U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Meeting No. 84-41

Docket No. 50-317/50-318

License No. DPR 53/69 Priority ____ Category C

Licensee: Baltimore Gas and Electric Company
P. O. Box 1475
Baltimore, MD 21203

Facility Name: Calvert Cliffs Nuclear Power Station Units 1 and 2

Meeting At: USNRC Region I, King of Prussia, PA.

Meeting Conducted May 17, 1984

NRC Personnel:

K. Ferlic, Project Engineer, 1A — June 19, 1984 Date

D. Trimble, Resident Inspector — June 19, 1984 Date

E. Wenzinger, Section Chief, 1A — June 19, 1984 Date

Approved by: E. Wenzinger, Acting Branch Chief, DPRP No. 1 — June 19, 1984 Date

Meeting Summary:
Special announced management meeting to discuss the salt water system corrosion problem at Calvert Cliffs Units 1 and 2 and subsequent shutdown of Unit 1. The licensee presented their basis of action, investigation findings, proposed repair and future corrosion protection plans. The NRC presented their concerns and reviewed the licensee's actions.

DETAILS

1. Licensee Attendees

A. Lundvall, Sr., Vice-President Supply
M. Miernicki, Principal Engineer, Plant Engineer Nuclear
R. Pond, Jr., Principal Metallurgist
L. Russell, Plant Superintendent
A. Thorton, Principal Engineer, Nuclear Plant Engineering Unit
J. Tiernan, Manager, Nuclear Power

2. NRC Attendees

E. Blackwood, Acting Chief, Projects Branch, No. 1
S. Ebneter, Chief, Engineering Programs Branch
K. Ferlic, Project Engineer
T. Foley, Senior Resident Inspector
T. Martin, Director, Division of Engineering and Technical Programs
K. Murphy, Technical Assistant, DPRP
R. Starostecki, Director, Division of Projects and Resident Programs
D. Trimble, Resident Inspector
E. Wenzinger, Chief, Projects Section 1A

Background

Since 1974, Calvert Cliffs has had identified corrosion problems in the salt water piping system of Units 1 and 2. During the current 1984 refueling shutdown of Unit 2, the Unit 2 component cooling water (CCW) Heat exchanger (Hx) sea water channel heads were to be cleaned, inspected, and coated with a coal tar epoxy mixture to provide corrosion resistance. During the cleaning process on 5/3/84 the needle gun used to chip away corrosion products resulted in two through-wall holes in the No. 22 component cooling water Hx channel heads. There was no known external indication of through wall leakage prior to removal of the No. 22 heat exchanger from service. Although corrosion deterioration of the channel heads was expected, the accelerated rate of deterioration of the No. 22 CCW Hx channel head was unexpected. The through-wall holes appeared to be due to severe graphitic corrosion.

Subsequent to discovering the accelerated corrosion on the No. 22 CCW Hx, the licensee removed the lagging from all CCW and service water (SRW) heat exchanger channel heads on both units 1 and 2 to inspect for leakage. Unit 1 was at 100% power at the time.

On 5/5, through-wall seepage was found in the channel heads of both unit 1 CCW Hx's. Subsequent to a phone discussion between the NRC and licensee (early on 5/6) the plant superintendent initiated unit 1 shutdown at 3:10 am. Since both component cooling water heat exchangers were considered inoperable, due to the corrosion and seepage, the licensee declared an unusual event at 3:40 a.m. in

accordance with the emergency response plan, for mode changes due to failure to meet technical specification limiting conditions for operation. Corrosion product removal inside the channel heads of the No. 12 CCW Hx (5/8) revealed two through-wall holes in each channel head. The No. 11 CCW Hx was being used for decay heat removal.

Because of the accelerated corrosion of the cast iron CCW Hx channel heads, a sampling of all cast iron components in the salt water system was to be performed. On 5/14, inspection of the salt water pump casings on both units revealed graphitic corrosion which had appeared to have corroded the wall thickness to below the minimum required. The licensee declared the salt water system inoperable at 7:35 p.m. on 5/14 until further evaluation could be performed. Unit 1 was shutdown in mode 5. Unit 2 was shut down in refueling mode 6 and all fuel movement was terminated, and containment integrity was established until the results of the evaluation of sea water system corrosion was available.

Throughout the difficulties encountered by Calvert Cliffs Units 1 and 2, the NRC has closely followed the licensee's actions. The Senior Resident and resident inspectors were onsite. A Regional based inspector was dispatched to review the licensee's repair of the CCW Hx channel heads.

