SMUD

SACRAMENTO MUNICIPAL UTILITY DISTRICT □ P. O. Box 15830, Sacramento CA 95852-1830, (916) 452-3211
AN ELECTRIC SYSTEM SERVING THE HEART OF CALIFORNIA

MAR 2 8 1988

GCA 88-066

U. S. Nuclear Regulatory Commission
Attn: Frank J. Miraglia, Jr.
Associate Director for Projects
11555 Rockville Pike
Rockville, MD 20852

Docket No. 50-312
Rancho Seco Nuclear Generating Station
License No. DPR-54
GALE VS. LEBOG CODE COMPARISON STUDY

Dear Mr. Miraglia:

The District hereby submits a GALE vs. LEBOG code comparison study which was performed by technical consultants Henry W. Morton and Thomas E. Potter. The study represents a supplemental Radioactive Liquid Effluent Systems Evaluation. The Radioactive Liquid Effluent Systems Evaluation, which the District submitted to the NRC via letter GCA 87-810, dated January 12, 1988, used the LEBOG code to outline the conditions under which Rancho Seco can operate within the 10 CFR 50, Appendix I guidelines.

The NRR reviewer of Proposed Amendment No. 155, Revision 2 is most familiar with the GALE code and has displayed an interest in reviewing the results of the GALE vs. LEBOG code comparison study. This transmittal fulfills a commitment to provide the study.

Please contact me if you have any questions. Members of your staff with questions requiring additional information or clarification may contact Mr. Richard Mannheimer at (209) 333-2935, extension 4919.

Sincerely,

G. Carl Andognini

G. Carl Andognini
Chief Executive Officer,
Nuclear

8804060464 880328
PDR ADOCK 05000312
P PDR

Attachment

cc: G. Kalman, NRC, Rockville
A. D'Angelo, NRC, Rancho Seco
J. B. Martin, NRC, Walnut Creek

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ADD: WAYNE MEINKE
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Morton and Potter

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March 7, 1988

Mr. Harvey Story
Rancho Seco Nuclear Generating Station
Mail Stop 292
1444 Twin Cities Road
Herald, California 95638-9799

Dear Mr. Story:

This letter is a response to your recent request to review the report, "Radioactive Liquid Effluent Systems Evaluation Using Program Lebog, Revision II," dated January, 1988. We have reviewed the report and compared results to similar analyses using GALE and LADTAPII described in our draft report dated February 8, 1988. This letter describes our review and findings.

Our review of the report included review of the model description, review of operational assumptions, review of input data related to plant design, and review of the computer code against the model description in the text of the report. We performed a test calculation using the LEBOG model (not the code) to reproduce LEBOG results for one case. We also performed a test calculation using the LEBOG model to try to reproduce results of GALE-LADTAP analyses in our draft report.

In our review we found one minor logic error, and identified one operational assumption and one modeling assumption that may need further consideration. From the standpoint of impact on conclusions, the modeling assumption is the most important and it is discussed last in this letter.

The logic error is the double counting of the plant availability factor in calculating annual release quantities from the secondary system. It is used first in calculating the concentration in secondary coolant (LEBOG line 440), and then is used again in calculating the quantity of liquid discharged (LEBOG line 210). It should only be used once, preferably in line 210. This error has a small effect. In our attempt to reproduce the results of the LEBOG test problem (0.05% failed fuel and 0.1 gpm primary-to-secondary leak), we calculate a fraction of 10CFR50 App I guidance of 0.84 rather than 0.64 from LEBOG. This calculation is shown in Attachment 1. If we introduce the double count of plant availability, we calculate 0.61, reasonably close to the LEBOG result.

The operational assumption that may need further consideration involves releases of secondary side water processed through the miscellaneous radwaste system. In the LEBOG methodology, this release is fixed at 0.00038 Curies per year of Cs-137 and a proportionate quantity of Cs-134 (1,000,000 gallons per year at 1.0E-07 microCuries per milliliter). It is not varied with different assumed values for failed-fuel fractions and primary-to-secondary leak rates. The report states that the assumption is based on past experience, but it is not clear from information in the report that direct extension of that experience is valid for all combinations of failed-fuel fractions and primary-to-secondary leak rates evaluated. Increases in this quantity by a factor of about two to three or less would not change results greatly, but larger increases could affect conclusions.

