Attachment B

102.2

Calculation N-6030-001

"Containment Aerosol and Iodine Removal Rates"

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	Paragraph 3.2 c	of Append	lix A of Regulate	ory Guide	21.183	Reference 6.4e	) states ir	n part:			
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### 2.2 RECOMMENDATIONS

The removal rates presented on Table 2-1 and Table 2-2 are suitable for use to calculate consequences from DBEs using the alternative source term when containment spray operation is considered. For DBEs where no containment spray operation is considered, the values presented on Table 2-2 can be used for all containment regions.

For calculation of realistic dose consequences, the 50<sup>th</sup> percentile removal rates presented on Table 8-29 and Table 8-30 may be used.

### 2.3 COMPARISON TO PREVIOUS RESULTS

The resultant removal rates presented in Table 2-1 and Table 2-2 are compared to the results in the Analysis of Record (A'OR), WCAP-10974 (Reference 6.1g) on Table 2-3. WCAP-10974 determined removal rates for elemental iodine and particulate iodine only. Removal rates for other particulates were not considered. As can be seen, the AOR removal rates are constant, while the removal rates determined in this calculation are time-dependent. This comparison illustrates the difference between the methodology used to generate the removal rates in this calculation and the current AOR.

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## **3 MODELING ASSUMPTIONS**

Froject or DCP/FCN/ECP N/A

### 3.1 CONFIGURATION SYMMETRY BETWEEN UNITS 2 AND 3

This analysis and its conclusions are applicable to both Units 2 and 3. References are provided to show that assumptions and design input data that have unit applicability are representative of both units.

### 3.2 CONTAINMENT SURFACE AREA USED FOR DEPOSITION

For the purposes of this calculation, the surface area used for natural deposition is assumed to be the same as the surface area used to determine the passive heat sinks in containment. As discussed in NUREG/CR-0009 (Reference 6.4h), the natural deposition model for elemental iodine assumes that the bulk gas in the containment atmosphere is well-mixed by natural convection, by steam flows, and by spray operations, therefore, all surfaces within the containment are available for elemental iodine and particulate aerosol deposition.

### 3.3 NUMBER OF CONTAINMENT SPRAY SYSTEM (CSS) HEADERS IN OPERATION

For the purposes of this calculation it is assumed that only one CSS header is in operation. One spray header in operation instead of both headers lowers the containment spray flow rate and the spray flux, thereby minimizing activity removal by the sprays and maximizing the airborne radionuclide concentrations.

### 3.4 CONTAINMENT SPRAY SYSTEM FLOW RATE

The CSS has two phases of operation, an injection phase and a recirculation phase. During the injection phase the CSS draws water from the RWST until this source is exhausted. Following this phase the CSS enters the recirculation phase, where water is drawn from the containment sump and recirculated through the CSS. Per Design Input 4.10, the recirculation phase flow rate is greater than the injection phase flow rate. For the purposes of this calculation the lower injection phase flow rate is modeled throughout the CSS operation. The lower flow rate and resultant spray flux minimizes the activity removal by the sprays and maximizes the airborne radionuclide concentrations.

### 3.5 DENSITY OF SPRAY SOLUTION

For the purposes of this calculation, the density of the spray solution is assumed to be equivalent to water at standard conditions. A value of  $1 \text{ g/cm}^3$  is used.

### 3.6 APPLICABILITY OF L'OCUMENT SO23-954-M4

Document SO23-954-M4 Revision 0 (Reference 6.6d) is considered "for information only." This document contains information on spray nozzle 1713A used in SONGS Units 2 & 3. This document contains data and information regarding this spray nozzle not found on other documents; therefore, it is assumed to be valid for use in this calculation.

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L		<u> </u>	l					<u> </u>			ž
3.7	SPRAY COVER	AGE FOR	R "TYPE D" NO	ZZLES							
	Reference 6.2f system. These	shows fo are design	ur different orien nated as follows:	ntations fo	or the S	PRACO 1713A	nozzles	used in th	e spray		
	Type /	4	Flow oriented v	ertically d	lown						
ł	Туре І	3	Flow oriented a	an angle	of 45°	downward					
	Туре (	2	Flow oriented h	orizontall	У						
	Туре І	)	Flow oriented at	an angle	of 10°	downward					
	types A throug orientation is u rings using this spray removal	h C, bu: n ised in this orientation coefficien	ot for D. Since t s calculation. Th on, which results it.	ype D is : is results s in a lowe	10° fror in over er spray	n vertical, the co estimating the c / flux rate and co	overage i overage onsequer	nformatio area for tl Itly in a lo	n for ty he spray wer aer	rpe A y rosol	
3.8	Containmen	T SUMP	<b>VOLUME</b>								
	This calculatio ft <sup>3</sup> ). This volum the minimum c SIS recirculatio	n assumes ne is deter containrne: on mode o	that the contain mined in Calcul nt emergency su of operation. This	ment sum ation A-9 mp volun s volume	np liqui 2-NF-0 ne avail is equa	d volume is 348, 02 (Reference 6 able at the start of 1 to:	946 gall .1a, shee of the po	ons (abou et 20), and ost-LOCA	t 46,64 represe CSS ar	7 ents nd	
		+ useabl + four S + Reacto - volume	e Refueling Wat afety Injection T or Coolant Syste e of water trappe	er Storag ank disch m depress d in the re	e Tank harge vo surized eactor o	volume olumes volume cavity and ducts					
		- volume	e of water neede	d to refall	the rea	ctor pressure ves	sel to th	e hot leg i	nozzle		
3.9	SPRAY DROPL	et Temp	ERATURE								
	The calculation temperature. G droplet, it is ass containment at	of eleme iven the p sumed tha mosphere	ntal iodine spray ost LOCA conta t the spray dropl temperature.	removal inment co ets reach	rate pe ondition an equi	rformed requires as and the small ilibrium tempera	s as an in size of e ture with	nput the sp ach indivi h the bulk	oray dro dual	oplet	
[											

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## **4** DESIGN INPUTS

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### 4.1 THERMAL POWER LEVEL

The maximum allowed core power level by the SONGS Unit 2 and Unit 3 license is 3,438 MWt (Reference 6.4a, Section 2.C.(1), and Reference 6.4b, Section 2.C.(1)).

#### 4.2 PWR CORE INVENTORY FRACTION RELEASED INTO CONTAINMENT

The core inventory release fractions, by radionuclide groups, for the gap release and early in-vessel damage phases for DEA LOCAs are listed on Table 4-1. These release fractions are obtained from Regulatory Guide 1.183 (Reference 6.4e, Table 2).

Tal	Table 4-1 — PWR Core Release Fractions										
Group	Gap Release Phase	Early In-vessel Phase	Total								
Noble Gases	0.05	0.95	1.0 .								
Halogens	0.05	0.35	0.4								
Alkali Metals	0.05	0.25	0.3								
Tellurium Metals	0.00	0.05	0.05								
Ba, Sr	0.00	0.02	0.02								
Noble Metals	0.00	0.0025	0.0025								
Cerium Group	0.00	0.0005	0.0005								
Lanthanides	0.00	0.0002	0.0002								

#### 4.3 TIMING OF RELEASE PHASES

The timing of the release phases is obtained from Regulatory Guide 1.183 (Reference 6.4e, Table 4). Table 4-2 presents the onset and duration of each sequential release phase for DBA LOCAs for PWRs. The specified onset is the time following initiation of the accident (i.e., time = 0). The early in-vessel phase immediately follows the gap release phase.

