VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

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U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Serial No. 89-022A
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Docket Nos. 50-338
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Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNITS 1 AND 2
CONTROL ROOM HABITABILITY - SUPPLEMENTAL INFORMATION

By letter Serial Number 89-022, dated March 1, 1989, Virginia Electric and Power Company submitted documentation of actions taken to ensure compliance of the North Anna Power Station with General Design Criterion (GDC) 19 of Appendix A to 10 CFR 50. A reevaluation of control room dose consequences was also submitted, which indicated that radiation exposure to control room operators would be increased above the values currently delineated in Chapter 15 of the North Anna Updated Final Safety Analysis Report. License amendments were requested to revise the limiting doses to the control room operators to the values in our March 1, 1989 submittal.

On November 15, 1989, Messrs. C. Nichols, J. Lee, and H. Walker of the NRC met with Virginia Electric and Power Company personnel to discuss and clarify the bases of those control room habitability calculations. As a result of that meeting, we were requested to provide additional information concerning some of the inputs used for our North Anna control room dose calculations. This information was requested so that independent dose calculations could be performed by the NRC as part of its Safety Evaluation Report supporting the proposed license amendment.

The requested data, which are attached, consist of the following:

- Steam Generator Tube Rupture hydraulic data used in the control room dose calculations (including the flashing fraction of primary coolant as a function of time) and source terms used, and the basis for our calculated 10 minute tube uncovery time.

- Main Steam Line Break hydraulic data used for the control room dose calculations, including break flows.

- The control room volume (as opposed to the pressure envelope volume), for use in calculation of doses due to shine.

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- A copy of the summary of the inputs used for the various dose calculations, which was shown to Mr. Lee during the meeting at North Anna.

- Documentation of the impact of using a reduced iodine filter efficiency (95%, versus the 99% used to determine the submitted doses).

During the meeting, Virginia Electric and Power Company also agreed to provide any information which we could locate on the original LOCA analysis regarding the duration of leakage from containment which was used. We have determined that our LOCA dose calculations dating back to 1972 made the same assumptions concerning containment leakage which were used in the most recent calculations: specifically, that the containment leakage rate is 0.1 volume % per day, and that the duration of this leakage is one hour. We have not located any documentation which indicates whether the NRC made other assumptions about containment leakage when they performed the calculations to support their SER of the original LOCA evaluation.

If you have questions regarding this additional information, please contact us.

Very truly yours,

W. L. Stewart
Senior Vice President - Nuclear

Attachments:

1. Supplemental Information: North Anna Control Room Dose Calculation Inputs

2. Summary of Control Room Habitability Inputs for Various Accidents (North Anna Data)

cc: U. S. Nuclear Regulatory Commission
101 Marietta Street, N. W.
Suite 2900
Atlanta, GA 30323

Mr. J. L. Caldwell
NRC Senior Resident Inspector
North Anna Power Station

Attachment 1

Supplemental Information:
North Anna Control Room Dose Calculation Inputs

1. Steam Generator Tube Rupture (SGTR) Data:

   a. The initial total secondary side steam generator mass is 99,100 lb_m (91,600 lb_m liquid and 7500 lb_m steam).

   b. Primary coolant is released to the affected steam generator as follows:

      1) 0 to 10 minutes: 44,000 lb_m

      2) 10 to 30 minutes: 88,000 lb_m

   c. The primary to secondary leak rate was taken from the North Anna Technical Specifications:

      1) 500 gpd (or 0.35 gpm) in the affected steam generator

      2) 1.0 gpm total

   d. The following steaming masses were used for the SGTR dose calculations:

Time Span (hours)	Steaming Mass: Faulted SG (lb_m)	Steaming Mass: Intact SG (lb_m)
0 - 2	81,640	341,000
2 - 8	0	605,500

   These values were calculated assuming the faulted steam generator is isolated in 30 minutes, and that the intact steam generators cool the RCS from 30 minutes to 8 hours. The RCS is cooled from Hot Full Power (HFP) to Hot Zero Power (HZP) in the first two hours after the accident, and from HZP to 350°F T_{avg} between 2 and 8 hours.

   e. The coolant activities used were based on the North Anna Technical Specification limits (see Table 1). The pre-accident iodine spike calculation assumed an increase in the primary coolant activity to 60 μCi/g I-131 dose equivalent. The iodine appearance rates used for the concurrent iodine spike calculation are given in Table 2.

   f. The addition of downcomer baffle plates to the North Anna Units 1 and 2 steam generators decreased the initial water mass inventory at Hot Full Power, with a resultant period of tube uncovery (water level below the top of the tubes) following a tube rupture event. A 10 minute tube uncovery time was conservatively calculated for North Anna, and was used in both our 1987 SGTR offsite dose calculation (submitted to the NRC in our letter serial number 87-474C, dated September 25, 1987) and the control room dose calculation submitted in 1989.

