanced.

Areas where the E/C program could be strengthened include the establishment of time constraints on the flow of data, the full use of baseline thickness measurements, the establishment of a mechanism to assure that the appropriate engineer is made aware of plant operating characteristics and changes to those characteristics, and oversight of the inspection contractor regarding performance of E/C inspections and data reporting for reproducibility.

2.0 INSERVICE INSPECTION (ISI) PROGRAM (IP 73051)

Selected items identified on the long term plan change record for Unit 1, the ISI 10-year long term plan and the ISI schedule of examinations for the Unit 2 . 3 refueling outage were selected for inspection. The inspection was performed to ascertain that ISI programmatic changes made during previous Unit 1 refueling outages were included on the permanent 10-year plan and in the licensee's computer data base, and that the examinations listed by the 10-year plan for the 1993 Unit 2 refueling outage were scheduled to be performed during the outage.

The items on the Unit 1 change record were determined to be included on the permanent 10-year long term plan and in the computer data base which provides confidence that the examinations will be performed at the appropriate time.

The 10-year program long term plan identifies the examinations that should be performed during the 1993 Unit 2 refueling outage. Items listed for the reactor pressure vessel, reactor coolant system, pressurizer and the pressurizer surge line were confirmed to be included in the inspection plan for this 1993 outage. This was established by comparing the 10-year plan with the Unit 2 1993 outage schedule of examinations.

The inspector determined that all of the selected items were included on the outage examination schedule for performance during the outage.

Conclusion

Changes to the ISI plan, which are found to be necessary during refueling outages are entered on the permanent record, and planned examinations are scheduled for performance at the appropriate time, thus providing confidence that the ISI program is maintained and tracked within ASME Code Section XI and regulatory requirements.

3.0 WATER CHEMISTRY (IP 84750)

3.1 Scope

The inspector reviewed Unit 1 and Unit 2 primary water and secondary side steam generator chemistry records for the period between January 1, 1992 through November 2, 1992.

3.2 Findings

The primary water results for the reactor coolant system (RCS), which included fluoride, chloride and dissolved oxygen, were found to be consistently well below Technical Specification (TS) limits. The fluoride, chloride and dissolved concentrations were consistently reported in the ppb (parts per billion) range as compared to the TS steady state limit of $\leq$ .15 ppm (parts per million). The fluoride ranged between 2.0 and 34.6 ppb, the chloride between 2.0 and 8.8 ppb, and dissolved oxygen at 10 ppb. The testing frequency was daily, thus meeting the TS requirement of once per 72 hours. For the secondary side, for example, Calvert Cliffs reported sodium concentrations of less than 10 ppb for SG-11 in this same period. The chemistry activities were controlled by various procedures. The principle specifications are CP-204 for primary water RCS system and CP-217 for secondary water systems. The requirements covering quality assurance and quality control are specified in CP-103. An overall review of these procedures indicated that they were written in great detail with appropriate data forms.

The inspector witnessed the analysis of a fluoride and chloride sample obtained from the RCS cold leg of Unit 2. The instrument (Dionex) calibration and control sample analyses attendant with the Unit 2 sample were found to conform to the aforementioned CP-103 requirement. The instrument calibration check was performed on 10/9/92 and the control standard immediately prior to running the RCS cold leg analyses. The fluoride and chloride control sample analyses were 10.4 and 9.30 ppb, respectively. The analyses of the cold leg sample were 3.99 ppb for fluoride and 3.37 for chloride.

The training record for the laboratory technician who performed the cold leg sample analysis was found to be continuous and covered a whole range of activities and subjects including the use of the Dionex instrument. The supervisory personnel were found to be knowledgeable and attentative to the activities in progress.

The inspector noted the excellent secondary side chemistry performance index (CPI) results and the positive round robin test results relative to other utilities. The CPI index for Units 1 & 2 was .12 - .26 and .16 - .29, respectively, which exceeded the goals established for Units 1 & 2. The INPO power industry median results ranged from .21 - .34. The CPI is a unitless number that attempts to quantify the chemical impurities which affect SGs. It is the ratio of three parameters; condensate oxygen, SG sodium and SG cation conductivity. The lower the index, the better the performance.

3.3 Conclusion

Chemistry control of the primary RCS system was found to be effective and in accordance with Technical Specification requirements. Chemistry control of the SG secondary side was found to be in accordance with industry standards.

4.0 UNIT 1 SURFACE CONDENSER

The inspector reviewed a metallurgical report on the failures of AL-6X stainless steel tubes removed from the Unit 1 surface condensers. On the basis of the evidence presented in the report, the inspector concurred with the Calvert Cliffs conclusion that the failure was caused by localized corrosion under deposits.

The inspector noted that the AL-6X performance may have been better had the tubes been solution annealed after forming and welding. The following information concerning the Units 1 and 2 surface condensers is noted.

- Units 1 and 2 condensers were retubed in 1982 because of excessive corrosion of the 70-30 copper-nickel tubes.

- Unit 2 was retubed with Titanium; Unit 1 with welded AL-6X stainless.

- Of the 49500 Unit 1 AL-6X tubes in six waterboxes, 1.9% (963) have been plugged because of eddy current indications greater than 60% throughwall.

- On the basis of the report, Calvert Cliffs concluded that retubing of Unit 1 with Titanium tubing was not warranted for the next refueling since 95% of the AL-6X tubes had no detectable defects.

5.0 EXIT MEETING

The findings of the inspection were discussed with the licensee representatives at the exit meeting on November 6, 1992, as indicated in Attachment 1. Within the scope of this inspection, no violations were observed.

ATTACHMENT 1

Persons Contacted

Baltimore Gas & Electric Company

* P. T. Crinigan, General Supervisor - Chemistry
* H. D. Enoch, Erosion/Corrosion Engineer
* K. M. Hoffman, Principal Engineer - Nuclear Inservice Inspection Unit
* T. Lupold, PES/SSEU
* W. Maki, Compliance Engineer
* D. Muth, Compliance Engineer
* B. Radford, Plant Engineering
* C. W. Smith, Plant Engineering
* D. Song, Inservice Inspection Engineer
* V. Spumar, PE SSEU
* J. Volkoff, Compliance Engineer

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* C. F. Lyon, Resident Inspector

* Indicates attendance at the exit meeting.