Table 4-2 — PWR LOCA Release Phases											
Phase	Onset	Duration									
Gap Release	30 sec	0.5 hr									
Early In-Vessel	0.5 hr	1.3 hr									

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4.4	CHEMICAL FORM Per Regulatory Guide 1.183 (Reference 6.4e, Section 3.5), of the radioiodine released from the reactor coolant system (RCS) to the containment in a postulated accident, 95 percent of the iodine released should be assumed to be cesium iodide (CsI), 4.35 percent elemental iodine, and 0.15 percent organic iodide. This includes releases from the gap and the fuel pellets. With the exception of elemental and organic iodine and noble gases, fission products should be assumed to be in particulate form.											
4.5	MASS TRANSFER COEFFICIENT FOR ELEMENTAL IODINE WALL DEPOSITION Standard Review Plan (SRP) 6.5.2 (Reference 6.4f, Section III.4.c.(1)) suggests that the mass transfer coefficient used for wall deposition should conservatively envelop all available experimental data. SRP 6.5.2 cites NUREG/CR-0009 (Reference 6.4h) as the source of the bounding mass transfer coefficient. NUREG/CR-0009 states on page 17: "As is described in section 6.1.9, the value of kg should not exceed 0.137 cm/sec. This maximum value is based on CSE [Containment Systems Experiment] tests, and its use assures that the predicted deposition rates remain within the range where the Knudsen-Hilliard model applies."											
4.6	PRIMARY CON The containmer of 459,000 cubi unsprayed, and	<i>TAINMEN</i> nt is mode ic feet, of flooded v	will be used in the with the spray which 82,000 cu volumes are cons	<i>IR VOLU</i> red volum abic feet a	ME ne of 1,9 are assu th WCA	907,000 cubic fe med to be event AP-10974 (Refer	et and an ually flo- rence 6.1;	unsprayed oded. The : g, page 4-4	i volu spraye }).	me ed,		
	The total prima cubic feet.	ry contair	nment net free ai	r volume	is then	1,907,000 + 459	9,000 - 8	2,000 = 2,5	284,00	xo	ļ	
4.7	Containment	T OPERAT	TING FLOOR EI	EVATIO	v							
	The containmer	nt operatio	ng floor is at plan	nt elevati	on 63' -	- 6" (see Refere	nces 6.2a	, 6.2c, and	6.2d)			
4.8	CONTAINMENT From drawing 2	<b>т I</b> NNiER <b>I</b> 23000 (Re	DIAMETER ference 6.2b), th	e contair	nment ir	nner diameter is	150' <b>–</b> 0	". ·				
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#### 4.9 PRIMARY CONTAINMENT SURFACE AREA

Per Modeling Assumption 3.2, the wetted surface area used for natural deposition is assumed to be the same surface area used for the passive heat sinks in the containment pressure/temperature (P/T) analysis for LOCA. The containment P/T analysis for LOCA, calculation N-4080-026 (Reference 6.1d, Design Input 4.8) states that the passive heat sinks are identical to those developed and used in the containment P/T response calculation for the design basis main steam line break (MSLB) event documented in calculation N-4080-027 (Reference 6.1e). From Section 8.2 of calculation N-4080-027. there are 21 heat sinks. These heat sinks and their exposed surface areas are shown on Table 4-3.

	Table 4-3 — Containment Surface Area	
Heat Sink Number	Passive Heat Sink	Exposed Surface Area (ft <sup>2</sup> )
1	Containment building dome	33,017
2	Containment building cylinder (above grade)	34,067
3	Containment building cylinder (below grade)	5,535
4	Reactor building basemat (exluding reactor cavity basemat)	12,773
5	Reactor cavity basemat and steam generator pedestals	1,644
6	Reactor cavity walls below containment floor	1,546
7	Reactor cavity walls above containment floor	1,311
8	Lined refueling canal walls and floor	9,192
9	Unlined exterior faces of refueling canal walls	11,050
10	Steam generator compartment walls and missile shields	43,085
11	Steam generator compartment walls with embeds	6,914
12	Elevated floor slabs (top half-thickness)	17,474
13	Elevated floor slabs (lower half-thickness with CS decking)	23,240
14	Lifting devices (carbon steel)	59,265
15	Miscellaneous carbon steel (thickness > 2.5 inch)	2,248
16	Miscellaneous carbon steel (1 inch <thickness <="2.5" inch)<="" td=""><td>9,230</td></thickness>	9,230
17	Miscellaneous carbon steel (0.5 inch <thickness <="1.0" inch)<="" td=""><td>8,718</td></thickness>	8,718
18	Miscellaneous carbon steel (thickness <= 0.5 inch)	158,855
19	Electrical equipment and other galvanized steel	131,698
20	Miscellaneous stainless steel	26,893
21	Reactor building stiffened sections	3,764
	Total exposed Surface Area	601,519

### 4.10 SPRAY SYSTEM FLOW RATE

Per Modeling Assumption 3.3 only one spray header of the containment spray system is assumed to be in operation. The minimum flow rate per spray header during the injection phase is 1,606 gpm from

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Calculation M-0014-009 (Reference 6.1b, page A6). The minimum flow rate per spray header during the recirculation phase is 1,991 gpm from Calculation M-0014-009 (Reference 6.1b, page A6).

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Per Modeling Assumption 3.4 the injection phase flow rate is used. For the purposes of this calculation this value is rounded down to 1,600 gpm.

### 4.11 CONTAINMENT SPRAY SYSTEM PIPING

The containment spray system consists of two independent spray headers (Reference 6.2e). Each spray header consists of three concentric rings of spray nozzles (Reference 6.2f). Each concentric ring is furnished with SPRACO 1713A nozzles (Reference 6.2f). Each containment spray header is capable of covering the containment with spray water. Parameters used in this calculation are shown in below;

тапіе 4-4 — Эргиу	System rarameters	
Parameter	Value	Reference
Spray Header 1		
Ring 052-21/2"-C-KEO		
Number of nozzles	20	6.2e
Type A (vertical)	10	6.2f
Type B (45°)	10	6.2f
Spray ring radius	25' - 6"	6.2f
Spray ring plant elevation	180' – 11 3/16"	6.2f
Ring 051-4"-C-KEO		
Number of nozzles	40	6.2e
Type A (vertical)	20	6.2f
Type C (horizontal)	20	6.2f
Spray ring radius	43' - 0"	6.2f
Spray ring plant elevation	171' – 7 5/16"	6.2f
Ring 049-4"-C-KEO		
Number of nozzles	56	6.2e
Type B (45°)	28	6.2f
Type D (10°)	28	6.2f
Spray ring radius	66' – 6''	6.2f
Spray ring plant elevation	143' - 3 11/16"	6.2f

