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February 16, 1996

U.S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 and 2; Docket Nos. 50-317 and 50-318;
License Nos. DPR 53 and DPR 69
Licensee Event Report 96-001
SRW Heat Exchanger Microfouling Higher Than Assumed in Design Basis

The attached report is being sent to you as required under 10 CFR 50.73 guidelines. Should you have questions regarding this report, we will be pleased to discuss them with you.

Very truly yours,

Peter E. Katz

PEK/CDS/bjd

Attachment

cc: D. A. Brune, Esquire
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NRC FORM 366 (4-95)

U. S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Calvert Cliffs, Unit 1	05000 317	1 OF 06

TITLE (4)

SRW Heat Exchanger Microfouling Higher Than Assumed in Design Basis

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME: Calvert Cliffs, U2	DOCKET NUMBER: 05000 318
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OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR: (Check one or more) (11)						
			20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)	50.73(a)(2)(viii)
POWER LEVEL (10)	100		20.2203(a)(1)		20.2203(a)(3)(i)	X	50.73(a)(2)(ii)	50.73(a)(2)(x)
			20.2203(a)(2)(i)		20.2203(a)(3)(ii)		50.73(a)(2)(iii)	73.71
			20.2203(a)(2)(ii)		20.2203(a)(4)		50.73(a)(2)(iv)	OTHER
			20.2203(a)(2)(iii)		50.36(c)(1)	X	50.73(a)(2)(v)	Specify in Abstract below
			20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (include Area Code)
Craig D. Sly, Senior Engineer	410-495-4858

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
X	YES (If yes, complete EXPECTED SUBMISSION DATE).	NO		07	01	96

ABSTRACT (Limit to 1400 spaces, i.e., approximately15 single-space typewritten lines) (16)

The results of an ongoing investigation into tube side microfouling in our service water (SRW) heat exchangers indicate they may not have been capable of meeting their intended safety function during certain past periods of high Chesapeake Bay water temperatures. Using data obtained from a model shell and tube closed heat exchanger called a Side Stream Monitor (SSM), the maximum calculated tube side microfouling level and growth rates in the SRW heat exchanger tubes appear to be higher than originally assumed in our design basis calculations.

Thermal performance calculations have been performed on the SRW heat exchanger using the highest fouling factor calculated to date from the SSM data. They show that during some past periods of high bay temperatures when the heat exchangers had not been cleaned for greater than 14 days, the SRW heat exchangers may not have been operable.

The plant is currently in a safe condition with bay water temperatures well below current SRW operability limits. Additional actions will be addressed in a supplement to this LER.

I. DESCRIPTION OF EVENT

In our response to Generic Letter 89-13 we committed to perform testing to verify the thermal performance of our service water (SRW) system heat exchangers. In late 1993, we completed thermal performance testing to verify the heat removal capability of our SRW heat exchangers in the clean condition. The results, while not conclusive, indicated the SRW heat exchangers may not have been capable of meeting their intended safety function at the most limiting design accident conditions specified in the Updated Final Safety Analysis Report (UFSAR). The calculated fouling of a clean SRW heat exchanger (baseline fouling) plus the associated uncertainty from the thermal performance testing was larger than the available design margin, indicating the possibility of actual thermal performance being less than required to meet current plant design requirements. We reported the results and corrective actions surrounding this issue in LER 317/93-007.

The SRW System is a closed loop cooling system. Its UFSAR safety function is to supply cooling water to the emergency diesel generators (EDGs) and the containment air coolers during an accident. Each unit has two independent loops of SRW. The SRW heat exchangers utilize bay water via the saltwater system as their source of cooling on the tube side. The primary consideration for SRW System heat duty during the most limiting postulated scenario is post accident containment response and EDG service water temperature.