The modeling assumption that needs further consideration is related to Cs-137 removal in the secondary loop. An assumption incorporated in GALE Rev 1 is that in plants without full-flow condensate demineralizers, 80% of the iodine and 90% of the other nuclides are partitioned to the stream that is pumped forward to the feedwater, bypassing the condensate demineralizers. This assumption is based on measurements at three plants. We have assumed in our analyses using GALE Rev 1 that Rancho Seco does not have full-flow condensate demineralization, based on the SMUD report demonstrating compliance with 10CFR50 App I, which states that the flow fraction to the demineralizers is 0.7. The LEBOG analysis also implicitly assumes 0.7. However, the LEBOG model assumes no partitioning of iodine or cesium between the stream pumped forward to feedwater relative to the stream entering the condensate demeralizer, ie., the cesium concentration entering the demineralizer is assumed to be the same as that bypassing it. In this respect, the LEBOG assumption is the same as in GALE Rev 0. For a given condensate demineralizer DF for cesium, the GALE Rev 1 model would estimate substantially less cesium removal from the secondary loop water than would the LEBOG model.

Separately, in the GALE Rev 1 model, the condensate demineralizer DF for cesium is assigned a value of 2. By comparison, a DF of 10 for cesium is assumed in the LEBOG analysis. The combination of these model differences and DF differences yields much higher effective removal of cesium, and thus much lower secondary coolant cesium concentrations, in LEBOG than in GALE Rev 1.

It may be that Rancho Seco data show that the secondary coolant concentrations calculated by GALE are too high, but we have been unable to obtain such data. It appears to us that the only options are either to use the GALE assumption, or to provide data to support an alternate assumption.

Differences in analyses using LEBOG and the GALE-LADTAP models, including the effect of values assigned to sensitive parameters, were compared by exercising the models with similar assumptions in a comparison case, in Attachment 3. We assumed 0.0012 failed fuel, 75 pounds/day primary-to-secondary coolant leakage, and 0.5 of the secondary coolant leakage from the Turbine Building treated by the sluiceable demineralizer. This was similar to a 50%-50% weighted average of GALE-LADTAP cases L1A-M and L2A-M in our report. In GALE case L1A-M, none of the secondary stream is processed through the sluiceable demineralizers while, in GALE case L2A-M, all of that stream is processed. The weighted average was compared with the LEBOG scenario in which 50% of the Turbine Building drains stream is processed. Comparison case values of other sensitive parameters used in the LEBOG and in the GALE & LADTAP analyses, and that differ, are listed in Attachment 2.

In addition to the overall comparison, corresponding parts of the models or of intermediate results were also compared. An estimate of the relative effect on dose to a person offsite is given in Table 1 as a ratio of GALE-LADTAP to LEBOG results. Some of the differences do not affect results; for instance, secondary coolant volume is unimportant. Offsetting differences can be seen within the comparison case. For example, the difference in the Turbine Building drain stream flow, a factor of 10 higher in LEBOG than in GALE, is partially offset by the difference in secondary coolant activity concentration, a factor of 4 lower in LEBOG than in GALE. Parameters and values in Table 1 are of the most interest for comparison, for most of the difference between LEBOG and GALE-LADTAP results is explainable by these data or assumptions which lead to calculated release and dose.

To broaden the comparison, the sensitivity of dose computed by GALE-LADTAP was examined as a function of a wider range of failed fuel fraction and of primary-to-secondary leakage. In order to manage the number of original GALE-LADTAP computations, the doses were derived by scaling GALE-LADTAP cases L1A and L1C (Feb. 8, 1988 report) as described in Attachment 4. Note that, for this comparison, it was assumed that the turbine building drain flow rate is 72,000 gallons per day and that half of this flow is processed through the sluiceable demineralizers. These assumptions make results more directly comparable to LEBOG results. Table 2 presents the resulting offsite dose as a

fraction of the 10 CFR Appendix I dose objective. To confirm this method, a comparable case was computed with GALE-LADTAP at 0.0012 failed fuel and 0.01 gpm primary-to-secondary leakage. The computed total body dose to the most exposed member of the public was 0.98 of the 3 mrem annual Appendix I objective compared to a scaled value of 0.99 of it.