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		<u> </u>		Table 4		av Sve	em Parameten			7		
				Param	eter	ay 0931	Value	•	Reference			
		Spra	ay Head	er 2	<u> </u>							
			Ring 046-2 <sup>1</sup> /2"-C-KEO									[
				Number of nozz	les	2	0	6.2	le		I	l
				Type A (vertical	)	1	0	f				
			•	Type B (45°)		1	0	f				
			Spray ring radius				2' – 6"	6.2	f			
		Í		Spray ring plant	elevation	1	81' – 11 11/16"	6.2	f			[
			Ring	045-4"-C-KEO	l		0		-		1	1
				Number of nozz.	les	4	0	0.2	e F			ŀ
				Type A (venical Type C (horizon	) tal)	2	0 A	9 <b>E</b>			ŀ.	
			-	Spray ring radius	s s	4	46' - 0" 62					
				Spray ring plant	- elevation	1	69' – 3 15/16"	2f			ĺ	
			Ring	043-4"-C-KEO					-			
				Number of nozzl	les	5	6	6.2	le			
			•	Type B (45°)		2	8	. 6.2	f	-		
			•	Type D (10°)		2	8	6.2	f			
			\$	Spray ring radius	3	6	3' – 6"	6.2	f			
				Spray ring plant	elevation	1	49' – 0 3/16''	6.2	f			

Given that a smaller annular region for a given spray flow rate produces a higher exit velocity, and that with a higher exit velocity the spray drops spend less time airborne, the upper end of the air core fraction (80%) will be used in this calculation.

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4.13	Per Modeling SPRACO 12 The spray cor nozzle. The S for three diffe shown on Fig the coverage assumed from	Assumption 713A NO2 verage from pray Enginer erent configure 4-1 the areas and con- in the pipe con- Orient Vertical (Ty Iorizontal ( 5° Downvar Assumption	on 3.6, this data <i>ZLE SPRAY CON</i> n a single SPRAM neering Company gurations, horizon rough Figure 4-3 offsets from the re- tenterline. These <b>Table 4-5 — SH</b> <b>ntation</b> <i>pes A &amp; D</i> ) (Type C) ard (Type B) on 3.6, this data is	is assume <i>ÆRAGE</i> CO 1713 <i>A</i> y (Referent to zzle at a paramete <b>PRACO</b> 1 <b>Covera</b> is assume	A nozzl nce 6.60 ical, and ice 6.60 a drop h ers are s <b>1713A</b> 1 <b>ge Dian</b> 19 fee 24 fee 21 fee d to be	applicable to the e is dependent o l) provides infor l 45° downward. l, page 8). For the eight of 100 fee ummarized belo Nozzle Spray C meter Offset t t t t t	e SONGS in the origination for mation for These contemporation is purposed to are used w: overage et from 0 N/A 7 f 4 f e SONGS	S design. entation of or the cove overage an es of this of d. Offsets Centerline feet feet S design.	f the erage a reas are calcula are	areas tion	

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## 4.15 ELEMENTAL IODINE EQUILIBRIUM CONSTANTS K1 AND K3

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The elemental iodine equilibrium constants K1 and K3 used to calculate the iodine partition coefficients are obtained from Tables 1 and 2 of ORNL-TM-2412 Part IV (Reference 6.6e). These values are shown below on Table 4-6.

<b>Table 4-6</b> 1	Equilibr	rium Constants K1 a	nd K3
Temperature (°C)	K1	Temperature (*C)	K3
0	315	0	4.1E-14
10	173	10	1.2E-13
20	102	20	3.4E-13
25	74.6	25	5.4E-13
30	61	30	8.4E-13
40	39	40	2.1E-12
50	26.2	50	4.8E-12
60	19	60 ·	1.0E-11
70	15.4	70	2.2E-11
80	13	80	4.3E-11
90	10.5	90	8.4E-11
100	9	100	1.5E-10
106	8.4	105	2.1E-10
110	8.36	110	2.7E-10
112.3	8.32	120	4.8E-10
120	7.14	130	7.8E-10
130	6.37	140	1.2E-09
140	5.95	150	2.0E-09
150	5.52		

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,10	IODINE CORE	INVENIC	)KY					c 11				
	The reactor co	re invento calculatio	ry of 100 n N-609	line isot 7.001 (1	opes is a Reference	s shown e 6 1f T	in Table 4-7. The second se	ne full co odine ma	re iodine	mass i orv is	S valid	
	for any San Or	ofre Unit	s 2 and 3	cycle v	which me	ets the f	ollowing require	ements:		01 10	, and	
	1 0 0 1		4	. <b>.</b> .								
	1. 3.8 w/c	$o \leq Cor$	e Avera	ge Enric	hment	≤ 4.8 w	/0					
	2. Core A	verage B	urnup	٤	40.0 G	WD/T						
	3. Core L	Jraniurn L	oading	≤ 95	.5 MTU							
	4. Core I	hermal Po	ower	≤ 3,5	07 MW-1	t (Inc	luding Uncertain	nty)				
	5. Numbe	er of Fael	Rods	≥ 51,	132 Rod	s						
			г		يك فيريبين			1				
				Table	4-7 — Ie	odine C	ore Inventory					[
			[	Isot	ope	Full Co	re Inventory (g)	[				[
			ſ	I—	127		4.64E+03	1				
				I	128		1.87E-02	ĺ				ſ
			1	I	129		2.05E+04					[
			- 1	I	130		1.28E+00					ł
			1	1-13	OM		8.27E-03	ł				
				I	131		/.33E+02					
				I T	122		1.315+01					]
				I-13	3M		1.58E-03					ļ
			1	I—	134	1	8.42E+00	[				[ ·
				I-13	4M		5.14E-02	ł				ł
				I	135		5.27E+01	}				ł .
			ļ	J	136		9.24E-02	)				ļ
				I-13	6M		2.43E-02	}				
				I—-	137		2.82E-02		· · ·			
				I	138		3.75E-03	[	1. A.		I	
				I—	139		7.62E-04		· .			1
			L	I	140		6.68E-05	ł				
								•				

Per surveillance requirement (SR) 3.5.4.1 of LCO 3.5.4 (References 6.4c and 6.4d), the Refueling Water Storage Tank (RWST) borated water temperature is verified every 24 hours to be  $\geq$  40 °F and  $\leq$  100 °F.