The actual tube side fouling factor for the SRW heat exchangers has been difficult to validate due to difficulties in mathematically separating the effects of microfouling and baseline fouling which are accounted for separately in the SRW heat exchanger design basis. Since issuance of LER 317/93-007, we have continued to investigate the low thermal margin issue for our SRW heat exchangers. In a letter from Baltimore Gas and Electric Company to Nuclear Regulatory Commission dated June 17, 1994, "Reply to Request for Additional Information - Service Water Operational Performance Inspection," we discussed our efforts to verify tube side microfouling for the SRW heat exchangers. We indicated that we were evaluating use of a Side Stream Monitor (SSM) to verify the tube side microfouling. The SSM provided a means of trending SRW performance which did not reduce system availability. The microfouling factor is a term used to describe the contribution of heat exchanger tube side microfouling to the fouling factor of the heat exchanger.

The SSM is a self-contained, skid-mounted shell and tube heat exchanger that was custom designed for use at Calvert Cliffs for the specific purpose of accurately modeling SRW heat exchanger tube side microfouling with respect to time and seasonal variations. It is located in the intake structure and ties into the circulating water seal water system. This system is supplied from the Unit 2 saltwater system. The SSM has been continuously recording tube side microfouling data since June 20, 1995. The data was scanned, recorded, downloaded, then used to calculate the tube side microfouling for each data set. An average daily fouling factor was then computed and plotted.

The SRW heat exchanger fouling factor currently used in our design basis was developed through extensive analysis and thermal performance testing. The current maximum allowable design fouling factor for the SRW heat exchangers is 0.0012 Hr-Ft2-oF/BTU. This fouling factor is made up of two independently derived components, baseline fouling and microfouling. The first component, baseline fouling is the fouling factor of a clean heat exchanger. Testing has shown the baseline fouling component has remained constant over the last two years at 0.0007 Hr-Ft2-oF/BTU. This baseline component is comprised of the tested fouling factor 0.00045 Hr-Ft2-oF/BTU and the testing uncertainty of 0.00025 Hr-Ft2-oF/BTU. The second component, microfouling measures the resistance to heat transfer created by the formation of a slime and silt layer on the inside of the heat exchanger tubes. Based on a qualitative study done in 1989, the microfouling of the SRW heat exchangers was postulated to build up to less than or equal to 0.0005 Hr-Ft2-oF/BTU during the 3 months between cleanings.

To date, we have collected data from three separate SSM operating cycles. An SSM operating cycle is defined as operation from initial cleaning to maximum equilibrium microfouling. The results of microfouling factor calculations using this data indicate that the maximum equilibrium microfouling and the microfouling growth rate are greater than currently assumed in our design basis calculations.

The SSM data indicates that following a mechanical cleaning, the time to reach the currently used maximum allowable microfouling value of 0.0005 Hr-Ft2-oF/BTU is as little as 14 days. This is a significantly shorter time than the 3 month interval upon which our tube cleaning was based in the past. The data also indicated the maximum equilibrium SRW heat exchanger microfouling level predicted by the worst case SSM data seen to date is 0.0010 Hr-Ft2-oF/BTU, resulting in a higher total equilibrium fouling factor (0.0017 Hr-Ft2-oF/BTU) than is currently used in the design basis calculations (0.0012 Hr-Ft2-oF/BTU).

The results of the SSM tests indicate the possibility that the SRW heat exchangers may not have been capable of meeting their intended safety function during certain past periods of high Chesapeake Bay water temperatures when the heat exchangers had not been cleaned within the past 14 days. Since operability of the SRW heat exchangers is a function of several factors including bay water temperature, tube side differential pressure and flow, and cleanliness, we have not yet determined at exactly what times in the past they were not operable. At the time of discovery both Units were at 100 percent power and bay water temperature was at less than 40 degrees Fahrenheit.

We have completed an operability evaluation for the SRW heat exchangers for both Units 1 and 2 that considers the conclusions of the SSM data and the current bay water temperatures. At Calvert Cliffs, the operability of the SRW heat exchangers is monitored by Operating Instruction (OI)-29, "Saltwater System." The operability of the SRW heat exchangers is a function of bay water temperature, SRW heat exchanger tube side differential pressure, and

tube side saltwater flow. The SRW operability curves in OI-29 were developed based on the design fouling factor of 0.0012 Hr-Ft2-oF/BTU.