Table 2 may be compared with Appendix B in the LEBOG report. The differences are not all in the same proportion. In general, the tabulated dose is influenced by 1) H-3 and miscellaneous waste at lowest failed fuel and primary-to-secondary leakage, and 2) secondary coolant leakage at largest failed fuel and primary-to-secondary leakage. For combinations of largest fuel failure and primary-to-secondary leakage, GALE-LADTAP results are substantially higher than LEBOG results.

LEBOG is commendable in that it focuses on the liquid waste and radionuclides that, historically, have produced most of the potential dose offsite. In doing so, LEBOG is concise, understandable, and easy to use in monitoring plant performance.

Please call if you wish to discuss these matters further.

Sincerely,

Thomas E. Potter

Thomas E. Potter

ATTACHMENT 1

CHECK OF SMUD LEBOG MODEL

CS-137 PRIMARY COOLANT CONCENTRATION

INPUT DATA

0.0005	D--FAILED FUEL FRACTION
1.00E-08	VSUB1--I-131 ESCAPE RATE COEFFICIENT (1/S)
2772	P--THERMAL POWER (MWt)
0.029	Y--I-131 FISSION YIELD (FRACTION)
3.3E+16	F--FISSION RATE (ATOMS/MWt-S)
88200	VRCS--PRIMARY SYSTEM VOLUME (GAL)
1.00E-06	R--I-131 DECAY CONSTANT (1/S)
45	B--LETDOWN FLOW RATE (GAL/MIN)
100	DFL--I-131 LETDOWN DF
0.14	CSRAT--RATIO OF CS-137 TO I-131 IN PRIM COOLANT

CALCULATIONS

8.42E-06	K = B/60.*(1-(1/DFL))/VRCS (1/S) CLEANUP REMOVAL CONSTANT
1.60E-02	PRICS137 = CSRAT*D*VSUB1*P*Y*F/(VRCS*3785*37000*(R+K)) (UCI/ML) PRIMARY COOLANT CONC CS-137

CS-137 SECONDARY COOLANT CONCENTRATION

INPUT DATA

0.1	PSECLK--PRIMARY TO SECONDARY LEAK RATE (GAL/MIN)
216000	VSEC--VOLUME OF COOLANT IN SEC SYSTEM (GAL)
16500	BSEC--FLOW RATE TO CONDENSATE DEMINS (GAL/M)
10	DFSDM--COND DEMIN DF FOR CS
50	Z--SEC LEAK RATE (GAL/MIN)

CALCULATIONS

0.001145	KSEC = BSEC/60*(1-(1/DFSDM))/VSEC (1/S) COND DEMIN REMOVAL CONSTANT
0.000003	LOSSLK = Z/(60*VSEC) (1/S) SECONDARY LEAKAGE REMOVAL CONSTANT
1.07E-07	SECCS137 = PRICS137*3785*PSECLK/60/(VSEC*3785*(KSEC+LOSSLK)) (UCI/ML) SECONDARY COOLANT CONC CS-137

ATTACHMENT 1
(continued)

DOSE CALCULATIONS

INPUT DATA

5570	AIJCS137--DOSE FACTOR FOR CS-137 (MREM/CI-CFS)
8930	AIJCS134--DOSE FACTOR FOR CS-134 (MREM/CI-CFS)
0.0927	AIJH3--DOSE FACTOR FOR H-3 (MREM/CI-CFS)
0.55	CS134RAT--RATIO OF CS-134 TO CS-137
100	H3REL--H-3 RELEASE (CI/YR)
18.93	FLO--DISCHARGE FLOW RATE (CFS)
1.00E+06	MWFLO--MISC RADWASTE FLOW RATE (GAL PER YR)
1.00E-07	MWCONC--MISC RADWASTE CS-137 CONC (UCI/ML)
0.5	SLCFRAC--FRACTION OF SEC LKG PROCESSED
50	DFSLCDM--CS DECON FACTOR FOR SLUICE DEMIN
0.61	AVAIL--AVAILABILITY FACTOR

