Calculation No. H-1-AE-MDC-1868, Revision 1
Feedwater Line Break Accident Outside Primary Containment

(NC.DE-AP.ZZ-0002(Q), Rev. 12, Form 1)	CALCULATION COVER SHEET	Page 1 of	21
CALCULATION NUMBER:	H-1-AE-MDC-1868	REVISION:	1
TITLE:	Feedwater Line Break Accident Outside Primary Containment		

#SHTS (CALC):	21	#ATT/#SHTS:	1/1	#IDV/50.59/72.48 SHTS:	7/4/0	#TOTAL SHTS:	33

CHECK ONE:

☒ FINAL ☐ INTERIM (Proposed Plant Change) ☐ VOID

☐ FINAL (Future Confirmation Req'd, enter tracking Notification number:)

SALEM OR HOPE CREEK: ☐ Q – LIST ☒ IMPORTANT TO SAFETY ☐ NON-SAFETY RELATED
HOPE CREEK ONLY: ☒Q ☐Qs ☐Qsh ☐F ☐R
ISFSI: ☐ IMPORTANT TO SAFETY ☐ NOT IMPORTANT TO SAFETY

☐ ARE STATION PROCEDURES IMPACTED? YES ☐ NO ☒

IF "YES", INTERFACE WITH THE SYSTEM ENGINEER & PROCEDURE SPONSOR. ALL IMPACTED PROCEDURES SHOULD BE IDENTIFIED IN A SECTION IN THE CALCULATION BODY [CRCA 70038194-0280]. INCLUDE AN SAP OPERATION FOR UPDATE AND LIST THE SAP ORDERS HERE AND WITHIN THE BODY OF THIS CALCULATION.

☐ CP and ADs INCORPORATED (IF ANY):

DESCRIPTION OF CALCULATION REVISION (IF APPL.):

See Revision 1 History on next page.

PURPOSE:

The purpose of this calculation is to determine the Exclusion Area Boundary (EAB), Low Population Zone (LPZ), and Control Room (CR) doses due to a Feedwater Line Break Accident (FWLBA) occurring outside containment using the TEDE dose criteria and normal coolant concentration corresponding to the core thermal power level of 4,031 MW_t, including instrument uncertainty.

CONCLUSIONS:

The analysis results presented in Section 7.1 indicate that the EAB, LPZ, and CR doses due to a FWLB accident are within their allowable TEDE limits. The results indicate that CREF system initiation is not required during a FWLB accident.
The comparisons in Section 7.2 confirm that the proposed increases in the EAB, LPZ, & CR doses are less than the minimal dose increase regulatory limits, and that the proposed total doses are less than the allowable regulatory limits. Therefore, pursuant to 10 CFR 50.59 guidance as defined in References 9.17 and 9.18, the proposed increase in the core thermal power level and resulting post-FWLBA dose consequences can be adopted as current licensing and design bases for the HCGS.

	Printed Name / Signature	Date
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REVISION HISTORY

Revision	Revision Description
0	Original Issue.
1	Revised to include the TEDE dose criteria and uprated reactor coolant concentration. As of 12/07/2005, the EPU project decided to adopt the AST analysis performed for the increased core thermal power level for the current design and licensing bases because it conservatively bounds the EPU project design. Section 7.2 indicates that the proposed increase in the EAB, LPZ, and CR doses and total doses are less than the corresponding minimal dose increases and applicable regulatory allowable limits as defined in the 10 CFR 50.59 rule. The implementation or cancellation of the proposed core thermal power related DCP would not have any adverse impact on this analysis. Some of design inputs are taken from the documents that support higher core thermal power operation. If the HCGS license is not amended for the proposed increased power level, these design inputs would become conservative assumptions without having any adverse impact on the validity of this analysis.

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1.0 PURPOSE:

The purpose of this calculation is to determine the Exclusion Area Boundary (EAB), Low Population Zone (LPZ), and Control Room (CR) doses due to a Feedwater Line Break Accident (FWLBA) occurring outside containment using the TEDE dose criteria and normal coolant concentration corresponding to the core thermal power level of 4,031 MW_t, including instrument uncertainty.

2.0 BACKGROUND:

The consequences of a realistic FWLBA were analyzed in Revision 0 of this calculation using the plant specific design and licensing bases design inputs to comply with the 10 CFR 50, Appendix 50, GDC 19 and 10 CFR 100 dose criteria.