SCE 26-426 REV. 2 [REFERENCE: SO123-XXIV-7.15]

**E&TS DEPARTMENT** ICCN NO./ PRELIM. CCN NO. CALCULATION SHEET PAGE OF **CCN CONVERSION:** CCN NO. CCN Calc No. N-6030-001 Project or DCP/FCN/ECP N/A Containment Aerosol and Iodine Removal Rates 24 of 281 Subject Sheet IRE DATE REV ORIGINATOR DATE IRE DATE ORIGINATOR DATE: REV REV INDICATOR J. Schulz 8/15/20(3 D. T. Dexheimer 8/15/2003 0 4.18 POST LOCA CONTAINMENT AND SUMP TEMPERATURE PROFILE Calculation N-4080-026 (Reference 6.1d) determines the containment and sump water temperature profile for 9 different LOCA cases. As discussed in Section 2.2.1 of calculation N-4080-026 Rev. 1. cases 1, 4, and 7 with diesel generator failure are the bounding LOCA cases. The temperature profiles for the containment atmosphere and sump water for these cases are used in this calculation and are obtained from Tables 9-1A, 9-4A, and 9-7A of calculation N-4080-026 Rev. 1 for cases 1, 4, and 7, respectively. The temperature profiles are shown below on Table 4-8: Table 4-8 — Containment Atmosphere and Water Sump Temperature Profile Time Vapor 'Temperature (°F) Sump Temperature (°F) Case 1 Case 7 (sei:) (hr) Case 4 Case 7 Case 1 Case 4 2.778E-14 120 120 120 120 120 120 0.00 90.5 89.9 111.8 197.8 206.4 216.1 2.778E-05 0.1 112.5 105 133.1 206.9 210.9 219.3 0.1 5.556E-05 217.7 127.4 116.7 146.1 213.9 0.3 8.333E-05 211 0.4 1.111E-04 139.3 126.3 156 213.8 216.4 218.1 0.5 1.389E-04 148.8 135.3 163.9 215 218.3 218.2 219.9 0.6 1.667E-04 156.1 142.6 170.5 216.4 218.8 217.6 220 0.7 1.944E-04 162.6 148.1 176.2 218.6 0.8 2.222E-04 167.6 153.7 181.1 217.4 220.3 218.1 0.9 2.500E-04 172.8 158.1 185.4 217.4 220.9 218.9 220.6 2.778E-04 189,1 218.4 218.9 1 178 162.1 2 5.556E-04 206.9 193 214.7 219.2 222.4 223.7 3 8.333E-04 221.9 210.2 230.5 222.5 225.3 230.9 225.2 236.7 4 220.5 241.3 228 1.111E-03 231.9 5 1.389E-03 239.8 228 249.3 227.3 231.1 241.4 229.2 6 245.5 234.1 255.2 234.1 245.3 1.667E-03 7 1.944E-03 250.4 239.2 260.1 230.5 236.6 246.9 238.9 8 2.222E-03 254.3 243.5 263.3 230.9 247.6 9 2.500E-03 257.3 247.2 265.1 230.5 241 248 10 2.778E-03 258.9 250.5 265.9 229.7 242.5 248.3 260.3 253.3 266.7 229.4 243.5 248.6 11 3.056E-03 255.4 229.8 244.4 12 3.333E-03 260.8 267.4 248.7 230.4 13 3.611E-03 260.7 257 266.8 245.1 248.9 260.3 258 266.2 230.7 245.9 249 12. 3.889E-03 15 4.167E-03 259.8 258.6 265.7 230 246.6 249.1 229.1 259.3 258.7 265.4 247.1 249.2 16 4.444E-03 17 4.722E-03 258.8 258.9 265.1 228.2 247.5 249.3 5.000E-03 258.6 258.6 264.8 227.3 247.8 249.4 18 5.278E-03 258.6 258.2 264.7 226.5 247.9 249.5 19 225.7 258.9 257.8 20 5.556E-03 264.6 248 249.5 22 6.111E-03 259 257.8 264.6 221.4 248 249.7 24 6.667E-03 258.8 258.6 264.5 217.1 242.7 249.8 236.7 26 7.222E-03 258.9 258.8 264.4 213.4 249.9 28 259.1 259.1 264.3 210.2 231.7 7.778E-03 250 30 8.333E-03 259.3 259.5 264.2 207.3 227.5 250.1 32 8.889E-03 259.7 260 264 205.8 223.9 250.1 34 9.444E-03 260.1 260.5 263.9 204.5 220.8 250.2

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SCE 26-426 REV. 2 [REFERENCE: SO123-XXIV-7.15]

