



PROJECT NAME: Zion Station
 PROJECT NO.: 8986-10
 CLIENT: Commonwealth Edison Company
 CALC. NO.: ATD-0190
 TITLE: Control Room Habitability Radiological Dose Analysis

UNIT NO.: 1 & 2
 FILE NO.: 4.6, 13.1
 SYSTEM: CR
 DIVISION: ATD

DESIGN CONTROL SUMMARY
 DESIGN VERIFICATION

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SAFETY RELATED NON SAFETY RELATED

QA SERIAL #

REV. #	DATE	APPROVER	REVIEWER	PREPARER	IDENTIFICATION OF PAGES ADDED/REVISED/SUPERSEDED/VOIDED & REVIEW METHOD	REVIEW METHOD	STATUS
REV. 0	10/29/92	G. P. Lahti	W. J. Johnson	R. S. Hubner	Pages 1 - 68, all new calculations.	See Page 68	Preliminary, based on Unverified data Superseded
REV. 1	DEC 1992	G. P. LAHTI	William J Johnson	R. S. Hubner	Revised only pages 1, 8, 12, 13, and 54, and 56; all other Rev. 0 pages are unchanged. Added page 69.	See page 69.	Verified data Superseded
REV. 2	11 March 93	G. P. Lahti	W. J. Johnson	Anthony G. Klazura	Revised All Pages (i.e., pages 1 through 85) This revision supercedes revisions 0 and 1.	See Page 85	Verified
REV. 3	3-31-94	W. J. Johnson	Robert S. Hubner	W. E. DeLise	Revised Page 1 and added Pages 86 through 102	See Page 102	Verified

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Calcs. For: CONTROL ROOM	
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1. PURPOSE

The purpose of this calculation is to evaluate the control room dose impact when using some limiting values (additional conservatism) for four design parameters that were used in the previous revision [Revision 2] of this calculation. The containment fan cooler flow rate is reduced by 1000 cfm; the recirculation flow rate is supplied using only a single centrifugal charging pump; the delay time for starting the containment spray injection is increased by 10.6 seconds, but it still terminates operation 4 hours after the initiation of the postulated accident; and the minimum additive tank volume is used. The actual values are described in the next section.

2. DESIGN INPUT

2.1 Source Term

The iodine and noble gas source terms given on page 5 of Revision 2 of this calculation [Reference 1] are used in this evaluation.

2.2 Plant Data

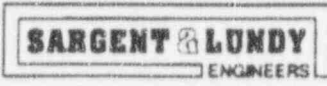
Two parameters in Table 2 of Revision 2 (page 6), "Primary Containment Data," have been made more conservative for this dose evaluation. They are:

Item	Value	Reference
Fan Cooler Flow Rate (cfm)	65000 each	Ref. 2 (attached)
Spray Additive Tank (gal)	2660	Ref. 2 (attached)

Three parameters in Table 3 of Revision 2 (page 8), "Containment Spray Data," have been made more conservative for this dose evaluation. They are:

Item	Value	Reference
Spray Injection Delay (sec)	120.6	Ref. 2 (attached)
Recirc. Spray Flow Rate (gpm)	1450.	Ref. 3
Organic Iodine Spray Removal Rate (Recirc. Pump) (1/hour)	0.01704	Ref. 4

All of the parameters in Table 4 of Revision 2, "Control Room Data," are unchanged. This includes the maximum and minimum control room unfiltered inleakages for the makeup system's Train A (144 cfm and 96 cfm) and Train B (119 cfm and 81 cfm).



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3. ASSUMPTIONS

The following assumptions are noted.

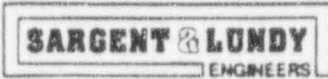
1. The five assumptions specified in Revision 2 (page 11) apply to this evaluation.
2. The containment injection delay includes the EDG sequence timer delay associated with the containment spray pump start.
3. The recirculation spray flow rate is delivered by a single centrifugal charging pump.
4. The minimum allowable spray additive tank volume is used.
5. The Engineering Judgements specified in Revision 2 (page 12) apply to this evaluation.

4. APPROACH

The POSTDBA computer code [Reference 5] model specified in Section 5.2 of Revision 2 (Reference 1, pages 22 through 46) is used in this dose evaluation. Therefore, the computer analysis uses the control room makeup flow rates ("g") of 1600, 1800, 2000, and 2200 cfm for each of the source release pathways, i.e., the containment leakage, the ECCS leakage, and the sump water leakage to the RWST. The computer run uses the largest control room unfiltered inleakage rate, which is the maximum inleakage for Train A of the control room makeup air system. Control room doses from other unfiltered inleakage rates ("f") are obtained using the Iodine Protection Factor (IPF) methodology (thyroid dose only) described in Revision 2 (page 13) where the makeup air iodine removal efficiency ("n") is equal to 0.99 [Table 4 of Revision 2].