CALCULATIONS

0.000378	MWREL = MWCONC*3785/1.E6*MWFLO CS-137 FROM MISC RADWASTE (CI/YR)
0.003315	SECREL = AVAIL*SECCS137*3785/1.E6*Z*60*8760*((1-SLCFRAC)+SLFRAC/DFSLCDM) CS-137 FROM SEC SYSTEM LKG (CI/YR)
0.489698	H3DOS = H3REL*AIJH3/FLO H-3 DOSE (MREM/YR)
1.835562	SECDOS = (SECREL*AIJCS137+CS134RAT*SECREL*AIJCS134)/FLO SEC SYSTEM RELEASE DOSE (MREM/YR)
0.209574	MWDOS = MWREL*(AIJCS137+AIJCS134*CS134RAT)/FLO MISC SYSTEM RELEASE DOSE (MREM/YR)
2.534836	TDOSE--TOTAL DOSE (MREM/YR)
0.844945	FRACTION OF 3 MREM/YR 10CFR50 APP I LIMIT FOR TOTAL BODY

ATTACHMENT 2

COMPARISON OF PARAMETER VALUES FOR LEBOG AND GALE ANALYSES

	------LEBOG UNITS------		------GALE UNITS------	
	LEBOG	GALE	LEBOG	GALE
COOLANT CONCENTRATION CALCULATION PARAMETERS				
PRIMARY COOLANT	88200	63385 GAL	734706	528000 LB
PRIM CS-137/I-131	0.14	0.75	0.14	0.75
LETDOWN FLOW	45	45 GPM	45	45 GPM
SECONDARY COOLANT	216000	11981 GAL	1799280	99800 LB
COND DEMIN CS DF	10	2	10	2
COND DEMIN FLOW RATE	16500	17147 GPM	8246700	8570000 LB/HR
RELEASE CALCULATION PARAMETERS				
PLANT AVAILABILITY	0.61	0.8	0.61	0.8
H-3 RELEASE	100	96 CI/YR	100	96 CI/YR
MISC RADWASTE RELEASE	LEBOG ASSUMES 0.000379 CI/YR CS-137 AND 0.000208 CI/YR CS-134 M&P ASSUMES VARIABLE RATE, DEPENDING ON PCA, SEC COOLANT ACTIVITY CS-137 RANGES FROM 0.0001 TO 0.0004 CI/YR BASES FOR ASSUMPTIONS DIFFERS GREATLY			
FRACTION OF TB LKG TREATED	LEBOG ASSUMES 0.5, M&P ASSUMES ALL OR NONE			
SLUICE DEMIN DF	50	100	50	100
TB LKG FLOW RATE	50	5 GPM	72000	7200 GPD
DOSE CALCULATION PARAMETERS				
DILUTION FLOW RATE	18.93	18.93 CFS	8500	8500 GPM

