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May 6, 1993

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318
Control Room Habitability - Interim Engineering Analysis For Thyroid Dose

REFERENCE: (a) Letter from Mr. R. E. Denton (BG&E) to NRC Document Control Desk, dated March 2, 1993, Control Room Habitability - Thyroid Dose Calculation

Gentlemen:

In Reference (a), we notified you of our intention to re-establish our thyroid dose calculation in accordance with 10 CFR Part 50, General Design Criteria (GDC) 19, as part of our planned Control Room HVAC Upgrade Project. On March 29, 1993, a telephone conference was held with you to discuss the referenced letter, to address interim measures to be taken while the thyroid dose calculation is being prepared, and to advise you of the scope of our plans for a permanent solution. The purpose of this letter is to submit the results of an interim analysis documenting our current methods for complying with GDC 19, pending the completion of the thyroid dose calculation.

As we discussed on March 29, an interim engineering analysis had already been prepared indicating that our post-LOCA thyroid dose will be maintained below the (GDC 19) 30-day limit of 30 rem, if the planned protective measures are implemented within a reasonable time frame. As we discussed, the protective measures that are available to our Control Room operators to be used following a loss-of-coolant accident (LOCA) are self-contained breathing apparatus (SCBA) and potassium iodide (KI) tablets. In accordance with the Calvert Cliffs Emergency Response Plan Implementing Procedures (ERPIPs), all licensed control room operators are trained in the use of SCBAs. A sufficient number of SCBAs are staged in the control room to provide protection to all control room operators following an accident. Additional SCBAs are staged elsewhere onsite for operators coming on-shift. KI tablets are stored in the onsite medical suite, a remote onsite staging area, and offsite locations, and are dispensed, as appropriate, by authorized individuals following recall of the Emergency Response Organization.

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The Bechtel computer program LOCADOSE was used to conservatively calculate the control room thyroid dose following a LOCA. A detailed summary of the assumptions used in this interim analysis is provided in Attachment (1). Based on this analysis, the 30-day thyroid dose, assuming no protective measures are implemented, was determined to be approximately 119 rem. The analysis was then modified to determine the amount of time the operators would have between the initiation of the accident and the implementation of the protective measures, in order to limit the 30-day thyroid dose to 30 rem. The analysis was performed assuming efficiencies of 90%, 95%, and 100% for the protective measures. (A Protection Factor [PF] of 10 is equivalent to an efficiency of 90%, and a PF of 1000 is equivalent to an efficiency of 99.9%.) The results of this interim analysis are as follows:

Efficiency	Operator Dose	Maximum Time To Implement Preventative Measures
100%	30 Rem	45 min
95%	30 Rem	38 min
90%	30 Rem	20 min

It is reasonable to approximate an efficiency of 100% (PF = 10,000) for SCBAs; therefore, the operators would have at least 45 minutes to don the SCBA. This time frame is consistent with guidance provided in our ERPIPs and Radiation Safety Procedures. Following recall of the Emergency Response Organization (within 60 minutes after the accident), selected individuals are authorized to administer KI tablets to all emergency organization personnel, including control room operators. In a very short time, KI absorption occurs in the thyroid and a blocking dose of KI will prevent the intake of additional iodine to the thyroid, thereby allowing the operators to remove the SCBAs, without increasing the thyroid dose. Based on the results of this interim analysis, we have concluded that the control room will remain habitable for operations personnel during and after all credible accident conditions.

In addition to the discussion of our interim analysis, we also provided a brief description of the scope of our Control Room HVAC upgrade project, and alternatives for a long-term solution. We plan to initiate a modification to the HVAC System which will isolate the intake on a Engineered Safety Features Signal. This modification is expected to reduce our Control Room thyroid dose by approximately 30%. As discussed, we plan to revise the GDC 19 thyroid dose calculation to remove unrealistic conservatisms, and to ensure the assumptions are updated to reflect the most current data available. This calculation may involve re-evaluating our atmospheric dispersion (chi/Q) factors and dose conversion (DCF) factors. The revised GDC 19 thyroid dose calculation would also include the effects of the modification to the HVAC intake isolation signal. If the results of the GDC 19 thyroid dose calculation do not meet the GDC 19 limit (30 rem thyroid), we will consider pursuing additional dose reductions through modifications to the Control Room HVAC filtration system. We are not prepared to discuss the specific nature of these modifications in any greater detail at this time.