The equation is $(IPF)_f = (g+f)/[(1-n)g + f]$

The inhalation dose is inversely proportional to the (IPF). Thus, if a thyroid dose of a particular pair of "f" and "g" values has been determined, then the dose for a different "f" value (and the same "g" value) can be determined by using the known dose value and the two calculated (IPF) values. If two thyroid dose values and one "f" value are known, then a related "f" value can be found for a constant known "g" value.



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5. CALCULATIONS

5.1 Hand Calculations

The particulate spray removal rate ("L") during the LOCA recirculation mode is directly proportional to the recirculation flow rate which changes from 2460 gpm [page 14 of Revision 2] to 1450 gpm. The ratio of these two flow rates is (1450/2640 =) 0.5492 which makes L = 0.5942(4.883) = 2.682 (1/hour). The automatic "DF of 50" reduction factor of 0.1 applies to this evaluation [page 14 of Revision 2].

The ECCS source leak rate (POSTDBA purge rate) is inversely proportional to the sump water source dilution volume. Because the minimum volume of the spray additive tank has been decreased in this evaluation, the sump water volume is decreased, the sump water concentration is increased, and the ECCS source leakage is increased due to the fixed leak rate of 0.9353 gph. Thus, the source purge rate ("P") increases by the following factor: [see page 16 of Revision 2 for relationship]

$$P_E = 0.08911 \{474910 / [474910 - (5000 - 2660)]\}$$

$$= 0.08911 (1.00495) = 0.08955 \text{ (cfm)}$$

The source leak rate back to the RWST is also related to the sump water volume, and the same correction factor is applied to its POSTDBA purge rate ("P"), i.e., 1.00495.

$$P_R = 7.556 \times 10^{-4} (1.00495) = 7.593 \times 10^{-4} \text{ (cfm)}$$

The only other parameter that changes from those used in Revision 2 is the containment mixing flow rates from the three fan coolers. This rate is changed from 66000 cfm to 65000 cfm per fan. The new total flow rate is 195000 cfm.

All other data is taken directly from Section 5.1 of Revision 2 (pages 14 through 21).

5.2 Computer Input

The input data structure, models, and parameter values for POSTDBA are described in Subsection 5.2.1 of Revision 2 (pages 22 through 46). The following changes were made to that data to obtain the computer output that is discussed in the next section.

1. The project number was changed and the calculation number was added to all JITLE lines.
2. The first time step was changed from 0.03056 hours to 0.03350 hours (pages 25 through 29 of Revision 2).



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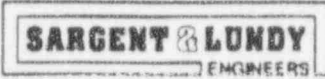
3. The particulate iodine spray removal rate was changed from 4.883 per hour to 2.682 per hour (page 25 of Revision 2).
4. The Organic iodine spray removal rate was changed from 0.03246 per hour to 0.01704 per hour (page 25 of Revision 2).
5. The containment mixing rate was changed from 198000 cfm to 195000 cfm (pages 26, 34, & 42 of Revision 2).
6. The ECCS purge rate was changed from 0.08911 cfm to 0.08955 cfm (page 33 of Revision 2).
7. The RWST backleakage purge rate was changed from 7.556×10^{-4} cfm to 7.593×10^{-4} cfm (page 41 of Revision 2).

5.3 POSTDBA Output

The control room inleakage used in the computer evaluation is 144 cfm for each of the makeup air flow rate ("g") which are 1600, 1800, 2000, & 2200 cfm. The source release pathways are the containment leakage, the ECCS leakage and the RWST back leakage. The computer output is organized on the makeup flow rate, and its results are in Section 8.1. The following table contains the 720 hour doses due to the sum of the containment leakage, the ECCS leakage, and RWST back leakage. This is done for each of the makeup flow rates mentioned above.

TABLE 1: Thirty Day Post Accident Doses for the Maximum Outside Air Inleakage

MAKEUP Flow (cfm)	30 DAY DOSES for 144 cfm Inleakage (in rem)				
	Whole Body	Skin Gamma	Skin Beta	Skin Total	Thyroid
1600	0.264	0.429	3.264	3.693	27.96
1800	0.268	0.434	3.304	3.738	25.46
2000	0.271	0.438	3.339	3.777	23.41
2200	0.273	0.442	3.369	3.811	21.70



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5.4 Thyroid Doses for Other Unfiltered Inleakage

The method for determining the control room (CR) thyroid doses for other inleakages (96 cfm minimum for Train A, 81 cfm minimum for Train B, and 119 cfm maximum for Train B) is the same as discussed in Section 5.4 of Revision 2. Equation 3 from Revision 2 is used to determine these CR thyroid doses where D_{144} is the thyroid dose for 144 cfm CR inleakage. This is done for each of the makeup flow rates ("g" values, 1600, 1800, 2000, and 2200 cfm).