To determine the period of tube uncovery, the faulted steam generator secondary inventory was calculated as a function of time from the trip. This calculation considered the following contributions:

1) the initial mass (99,100 lb_m);

2) the mass dissipated to atmosphere to cool the unit to HZP conditions, based on the energy removal required to reduce the core stored energy, the RCS metal stored energy, and the RCS fluid energy;

3) primary to secondary break flow, based on 132,000 lb_m total break flow;

4) auxiliary feed flow to the faulted generator, beginning 60 seconds after the trip, and terminating only after the narrow range level is recovered in the faulted steam generator; and

5) boiloff of secondary fluid to remove decay heat, which was calculated as a function of time.

This inventory was then compared with the calculated mass required to keep the tubes covered to determine the uncovery time. The predicted tube uncovery time for the full break (which was determined to be the limiting break size) was about 9 minutes. For the dose calculations, this value was conservatively increased to 10 minutes.

2. Main Steam Line Break (MSLB) Data:

a. The primary coolant volume is 9380 ft^3.

b. The feedwater flow rate to the affected steam generator is 9.35×10^6 lb_m/hr.

c. The feedwater isolation time for the affected steam generator is 9.3 seconds.

d. The primary to secondary leak rate was taken from the North Anna Technical Specifications:

1) 500 gpd in the affected steam generator

2) 1.0 gpm total (3 steam generators) = 1440 gpd

e. The steam generator masses used were:

1) Liquid = 1.67×10^5 lb_m/steam generator

2) Steam = 4238.6 lb_m/steam generator

These values were taken from the North Anna UFSAR.

f. The steam generator (secondary side) volume is 101 m^3.

g. The steam release from the affected steam generator is 358,000 lb_m during the first 30 minutes (until the affected steam generator is isolated), and 0 lb_m for the remainder of the analysis.

h. The energy and mass release rates as a function of time are:

Time (sec)	Mass Release (lb/sec)	Energy Release (BTU/sec)
0	10511	12.568×10^6
36	1079	1.215×10^6
90	822.2	0.9229×10^6
180	195.4	0.2129×10^6
236	123.7	0.1336×10^6
521	123.6	0.1338×10^6
1311	123.5	0.1346×10^6
1701	123.4	0.1349×10^6
1800	123.4	0.1350×10^6

These rates are based on operation at 102% full power, and a 1.4 ft^2 double ended rupture.

i. The auxiliary feedwater flow to the unaffected steam generators is 900 gpm for the full 8 hours releases occur from these steam generators.

j. The coolant activities used were based on the North Anna Technical Specification limits (see Table 1). The pre-accident iodine spike calculation assumed an increase in the primary coolant activity to 60 μCi/g I-131 dose equivalent. The iodine appearance rates for the concurrent iodine spike calculation are given in Table 2.

k. The turbine building volume is 4×10^6 ft^3.

3. The control room volume for calculation of dose due to shine is 1.165×10^5 ft^3. This volume represents only the control room, and does not include the entire pressure envelope.

4. A copy of a table summarizing some of the inputs for various North Anna control room dose calculations is given in Attachment 2. A version of this table was shown to Mr. Jay Lee of the NRC during our November 15 meeting at North Anna.

5. The impact on control room doses when the assumed iodine filter efficiencies are reduced from 99 to 95 percent can be seen in Table 3. As noted during the November 15 meeting, dose calculations are in progress to support a recirculation rate lower than the 2000 cfm used to calculate the doses submitted earlier this year. A lower iodine filter efficiency is being used in those calculations to more accurately reflect the North Anna charcoal filter design and be consistent with Regulatory Guide 1.52.

The sensitivity of of the 30-day control room doses following a steam generator tube rupture to variations in the control room recirculation rate and charcoal filter efficiency is illustrated in Table 3. The doses in the first column are based on operation of two fan/filters in the recirculation mode (1000 cfm each) with an iodine filter efficiency of 99%. This is the second steam generator tube rupture case described in our March 1, 1989, submittal, which assumes automatic initiation of recirculation upon receipt of an SI signal. This assumption incorporates some planned modifications of the North Anna control room ventilation system which were recommended as a result of the control room habitability evaluations. The second column in Table 3 similarly contains doses based on operation of two fan/filters (2000 cfm), but assuming a 95% filter efficiency. The doses in the third column were calculated assuming only one fan/filter operating (1000 cfm) with a 95% filter efficiency for iodine. This third case is representative of the calculations currently in progress. All doses listed are for the pre-accident iodine spike case, with control room recirculation starting automatically upon receipt of an SI signal 6.5 minutes after the tube rupture occurs.

