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ARTHUR E. LUNDVALL, JR.
VICE PRESIDENT
SUPPLY

November 21, 1981

Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

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U.S. NUCLEAR REGULATORY COMMISSION

ATTENTION: Mr. R. A. Clark, Chief
Operating Reactors Branch #3
Division of Licensing

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit No. 1 and Unit No. 2
Docket Nos. 50-317 and 50-318
Response to Questions on Boron Dilution Alarm

REFERENCE (A): A. E. Lundvall to R. A. Clark letter dated 3/23/81

(B): R. A. Clark to A. E. Lundvall letter dated 8/4/81

Gentlemen:

Reference (A) transmitted our proposed method for providing an alarm in the event of a boron dilution incident. Enclosed is our response to questions posed by NRC staff in Reference (B) relative to our proposal.

BACKGROUND

At the time of licensing of Units 1 and 2 for the current cycles, we agreed to provide the operator with a positive alarm to notify him in the event of a boron dilution incident. Hardware changes were to be incorporated by the beginning of the next cycle for each Unit. Reference (A) transmitted our proposed alarm system. Reference (B) requested that additional information be provided within 60 days which Mr. Jaffe of your staff agreed to extend to October 16. On October 13, Mr. Jaffe notified us that hardware and Technical Specification changes previously mandated should not be provided if our analysis did not indicate their need. We have reviewed possible dilution sources and mechanisms and have determined that additional Technical Specifications providing for hardware and for further limitations on dilution sources and on shutdown margin are not warranted.

Very truly yours,

BALTIMORE GAS AND ELECTRIC COMPANY

A. E. Lundvall, Jr. for

A. E. Lundvall, Jr.
Vice President - Supply

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MEB/AEL/djw

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Enclosure: Responses to Questions on Boron Dilution Alarm

Copies To: J. A. Biddison, Esquire (w/ Attach)
G. F. Trowbridge, Esquire (w/ Attach)
D. H. Jaffe - NRC
P. W. Kruse - CE

ENCLOSURE

QUESTION 1:

In the proposed Technical Spepcifications (TS) change you have split section 3.1.1.2 in two parts. The second of them, subsection 3.1.1.2.2, to be applied when partially draining the reactor coolant system in the cold shutdown mode, requires that the shutdown margin is increased to 4.3% and two charging pumps are taken out of service. An analysis of this partially drained cold shutdown mode has given a minimum time of 51.7 minutes from the initiation of the dilution event to criticality. However, we do not think it is the most limiting case because:

a. The active volume of coolant circulating in the reactor pressure vessel and the RHR loop during the cold shutdown mode with the primary loop filled up is not significantly larger than the active volume in the drained mode; and

b. The proposed TS 3.1.1.2.1 permits a shutdown margin of only 3.0% and does not limit the number of operable charging pumps.

Provide either an analysis of an event caused by inadvertent operation of all three charging pumps during a normal cold shutdown mode, or consider upgraded limitations to the shutdown margin and to the number of available charging pumps in the normal cold shutdown mode.

RESPONSE:

1. The active volume of the coolant circulating in the reactor pressure vessel and the RHR loop during the cold shutdown mode with the primary loop filled is 4159 $ft.^3$. This includes the smallest combination of volumes of the Shutdown Cooling System (SDC) and RCS that will achieve flow to one RCS cold leg. It does not include any volume in the reactor vessel above the top of the hot leg and includes only the one RCS hot leg and one cold leg volume directly between the reactor vessel and the SDC injection and return points.

2. The analysis of the boron dilution event in Mode 5 with 3% shutdown margin, all CEA's withdrawn, one charging pump operating, and on normal shutdown cooling (not in the drained mode) indicates 58.87 minutes from initiation of the event to criticality at 1900 ppm. As standard Plant practice has been to place two charging pumps in pull-to-lock whenever SDC is operating, and to minimize CEA withdrawal in Modes 4 and 5, there is a high probability that the operator will have more than one hour to notice and terminate a dilution incident.

3. The analysis of the dilution event in Mode 4 with 4.3% shutdown margin, three charging pumps operating, and on normal shutdown cooling indicates 27.6 minutes from initiation of the event to criticality at 1900 ppm. Reducing the number of operating charging pumps to two in this configuration increases the time to 41.47 minutes. This is the most limiting case as Technical Specification 3.1.2.4

requires at least two charging pumps be operable in Mode 4. Plant practice of placing two charging pumps in pull-to-lock and minimizing CEA withdrawal in Modes 4 and 5 provides a high probability that the operator will have more than one hour to notice and terminate a dilution incident.