Project or DCP/FCNEOP         NA         Cale No.         N-6030-001         CON CONVERSION: CON NO. CCN           Subject         Containment Aerosol and Iodine Removal Rates         Sheet         23         of         28           REV         ORIGINATOR         DATE         IRE         DATE         REV         ORIGINATOR         DATE         IRE         Containment Atmasphere and Water Sump Temperature         FD         Contain         IRE         DATE         IRE         Contain         Contain         IRE         Contain			RTS DEP	ARTMENT TION SH	IEET		ICCN N PRELI	10.7 M. CCN N	10.		PAGE	E0	=
Subject         Containment Acrossl and Iodine Removal Rates         Shoet         25         of         28           REV         ORIGINATOR         DATE         IRE         DATE         Rev         ORIGINATOR         DATE         IRE	Proiect	or DCP/FCN/	ECP N'A			Calc No	. N-60	)30-001		CCN CO CCN NO	NVERS	SION:	
REV         ORIGINATOR         DATE         IRE         DATE         REV         ORIGINATOR         DATE         IRE         DATE           0         J.Schulz         0752001         D. T. Destleiner         075201         D. T. Destleiner         D. Destleiner	Subjec	t Containmer	nt Aerosol	and Iodine Remov	val Rates				······	She	et	2 <u>5</u> of	281
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													N.
$ \begin{array}{ c c c c } \hline \hline Vapor Temperature (F) \\ \hline Cose I & Case I & Ca$			Table 4-	8 — Containm	ent Atm	osphere Profile	and Wa	ater Sun	np Temj	perature			
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			(sec)	Time (hr)	Vapor I Case 1	Cemperat Case 4	ure (°F) Case 7	Sump Case 1	Tempera Case 4	ture (°F) Case 7			
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$			36	1.000E-02	260.3	261	263.7	203.3	218.1	250.3	1		
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			38	1.056E-02	260.5	261.3	263.6	202.2	215.7	250.3			Į
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		I	40	1.111E-02	260.5	261.4	263.4	201.2	213.6	250.4	ł		1
			42	1.167E-02	260.3	261.4	263.3	200.3	211.7	250.4	ł		[
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			44	1.222E-02	259.7	261	263.5	199.4	210	250.5	i		1
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			46	1.278E-02	258.9	260.3	203.3	198.6	208.4	250.5	]		j
50       1.389E-02       255.8       255.8       257.7       262.8       196.6       203.6       250.7         54       1.500E-02       255.8       255.7       256.1       262.5       195.5       202.6       250.8         56       1.556E-02       255.7       256.1       262.5       195.5       201.8       250.8         60       1.667E-02       255.7       256.1       262.1       194.5       201.3       250.9         62       1.722E-02       255.5       256.1       261.7       193.7       199.7       251.4         66       1.833E-02       255.5       256.1       261.1       193.4       199.7       251.4         70       1.944E-02       255.5       256.1       261.2       192.7       198       251.4         71       0.056E-02       255.4       256.1       261.1       193.1       197.2       252.1         76       2.111E-02       255.4       256.1       260.1       192.4       197.6       251.8         80       2.222E+02       255.4       256.1       260.1       192.4       195.6       252.3         81       2.476E+02       255.4       256.2       260.1			48	1.333E-02	258	239,5	203.1	197.9	207.1	250.6	[		ſ
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$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			52	1.4446-02	233.0	251.1	202.0	190.0	204.7	250.7			
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$			56	1.500E-02	255.7	256.0	262.0	195.5	202.6	250.8	1		
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$			58	1.611E-02	255.7	2561	262.3	195	201.8	250.8			
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			60	1.667E-02	255.7	256.1	262.1	194.5	201	250.9			
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$ \begin{array}{cccccccccccccccccccccccccccccccccccc$			64	1.778E-02	255.5	256	261.7	193.7	199.7	251			
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$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$			68	1.889E-02	255.5	256	261.4	193	198.5	251.4			
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$\begin{array}{ c c c c c c c c c c c c c c c c c c c$			00	2,5005-02	256.8	256	259.7	193.1	195.5	253.3	ł		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			92	2.556E-02	256.9	256.4	259.6	193.1	195.2	253.4	ł		l
962.667E-02257.3257259.3193.3195.6233.7982.722E-02257.5257.1259.2193.4195.7253.91032.778E-02257.7257.3259.1193.5195.92541052.917E-02258.2257.8258.8193.7196.2254.31103.056E-02258.6258.2258.5193.9196.6254.71153.194E-02259258.5258.3194.11972551203.333E-02259.5258.8258194.3197.4255.31253.472E-02259.8257.8194.5197.7255.51303.611E-02260.2259257.6194.7198.1255.81353.750E-02260.6259.1257.4194.9198.5256.11403.889E-02260.9259.2257.7195.3199.3256.61504.167E-02261.3259.2257.7195.3199.7256.81554.306E-02262259.2256.5195.7200.4257.31604.444E-02262.3259.2255.9196.1200.8257.51704.722E-02263259.2255.9196.1200.8257.5			94	2.611E-02	257.1	256.6	259.4	193.2	195.4	253.6	l		
98 $2.722E-02$ $257.5$ $257.1$ $259.2$ $193.4$ $195.7$ $253.9$ 103 $2.778E-02$ $257.7$ $257.3$ $259.1$ $193.5$ $195.9$ $254$ 105 $2.917E-02$ $258.2$ $257.8$ $258.8$ $193.7$ $196.2$ $254.3$ 113 $3.056E-02$ $258.6$ $258.2$ $258.5$ $193.9$ $196.6$ $254.7$ 115 $3.194E-02$ $259$ $258.5$ $258.3$ $194.1$ $197$ $255$ 120 $3.333E-02$ $259.5$ $258.8$ $258$ $194.3$ $197.4$ $255.3$ 125 $3.472E-02$ $259.8$ $257.8$ $194.5$ $197.7$ $255.5$ 130 $3.611E-02$ $260.2$ $259$ $257.6$ $194.7$ $198.1$ $255.8$ 135 $3.750E-02$ $260.6$ $259.1$ $257.4$ $194.9$ $198.5$ $256.1$ 140 $3.889E-02$ $260.9$ $259.2$ $257.2$ $195.3$ $199.3$ $256.6$ 150 $4.167E-02$ $261.6$ $259.2$ $256.8$ $195.5$ $199.7$ $256.8$ 155 $4.306E-02$ $262$ $259.2$ $256.5$ $195.7$ $200.1$ $257.3$ 160 $4.444E-02$ $262.3$ $259.2$ $256.2$ $195.9$ $200.4$ $257.3$ 165 $4.583E-02$ $262.6$ $259.2$ $255.9$ $196.1$ $200.8$ $257.5$ 170 $4.722E-02$ $263$ $259.1$ $255.6$ $196.3$ $201.2$ $257.7$ <td></td> <td></td> <td>96</td> <td>2.667E-02</td> <td>257.3</td> <td>257</td> <td>259.3</td> <td>193.3</td> <td>195.6</td> <td>253.7</td> <td>ł.</td> <td></td> <td>1</td>			96	2.667E-02	257.3	257	259.3	193.3	195.6	253.7	ł.		1
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$			98	2.722E-02	257.5	257.1	259.2	193.4	195.7	253.9	}		
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$			100	2.778E-02	257.7	257.3	259.1	193.5	195.9	254			
11)       3.056E-02       258.6       258.2       258.5       193.9       196.6       254.7         115       3.194E-02       259       258.5       258.3       194.1       197       255         120       3.333E-02       259.5       258.8       258       194.3       197.4       255.3         125       3.472E-02       259.8       258.9       257.8       194.5       197.7       255.5         130       3.611E-02       260.2       259       257.6       194.7       198.1       255.8         135       3.750E-02       260.6       259.1       257.4       194.9       198.5       256.1         140       3.889E-02       260.9       259.2       257.2       195.1       198.9       256.3         145       4.028E-02       261.3       259.2       257       195.5       199.7       256.6         150       4.167E-02       261.6       259.2       256.5       195.7       200.1       257         160       4.444E-02       262.3       259.2       256.5       195.7       200.4       257.3         165       4.583E-02       262.6       259.2       255.9       196.1       200.8			105	2.917E-02	258.2	257.8	258.8	193.7	196.2	254.3			