Table 1

Coolant Activities Based on
North Anna Technical Specification Limits

Nuclide	Primary Coolant Concentration (μCi/g)	Secondary Liquid Concentration (μCi/g)	Secondary Steam Concentration (μCi/g)
Kr-85m	0.564	-	3.72 E-4
Kr-85	1.37	-	9.04 E-4
Kr-87	0.326	-	2.15 E-4
Kr-88	0.986	-	6.51 E-4
Xe-131m	0.837	-	5.52 E-4
Xe-133	75.5	-	4.98 E-2
Xe-135m	0.0507	-	3.35 E-5
Xe-135	1.64	-	1.08 E-3
Xe-138	0.180	-	1.19 E-4
I-131	0.656	7.08 E-2	7.08 E-4
I-132	0.239	8.60 E-3	8.60 E-5
I-133	1.06	9.53 E-2	9.53 E-4
I-134	0.148	2.54 E-3	2.54 E-5
I-135	0.571	3.67 E-2	3.67 E-4

Table 2

Concurrent Iodine Spike
Appearance Rates

Nuclide	Appearance Rate (Ci/sec)
I-131	1.16
I-132	2.29
I-133	2.70
I-134	3.30
I-135	2.53

Table 3

Steam Generator Tube Rupture
30-Day Control Room Doses

Recirc. Rate (cfm)	2000	2000	1000
Filter Efficiency (%)	99	95	95
Thyroid dose (rem)	16.5	17.1	26.6
Gamma dose (rem)	0.012	0.012	0.012
Beta dose (rem)	0.57	0.57	0.57

Attachment 2

Summary of Control Room Habitability

Inputs for Various Accidents

(North Anna Data)

I. COMMON PARAMETERS FOR ALL CALCULATIONS

1.	Core Thermal Power Level (MWt) (includes an additional 2% for instrument error)	2958
2.	Control Room Unfiltered In-leakage (cfm) 0-720 hr	10
3.	Control Room Volume	1.165×10^5
4.	Control Room Emergency Ventilation Filter Efficiency (%): Elemental Iodine *Except LOCA - 90% used.	99*
5.	Breathing Rate (m^3/sec)	3.47×10^{-4}
6.	Duration of Bottled Air (hr)	1
7.	Control Room Recirculation Rate (cfm)	2,000
8.	Control Room Emergency Ventilation Rate (cfm)	1,000
9.	Occupancy Factors	
	0-24 hrs	1.0
	24-96 hrs	0.6
	96-720 hrs	0.4
	(included in X/Qs)	

II. LOSS OF COOLANT ACCIDENT (LOCA)

1.	Containment Volume (ft^3)	1.84×10^6
2.	Containment Leak Rate (Vol/day)	
	0 to 1 hr	.001
	1 to 720 hr	0.0
3.	Composition of Iodine Release to Containment:	
	Elemental	91
	Methyl	4
	Particulate	5
4.	Fraction of Core Activity Available for Leakage from Containment (%)	
	Noble Gases	100
	Halogens	25*
	*with 50% plateout.	
5.	Containment Spray Removal Coefficients (hr^{-1})	
	Elemental Iodine	10
	Methyl Iodine	0
	Particulate Iodine	0
6.	Containment Mixing Rate (Unsprayed Volumes/Hr)	2
7.	Containment Spray Coverage (%)	70
8.	Containment Sump Volume (liters)	1.5×10^6
9.	Sump Water Temperature (°F)	<212
10.	Fraction of Core Iodine in Sump (%)	50
11.	Fraction of Iodine in ECCS Leakage Released to the Atmosphere (%)	10
12.	ECCS Leak Rate (cc/hr) 2 x Tech. Spec.	0-10 min. 50 gpm 10 min-30 days 900cc/hr
13.	Safeguards Area Exhaust, Iodine Filter Efficiency (%)	90

LOCA (Cont)

14.	Control Room Emergency Ventilation Filter Efficiency (%)	
	Elemental Iodine	90
	Methyl Iodine	0
	Particulate Iodine	99
15.	Atmospheric Dispersion Coefficients, X/Q values (sec/m^3)	
	a. Containment Leakage	
	0-8 hr	7.97×10^{-3}
	8-24 hr	6.30×10^{-3}
	24-96 hr	2.47×10^{-3}
	96-720 hr	7.17×10^{-4}
	b. ECCS Leakage	
	0-8 hr	7.88×10^{-4}
	8-24 hr	5.75×10^{-4}
	24-96 hr	2.05×10^{-4}
	96-720 hr	3.15×10^{-5}
16.	Control Room Isolation Occurs at Time	0
17.	Bottled Air Actuation Time (hrs)	0
18.	Recirculation Start Time (hrs)	0