Licensing Change Request LCR H01-002 (Ref. 9.7) was submitted to the NRC staff to amend the Hope Creek plant operating license to implement the full scope Alternative Source Term (AST) and TEDE dose criteria. The staff issued a SER (Ref. 9.8) to approve Amendment No. 134 on 10/03/2001, which revises the plant licensing basis to specify the AST in place of the previous source term and establishes the TEDE acceptance criteria in Table 6 of RG 1.183 (Ref. 9.1) in lieu of the whole body and thyroid dose guidelines provided in 10 CFR 100.11. The AST and TEDE dose acceptance criteria are to be used for the design basis accidents (DBAs).

The HCGS licensed reactor thermal power level is proposed to increase by 20%, and the radiological impact of the extended power uprate needs to be evaluated. The FWLBA is considered less severe than the main steam line break (MSLB) accident, which does not result in any fuel damage (Ref. 9.19, Section 2.3.4). Therefore, its is assumed that no fuel damage occurs during the FWLBA. The AST addresses the time dependent radioactive source spectrums resulting from damaged core and fuel. There is no fuel damage postulated during the FWLB accident, therefore, the AST is not applicable to the FWLBA scenario. However, this calculation analyzes the FWLBA using the TEDE dose criteria and uprated coolant activity concentrations. The RG 1.183 neither provides any guidance for radioactive release from the FWLB accident nor specifies the TEDE dose criteria, therefore, the acceptable site boundary dose criterion is assumed to be the lowest limit allowed in Table 6 of RG 1.183 (Ref. 9.1), which is a small fraction (10%) of the exposure guideline values. This criteria are incorporated in the assumptions 4.4 and 4.6. There are no specific ESF functions credited in this analysis. The CR is assumed to be in a normal mode of operation and the CR emergency filtration (CREF) system is not credited for mitigation of the CR dose.

The design basis FWLBA is analyzed using design basis reactor coolant iodine concentrations and 95% atmospheric dispersion factors at the HCGS CR air intake due to the post-accident releases from the Turbine Building (TB) louvers. The design basis FWLBA will supersede the realistic FWLBA analyzed in the Revision 0 of this calculation.

3.0 ANALYTICAL APPROACH:

This analysis uses Version 3.02 of the RADTRAD computer code to calculate the potential radiological consequences of the FWLBA. The RADTRAD code is documented in NUREG/CR-6604 (Ref. 9.2). The RADTRAD code is maintained as Software ID Number A-0-ZZ-MCS-0225, (Ref. 9.12).

The radiological consequences of the FWLB accident were evaluated in Revision 0 of this calculation using the accident scenario described in UFSAR Section 15.6.6.5 (Ref. 9.6). The design basis reactor coolant activity concentrations and the activity released to the environment are calculated in Section 6.2 using the mass of condensate released from the FWLB. Since the condensate demineralizers remove the dissolved fission products in the condensate, the FWLB is postulated to occur between the condenser and condensate demineralizer in order to maximize the dose consequences. The iodine activity from the condensate released from the FWLB is postulated to release to the environment via turbine building.

The potential post-FWLBA release paths are the TB vent, south plant vent, and TB louvers, which are shown in References 9.11 and 9.13 with respect to the CR air intake with its tornado missile barrier. The χ/Qs for these release paths are obtained from Reference 9.5 Section 8.0, and listed in the following table:

Time Interval (hr)	HCGS Control Room 95% Atmospheric Dispersion Factors (X/Qs) (s/m^3)		
	South Plant Vent	TB Louvers (s/m^3)	TB Vent (s/m^3)
0-2	5.75E-04	6.17E-04	3.48E-04
2-8	3.84E-04	4.00E-04	2.55E-04
8-24	1.40E-04	1.44E-04	9.11E-05
24-96	9.08E-05	1.00E-04	5.37E-05
96-720	7.01E-05	7.49E-05	3.82E-05

Comparison of χ/Qs in the above table indicates that the TB louvers release path is the most limiting release path for the post-FWLBA release. Therefore, the CR dose is calculated using the post-FWLBA release through the TB louvers. Since the post-FWLBA activity is postulated to release instantaneously as a single puff, the CR Emergency Filtration (CREF) is not credited. The CR is assumed to be in the normal mode of operation for the entire duration of the accident.

DOSE EQUIVALENT I-131 is the concentration of I-131 in μCi/g, which alone would produce the same thyroid dose as the quantity and isotopic mixture of I-131, I-132, I-133, I-134, and I-135 actually present. The thyroid dose conversion factors used for this calculation are listed in Table 1.

In Table 2, a scaling factor is developed based on the maximum equilibrium iodine concentration of 0.2 μCi/g DE I-131. The isotopic iodine isotopic activities released to environment are calculated in Table 3 using the amount of coolant mass that becomes airborne (Section 6.2).