Equation 1: The (IPF) equation is $(IPF)_f = (g+f)/[(1-n)g + f]$, where $n = 0.99$.

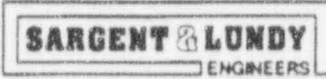
Since the dose is inversely proportional to the (IPF), the (IPF) for the 30 rem dose limit, $(IPF)_{*30}$, can be found using the following equation.

Equation 2: $(IPF)_{*30} = (IPF)_{144} \times [D_{144}/30 \text{ rem}]$

The following table gives the $(IPF)_f$ and $(IPF)_{*30}$ values for each of the inleakage values used in this analysis.

TABLE 2: (IPF) Values for Unfiltered Inleakage into the CR Makeup Air Supply and the (IPF) Values for 30 rem to the Thyroid for each Makeup Flow Rate

MAKEUP Flow (cfm)		Maximum Inleakage		Minimum Inleakage		(IPF) for 30 rem to the thyroid (IPF)*30
		Train A (cfm)	Train B (cfm)	Train A (cfm)	Train B (cfm)	
g	f=	144	119	96	81	
1600	(IPF) _f	10.90	12.73	15.14	17.33	10.16
1800		12.00	14.01	16.63	19.00	10.18
2000		13.07	15.24	18.07	20.60	10.20
2200		14.12	16.45	19.46	22.15	10.21



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Equation 3: The dose equation is $D_f = D_{144} \{ (IPF)_{144} / (IPF)_f \}$, where "g" is constant in Equation 1.

TABLE 3: Summary of the Range of Control Room Thyroid doses for Each of the Makeup System Trains (used Eq. 3, TABLE 1 and TABLE 2)

MAKEUP	Thyroid Doses Based on Makeup Flow and Inleakage (in rem)				
	Flow (cfm)	Train A Inleakage (cfm)		Train B Inleakage (cfm)	
g	f=	Maximum=144	Minimum=26	Maximum=119	Minimum=81
1600	D O S E S	27.96	20.13	23.94	17.59
1800		25.46	18.37	21.81	16.08
2000		23.41	10.93	20.08	14.85
2200		21.70	15.75	18.63	13.83

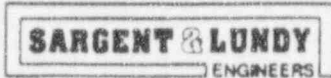
The inleakage flow rates for the 30 rem limiting thyroid dose are determined using the following relationship [IPFs from TABLE 2].

Equation 4: $f_{*30} = g \{ [0.01 (IPF)_{*30} - 1.0] / [1.0 - (IPF)_{*30}] \}$

The f_{*30} values for each "g" value are in the following table.

TABLE 4: Unfiltered Inleakage Needed to Reach the CR Thyroid Dose Limit of 30 rem for the Specified Filtered Makeup Air Flow Rates

g (cfm)	(IPF) _{*30}	f _{*30} (cfm)
1600	10.16	157
1800	10.18	176
2000	10.20	195
2200	10.21	214



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6. RESULTS

6.1 Summary

The whole body dose and the skin doses are primarily caused by the noble gas concentration in the control room. Since the makeup system does not remove any noble gas, the change in these doses in relation to the infiltration rate will be small. This can be seen in the computer output in Section 8.1. The control room has whole body and skin doses that are a small fraction of the allow dose level of 5.0 rem to the whole body and 30.0 rem to the skin [Reference 6]. The computer calculated doses (including the thyroid doses) are given in TABLE 1 which is in Section 5.3.

The control room thyroid doses are based on the makeup flow rates and inleakage rates used in this analysis and they are summarized in TABLE 3 in Section 5.4. The Control Room thyroid dose limit is 30 rem, and all of the thyroid doses given in TABLE 3 are below this limit. The unfiltered inleakages required to produce 30 rem to the thyroid in the Control Room are given in TABLE 4. When the maximum unfiltered inleakage of 144 cfm is subtracted from the 30 rem inleakage flow rates, the resulting margins are 13 cfm at 1600 cfm filtered makeup (FM); 32 cfm at 1800 cfm FM; 51 cfm at 2000 cfm FM; and 70 cfm at 2200 cfm FM.

6.2 Microfiche

Title: CR Habitability Dose, Zion, ATD0190 R3, SR; ATD, file 4.6, CR
The microfiche is attached on the next page.

7. REFERENCES

1. ATD-0190 Revision 2, "Control Room Habitability, Radiological Dose Analysis," March 11, 1993.
2. Commonwealth Edison's Modification Design Engineering letter to R. Hameetman, from J.C. Ashley, dated Feb. 3, 1994. [Attached]
3. ATD-0377 Revision 0, "RHR Pump Recirculation Flow," March, 1994.
4. ATD-0206 Revision 2, "Organic Iodine Recirculation Spray Removal Rate, March, 1994.
5. Hubner, R.S. , POSTDBA User Manual, "PWR Power Plant Dose After DBA," Program No. 03.7.287-1.0, Issued August, 1991.
6. 10CFR50, General Design Criterion 19 of Appendix A.