Should you have any questions regarding this matter, we will be pleased to discuss them with you.

Very truly yours,

RED/NH/nh/dlm

Attachment: (1) Assumptions Used in Interim Engineering Analysis for a 30-Day Thyroid Dose for Control Room Personnel

cc: D. A. Brune, Esquire
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ATTACHMENT (1)

ASSUMPTIONS USED IN INTERIM ENGINEERING ANALYSIS FOR A 30-DAY THYROID DOSE FOR CONTROL ROOM PERSONNEL

The following assumptions were used in the interim engineering analysis which documents our current methods for complying with General Design Criteria 19, pending completion of a final thyroid dose calculation.

Computer Code

The Bechtel standard computer program LOCADOSE is a set of computer programs used to calculate radionuclide transport and individual doses. Two modules of the program are required to calculate nodal and offsite doses: the Activity Transport Program; and the Dose Calculation Program.

The Activity Transport Program in LOCADOSE simulates the release of radioactivity from a user-defined source (reactor core, reactor coolant system, damaged assembly, . . .), via the manual insertion of isotopic activities or via the automatic generation of activities based on the reactor power and the methodology of TID 14844. The code allows for separate iodine species (elemental, particulate, organic), iodine spiking factors, group release fractions, and the calculation of time-dependent daughter activities.

LOCADOSE allows the modeling of up to nine internal compartments or nodes (sprayed containment, unsprayed containment, control room, sump, . . .). The transport of fission products from one node to another is accomplished by the solution of a set of first-order differential equations, which include user-specified time-dependent production and removal terms (containment sprays, recirculation, plateout, purge and intake filters, atmospheric dispersion and natural decay) and which are evaluated using a matrix solution. The program also allows for variable purge valve closure times, user-specified filter efficiencies, and an automatic spray cut-off option. The program also calculates integrated activities within each node for each time step and the activity released to the environment during each time step, by modeling the nodal leak rates and purge options. This information is stored in a file called LOCATRAN to be read by the Dose Calculation Program.

The Dose Calculation Program utilizes the activities stored in the LOCATRAN file in conjunction with user input (atmospheric dispersion coefficients, breathing rates, occupancy factors) and a library of dose conversion factors to calculate time-dependent doses and dose rates. These doses are calculated at the internal nodes, including the control room intake, and at selected offsite dose points assuming a semi-infinite cloud model for immersion doses.

Assumptions

1) The pre-accident thermal power rating is 2754 MWt (102% power).

2) The fission product source term is based on guidance from TID 14844. This assumes that 100% of the noble gases and 50% of the iodines of the total core inventory are released to the containment volume immediately after initiating the accident. They are assumed to be instantaneously and uniformly dispersed in the containment. Of the released iodine, 50% is assumed to plate out on internal reactor surfaces, leaving only 25% of the total iodine available for leakage. The gaseous iodine is assumed to be present in the following forms; 91% elemental, 4% organic, and 5% particulate. The effectiveness of the iodine removal mechanisms are dependent on the form of the iodine being removed.

ASSUMPTIONS USED IN INTERIM ENGINEERING ANALYSIS FOR A 30-DAY THYROID DOSE FOR CONTROL ROOM PERSONNEL

3) The containment free volume is assumed to be 2.035E+06 cubic feet (UFSAR Chapter 14.17). This volume is divided into two regions representing the sprayed and unsprayed portions of the containment. The dividing point is the 69' operating deck. Since Containment Spray Header No. 1 is located at 182' 7" and the inside diameter of the containment is 130', the sprayed volume is estimated to be 1.48E+06 cubic feet, or 72. % of the containment volume. Thus the unsprayed volume, which is the difference between the net free containment volume and the sprayed volume, is 5.55E+05 cubic feet or 27.3% of containment.