The RADTRAD V3.02 (Ref. 9.2) default nuclide inventory file (NIF) Bwr_def is modified based on the post-FWLB iodine activity release to the environment as shown in Table 3. The modified NIF HEPUFWLB_def.txt is used to calculate the EAB, LPZ, and CR doses, which are shown in Section 7.0 and compared with their allowable dose limits.

Determine Compliance of Increased Dose Consequences With 10CFR50.59 Guidance

Consistent with the RG 1.183, Section 1.1.1, once the initial AST implementation has been approved by the staff and has become part of the facility design basis, the licensee may use 10 CFR 50.59 and its supporting guidance in assessing safety margins related to subsequent facility modifications and changes to procedures. The NRC Safety Evaluation Report for Amendment 134 (Ref. 9.8) approved the AST for the HCGS licensing basis analyses.

An increase in control room, EAB or LPZ dose consequence is considered acceptable under the 10 CFR 50.59 rule if the magnitude of the increase is minimal (as defined by the guidance in Refs. 9.17 and 9.18), and if the total calculated dose is less than the allowable regulatory guide 1.183 dose limit. The current licensing basis analysis is documented in the calculation H-1-AE-MDC-1868, Rev 0. The increases in the proposed EAB, LPZ, & CR doses are compared with the 10 CFR 50.59 allowable minimal dose increases in Section 7.2. Similarly, the proposed calculated total doses are compared with the allowable regulatory guide dose limits. The comparison in Section 7.2 confirms that the increase in the EAB, LPZ, & CR doses and the total calculated doses are less than the corresponding minimal dose increases and allowable regulatory guide limits. Therefore, pursuant to 10 CFR 50.59 guidance as defined in References 9.17 and 9.18, the proposed increase in the core thermal power level and resulting post-FHA doses can be adopted as current design and licensing bases for the HCGS.

4.0 ASSUMPTIONS:

Assumptions for Evaluating the Radiological Consequences of a FWLBA

The assumptions for evaluating the radiological consequences of a FWLBA are listed in the following section. These assumptions are incorporated as Design Inputs in Sections 5.3.1 through 5.3.4 for the FWLBA analysis.

SOURCE TERM

4.1 No fuel damage is postulated for the FWLB accident because it is less severe than the MSLB accident (Ref. 9.19, Section 2.3.4). The iodine activity concentrations in the condensate are assumed to correspond to 2% of the normal reactor coolant iodine concentrations based on the maximum equilibrium iodine concentration of 0.2 μCi/g Dose Equivalent I-131 allowed by the technical specification (Ref. 9.4) for normal operation of the plant. The chemical forms of iodine release from feedwater to the environment are assumed to be 97% elemental and 3% organic. Noble gas activity in the condensate is assumed to be negligible.

TRANSPORT

4.2 Since the condensate demineralizers remove the dissolved fission products in the condensate, the FWLB is postulated to occur between the condenser and condensate demineralizer in order to maximize the dose consequences. The entire content of the condenser hotwells and piping upstream of the condensate demineralizer is assumed to be released through the feedwater line break. The condensate mass of 4,309,629 lbs (Section 6.2) is assumed to be released from the FWLB, and is incorporated in Design Input 5.3.1.9.

4.3 10% of the iodine activity in the condensate mass is assumed to be released to the atmosphere instantaneously as a ground-level release. No credit is assumed for plateout, holdup, or dilution within facility buildings.

Offsite Dose Consequences:

The following guidance is used in determining the TEDE for a maximum exposed individual at EAB and LPZ locations:

4.4 The maximum EAB TEDE for any two-hour period following the start of the radioactivity release is determined and used in determining compliance with the following dose acceptance criterion:

EAB Dose Acceptance Criterion: 2.5 Rem TEDE (Ref. 9.1, Table 6)

4.5 The breathing rates for persons at offsite locations are given in Reference 9.1, Section 4.1.3, and are incorporated in Design Inputs 5.3.4.3 and 5.3.4.4.

4.6 The maximum Low Population Zone TEDE is determined for the most limiting receptor at the outer boundary of the LPZ (Ref. 9.1, Section 4.1.6), and used in determining compliance with the following dose acceptance criterion:

LPZ Dose Acceptance Criterion: 2.5 Rem TEDE (Ref. 9.1, Table 6)

4.7 No correction is made for depletion of the effluent plume by deposition on the ground (Ref 9.1, Section 4.1.7).

Control Room Dose Consequences

The following guidance is used in determining the TEDE for maximum exposed individuals located in the control room:

4.8 The CR TEDE analysis considers the following sources of radiation that will cause exposure to control room personnel (Ref 9.1, Section 4.2.1):

- Contamination of the control room atmosphere by the intake or infiltration (i.e., filtered CR ventilation inflow via the CR air intake, and unfiltered inleakage) of the radioactive material contained in the post-accident radioactive plume released from the facility,
- Contamination of the control room atmosphere by the intake or infiltration (i.e., filtered CR ventilation inflow via the CR air intake, and unfiltered inleakage) of airborne radioactive material from areas and structures adjacent to the control room envelope,
- Radiation shine from the external radioactive plume released from the facility (i.e., external airborne cloud shine),
- Radiation shine from radioactive material in the reactor containment (i.e., containment shine dose; not applicable to a FWLB occurring outside containment),
- Radiation shine from radioactive material in systems and components inside or external to the control room envelope, e.g., radioactive material buildup in recirculation filters (i.e., CR filter shine dose).