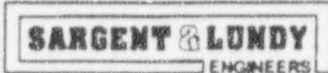
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8. ATTACHMENTS

8.1 Computer Output

1600 cfm

ZION 1&2, PROJ. No. 9140-98, ATD190 Rev 3, CONTROL RM DOSES FROM CNTMT LEAKAGE W/144 CFM INLEAKAGE TO CONTROL RM. CASE 1, 1600 CFM MAKEUP FLOW

SUM OVER ALL NUCLIDES

HOURS	-----INSIDE CONTROL ROOM DOSE, REM-----					
	TIME, GAMMA	BODY GAMMA	SKIN BETA	SKIN TOTAL	SKIN THYROID	
.034	3.394E-05	4.891E-05	3.967E-04	4.456E-04	1.548E-02	
.281	1.955E-03	2.808E-03	2.357E-02	2.637E-02	5.406E-01	
.341	2.770E-03	3.975E-03	3.352E-02	3.749E-02	6.838E-01	
.719	9.963E-03	1.428E-02	1.214E-01	1.357E-01	1.524E+00	
.914	1.462E-02	2.096E-02	1.778E-01	1.987E-01	1.918E+00	
1.414	2.815E-02	4.041E-02	3.380E-01	3.784E-01	2.844E+00	
2.000	4.495E-02	6.472E-02	5.308E-01	5.955E-01	3.815E+00	
4.000	9.610E-02	1.400E-01	1.090E+00	1.230E+00	6.663E+00	
8.000	1.605E-01	2.391E-01	1.800E+00	2.039E+00	1.157E+01	
24.000	2.253E-01	3.525E-01	2.695E+00	3.048E+00	2.115E+01	
96.000	2.506E-01	4.024E-01	3.061E+00	3.464E+00	2.498E+01	
720.000	2.640E-01	4.291E-01	3.264E+00	3.693E+00	2.688E+01	

ZION 1&2, PROJ. No. 9140-98, ATD190 Rev 3, CONTROL ROOM DOSES FROM ECCS LEAKAGE W/144 CFM INLEAKAGE TO CONTROL RM. CASE 1, 1600 CFM MAKEUP FLOW

SUM OVER ALL NUCLIDES

HOURS	-----INSIDE CONTROL ROOM DOSE, REM-----					
	TIME, GAMMA	BODY GAMMA	SKIN BETA	SKIN TOTAL	SKIN THYROID	
.250	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
.500	1.592E-07	2.392E-07	9.359E-07	1.175E-06	7.646E-04	
.883	8.364E-07	1.257E-06	4.983E-06	6.240E-06	4.399E-03	
1.383	2.112E-06	3.176E-06	1.279E-05	1.597E-05	1.232E-02	
2.000	3.878E-06	5.834E-06	2.395E-05	2.978E-05	2.525E-02	
6.000	1.329E-05	2.005E-05	8.992E-05	1.100E-04	1.320E-01	
8.000	1.660E-05	2.506E-05	1.158E-04	1.409E-04	1.865E-01	
24.000	2.594E-05	3.930E-05	1.993E-04	2.386E-04	4.343E-01	
96.000	3.084E-05	4.689E-05	2.460E-04	2.929E-04	7.427E-01	
720.000	3.342E-05	5.092E-05	2.657E-04	3.166E-04	9.986E-01	



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ZION 1&2, PROJ. No. 9140-98, ATD190 Rev 3, CONTROL ROOM DOSES FROM LEAK TO RWST W/144 CFM INLEAKAGE TO CONTROL RM. CASE 1, 1600 CFM MAKEUP FLOW

SUM OVER ALL NUCLIDES

-----INSIDE CONTROL ROOM DOSE, REM-----

HOURS	TIME, BODY GAMMA	SKIN GAMMA	BETA	SKIN TOTAL	SKIN THYROID
.250	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
.500	1.350E-08	2.028E-08	7.935E-08	9.963E-08	6.483E-05
.883	7.092E-08	1.066E-07	4.225E-07	5.291E-07	3.730E-04
1.383	1.791E-07	2.693E-07	1.085E-06	1.354E-06	1.045E-03
2.000	3.288E-07	4.947E-07	2.030E-06	2.525E-06	2.141E-03
6.000	1.127E-06	1.700E-06	7.624E-06	9.324E-06	1.119E-02
8.000	1.408E-06	2.125E-06	9.822E-06	1.195E-05	1.581E-02
24.000	2.199E-06	3.332E-06	1.690E-05	2.023E-05	3.683E-02
96.000	2.615E-06	3.976E-06	2.086E-05	2.483E-05	6.298E-02
720.000	2.834E-06	4.318E-06	2.253E-05	2.684E-05	8.469E-02