8.33 LBPG--LB PER GALLON WATER

ATTACHMENT 3

CHECK OF SMUD LEBOG MODEL
REPRODUCE 50-50 WTD AVG OF GALE/LADTAP L1A-M AND L2A-M

GALE/LADTAP VALUES FOR COMPARISON	LEBOG CALCULATION	
	CS-137 PRIMARY COOLANT CONCENTRATION	
	INPUT DATA	
	0.0012	D--FAILED FUEL FRACTION
	1.00E-08	VSUB1--I-131 ESCAPE RATE COEFFICIENT (1/S)
	2772	P--THERMAL POWER (MWt)
	0.029	Y--I-131 FISSION YIELD (FRACTION)
	3.3E+16	F--FISSION RATE (ATOMS/MWt-S)
63385	88200	VRCS--PRIMARY SYSTEM VOLUME (GAL)
	1.00E-06	R--I-131 DECAY CONSTANT (1/S)
	45	B--LETDOWN FLOW RATE (GAL/MIN)
	100	DFL--I-131 LETDOWN DF
	0.14	CSRAT--RATIO OF CS-137 TO I-131 IN PRIM COOLANT
	CALCULATIONS	
	8.42E-06	K = B/60.*(1-(1/DFL))/VRCS (1/S) CLEANUP REMOVAL CONSTANT
1.35E-02	3.83E-02	PRICS137 = CSRAT*D*VSUB1*P*Y*F/(VRCS*3785*37000*(R+K)) (UCI/ML) PRIMARY COOLANT CONC CS-137
	CS-137 SECONDARY COOLANT CONCENTRATION	
	INPUT DATA	
	0.00625	PSECLK--PRIMARY TO SECONDARY LEAK RATE (GAL/MIN) (EQUIV TO 75 LB/DAY)
11981	216000	VSEC--VOLUME OF COOLANT IN SEC SYSTEM (GAL)
17147	16500	BSEC--FLOW RATE TO CONDENSATE DEMINS (GAL/M)
2	10	DFSDM--COND DEMIN DF FOR CS
5	50	Z--SEC LEAK RATE (GAL/MIN)
	CALCULATIONS	
	0.001145	KSEC = BSEC/60*(1-(1/DFSDM))/VSEC (1/S) COND DEMIN REMOVAL CONSTANT
	0.000003	LOSSLK = Z/(60*VSEC) (1/S) SECONDARY LEAKAGE REMOVAL CONSTANT
6.88E-08	1.61E-08	SECCS137 = PRICS137*3785*PSECLK/60/(VSEC*3785*(KSEC+LOSSLK)) (UCI/ML) SECONDARY COOLANT CONC CS-137

ATTACHMENT 3
(continued)

GALE/LADTAP VALUES FOR COMPARISON	LEBOG CALCULATION	
	DOSE CALCULATIONS	
	INPUT DATA	
	5570	AIJCS137--DOSE FACTOR FOR CS-137 (MREM/CI-CFS)
	8930	AIJCS134--DOSE FACTOR FOR CS-134 (MREM/CI-CFS)
	0.0927	AIJH3--DOSE FACTOR FOR H-3 (MREM/CI-CFS)
	0.55	CS134RAT--RATIO OF CS-134 TO CS-137
96	100	H3REL--H-3 RELEASE (CI/YR)
18.93	18.93	FLO--DISCHARGE FLOW RATE (CFS)
	1.00E+06	MWFLO--MISC RADWASTE FLOW RATE (GAL PER YR)
	1.00E-07	MWCONC--MISC RADWASTE CS-137 CONC (UCI/ML)
	0.5	SLCFRAC--FRACTION OF SEC LKG PROCESSED
100	50	DFSLCDM--CS DECON FACTOR FOR SLUICE DEMIN
0.8	0.61	AVAIL--AVAILABILITY FACTOR
	CALCULATIONS	
	0.000378	MWREL = MWCONC*3785/1.E6*MWFLO CS-137 FROM MISC RADWASTE (CI/YR)
	0.000497	SECREL = AVAIL*SECCS137*3785/1.E6*Z*60*8760*((1-SLCFRAC)+SLFRAC/DFSLCDM) CS-137 FROM SEC SYSTEM LKG (CI/YR)
0.07	0.489698	H3DOS = H3REL*AIJH3/FLO H-3 DOSE (MREM/YR)
0.18	0.275334	SECDOS = (SECREL*AIJCS137+CS134RAT*SECREL*AIJCS134)/FLO SEC SYSTEM RELEASE DOSE (MREM/YR)
0.07	0.209574	MWDOS = MWREL*(AIJCS137+AIJCS134*CS134RAT)/FLO MISC SYSTEM RELEASE DOSE (MREM/YR)
0.32	0.974607	TDOSE--TOTAL DOSE (MREM/YR)
	0.324869	FRACTION OF 3 MREM/YR 10CFR50 APP I LIMIT FOR TOTAL BODY

RATIO OF GALE/LADTAP DOSE FROM SECONDARY RELEASES TO LEBOG DOSE FROM SEC RELEASES:

0.64

Table 1

Effect of Values of Selected Parameters on Computed Dose Equivalent Offsite

Symbol	Parameter	GALE & LADTAP	LEBOG	Impact on Result[a] $\left(\frac{\text{GALE.LADTAP}}{\text{LEBOG}}\right)$
VRCS	Primary coolant volume (gal)	63385	88200	minor
PRICS137	Primary coolant conc (uCi/g)	1.35E-2	3.83E-2	0.35
VSEC	Second. coolant volume (gal)	11981	216000	none (not used)
DFSDM	DF Cs in condensate demin	2	10	1.8
	Fraction of Cs in steam in condensate demin feed	0.1	0.7[b]	7
BSEC	Flow to condensate demin	17147	16500	negligible
SECCS137	Cs conc in second cool (uCi/g)	6.88E-8	1.61E-8	(accounted for by factors above)
H3REL	H-3 release rate (Ci/yr)	100	96	c
MWREL	Misc. Radwaste effl (Ci Cs137/yr)	calc	3.78E-4	c
FLO	Canal dilution flow (cfs)	18.93	18.93	1.0
DFSLCDM	DF Cs in sluice demins	100	50	negl for 50% treatment case
Z	Turbine Bldg drain flow (gpm)	5	50	0.1
AVAIL	Plant availability	0.8	0.61	1.31
	Product of all factors			0.6

a Secondary system releases only.

b Condensate demineralizer flow is 0.7 of secondary steam flow.

c H-3 and Misc. Radwaste System releases account for 0.7 mrem/yr in LEBOG and 0.14 mrem/yr in GALE-LADTAP.

ATTACHMENT 4

SENSITIVITY OF DOSE TO FAILED FUEL, PRIM-SEC LKG--2/8/88 M&P REPORT
TURB DRN, H3, MRW CONTRIBUTIONS CALCULATED BY DIFFERENCE THEN SCALED

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
CASE	FLD FUEL FRAC	P/S LKG	MAX TB	AGE	MAX ORG	ORG	AGE	TURB DRN MAX TB	TURB DRN MAX ORG
		LB/D	MREM/YR		MREM/YR			MREM/YR	MREM/YR
1A	0.0012	75	0.489	AD	1.63	GI	AD	0.346	1.541
1B	0.0012	750	3.6	AD	15.5	GI	AD		
1C	0.0036	75	1.32	AD	4.64	GI	AD	1.031	4.540
1D	0.0036	750	10.6	AD	45.5	GI	AD		
2A	0.0012	75	0.147	AD	0.171	LIV	AD	0.003	0.014
2B	0.0012	750	0.176	AD	0.255	GI	AD		
2C	0.0036	75	0.285	AD	0.355	LIV	AD	0.010	0.045
2D	0.0036	750	0.376	AD	0.632	GI	AD		

DOSE FROM TURBINE BUILDING DRAINS COMPUTED FROM DIFFERENCE BETWEEN 1A AND 1B. THE DIFFERENCE BETWEEN 1A AND 1B IS 9 TIMES THE TURBINE BUILDING DRAIN CONTRIBUTION IN CASE 1A.

DOSE FROM TRITIUM, "H3", AND MISC RADWASTE, "MRW", IS DIFFERENCE BETWEEN MAX TURB DRN AND DOSE FROM ALL SOURCES (COLS 4 AND 6)

DIFFERENCE BETWEEN H3 AND MRW CONTRIBUTIONS FOR 1A AND 1C IS DUE TO DIFFERENCE IN MRW CONTRIBUTION. H3 CONTRIBUTION IS SAME IN BOTH CASES. THAT DIFFERENCE REPRESENTS TWICE THE MRW CONTRIBUTION TO CASE 1A, BECAUSE IT IS DUE SOLELY TO TRIPLING OF FAILED FUEL FRACTION FROM CASE 1A TO 1C.