Note: The external airborne cloud shine dose and the CR filter shine dose due to a FWLBA are insignificant compared to those due to a LOCA (see the core release fractions for LOCA and non-LOCA design basis accidents in Tables 1 and 3 of Reference 9.1. Therefore, these direct dose contributions are considered to be insignificant and are not evaluated for a FWLBA.

4.9 The radioactive material releases and radiation levels used in the control room dose analysis are determined using the same source term, transport, and release assumptions used for determining the exclusion area boundary (EAB) and the low population zone (LPZ) TEDE values (Ref. 9.1, Section 4.2.2).

4.10 The occupancy and breathing rate of the maximum exposed individual present in the control room are incorporated in Design Input 5.3 (Ref. 9.1, Section 4.2.6).

4.11 10 CFR 50.67 (Ref 9.16) establishes the following radiological criterion for the control room.

CR Dose Acceptance Criterion: 5 Rem TEDE

4.12 Although allowed by Reference 9.1, Section 4.2.4, credit is not taken for the engineered safety features of the CR emergency filtration (CREF) system that mitigate airborne activity within the control room.

4.13 No credits for KI pills or respirators are taken (Ref. 9.1, Section 4.2.5).

5.0 DESIGN INPUTS:

5.1 General Considerations

5.1.1 Applicability of Prior Licensing Basis

The characteristics of the TEDE dose calculation methodology may be incompatible with many of the analysis assumptions and methods currently used in the facility's design basis analyses. The HCGS plant specific design inputs and assumptions used in the current TID-14844 analyses were assessed for their validity to represent the as-built condition of the plant and evaluated for their compatibility to meet the TEDE methodology. The analysis in this calculation ensures that analysis assumptions, design inputs, and methods are compatible with the TEDE criteria.

5.1.2 Credit for Engineered Safety Features

Credit is taken only for accident mitigation features that are classified as safety-related, are required to be operable by technical specifications, are powered by emergency power sources, and are either automatically actuated or, in limited cases, have actuation requirements explicitly addressed in emergency operating procedures. None of the ESF functions are credited in this FWLBA analysis. The dose mitigation function of the CREF system is not credited in this analysis.

5.1.3 Assignment of Numeric Input Values

The numeric values that are chosen as inputs to the analyses required by 10 CFR 50.67 (Ref. 9.16) are compatible with the TEDE dose criteria and selected with the objective of producing conservative radiological consequences. For conservatism, the design basis reactor coolant iodine concentrations are considered and the CREF is not credited for the CR dose mitigation.

5.1.4 Meteorology Considerations

The control room atmospheric dispersion factors (χ/Qs) for the Turbine Building louvers release point are developed (Ref. 9.5) using the NRC sponsored computer code ARCON96. The EAB and LPZ χ/Qs were reconstituted using the HCGS plant specific meteorology and appropriate regulatory guidance (Ref. 9.9). The off-site χ/Qs reconstituted in Reference 9.9 were accepted by the staff in previous licensing proceedings.

5.2 Accident-Specific Design Inputs/Assumptions

The design inputs/assumptions utilized in the EAB, LPZ, and CR habitability analyses are listed in the following sections. The design inputs are compatible with the TEDE dose criteria and assumptions are consistent with those identified in the applicable UFSAR sections. The design inputs and assumptions in the following sections represent the as-built design of the plant.