III. MAIN STEAM LINE BREAK (MSLB)

1.	Primary to Secondary Leak Rate via the Affected Steam Generator (gpd)	500
2.	Primary to Secondary Leak Rate via the 2 Non-affected Steam Generators (gpd)	940
3.	Duration of Release via the Affected Steam Generator (min.)	30
4.	Duration of Release via the 2 Non-affected Steam Generators (hr)	8
5.	Off-site Power *Therefore, the condenser is not available for cooldown.	Lost*
6.	Pre-accident Iodine Spike I131 Dose Equivalent (μCi/cc)	60
7.	Duration of Concurrent Iodine Spike (hr)	4
8.	Break Location	Turbine Bldg.
9.	X/Q values (sec/m^3) Main Steam Reliefs	
	0-8 hr	7.97×10^{-3}
	8-24 hr	6.30×10^{-3}
	24-96 hr	2.47×10^{-3}
	96-720 hr	7.17×10^{-4}
10.	Steam Condition	
	Pressure (psia)	850
	Temperature (°F)	525
11.	Control Room Isolation Time (hrs)	0
12.	Concurrent Iodine Spike Appearance Rates (Ci/Sec)	
	I131	1.16
	I132	2.29
	I133	2.70
	I134	3.30
	I135	2.53

III. MSLB (Cont'd)

13.	Iodine Partition Factors	
	Covered	0.01
	Uncovered	1.0
14.	Secondary Side Mass (lbs/SG)	
	Liquid	167,000
	Steam	4238.6
15.	Primary Coolant Volume (ft^3)	9380 (@ 577°F)
16.	Total Steam Flow Rate (lb/hr)	-
17.	Volume of Liquid in the Secondary Side of SG (m^3)	101
18.	Auxiliary FW Flow to Non Affected SG's (gpm)	900
19.	Steam.Release from Affected SG (lbs) 0-05 hr	358,000
20.	Aux FW Flow to Affected SG (lb/hr)	9.35×10^6

IV. FUEL HANDLING ACCIDENT (FHA)

1.	No. of Damaged Fuel Assemblies	1
2.	Radial Peaking Factor	1.65
3.	% of Total Activity in Gap	
	Noble Gases	10
	Kr-85	30
	Iodine	10
4.	Fuel Pool DF	
	Noble Gases	1
	Iodine	100
5.	Constituents of Iodine Above the Pool (%):	
	Elemental	75
	Methyl	25
6.	Time after Shutdown Accident Occurs (hr)	100
7.	Time after Accident the Bottled Air is Actuated (min.)	10
8.	Duration of Release from Fuel Building (hr)	2
9.	Fuel Building Exhaust Filter Efficiency (%):	
	Elemental Iodine	90
	Methyl Iodine	70
10.	Fuel Building Exhaust Rate (cfm)	29,000
11.	Fuel Building Volume (ft^3)	1.85×10^5
12.	Control Room Isolation Time (hr)	0
13.	X/Q values (sec/m^3)	
	0-8 hr	7.97×10^{-3}
	8-24 hr	6.30×10^{-3}
	24-96 hr	2.47×10^{-3}
	96-720 hr	7.17×10^{-4}
14.	Recirculation Start Time (min)	10

V. STEAM GENERATION TUBE RUPTURE (SGTR)

1.	Tubes Uncovered	@ 5 min
2.	Duration Tubes Uncovered	10 min
3.	Control Room Isolation	@ 6.5 min
4.	Bottled Air Actuation	@ 6.5 min
5.	Control Room Recirc Rate Control Room Recirc Actuation	2000 cfm @ 16.5 min
6.	Emergency Ventilation Filter Eff.	99%
7.	Control Room Normal Ventilation Rate	1460 cfm
8.	Off-site Power	Lost
9.	Duration of Release via the Affected Steam Generator (min)	30
10.	Duration of Release via the 2 Non-Affected Steam Generators (hrs)	8
11.	Steam Release from Affected Steam Generator (lbs) 0-0.5 hrs	81,640
12.	Steam Release from 2 Non-Affected Steam Generators 0-2 hrs 2-8 hrs	 341,000 605,500
13.	Pre Accident Iodine Spike I131 Dose Equivalent (uCi/cc)	60
14.	Duration of Concurrent Iodine Spike (hrs)	4
15.	Concurrent Iodine Spike Appearance Rates (Ci/Sec) I131 I132 I133 I134 I135	 1.16 2.29 2.70 3.30 2.53
16.	Primary to Secondary Leak Rate Via the Affected Steam Generator (gpd)	500

V. SGTR (Cont'd)

17.	Primary to Secondary Leak Rate Via the 2 Non-Affected Steam Generators (gpd)	940
18.	X/Q Values (sec/m^3)	
	Main Steam Reliefs	
	0-8 hr	7.97×10^{-3}
	8-24 hr	6.30×10^{-3}
	24-96 hr	2.47×10^{-3}
	96-720 hr	7.17×10^{-4}
19.	Iodine Partition Factors	
	Covered	0.01
	Uncovered	1.0