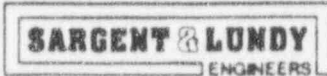
1800 cfm

ZION 1&2, PROJ. No. 9140-98, ATD190 Rev 3, CONTROL RM DOSES FROM CNTMT LEAKAGE W/144 CFM INLEAKAGE TO CONTROL RM CASE 2, 1800 CFM MAKEUP FLOW

SUM OVER ALL NUCLIDES

-----INSIDE CONTROL ROOM DOSE, REM-----

HOURS	TIME, BODY GAMMA	SKIN GAMMA	BETA	SKIN TOTAL	SKIN THYROID
.034	3.740E-05	5.388E-05	4.394E-04	4.933E-04	1.566E-02
.281	2.147E-03	3.082E-03	2.596E-02	2.904E-02	5.414E-01
.341	3.039E-03	4.359E-03	3.687E-02	4.123E-02	6.831E-01
.719	1.084E-02	1.553E-02	1.323E-01	1.478E-01	1.500E+00
.914	1.584E-02	2.271E-02	1.928E-01	2.156E-01	1.876E+00
1.414	3.019E-02	4.334E-02	3.630E-01	4.063E-01	2.742E+00
2.000	4.774E-02	6.872E-02	5.645E-01	6.332E-01	3.632E+00
4.000	9.999E-02	1.456E-01	1.135E+00	1.281E+00	6.208E+00
8.000	1.646E-01	2.451E-01	1.848E+00	2.093E+00	1.065E+01
24.000	2.289E-01	3.577E-01	2.738E+00	3.096E+00	1.929E+01
96.000	2.541E-01	4.073E-01	3.102E+00	3.509E+00	2.274E+01
720.000	2.675E-01	4.340E-01	3.304E+00	3.738E+00	2.447E+01



Calcs. For: CONTROL ROOM	
HABITABILITY RAD. DOSE ANALYSIS	
X	Safety-Related
	Non-Safety Related

Calc. No.: ATD-0190	
Rev. 3	Date:
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Client: Commonwealth Edison	Prepared by	Date
Project: Zion units 1&2	Reviewed by	Date
Proj. No.: 9140-98	Equip. No.: N/A	Approved by
		Date

ZION 1&2, PROJ. NO. 9140-98, ATD190 Rev. 3, CONTROL RM DOSES FROM ECCS LEAKAGE W/144 CFM INLEAKAGE TO CONTROL RM. CASE 2, 1800 CFM MAKEUP FLOW

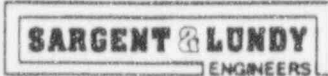
SUM OVER ALL NUCLIDES

HOURS	-----INSIDE CONTROL ROOM DOSE, REM-----					
	TIME, BODY	GAMMA	GAMMA	BETA	TOTAL	SKIN
.250	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
.500	1.599E-07	2.402E-07	9.400E-07	1.180E-06	7.679E-04	
.883	8.311E-07	1.249E-06	4.951E-06	6.200E-06	4.369E-03	
1.383	2.073E-06	3.118E-06	1.256E-05	1.568E-05	1.209E-02	
2.000	3.763E-06	5.661E-06	2.323E-05	2.889E-05	2.445E-02	
6.000	1.246E-05	1.880E-05	8.416E-05	1.030E-04	1.229E-01	
8.000	1.548E-05	2.336E-05	1.077E-04	1.311E-04	1.725E-01	
24.000	2.390E-05	3.620E-05	1.831E-04	2.193E-04	3.965E-01	
96.000	2.834E-05	4.309E-05	2.254E-04	2.685E-04	6.762E-01	
720.000	3.068E-05	4.675E-05	2.433E-04	2.900E-04	9.085E-01	

ZION 1&2, PROJ. No. 9140-98, ATD190 Rev. 3, CONTR RM DOSES FROM LEAKAGE TO RWST W/144 CFM INLEAKAGE TO CONTROL RM. CASE 2, 1800 CFM MAKEUP FLOW

SUM OVER ALL NUCLIDES

HOURS	-----INSIDE CONTROL ROOM DOSE, REM-----					
	TIME, BODY	GAMMA	GAMMA	BETA	TOTAL	SKIN
.250	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
.500	1.356E-08	2.037E-08	7.970E-08	1.001E-07	6.511E-05	
.883	7.047E-08	1.059E-07	4.198E-07	5.257E-07	3.704E-04	
1.383	1.758E-07	2.644E-07	1.065E-06	1.329E-06	1.025E-03	
2.000	3.191E-07	4.800E-07	1.969E-06	2.450E-06	2.073E-03	
6.000	1.057E-06	1.594E-06	7.136E-06	8.730E-06	1.042E-02	
8.000	1.312E-06	1.981E-06	9.135E-06	1.112E-05	1.462E-02	
24.000	2.027E-06	3.070E-06	1.552E-05	1.859E-05	3.362E-02	
96.000	2.403E-06	3.654E-06	1.911E-05	2.277E-05	5.734E-02	
720.000	2.602E-06	3.964E-06	2.063E-05	2.459E-05	7.705E-02	