Design Input Parameter		Value Assigned		Reference	
5.3 FWLBA Parameters					
5.3.1 Source Term					
5.3.1.1 Proposed core power level		4,031 MW_t		9.3, Section 3.2.1	
5.3.1.2 Uprated Isotopic Reactor Coolant Concentration (μCi/gm)				9.3, Appendix A	
Isotope	**Activity**	**Isotope**	**Activity**	**Isotope**	**Activity**
I-131	1.30E-02	I-133	8.90E-02	I-135	1.30E-01
I-132	1.20E-01	I-134	2.40E-01		
5.3.1.3 Total hotwell capacity		430,560 gallons		9.21, Section 3.2.1, Item 9	
5.3.1.4 Fuel damage		None		Section 2.0 and Assumption 4.1	
5.3.1.5 Iodine carry-over from reactor coolant		≤ 1% 2%		9.19, Section 2.2.1.2 Assumed in the analysis	
5.3.1.6 Iodine flashing from condensate to TB atmosphere		10%		9.1, Appendix A, Section 5.5	
5.3.1.7 Maximum equilibrium iodine concentration		0.2 μCi/g DE I-131		9.4	
5.3.1.8 Condensate maximum temperature		140^0F		9.20, Section 3.3.1, Item 10	
5.3.1.9 Mass of condensate released from FWLBA		4,309,629 lb		Section 6.2	
5.3.2 Activity Transport (see Figure 1)					
5.3.2.1 Activity release rate		2.0E+05 source volume%/day		Assumed as a single puff	
5.3.2.2 Duration of release		Instantaneously in a single puff		Conservatively Assumed	
5.3.2.3 Type of release		Ground level release		Conservatively Assumed	
5.3.2.4 Chemical form of Iodine in condensate					
Elemental		97.0%		Conservatively Assumed	
Organic		3.0%			
5.3.2.5 Dilution or holdup within the facility building		Not credited		Conservatively Assumed	
5.3.2.6 Source volume		100 ft^3		Assumed to facilitate RADTRAD nodalization	
5.3.3 Control Room Parameters (see Figure 1)					
5.3.3.1 CR volume		85,000 ft^3		9.10, page 10	
5.3.3.2 CR normal air inflow rate (0-720 hrs)		3,000 ± 10% cfm (conservatively modeled as 3,300 cfm)		9.14 and Assumption 4.12	
5.3.3.3 CR occupancy factors					
Time (Hr)		**%**		9.1, Section 4.2.6	
0-24		100			
24-96		60			
96-720		40			

Design Input Parameter	Value Assigned	Reference
5.3.3.4 CR breathing rate (m^3/sec)	3.5E-04	9.1, Section 4.2.6
5.3.3.5 CR atmospheric dispersion factors for Turbine Building louvers release (χ/Q) (sec/m^3)		
Time (Hr)	**X/Q (sec/m^3)**	
0-2	6.17E-04	9.5, Section 8.3
2-8	4.00E-04	
8-24	1.44E-04	
24-96	1.00E-04	
96-720	7.49E-05	
5.3.4 Site Boundary Release Model Parameters		
5.3.4.1 EAB atmospheric dispersion factor (χ/Q) (sec/m^3)	1.9E-04	9.9, Pages 5 & 9
5.3.4.2 LPZ atmospheric dispersion factors (X/Qs)		
Time (Hr)	**X/Q (sec/m^3)**	
0-2	1.9E-05	9.9, Pages 5 & 9
2-4	1.2E-05	
4-8	8.0E-06	
8-24	4.0E-06	
24-96	1.7E-06	
96-720	4.7E-07	
5.3.4.3 EAB breathing rate (m^3/sec)	3.5E-04	9.1, Section 4.1.3
5.3.4.4 LPZ breathing rates (m^3/sec)		
Time (Hr)	**(m^3/sec)**	
0-8	3.5E-04	9.1, Section 4.1.3
8-24	1.8E-04	
24-720	2.3E-04	

6.0 CALCULATIONS:

6.1 Dose Conversion Factors and Iodine Spike Coolant Activity

Iodine isotopic dose conversion factors (DCFs) are obtained from Reference 15, page 136. These DCFs are provided in Sv/Bq for Committed Dose Equivalent (CDE) per Unit Intake, which are converted into rem/Ci in Table 1 using the following conversion factor:

Sv/Bq = 100 rem/Sv x 3.7 x 10^{10} Bq/Ci = 3.7 x 10^{12} rem/Ci/Sv/Bq

Example: I-131 DCF 2.92E-07 Sv/Bq x 3.7E+12 rem/Ci/Sv/Bq = 1.08E+06 rem/Ci

6.2 Airborne Iodine From Condensate Release

There is no fuel damage as a consequence of this accident. The activity in the main condenser hotwell prior to occurrence of the break is released to the environment. The iodine concentration in the main condenser hotwell is 0.02 times the iodine concentration in the reactor coolant. The reactor coolant iodine activity based on the above off-gas release rate is calculated in Table 1. None of the condensate released from the break flashes to steam because the maximum temperature of condensate is 140^0F, which is less than 212^0F, therefore, it is assumed that 10% of the iodine in the condensate is assumed to become airborne (Ref. 9.1, Appendix A, Section 5.5). The iodine activity released from the break is calculated in Table 2 based on the condensate mass released from the break, the iodine concentration in the condensate, and the condensate flashing factor:

Total condenser hotwell volume = 430,560 gallons (Ref. 9.21, Section 3.2.1, Item 9)

Piping volume is assumed to be 20% of total hotwell volume = 0.20 x 430,560 gallons = 86,112 gallons

Total condensate volume release from break

= 430,560 gallons + 86,112 gallons = 516,672 gallons x (1/7.481) ft^3/gallon x 62.4 lb/ft^3 = 4,309,629 lb

However, the carry-over of iodine from reactor coolant to main steam, which condenses into feedwater ≤ 1% (Ref. 9.19, Section 2.2.1.1), it is conservatively assumed to be 2% to compensate any uncertainty associated with the estimated condensate mass release of 4,309,629 lb from the break .

Flashing fraction = 0.10

Total amount of reactor coolant iodine that becomes airborne =

= 4,309,629 lb × 0.02 × 0.10 = 8,619.3 lb

= 8,619.3 lb × 453.6 g/lb = 3.91E+06 g

7.0 RESULTS SUMMARY:

7.1 The results of the FWLBA analysis are summarized in the following table:

	Feedwater Line Break Accident TEDE Dose (rem)		
	Receptor Location		
	Control Room	EAB	LPZ
Calculated Dose	5.69E-03	2.87E-03 (0.0 hr)	2.88E-04
Allowable TEDE Limit	**5.0E+00**	**2.5E+00**	**2.5E+00**
	RADTRAD Computer Run No.		
	HEPUFWLB01	HEPUFWLB01	HEPUFWLB01

Significant assumptions used in this analysis:

- Post-FWLBA activity is released to the environment in a single puff at ground level through TB Louvers
- CREF system is not credited.
- Core thermal power = 4,031 MW_t

7.2 Compliance of proposed dose increases with the 10 CFR 50.59 rule is shown as follows:

Design Basis Accident	Current Licensing Basis Dose (rem) Thyroid A	Whole Body B	Equivalent TEDE C=A*0.03+B	Proposed Total Dose (rem) TEDE D	Regulatory Dose Limit (rem) TEDE E	Proposed Increase (rem) TEDE F=D-C	Minimal Increase (rem) TEDE G=0.1(E-C)	RG Dose Limit (rem) TEDE H
Feedwater Line Break Accident	H-1-AE-MDC-1868, R0			H-1-AE-MDC-1868, Rev 1				
Control Room	4.38E-03	0	0.0001314	0.00569	5.00	0.006	0.50	5.00
Exclusion Area Boundary	1.69E-03	0	0.0000507	0.00287	25.00	0.003	2.50	2.50
Low Population Zone	1.29E-04	0	0.00000387	0.000288	25.00	0.000	2.50	2.50

C Equivalent TEDE calculated using equation presented in Regulatory Guide 1.183 (Ref. 9.1, Footnote 7)

E From 10 CFR 50.67 (Ref. 9.16)

H Assumed To Be 10% of Regulatory Dose Limit

8.0 CONCLUSIONS:

The analysis results presented in Section 7.1 indicate that the EAB, LPZ, and CR doses due to a FWLB accident are within their allowable TEDE limits. The results indicate that CREF system initiation is not required during a FWLB accident.

The comparisons in Section 7.2 confirm that the proposed increases in the EAB, LPZ, & CR doses are less than the minimal dose increase regulatory limits, and that the proposed total doses are less than the allowable regulatory limits. Therefore, pursuant to 10 CFR 50.59 guidance as defined in References 9.17 and 9.18, the proposed increase in the core thermal power level and resulting post-FWLBA dose consequences can be adopted as current licensing and design bases for the HCGS.