4. In view of the low probability of a dilution incident and the even lower probability of it occurring at BOC with all CEA's withdrawn, shutdown cooling operating, and three charging pumps running, we find that Technical Specifications which restrict charging pump operability and increase shutdown margin for all cycle burnups are not warranted.

QUESTION 2:

The criteria in SRP 15.4.6 do not refer to the time of initiation of a dilution event, but to the time of alarm. In order to determine that the time interval available for corrective measures meets the intervals stated in SRP 15.4.6, information on the method of determining alarm setting and alarm time is needed. To support proposed alarm settings, calculational results which describe the correlation between the neutron flux and boron dilution need to be provided. Also, identify the procedure(s) that will be modified to specify how the operating staff determines the correct alarm setpoints.

RESPONSE:

Based on plant practices of limiting CEA withdrawal in Modes 4 and 5 and of placing two charging pumps in pull-to-lock when operating the shutdown cooling system, we find that a high probability exists that the operator will have at least one hour to notice and terminate a dilution event. The small probability of a dilution incident therefore does not justify the cost and effort to provide, monitor, maintain, and backup two independent Tech Spec'd alarm systems. We expect to utilize the plant boronometer and the WRLC computer alarm system when they are functional.

QUESTION 3:

It is the staff's position that the single failure criteria should be met when evaluating the capability to protect against boron dilution events. To meet this criteria, two independent means should be available for detecting and alerting the operator to a boron dilultion event during all modes of operation, Alerting means an audible signal.

We find your submittal unclear on this point. Proposed TS Table 3.3-1 would require a minimum of 2 Criticality Alarms in the Shutdown Modes 3, 4, and 5. The "Background" section indicates its two WRLC alarming through the single computer with a backup Plant boronometer. The Calvert Cliffs FSAR Table 9-12 gives the range of the boronometer as 0-2000 ppm. If this is correct, we do not understand how the boronometer can be used during cold shutdown or refueling.

We suggest you select two independent methods of alarming a boron dilution event and make applications for appropriate T.S. Backup for either channel being out of service could be operator recording a reliable indication of reactivity status at stated time intervals, which, when added to the "alarm to event time (15 to 30 min)" is less than the calculated time from initiation of the boron dilution event to criticality. The backup monitoring should also be covered in the TS.

RESPONSE:

See response to Question 2.

QUESTION 4:

In your analyses, you do not take into account the possibility of having continuous flow of unborated water through the standing charging pumps. Such flow might be established by the operation of a make-up pump controlling level in the CVCS tank. The capacity of that pump is not given in FSAR. Please discuss the possibility of flow higher than 44 gpm with two charging pumps out of service.

RESPONSE:

The shutoff head of the make-up pump is about 125 psid and plant practice is to maintain RCS pressure above 150 psia (to avoid venting Reactor Coolant Pumps) unless required to permit maintenance.

The calculated flow rate achievable by the Reactor Coolant Make-up Pumps into the RCS through standing Charging Pumps is 84 gpm if the RCS is depressurized and drained. However, in this mode the Make-up Pumps are verified out of service every 12 hours in accordance with Technical Specification 4.1.1.2.2.b.

A conservative flow rate of 100 gpm is assumed with the RCS depressurized but not drained. This flow rate cannot be achieved unnoticed through the Volume Control Tank (VCT), however, without failure of the high level and high pressure alarms on the tank, the tank relief valve, and unless the flow rate achieved is coincidentally equal to that dialed in on the control panel.

One of the two flow paths that bypass the VCT involves the Refueling Water Tank (RWT) make-up path and charging pump RWT suction path. To achieve this flow rate through this path would require three valves to be out of position, one of which is locked and another which has its position indicated in the control room. The other bypass path is associated with the chemical addition tank and is isolated from the charging pump suction by a locked shut valve that is checked shut monthly. A parallel flow path through the chemical addition tank itself would require three valves to be out of position and the flow rate would be severely restricted by the half inch piping. For flow to proceed unnoticed through any of these paths, the flow rate achieved must coincidentally equal that dialed in on the control panel.

We find that there is a very low probability of occurrence of dilution by this mechanism at BOC, in cold shutdown, with the RCS depressurized, with all CEA's withdrawn, and with the achieved flow rate coincidentally achieving that dialed in on the control panel.