4) The containment leak rate is assumed to be 0.2% per day for the first 24 hours and 0.1% per day for the duration of the accident per Regulatory Guide 1.4. Since the containment volume is 2.035E+06 cubic feet, the containment leak rate is 2.8264 cfm for the first day and 1.4132 cfm for the duration of the event.

5) All containment leakage is assumed to be discharged directly to the atmosphere. There is no credit taken for leakage to the penetration room. This is conservative, because approximately half of the containment penetrations terminate in the penetration room and therefore, a large percentage of the leakage could be assumed to go into this room. The ventilation system in the penetration room contains both HEPA and charcoal filters which would be assumed to reduce the radionuclide concentrations in the room prior to discharging the air to the plant vent. This is a dose reduction method that is not credited.

6) Two of the three iodine filters in containment are assumed to operate at 20000 cfm. One filter starts at t=0, while the second is manually started at 20 minutes. The elemental, organic and particulate iodine removal efficiencies are assumed to be 90%, 30% and 90%, respectively.

7) Two containment cooling units are assumed to operate post-LOCA with a flow of 55000 cfm each.

8) With minimum safeguards equipment in operation, one of two containment spray pumps are assumed to operate at 180 gpm. The spray delay time after containment spray actuation signal (CSAS) actuation is 60 seconds. The delay time for CSAS actuation is assumed to be 30 seconds.

9) The plateout removal coefficient of elemental iodine, by wall deposition due to the containment spray, is estimated by equations contained in Standard Review Plan 6.5.2, Revision 2. Assuming a total containment free volume of 2.035E+06 cubic feet and a total containment wetted surface area of 3.089E+05 ft**2 (UFSAR Table 14.16-1) yield a removal coefficient of 2.43/hr. The plateout removal of elemental iodine is limited by a maximum decontamination factor of 200, per the Standard Review Plan 6.5.2, Revision 2. This value is reached about 1.1 hours into the event. Plateout is assumed to occur in both the sprayed and unsprayed portion of the containment volume.

10) The spray removal coefficient for elemental iodine is estimated by the well-mixed droplet model given in the Standard Review Plan 6.5.2, Revision 2. This model yields a spray removal coefficient of 14.4/hr. The spray removal of elemental iodine is limited by a maximum decontamination factor of 13.7 (Standard Review Plan 6.5.2, Revision 2). The decontamination factor is reached about 13 minutes into the event.

ATTACHMENT (1)

ASSUMPTIONS USED IN INTERIM ENGINEERING ANALYSIS FOR A 30-DAY THYROID DOSE FOR CONTROL ROOM PERSONNEL

11) The spray removal coefficient for particulate iodine is estimated by the Standard Review Plan 6.5.2, Revision 2. This yields a particulate spray removal coefficient of 3.34/hr until a DF=50 is reached for particulate iodine, after which particulate spray removal is conservatively assumed to cease.

12) The containment iodine removal filters are assumed to remain in operation for the entire duration of the event.

13) The atmospheric dispersion coefficient from the containment to the Control Room was assumed to be 7.7E-4 (0-8 hours), 4.5E-4 (8-24 hours), 2.5E-4 (1-4 days), and 6.3E-5 (4-30 days). These values are based on three years of onsite data.

14) The Control Room volume is assumed to be 166000 cubic feet.

15) The Control Room supply damper begins to close on high radiation signal at 2.1 seconds and is completely isolated by 25.4 seconds. With the supply damper open, the unfiltered leakage is 21100 cfm, while with the supply damper closed, the unfiltered leakage is 910 cfm.

16) The Control Room recirculation flow starts at 2.1 seconds on high radiation signal. The portion of the recirculation flow which passes through the 90% efficient post-LOCI filters is 2000 cfm.

17) The Control Room occupancy factors are assumed to be 1.0 (0-1 day), 0.6 (1-4 days), and 0.4 (4-30 days), per Standard Review Plan 6.4-19, Rev. 2.