9.0 REFERENCES:

1. U.S. NRC Regulatory Guide 1.183, Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors, July 2000
2. S.L. Humphreys et al., "RADTRAD 3.02: A Simplified Model for Radionuclide Transport and Removal and Dose Estimation," NUREG/CR-6604, USNRC, April 1998
3. Vendor Technical Document (VTD) No. 430059, Volume 002, Rev 1, EPU TR T0807 Coolant Radiation Sources.
4. HCGS Technical Specification 3/4.4.5, "Specific Activity" Limiting Condition for Operation
5. Calculation No. H-1-ZZ-MDC-1879, Rev 1, Control Room & Technical Support Center χ/Qs Using ARCON96 Code
6. HCGS UFSAR Section 15.6.6.5, "Radiological Consequence."
7. HCGS Licensing Change Request LCR No. H01-002, Dated 05/17/01, Request For Change to Technical Specifications, Increase in Allowable MSIV Leakage Rate and Elimination of MSIV Sealing System.
8. NRC Safety Evaluation Report, Hope Creek Generating Station – Issuance of Amendment No. 134 for Increase in Allowable MSIV Leakage Rate and Elimination of MSIV Sealing System.
9. Calculation No. H-1-ZZ-MDC-1820, Rev 0, Offsite Atmospheric Dispersion Factors
10. Calculation No. H-1-ZZ-MDC-1882, Rev 0, Control Room Envelope Volume
11. HCGS Architectural Drawing No. A-0221-0, Sheet 1, Rev 10, General Plant Roof Plan
12. Critical Software Package Identification No. A-0-ZZ-MCS-0225, Rev 2, RADTRAD Computer Code.
13. HCGS General Arrangement Drawings:
    a. P-0006-0, Rev 7, Plan EL 153'-0" & EL 162'-0"
    b. P-0007-0, Rev 7, Plan EL 171'-0" & EL 201'-0"
    c. P-0010-0, Rev 6, Sections A-A & B-B
    d. P-0011-0, Rev 5, Sections C-C & D-D
14. HCGS Air Flow Diagram No. M-78-1, Rev 21, "Aux Bldg Control Area Air Flow Diagram."
15. Federal Guidance Report 11, EPA-520/1-88-020, Environmental Protection Agency
16. 10 CFR 50.67, "Accident Source Term."
17. PSEG Procedure No. NC.NA-AS.ZZ-0059(Q), Rev 11, 10CFR50.59 Program Guidance.
18. Nuclear Energy Institute Report No. NEI 96-07, Rev 1, Guidelines for 10 CFR 50.59 Implementation.
19. Vendor Technical Document (VTD) No. PNO-A46-4100-0047, Rev 2, GE Specification Document No. 22A2703F, Rev 3, Radiation Sources.
20. Vendor Technical Document (VTD) No. 430054, Volume 2, Rev 1, EPU TR T0702, Condensate Demineralizer
21. Vendor Technical Document (VTD) No. 430055, Volume 2, Rev 1, EPU TR T0703, BOP Power Cycle Mechanical Performance.

10.0 TABLES:

Table 1
Iodine Isotopic Dose Conversion Factors

Isotope	Isotopic Dose Conversion Factor (Sv/Bq) A	Conversion Factor (rem/Ci/Sv/Bq) B	Iodine Dose Conversion Factor (rem/Ci) C=AxB
I-131	2.920E-07	3.700E+12	1.080E+06
I-132	1.740E-09	3.700E+12	6.438E+03
I-133	4.860E-08	3.700E+12	1.798E+05
I-134	2.880E-10	3.700E+12	1.066E+03
I-135	8.460E-09	3.700E+12	3.130E+04

A From Reference 9.15, Page 136
B From Section 6.1

Table 2
Scaling Factor for Maximum Equilibrium Iodine Concentration

Isotope	Normal Iodine Activity Concentration (μCi/g) A	Iodine Dose Conversion Factor (rem/Ci) B	Product (μCi.rem/Ci.g) (A x B)
I-131	1.300E-02	1.080E+06	1.404E+04
I-132	1.200E-01	6.438E+03	7.726E+02
I-133	8.900E-02	1.798E+05	1.600E+04
I-134	2.400E-01	1.066E+03	2.558E+02
I-135	1.300E-01	3.130E+04	4.069E+03
Total			3.514E+04

A From Reference 9.3, Appendix A

I-131 DE Based on Normal Iodine Concentration	3.254E-02

Iodine Scaling Factor Based on 0.2 μCi/g DE I-131	6.147E+00

Table 3

Isotopic Maximum Equilibrium Iodine Activity Release

Isotope	Design Basis Iodine Concentration (μCi/g) A	Iodine Scaling Factor B	Mass of Coolant Becomes Airborne (g) C	Maximum Equilibrium Iodine Activity Release (Ci) AxBxC/1E6
I-131	1.300E-02	6.147E+00	3.910E+06	.3124E+00
I-132	1.200E-01	6.147E+00	3.910E+06	.2884E+01
I-133	8.900E-02	6.147E+00	3.910E+06	.2139E+01
I-134	2.400E-01	6.147E+00	3.910E+06	.5768E+01
I-135	1.300E-01	6.147E+00	3.910E+06	.3124E+01

A From Table 2
B Scaling Factor Based on 0.2 μCi/g DE I-131 From Table 2
C From Section 6.2

CALC. NO.: H-1-AE-MDC-1868			REFERENCE:				
ORIGINATOR, DATE	REV:	G. Patel/NUCORE, 06/21/2006	1				
REVIEWER/VERIFIER, DATE		M. Drucker/NUCORE 06/22/2006					