THE ABOVE RELATIONSHIPS CAN BE USED TO ISOLATE THE CONTRIBUTIONS FROM H3 AND MRW TO DOSE:

TOTAL BODY DOSE

0.14 TBH3MRW1A--H-3 AND MISC RADWASTE DOSE IN CASE 1A
= DOSE FROM ALL SOURCES - TURB DRAIN CONTRIBUTION
0.29 TBH3MRW1C--H-3 AND MISC RADWASTE DOSE IN CASE 1C
= DOSE FROM ALL SOURCES - TURB DRAIN CONTRIBUTION
0.07 TBMRW1A--MISC RADWASTE DOSE IN CASE 1A
= (TBH3MWR1C - TBH3MWR1A) / 2
0.07 TBH31A--H-3 DOSE IN CASE 1A
= TBH3MRW1A - TBMRW1A

TABLE 2

SENSITIVITY OF FRACTION OF 10CFR50 APP I DOSE LIMIT TO FF AND P-S LKG

% FF	PRIMARY-TO-SECONDARY LEAK RATE (GPM)									
	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10
0.01	0.10	0.18	0.26	0.34	0.42	0.50	0.57	0.65	0.73	0.81
0.02	0.18	0.34	0.50	0.65	0.81	0.97	1.12	1.28	1.44	1.59
0.03	0.26	0.50	0.73	0.97	1.20	1.44	1.67	1.91	2.15	2.38
0.04	0.35	0.66	0.97	1.29	1.60	1.91	2.23	2.54	2.85	3.17
0.05	0.43	0.82	1.21	1.60	1.99	2.38	2.78	3.17	3.56	3.95
0.06	0.51	0.98	1.45	1.92	2.39	2.86	3.33	3.80	4.27	4.74
0.07	0.59	1.13	1.68	2.23	2.78	3.33	3.88	4.43	4.97	5.52
0.08	0.67	1.29	1.92	2.55	3.17	3.80	4.43	5.05	5.68	6.31
0.09	0.75	1.45	2.16	2.86	3.57	4.27	4.98	5.68	6.39	7.09
0.10	0.83	1.61	2.39	3.18	3.96	4.74	5.53	6.31	7.10	7.88
0.11	0.91	1.77	2.63	3.49	4.36	5.22	6.08	6.94	7.80	8.66
0.12	0.99	1.93	2.87	3.81	4.75	5.69	6.63	7.57	8.51	9.45
0.13	1.07	2.09	3.11	4.12	5.14	6.16	7.18	8.20	9.22	10.24
0.14	1.15	2.25	3.34	4.44	5.54	6.63	7.73	8.83	9.92	11.02
0.15	1.23	2.40	3.58	4.75	5.93	7.11	8.28	9.46	10.63	11.81

FRACTION IS THE RATIO OF CALCULATED TOTAL BODY DOSE TO 10CFR50 APP I OBJECTIVE, 3 MREM/YR, USING H-3, MISC RADWASTE, AND TURBINE BUILDING DRAIN DOSES CALCULATED IN ATTACHMENT 4

FRACTION IS COMPUTED BY SCALING RESULTS FROM CASE 1A, WHICH IS BASED ON FOLLOWING ASSUMPTIONS: 0.12% FAILED FUEL, 0.00625 GPM (75 LB/D) PRIMARY-TO-SECONDARY LEAK, 7,200 GAL/D SECONDARY LEAKAGE

FRACTION = (TBH31A + %FF / .12 * (TBMRW1A + TBTDRN1A * TDRNFLO * ((1 - TDTRTF) + TDTRTF / TDTRTDF) / 7200 * PRMTOSEC / .00625)) / 3

72000 TDRNFLO--TURB DRAIN FLOW RATE (GPD)
0.5 TDTRTF--TURB DRAIN TREATMENT FRACTION
50 TDTRTDF--TURB DRAIN TREATMENT DF
0.07 TBMRW1A--MISC RADWASTE DOSE IN CASE 1A
0.07 TBH31A--H-3 DOSE IN CASE 1A
0.35 TBTDRN1A--TURBINE BUILDING DRAIN DOSE IN CASE 1A
%FF--PERCENT FAILED FUEL
PRMTOSEC--PRIMARY-TO-SECONDARY LEAK RATE (GPM)