Calcs. For: CONTROL ROOM	
HABITABILITY RAD. DOSE ANALYSIS	
<input checked="" type="checkbox"/> Safety-Related	<input type="checkbox"/> Non-Safety Related

Calc. No.:	ATD-0190
Rev. 3	Date:
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Client:	Commonwealth Edison	Prepared by	Date
Project:	Zion units 1&2	Reviewed by	Date
Proj. No.:	9140-98	Equip. No.:	N/A
		Approved by	Date

2000 cfm

ZION 1&2, PROJ. No. 9140-98, ATD190 Rev.3, CONTROL RM DOSES FROM CNTMT LEAKAGE W/144 CFM INLEAKAGE TO CONTROL RM. CASE 3, 2000 CFM MAKEUP FLOW

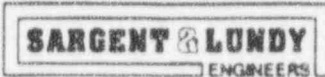
SUM OVER ALL NUCLIDES

HOURS	-----INSIDE CONTROL ROOM DOSE, REM-----					
	TIME, BODY	GAMMA	GAMMA	BETA	TOTAL	THYROID
.034	4.086E-05	5.884E-05	4.821E-04	5.410E-04	1.583E-02	
.281	2.336E-03	3.352E-03	2.831E-02	3.166E-02	5.421E-01	
.341	3.301E-03	4.735E-03	4.015E-02	4.488E-02	6.823E-01	
.719	1.168E-02	1.673E-02	1.427E-01	1.594E-01	1.477E+00	
.914	1.700E-02	2.436E-02	2.071E-01	2.315E-01	1.835E+00	
1.414	3.207E-02	4.604E-02	3.860E-01	4.321E-01	2.646E+00	
2.000	5.025E-02	7.234E-02	5.948E-01	6.672E-01	3.466E+00	
4.000	1.033E-01	1.504E-01	1.175E+00	1.325E+00	5.815E+00	
8.000	1.681E-01	2.501E-01	1.889E+00	2.139E+00	9.877E+00	
24.000	2.320E-01	3.620E-01	2.774E+00	3.136E+00	1.776E+01	
96.000	2.571E-01	4.115E-01	3.137E+00	3.548E+00	2.092E+01	
720.000	2.705E-01	4.381E-01	3.339E+00	3.777E+00	2.250E+01	

ZION 1&2, PROJ. No. 9140-98, ATD190 Rev.3, CONTROL ROOM DOSES FROM ECCS LEAKAGE W/144 CFM INLEAKAGE TO CONTROL RM. CASE 3, 2000 CFM MAKEUP FLOW

SUM OVER ALL NUCLIDES

HOURS	-----INSIDE CONTROL ROOM DOSE, REM-----					
	TIME, BODY	GAMMA	GAMMA	BETA	TOTAL	THYROID
.250	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
.500	1.606E-07	2.413E-07	9.440E-07	1.185E-06	7.711E-04	
.883	8.258E-07	1.241E-06	4.919E-06	6.160E-06	4.339E-03	
1.383	2.037E-06	3.063E-06	1.233E-05	1.540E-05	1.186E-02	
2.000	3.655E-06	5.500E-06	2.256E-05	2.805E-05	2.370E-02	
6.000	1.174E-05	1.771E-05	7.918E-05	9.689E-05	1.151E-01	
8.000	1.451E-05	2.190E-05	1.008E-04	1.227E-04	1.606E-01	
24.000	2.220E-05	3.363E-05	1.696E-04	2.033E-04	3.654E-01	
96.000	2.627E-05	3.994E-05	2.084E-04	2.484E-04	6.219E-01	
720.000	2.842E-05	4.330E-05	2.248E-04	2.681E-04	8.351E-01	



Calcs. For: CONTROL ROOM	
HABITABILITY RAD. DOSE ANALYSIS	
X	Safety-Related
	Non-Safety Related

Calc. No.: ATD-0190	
Rev. 3	Date:
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Client: Commonwealth Edison	Prepared by	Date
Project: Zion units 1&2	Reviewed by	Date
Proj. No.: 9140-98	Equip. No.: N/A	Approved by
		Date

ZION 1&2, PROJ. No. 9140-98, ATD190 Rev. 3, CONTROL RM DOSES FROM LEAK TO RWST W/144 CFM INLEAKAGE TO CONTROL RM. CASE 3, 2000 CFM MAKEUP FLOW