11.0 FIGURES:

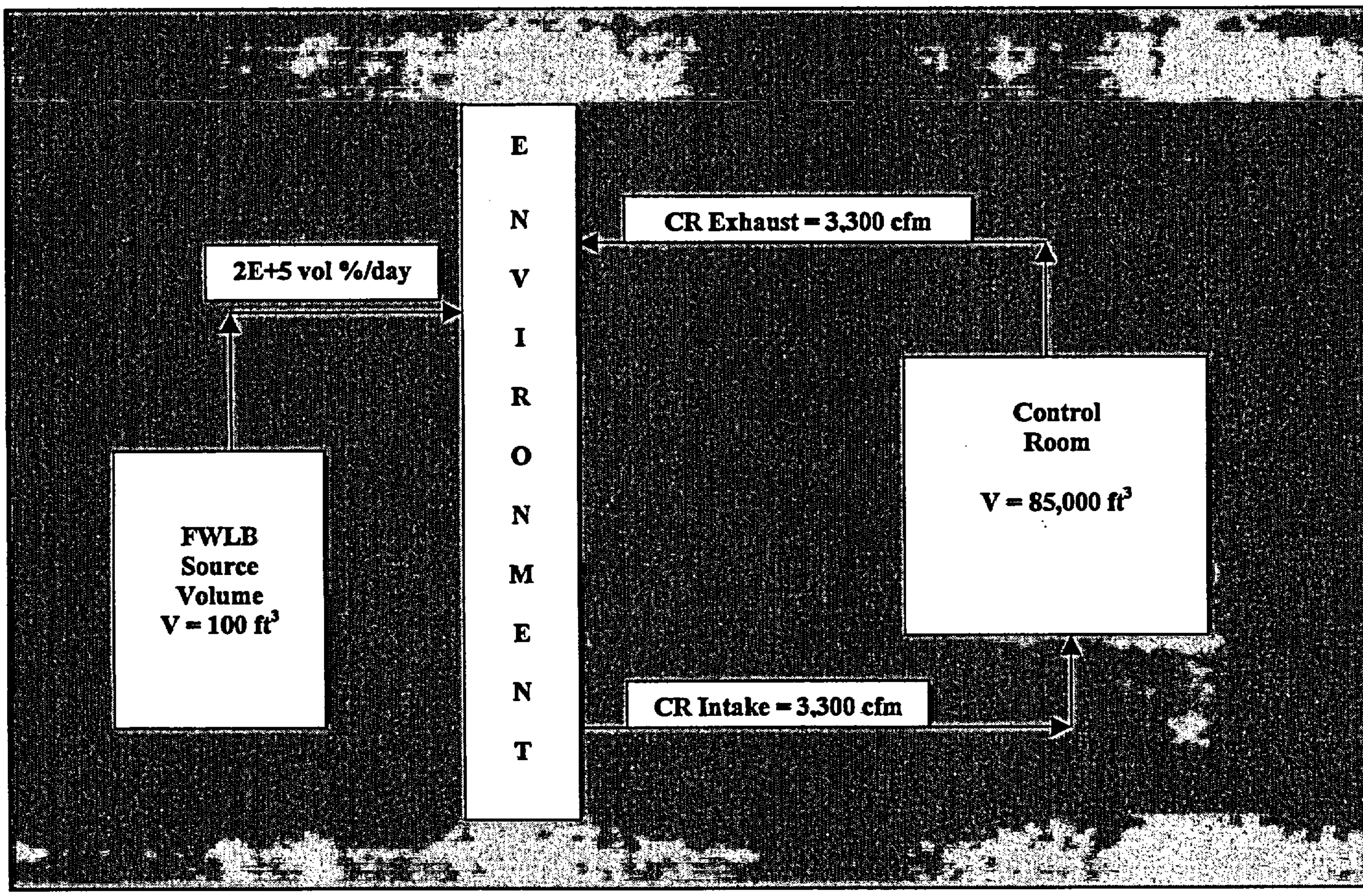

Figure 1: RADTRAD Nodalization For FWLBA Release

12.0 AFFECTED DOCUMENTS:

The following documents will be revised:

UFSAR Section 15.6.6

UFSAR Section 15A.7 Feedwater Line Break Accident (Section 15.6.6)

UFSAR Table 15.6-21

UFSAR Table 15.6-22

UFSAR Table 15.6-24

13.0 ATTACHMENTS:

Attachment A : 1 Diskette with the following electronic files:

Calculation No: H-1-AE-MDC-1868, Rev 1.
Peer Review Comment Resolutions – Mark Drucker
Owner's Acceptance Comment Resolution Form 2 – Michael E. Crawford
Certification for Design Verification Form-1
RCPD Form-1