115       3.194E-02       259       258.5       258.3       194.1       197       255         120       3.333E-02       259.5       258.8       258       194.3       197.4       255.3         125       3.472E-02       259.8       258.9       257.8       194.5       197.7       255.5         130       3.611E-02       260.2       259       257.6       194.7       198.1       255.8         135       3.750E-02       260.6       259.1       257.4       194.9       198.5       256.1         140       3.889E-02       260.9       259.2       257.2       195.1       198.9       256.3         145       4.028E-02       261.3       259.2       257.7       195.3       199.3       256.6         150       4.167E-02       261.6       259.2       256.5       199.7       256.8         155       4.306E-02       262       259.2       256.5       195.7       200.1       257         160       4.444E-02       262.3       259.2       256.2       195.9       200.4       257.3         165       4.583E-02       262.6       259.2       255.9       196.1       200.8       257.5			110	3.056E-02	258.6	258.2	258.5	193.9	196.6	254.7	1		
120       3.333E-02       259.5       258.8       258       194.3       197.4       255.3         125       3.472E-02       259.8       258.9       257.8       194.5       197.7       255.5         130       3.611E-02       260.2       259       257.6       194.7       198.1       255.8         135       3.750E-02       260.6       259.1       257.4       194.9       198.5       256.1         140       3.889E-02       260.9       259.2       257.2       195.1       198.9       256.3         145       4.028E-02       261.3       259.2       257.7       195.3       199.3       256.6         150       4.167E-02       261.6       259.2       256.5       199.7       256.8         155       4.306E-02       262       259.2       256.5       195.7       200.1       257         160       4.444E-02       262.3       259.2       256.2       195.9       200.4       257.3         165       4.583E-02       262.6       259.2       255.9       196.1       200.8       257.5         170       4.722E-02       263       259.1       255.6       196.3       201.2       257.7 </td <td></td> <td></td> <td>115</td> <td>3.194E-02</td> <td>259</td> <td>258.5</td> <td>258.3</td> <td>194.1</td> <td>197</td> <td>255</td> <td>ł</td> <td></td> <td></td>			115	3.194E-02	259	258.5	258.3	194.1	197	255	ł		
125       3.472E-02       259.8       258.9       257.8       194.5       197.7       255.5         130       3.611E-02       260.2       259       257.6       194.7       198.1       255.8         135       3.750E-02       260.6       259.1       257.4       194.9       198.5       256.1         140       3.889E-02       260.9       259.2       257.2       195.1       198.9       256.3         145       4.028E-02       261.3       259.2       257.2       195.3       199.3       256.6         150       4.167E-02       261.6       259.2       256.5       199.7       256.8         155       4.306E-02       262       259.2       256.5       199.7       256.8         155       4.306E-02       262       259.2       256.5       195.7       200.1       257         160       4.444E-02       262.3       259.2       256.2       195.9       200.4       257.3         165       4.583E-02       262.6       259.2       255.9       196.1       200.8       257.5         170       4.722E-02       263       259.1       255.6       196.3       201.2       257.7 <td></td> <td></td> <td>120</td> <td>3.333E-02</td> <td>259.5</td> <td>258.8</td> <td>258</td> <td>194.3</td> <td>197.4</td> <td>255.3</td> <td></td> <td></td> <td></td>			120	3.333E-02	259.5	258.8	258	194.3	197.4	255.3			
130       3.611E-02       260.2       259       257.6       194.7       198.1       255.8         135       3.750E-02       260.6       259.1       257.4       194.9       198.5       256.1         140       3.889E-02       260.9       259.2       257.2       195.1       198.9       256.3         145       4.028E-02       261.3       259.2       257       195.3       199.3       256.6         150       4.167E-02       261.6       259.2       256.5       195.7       200.1       257         160       4.444E-02       262.3       259.2       255.6       195.9       200.4       257.3         165       4.583E-02       262.6       259.2       255.9       196.1       200.8       257.3         170       4.722E-02       263       259.1       255.6       196.3       201.2       257.7			125	3.472E-02	259.8	258.9	257.8	194.5	197.7	255.5			
135       3.750E-02       260.6       259.1       257.4       194.9       198.5       256.1         140       3.889E-02       260.9       259.2       257.2       195.1       198.9       256.3         145       4.028E-02       261.3       259.2       257       195.3       199.3       256.6         150       4.167E-02       261.6       259.2       256.5       195.7       200.1       257         160       4.444E-02       262.3       259.2       256.2       195.9       200.4       257.3         165       4.583E-02       262.6       259.2       255.9       196.1       200.8       257.5         170       4.722E-02       263       259.1       255.6       196.3       201.2       257.7			130	3.611E-02	260.2	259	257.6	194.7	198.1	255.8	ł	]	
140       3.889E-02       260.9       259.2       257.2       195.1       198.9       256.3         145       4.028E-02       261.3       259.2       257       195.3       199.3       256.6         150       4.167E-02       261.6       259.2       256.8       195.5       199.7       256.8         155       4.306E-02       262       259.2       256.5       195.7       200.1       257         160       4.444E-02       262.3       259.2       256.2       195.9       200.4       257.3         165       4.583E-02       262.6       259.2       255.9       196.1       200.8       257.5         170       4.722E-02       263       259.1       255.6       196.3       201.2       257.7			135	3.750E-02	260.6	259.1	257.4	194.9	198.5	256.1		· ·	
145       4.028E-02       261.3       259.2       257       195.3       199.3       256.6         150       4.167E-02       261.6       259.2       256.8       195.5       199.7       256.8         155       4.306E-02       262       259.2       256.5       195.7       200.1       257         160       4.444E-02       262.3       259.2       256.2       195.9       200.4       257.3         165       4.583E-02       262.6       259.2       255.9       196.1       200.8       257.5         170       4.722E-02       263       259.1       255.6       196.3       201.2       257.7			140	3.889E-02	260.9	259.2	257.2	195.1	198.9	256.3			
150       4.167E-02       261.6       259.2       256.8       195.5       199.7       256.8         155       4.306E-02       262       259.2       256.5       195.7       200.1       257         160       4.444E-02       262.3       259.2       256.2       195.9       200.4       257.3         165       4.583E-02       262.6       259.2       255.9       196.1       200.8       257.5         170       4.722E-02       263       259.1       255.6       196.3       201.2       257.7			145	4.028E-02	261.3	259.2	257	195.3	199.3	256.6			1
155       4.306E-02       262       259.2       256.5       195.7       200.1       257         160       4.444E-02       262.3       259.2       256.2       195.9       200.4       257.3         165       4.583E-02       262.6       259.2       255.9       196.1       200.8       257.5         170       4.722E-02       263       259.1       255.6       196.3       201.2       257.7			150	4.167E-02	261.6	259.2	256.8	195.5	199.7	256.8			
160         4.444£-02         262.3         259.2         256.2         195.9         200.4         257.3           165         4.583E-02         262.6         259.2         255.9         196.1         200.8         257.5           170         4.722E-02         263         259.1         255.6         196.3         201.2         257.7			155	4.306E-02	262	259.2	256.5	195.7	· 200.1	257			
165         4.3832-02         262.6         259.2         255.7         196.1         200.8         257.5           170         4.722E-02         263         259.1         255.6         196.3         201.2         257.7			160	4.444E-02	202.3	239.2	236.2	195.9	200.4	257.3			
1/0 4.122E-02   203 239.1 233.0   190.3 201.2 237.7			165	4.583E-02	202.0	239.2	233.9	196.1	200.8	257.5			
			170	4.122E-V2	205	209.1	233.0	130.2	201.2	251.1	1		