A management meeting was jointly agreed to by the licensee and NRC to discuss:

1) the unit 1 shutdown
2) extent of the salt water corrosion problem
3) future corrective actions and long term resolution

Licensee Presentation and Discussion

The licensee presented a brief history of the salt water system corrosion problem and the Baltimore Gas and Electric (BG&E) action prior to the discovery of the severe corrosion in the No. 22 CCW Hx channel head on May 5, 1984. In particular, BG&E reviewed the corrosion related work performed during the fall 1983 unit 1 refueling outage. Ultrasonic readings had been taken on Unit 1 CCW Hx channel heads using a 2.5 MHZ transducer. The results were thought to be satisfactory. Plans to coat the Unit 2 channel heads with a coal tar epoxy during the spring 1984 unit 2 refueling outage were made. Other cast iron components were under observation in accordance with the licensee's ongoing corrosion control program.

The licensee discussed the phenomenon of graphitic corrosion and the examination techniques employed. In particular, it was pointed out that the graphitic corrosion process is a leeching process with no material being removed but rather iron oxides and carbides are formed. Consequently, a visual inspection does not necessarily reveal the extent of the corrosion. The methodology used to evaluate the wall thickness of the cast iron was re-evaluated. It was determined that use of a 1 MHZ Transducer on the cast iron resulted in data which were much more reliable than the 2.5 MHZ transducer. The graphitic corrosion in the Hx channel heads was found to be accelerated by galvanic

corrosion. Although sacrificial zinc anodes were present, they were undersized for the large salt water flow which was present. The galvanic couple appeared to be between the tube sheet and channel head. The SRW Hx's were not as severely degraded and the degradation which did occur was localized. Other cast iron salt water system components were being degraded at markedly different rates depending on the local environment and degradation was found to be less severe where galvanic action was not present.

To assess the extent of the corrosion problem, samples of all salt water system cast iron components (CCW Hx channel heads, SRW Hx channel heads, ECCS room air coolers salt water heads, basket strainers to ECCS room coolers, valves, salt water pumps and piping) were inspected. Components which were suffering corrosion were evaluated against minimum wall thickness requirements. Initial calculations for the salt water pumps indicated that several pumps would not meet the minimum wall thickness and were declared inoperable. Refined calculations, which were on going and included other concerns (e.g. actual location of seismic constraints), indicated that the initial calculations were overly conservative and the required minimum wall thickness could be less. The conclusion of the evaluation of all cast iron salt water system components was that the only components suffering severe corrosion were the CCW Hx channel heads, several SRW Hx channel heads and several salt water pumps.

The planned repair of the degraded cast iron salt water components was presented. The salt water pump casings would be replaced if final calculations indicated deterioration beyond the required minimum wall thickness. The SRW Hx channel heads were not severely degraded and the localized corrosion problems could be repaired in the accordance with the applicable codes by use of plugs/patches. The eight CCW Hx channel heads (two channel heads per heat exchanger, two heat exchangers per unit) would to be handled differently. Four channel heads (two per heat exchanger, one heat exchanger on each unit) will be replaced with new channel heads. The remaining four will be repaired. BG&E presented the method of repair. The repair uses a coal tar epoxy for sealant and carbon steel "girdles" for longitudal and circumferential strength. Although the repaired channel heads were considered by BG&E to meet applicable code requirements, they will be replaced at the next outage of sufficient duration (outage of at least one week). It was understood that the outage of sufficient duration may not occur until the next planned refueling outage on each unit (Unit 1 approximately 12 months, Unit 2 approximately 18 months from now). The licensee stated that they would monitor the repaired CCW Hx channel heads for degradation and this monitoring would include an onshift visual surveillance.

The circumstances surrounding the Unit 1 shutdown on May 6, 1984 and the plant Operations and Safety Review Committee review of the operability of the CCW HX and throughwall leakage of the channel heads was presented and discussed.

NRC Action

The NRC Staff evaluated the licensee's actions and proposed repair of tne corrosion degraded salt water system components. The licensee was questioned on the extent of the corrosion problem and techniques utilized in assessing the degradation. Particular concern was raised over the fact that the codes did not address leakage of the repaired heat exchangers. The NRC requested the licensee to establish guidance on the criteria for the operability of the repaired CCW heat exchangers. The resident inspectors at Calvert Cliffs will continue to monitor the repairs/replacements and the salt water system surveillance.