II. CAUSE OF EVENT

The cause of the reduced design margin is that the original design calculations assumed minimum SRW flow to be the most limiting case. The SRW heat exchangers were sized based on these calculations. Current calculations recognize that assuming maximum SRW design flow rate to the containment air coolers during a combined loss-of-offsite power/loss-of-coolant accident results in heat being transferred from containment to the SRW System at a faster rate than desired. This causes higher post accident SRW temperatures than previously calculated, which challenges the ability of the EDGs to perform their design function. Because the resulting SRW heat exchanger design margins are relatively small, significant changes in design input parameters, such as fouling factors, can pose a challenge to SRW system operability.

III. ANALYSIS OF EVENT

The most limiting design basis accident under consideration in this case is a loss-of-offsite power concurrent with a loss-of-coolant accident followed by the most limiting single failure of an EDG. Failure of the EDG causes a loss of one train of Emergency Core Cooling System equipment, including one of two trains of Containment Spray, two of four Containment Air Coolers, and one train each of service water, saltwater, and component cooling water. At the time the accident occurs, the temperature of the Chesapeake Bay (i.e., saltwater inlet to the SRW heat exchanger) is assumed to be at the upper limit of the applicable OI-29 SRW operability curve. The OI-29 operability curves were developed assuming a fouling factor of 0.0012 Hr-Ft2-oF/BTU. Now that the fouling factor has probably increased, these curves were probably not conservative enough to ensure the ability of the SRW system to perform its intended safety function during this worst case scenario during some past periods of elevated bay temperatures.

We are still evaluating the results of the SSM testing and the impact on system performance. We are issuing this LER at this point in the discovery process to share the insights we have gained from the SSM test results in as timely a manner as possible. A supplement to this LER will be issued when the analysis of the SSM data and its effects are validated and better understood. The expected completion date of the supplemental LER is July 1, 1996.

IV. CORRECTIVE ACTIONS

Upon determining that our SRW heat exchangers were potentially not able to perform their intended design function, we established conservative operability limits based on the worst case SSM testing results. These operability limits are referenced in the Operations Shift Turnover Notes and will be incorporated into OI-29 when supporting design calculations are approved. The current operability limit is 70 degrees Fahrenheit without any allowance for an increased cleaning frequency.

We continue to monitor bay temperature and the SRW heat exchangers for signs of excessive fouling that might result in operability concerns.

Presently there are several strategies being implemented to address this issue, including:

A. Validation of the SSM analysis program and incorporation of the results into the design basis calculations, as appropriate.

B. Continuation of the SSM data collection effort to gain additional information on seasonal variations, and critical factors that affect microfouling.

C. Evaluation of the effects of the SSM results on the ability of all other major heat exchanger groups that utilize bay water as a cooling source to perform their intended safety function. None were initially estimated to be significantly affected.

D. Investigation of equipment and system modifications that will minimize the microfouling and/or reduce the peak post-accident heat load on the SRW heat exchangers.

E. Investigation of interim programmatic modifications, such as increasing the cleaning frequency of the SRW heat exchangers, to raise their operability limits for periods of high bay water temperatures.

We are currently pursuing the actions described above. Additional actions will be developed and implemented based on the results of the above items. These additional actions will be discussed in the supplement to this LER.

V. ADDITIONAL INFORMATION

A. Component Identification

Component	IEEE 803 EIIS Funct	IEEE 805 System ID
Service Water Heat Exchanger	HX	BI
Containment Air Cooler	CLR	BK
Emergency Diesel Generator	DG	EK
Saltwater System	N/A	KE
Containment Spray System	N/A	BE

B. Previous Similar Events

There have been two previous similar issues reported in LERs concerning the ability of the SRW heat exchangers to meet their intended safety functions in all design basis conditions. LER 317/93-007 discusses the results of the baseline fouling tests that were performed in 1993. The results, while not conclusive, indicated that the SRW heat exchangers may not have been able to meet their intended safety function at the most limiting accident conditions. LER 317/95-003 discusses an entry into Technical Specification 3.0.3 due to bay water temperatures exceeding administrative limits. The cause was a combination of circumstances that resulted in circulating water discharging back into the intake structure at a temperature that exceeded the administrative limits of the SRW heat exchanger in OI-29.

Neither of these past events could have reasonably been expected to have caused us to question the validity of the microfouling factors that were being used for the SRW heat exchangers at the time.