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E&TS DEPARTMENT CALCULATION SHEET

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OF

Project or DCP/FCN/ECP N/A

Calc No. N-6030-001

CCN CONVERSION: CCN NO. CCN

Subject Containment Aerosol and Iodine Removal Rates

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGI	ATOR	DATE	IRE	E DATE	Ę
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003	1						] ≩¥
~ <u>~</u>											1 <sup>e</sup> ğ
				<u> </u>	. <u>.</u>						
											[
		Table 4-	8 — Containm	ent Atmo	sphere	and Wa	ater Sun	np Temp	erature		1
					Profile			• •			
				¥7 **	·		í e	T			
		(1967)	(hr)	Cose 1	Case 4	Case 7	Case 1	Case 4	Case 7		
		175	4.861E-02	263.4	259 1	255.3	196.4	201.6	257.9		1
		180	5.000E-02	263.6	259	255	196.6	202	258.1		
		185	5.139E-02	264	258.9	254.8	196.8	202.5	258.3		
		190	5.278E-02	264.2	258.8	254.6	197	202.9	258.5		1
		195	5.417E-02	264.4	258.7	254.2	197.2	203.4	258.7		Į –
		200	5.556E-02	264.7	258.6	253.8	197.4	204	258.9		Į –
		205	5.694E-02	264.9	258.5	253.5	197.7	204.5	259.1		ł
		210	5.833E-02	265	258.4	253.2	198	205	259.2		1
		215	5.972E-02	265.2	258.3	252.8	198.3	205.5	259.4		
		220	0.111E-02	200.3	258.2	252.5	198.6	206 .	259.5		
		225	0.430E-02	203.4 265.5	220.1	252.1	198.9	200.3	239.0		ļ
		230	6 528 5-02	203.5	250	251.0	199.5	207 5	250.8		ł
		235	6.667E-02	265.6	257.8	251.4	2001	207.5	259.0		ļ
		245	6.806E-02	265.7	257.7	250.8	200.6	208.5	260		1
		250	6.944E-02	265.8	257.6	250.5	201	209	260		
		255	7.083E-02	265.8	257.5	250.2	201.4	210.3	260.1		ł
		260	7.222E-02	265.9	257.3	249.9	201.9	211	260.1		
		265	7.361E-02	265.9	257	249.6	202.4	211.4	260.2		ſ
		270	7.500E-02	265.9	256.8	249.3	202.8	211.9	260.2		ł
		275	7.639E-02	265.9	256.6	249	203.3	212.3	260.2		1
		280	7.778E-02	265.8	256.4	248.7	203.8	212.8	260.3		1
		285	7.917E-02	265.8	256.3	248.4	204.2	213.2	260.3		
		290	8.056E-02	265.7	256.1	248.1	204.7	213.6	260.3		
		295	8.194E-02 9.222E-02	265.6	255.9	247.8	205.2	214	260.3		
		310	8.535E+02 8.611E-02	265.3	2554	247.0	205.0	214.2	260.3		
		320	8 889F-02	264.9	255	246.5	206.4	216	260.2	(	
		330	9.167E-02	264.5	255.1	246	207.4	216.8	260.1		
		340	9.444E-02	264.1	254.5	245.5	208.3	217.5	260		
		350	9.722E-02	263.8	254.2	245.2	209.2	218.2	259.9		
		360	1.000E-01	263.4	253.9	244.7	210	218.9	259.8		
		370	1.028E-01	263.2	253.6	244.2	210.8	219.5	259.7		
		380	1.056E-01	262.9	253.2	243.7	211.6	220.2	259.5		
		390	1.083E-01	262.5	252.9	243.3	212.4	220.8	259.4		
		400	1.111E-01	262.2	252.7	242.8	213.1	221.4	259.2		
		420	1.167E-01	261.6	252.1	241.9	214.6	222.6	258.8		
		440	1.222E-01	260.9	251.5	241	215.9	223.7	258.3		
		460	1.278E-01	260.3	251	240.2	217.2	224.7	257.9		
		480	1.333E-VI	239.8	220.2	239.5	218.4	225.1	251.4		
		500	1.309E-01	227.2	247.0 240	230.2	217.2	220.0 227 1	200.8		
		520	1.4446-01	200.0	249	237.1	220.0	227.4 228 1	250.5		ļ
		40	1.5000-01	250	270.1 247 A	230.9	221.1	220.1	255.1		
		500	16115-01	2564	271.4 746 6	230.2	2226	220.1	254.6		
		600	1.667E-01	255.7	245.8	234.6	224 5	229.7	254	1	
		650	1.806E-01	253.9	244.1	233	226.2	230.5	252.4	İ	
	1	000	1.0000 01 1		,	~~~	~~~.4	~~~~	202.T		

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N-6030-001

SCE 26-426	REV.2	[REFERENCE:	SO123-XXIV-7.15]

Subject Containment Aeroso and Iodine Removal Rates

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGI	ATOR	DATE	IR	E DATE	~
											- <u>5</u>
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003	I	ļ					22
		}	}	1							N
┟┈╍──┙			<u>.</u>							I	<u> </u>
1				······						1	}
		Table 4-	8 — Containm	ent Atmo	sphere	and Wa	iter Sun	np Temp	erature		
		}			Profile						
ł			Time	Vanor	emperat	ure (°F)	Sumo	Temperat	ure (*F)		
1		(sec)	(hr)	Case 1	Case 4	Case 7	Case 1	Case 4	Case 7		}
		700	1.944E-01	252	242.3	231.2	227.4	230.9	250.9		
}		750	2.083E-01	250.2	240.6	229.4	228.2	231.1	249.4		
		800	2.222E-01	248.4	239	227.7	228.7	231.1	247.8		
]		850	2.361E-01	246.7	237.3	226.1	229	230.9	246.3		
1		900	2.500E-01	245.5	235.8	224.5	229	230.5	244.8		
{		950	2.639E-01	243.7	234.2	223	228.9	230.1	243.3		
<b>1</b> '		1000	2.778E-01	242.1	232.9	221.4	228.6	229.6	241.8		i (
		1050	2.917E-01	240.6	231.4	220.1	228.2	229	240.3		
		1100	3.056E-01	239.1	230	218.7	227.8	228.3	238.9		(
		1150	3.1946-01	237.0	228.5	217.3	221.3	227.0	237.5		
		1200	2 280E 01	220.2	221.2	213.9	220.1	220.9	230.1		
		1220	3.369E-01 3.444F-01	233.0	220.0	213.5	220.5	220.0	235.0		
1		1240	3 500F-01	234 5	220.1	214.7	220.2	220.5	234.6		
		1280	3.556E-01	234.2	225	213.7	225.7	225.7	234		
ļ		1300	3.611E-01	233.5	224.5	213.1	225.5	225.5	233.5		
ł		1320	3.667E-01	233	224	212.6	225.3	225.2	233		
		1340	3.722E-01	232.4	223.4	212	225	224.9	232.5		
í		1360	3.778E-01	231.9	222.9	211.5	224.7	224.6	232		[ [
	-	1380	3.833E-01	231.4	222.4	211	224.5	224.3	231.6		1
ł		140()	3.889E-01	230.8	221.9	210.5	224.2	224	231.1		1 1
[		1450	4.028E-01	229.5	220.7	209.2	223.6	223.2	229.9		
1		1500	4.167E-01	228.2	219.6	207.9	222.9	222.5	228.8		
		1550	4.306E-01	226.9	218.4	206.8	222.3	221.8	227.7		
		1600	4.444E-01	225.6	217.2	205.6	221.6	221.1	226.6		
		1700	4.383E-VI	224,4	210	204.4	221	220.4	223.0		{
		1750	4.7220-01	223.1	214.0	203.2	220.4	219.7	224.0		
		1800	5.000E-01	221.5	212.0	202	219.7	219	223.0		
		1850	5.139E-01	2197	211.4	199.7	218.5	217.6	221.7		1 1
		1900	5.278E-01	218.5	210.3	198.6	217.9	217	220.8		[ [
		1950	5.417E-01	217.4	209.2	197.5	217.2	216.3	219.9		1
		2000	5.556E-01	216.2	208.1	196.5	216.6	215.7	219		
		2050	5.694E-01	215.1	207.2	195.4	216	215.1	218.2		
		2100	5.833E-01	214	206.1	194.3	215.4	214.4	217.4		
		215)	5.972E-01	212.8	205.1	193.3	214.9	213.8	216.6		
		220)	6.111E-01	211.8	204.1	192.3	214.3	213.2	215.8		
		225)	6.250E-01	210.7	203	191.3	213.7	212.6	215		
l		230)	6.389E-01	209.6	202	190.3	213.2	212	214.3		
		235)	6.528E-01	208.6	201.1	189.3	212.6	211.5	213.6		
		240)	6.667E-01	207.5	200.1	188.3	212	210.9	212.9		
		2423	6.722E-01	207.2	199.7	188	211.8	210.7	212.8		
		244)	6.778E-01	200.8	199.3	188.3	211.7	210.5	212.7		{
		2460	0.833E-01	206.5	199	187.6	211.6	210.4	212.6	ĺ	
		2480	0.889E-UI	200.1	198.7	18/.2	211.0	210.5	212.5		
		2203	7 2225-01	203.8 204	190.4	1844	211.5	210.3 210 I	212.4		
		2000	1.2225-01	204	170.7	102.2	2.11.2	£10.1	212.1		