SUM OVER ALL NUCLIDES

-----INSIDE CONTROL ROOM DOSE, REM-----

TIME, HOURS	BODY GAMMA	SKIN GAMMA	SKIN BETA	SKIN TOTAL	SKIN THYROID
.250	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
.500	1.362E-08	2.046E-08	8.005E-08	1.005E-07	6.539E-05
.883	7.002E-08	1.052E-07	4.171E-07	5.223E-07	3.679E-04
1.383	1.727E-07	2.597E-07	1.046E-06	1.305E-06	1.006E-03
2.000	3.099E-07	4.663E-07	1.912E-06	2.379E-06	2.009E-03
6.000	9.958E-07	1.502E-06	6.714E-06	8.215E-06	9.757E-03
8.000	1.230E-06	1.857E-06	8.550E-06	1.041E-05	1.362E-02
24.000	1.883E-06	2.852E-06	1.438E-05	1.724E-05	3.098E-02
96.000	2.228E-06	3.387E-06	1.767E-05	2.106E-05	5.274E-02
720.000	1.410E-06	3.671E-06	1.907E-05	2.274E-05	7.082E-02

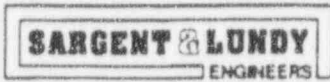
2200 cfm

ZION 1&2, PROJ. No. 9140-98, ATD190 Rev. 3, CONTROL RM DOSES FROM CNTMT LEAKAGE W/144 CFM INLEAKAGE TO CONTROL RM. CASE 4, 2200 CFM MAKEUP FLOW

SUM OVER ALL NUCLIDES

-----INSIDE CONTROL ROOM DOSE, REM-----

TIME, HOURS	BODY GAMMA	SKIN GAMMA	SKIN BETA	SKIN TOTAL	SKIN THYROID
.034	4.431E-05	6.378E-05	5.247E-04	5.885E-04	1.601E-02
.281	2.521E-03	3.617E-03	3.062E-02	3.424E-02	5.428E-01
.341	3.558E-03	5.103E-03	4.336E-02	4.846E-02	6.815E-01
.719	1.248E-02	1.788E-02	1.527E-01	1.706E-01	1.454E+00
.914	1.809E-02	2.592E-02	2.207E-01	2.466E-01	1.796E+00
1.414	3.382E-02	4.853E-02	4.074E-01	4.559E-01	2.556E+00
2.000	5.253E-02	7.560E-02	6.224E-01	6.980E-01	3.314E+00
4.000	1.062E-01	1.546E-01	1.210E+00	1.364E+00	5.473E+00
8.000	1.710E-01	2.544E-01	1.924E+00	2.179E+00	9.224E+00
24.000	2.346E-01	3.658E-01	2.805E+00	3.171E+00	1.649E+01
96.000	2.596E-01	4.151E-01	3.167E+00	3.582E+00	1.939E+01
720.000	2.730E-01	4.417E-01	3.369E+00	3.811E+00	2.086E+01



Calcs. For: CONTROL ROOM	
HABITABILITY RAD. DOSE ANALYSIS	
<input checked="" type="checkbox"/> Safety-Related	<input type="checkbox"/> Non-Safety Related

Calc. No.: ATD-0190	
Rev. 3	Date:
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Client: Commonwealth Edison	Prepared by	Date
Project: Zion units 1&2	Reviewed by	Date
Proj. No.: 9140-98	Equip. No.: N/A	Approved by
		Date

ZION 1&2, PROJ. No. 9140-98, ATD190 Rev. 3, CONTROL RM DOSES FROM ECCS LEAKAGE W/144 CFM INLEAKAGE TO CONTROL RM. CASE 4, 2200 CFM MAKEUP FLOW

SUM OVER ALL NUCLIDES

-----INSIDE CONTROL ROOM DOSE, REM-----

TIME, HOURS	BODY GAMMA	SKIN GAMMA	SKIN BETA	SKIN TOTAL	SKIN THYROID
.250	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
.500	1.613E-07	2.423E-07	9.480E-07	1.190E-06	7.743E-04
.883	8.205E-07	1.233E-06	4.887E-06	6.121E-06	4.310E-03
1.383	2.001E-06	3.010E-06	1.212E-05	1.513E-05	1.164E-02
2.000	3.554E-06	5.348E-06	2.192E-05	2.727E-05	2.300E-02
6.000	1.112E-05	1.676E-05	7.484E-05	9.160E-05	1.083E-01
8.000	1.368E-05	2.065E-05	9.490E-05	1.155E-04	1.505E-01
24.000	2.077E-05	3.145E-05	1.583E-04	1.898E-04	3.394E-01
96.000	2.453E-05	3.729E-05	1.942E-04	2.315E-04	5.767E-01
720.000	2.652E-05	4.039E-05	2.094E-04	2.498E-04	7.740E-01

ZION 1&2, PROJ. No. 9140-98, ATD190 Rev. 3, CONTROL RM DOSES FROM LEAK TO RWST W/144 CFM INLEAKAGE TO CONTROL RM. CASE 4, 2200 CFM MAKEUP FLOW

SUM OVER ALL NUCLIDES

-----INSIDE CONTROL ROOM DOSE, REM-----

TIME, HOURS	BODY GAMMA	SKIN GAMMA	SKIN BETA	SKIN TOTAL	SKIN THYROID
.250	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
.500	1.367E-08	2.054E-08	8.038E-08	1.009E-07	6.566E-05
.883	6.957E-08	1.046E-07	4.144E-07	5.190E-07	3.655E-04
1.383	1.697E-07	2.552E-07	1.027E-06	1.283E-06	9.872E-04
2.000	3.014E-07	4.534E-07	1.859E-06	2.312E-06	1.950E-03
6.000	9.425E-07	1.421E-06	6.345E-06	7.767E-06	9.183E-03
8.000	1.160E-06	1.751E-06	8.046E-06	9.797E-06	1.276E-02
24.000	1.761E-06	2.667E-06	1.343E-05	1.609E-05	2.878E-02
96.000	2.080E-06	3.162E-06	1.647E-05	1.963E-05	4.890E-02
720.000	2.249E-06	3.425E-06	1.775E-05	2.118E-05	6.564E-02

8.2 Copy of Reference 2

Calc. No. ATD-0190
Revision 3
Page 101
Proj. No. 9140-98
Safety Related

February 3, 1994

To: R. Harnettman

Subject: Control Room Habitability Radiological Dose Analysis

Following a review of Control Room Habitability Calculation ATD-0190, Revision 2, it has been determined that input parameter changes are required. Listed below are the requested changes:

- The fan cooler flow rate of 68000 cfm, as listed on page 6 of ATD-0190, should be changed to 65000 cfm to reflect fan cooler capacity test results.
- Containment spray injection delay time should be changed from 110 seconds, as listed on page 8, to 120.6 seconds to reflect the EDG sequence timer delay associated with the CS pump start.
- The recirculation spray flow rate of 2460 gpm, as listed on page 8, should also be revised based on nonconservative assumptions in supporting Calculation 91-0083, Revision 0. 91-0083 assumption IV.3 lists a flow rate of 600 gpm delivered via a single centrifugal charging pump as the only demand on the RHR pump other than the CS ring header. This assumption should be revised to reflect the most limiting condition where one RHR pump is aligned to the suction of both SI pumps, both CC pumps, and one CS header during the recirculation phase of an accident. The resultant CS flow rate should be used to reanalyze Calculation ATD-0190. Consideration should be given to other ATD-0190 input parameters that may be affected by the altered flow rate such as spray droplet size (ATD-0190, Reference 21). Additionally, there appears to be no information regarding assumed containment pressure in relation to Calculation 91-0083. Please provide the assumed value and the basis for this assumption.
- The spray additive tank volume of 5000 gallons, as listed on page 6 of Calculation ATD-0190, may not be the most conservative input parameter. The Technical Specifications list a minimum tank volume of 2660 gallons. Use the most conservative volume for the reanalysis and provide an explanation for the assumption.

Please provide an engineering estimate for the work scope defined above. Authorization to perform this work is on hold pending estimate approval.


J.C. Ashley
Modification Design Engineering

cc: K. Ainger
P. Beinacke

REVIEW METHOD SHEET

Calc. No. ATD-0190
 Revision 3
 Page 102 (LAST)
 Proj. No. 9140-98
 Safety Related

This calculation has been reviewed by me according to the method(s) checked below.

1. Computer Aided Calculations

<input checked="" type="checkbox"/> a	Review to determine that the computer program(s) has been validated and documented, is suitable to the problem being analyzed, and that the calculation contains all necessary information for reconstruction at a later date.
<input checked="" type="checkbox"/> b	Review to determine that the input data as specific for program execution is consistent with the design input, correctly defines the problem for the computer algorithm and is sufficiently accurate to produce results within any numerical limitations of the program.
<input checked="" type="checkbox"/> c	Review to verify that the results obtained from the program are correct and within stated assumptions and limitations of the program and are consistent with the input.
d	Review validation documentation for temporary changes to listed, or developmental, or unique single application programs, to assure that methods used adequately validate the program for the intended application.
e	Review of code input only, since the computer program has sufficient history of use at Sargent & Lundy in similar calculations.
<input checked="" type="checkbox"/> f	Review arithmetic necessary to prepare code input data.
g	Other:

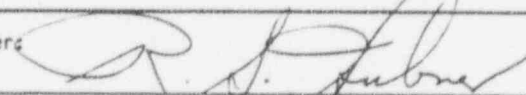
2. Hand Prepared Calculations

<input checked="" type="checkbox"/> a	Detailed review of the original calculation.
b	Review by an alternate, simplified, or approximate method of calculation.
c	Review of a representative sample of repetitive calculations.
d	Review of the calculation against a similar calculation previously performed.

3. Revisions

a	Editorial changes only.
b	Elimination of unapproved input data without altering calculation results.
c	Other:

4. Other

Reviewer:  Date: 3/25/94