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Subject Containment Aerosol and Iodine Removal Rates

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		<u></u>		·	<u>u</u>	l						
						1 3 8 7 /						
		Table 4-	8 — Containm	ent Atmo	sphere	and wa	iter Sun	ip Temp	erature			
	·				Prome							
			Time	Vapor T	emperat	ure (°F)	Sump	Temperat	ure (°F)		•	
		(sec)	<u>(hr)</u>	Case I	Case 4	Case 7	Case J	Case 4	Case 7		- 1	
		270)	7.500E-01	203.4	196.5	187.9	211.3 ·	210	211.9			
		2803	8.056E-01	203.7	2013	191	211.1	203.3	211.0			
		3000	8.333E-01	209.1	203.2	195.7	210.9	209.7	211.7			
		310)	8.611E-01	210.5	204.8	197.6	210.8	209.6	211.1			
		320)	8.889E-01	211.6	206.2	199.1	210.8	209.5	210.9			
		3300	9.167E-01	212.7	207.4	200.4	210.7	209.5	210.8			
		3400	· 9.444E-01	213.6	208.4	201.6	210.7	209.5	210.6			
		3500	9.722E-01	214.4	209.3	202.6	210.0	209.4	210.5			
		370.3	1.00000000	213.1	210.1	203.0	210.0	209.4	210.4			
		3801	1.056E+00	216.3	211.5	205.2	210.5	209.4	210.3			
		3900	1.083E+00	216.8	212.1	205.9	210.5	209.4	210.2			
		4000	1.111E+00	217.3	212.7	206.5	210.5	209.4	210.1			
		4500	1.250E+00	219.3	215	209	210.6	209.6	209.9		1	
	,	5000	1.389E+00	220.4	216.6	210.8	210.7	209.8	209.9			
		5500	1.528E+00	221.1	217.6	211.8	210.9	210.2	209.9		- 1	
		6000	1.667E+00	221.6	218.1	212.4	211.1	210.5	210			
		6500	1.80000+00	221.7	218.4	212.8	211.5	210.9	210.1			
		7500	2 083E+00	221.5	218.4	212.9	211.5	211.2	210.5		·	
		8000	2.222E+00	220.7	218.1	213.9	212.1	211.9	209.7			
		8500	2.361E+00	220.5	217.9	214.4	212.4	212.2	209.3			
		9000	2.500E+00	220.1	217.8	214.7	212.6	212.4	209.1			ĺ
		9500	2.639E+00	219.8	217.6	215	212.9	212.7	208.8			
		100(Ю	2.778E+00	219.4	217.4	215.2	213.1	212.9	208.6		1	
		125(0	3.472E+00	217.7	216.2	215.3	213.7	213.8	207.7			
		17500	4.10/2+00	213.7	214.5	214.5	213.0	214.1	207			•
		20000	5.556E+00	210.8	210	210.6	212.8	213.6	205.3			
		225()0	6.250E+00	208.9	208.2	209	211.9	212.8	204.3			
		25000	6.944E+00	207.1	206.5	207.5	210.8	211.9	203.2			
		275(10	7.639E+00	205.2	204.6	205.9	209.7	<b>2</b> 10.9	202.1			1
		30000	8.333E+00	203.2	202.7	204.1	208.5	209.8	200.9			
		350()0	9.722E+00	199.1	198.6	200.4	205.9	207.4	198.5			
		40000	1.111E+01	195.4	194.9	197	203.2	204.8	195.9		1	
	]	40000	1.250E+01	192.2	191./	194.2	200.0	202,3	193.5			ĺ
		55000	1.509E+01	1864	185.6	191.0	196.5	1077	191.2			
		60000	1.667E+01	183.9	183	187	194	1957	1871			
		65000	1.806E+01	181.7	180.8	185	192.1	193.8	185.4			
		70000	1.944E+01	179.7	178.7	183.1	190.5	192.1	183.8			ļ
	•	75000	2.083E+01	177.8	176.7	181.4	189	190.6	182.3			
		80000	2.222E+01	176.2	175	180	187.6	189.3	181		ł	
		85000	2.361E+01	174.6	173.3	178.7	186.4	188	179.8			
		90000	2.500E+01	173.2	171.8	177.6	185.3	186.9	178.8			
	!	95000	2.639E+01	171.9	170.5	176.6	184.2	185.9	177.8			

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Sump Temperature (\*F)

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Table 4-8 — Containment Atmosphere and Water Sump Temperature Profile

Vapor 'Temperature (°F)

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Case 4 Case 7 Case 1 Case 4 Case 7 (sec) (hr) Case 1 100000 2.778E+01 170.8 169.3 175.7 183.3 184.9 177 164.7 179.8 181.5 173.9 125000 3.472E+01 166.2 171.7 162 160.4 168.1 177.1 178.7 171.3 150000 4.167E+01 175000 4.861E+01 158 156.1 164.5 174.6 176.1 168.8 172.3 152.7 173.9 200000 5.556E+01 154.7 161.6 166.7 225000 6.250E+01 151.7 149.8 159.1 170.5 172.1 164.9 250000 6.944E+01 149 146.8 156.5 168.8 170.4 163.2 144.1 167.3 168.8 146.5 154.2 7.639E+01 161.6 275000 8.333E+01 144.4 141.9 152.4 166 167.5 160.3 300000 400000 1.111E+02 136.5 133.7 145.6 161.4 162.9 155.9 159.4 140.4 157.8 500C00 130.5 127.6 152.4 1.389E+02 600000 1.667E+02 126 122.8 136.6 155.3 156.7 150 700000 1.944E+02 121.6 120 132.6 152.8 154.6 147.6 152.5 118.3 130.5 151.6 146.1 800000 2.222E+02 119.9 900000 2.500E+02 118.2 114.8 128.4 150.2 150.2 144.8 114 126.2 148.3 148.1 143.5 1000000 2.778E+02 117 145.1 1250000 3.472E+02 113 115.7 123 145.2 141.5 112.2 1500000 4.167E+02 112.3 120.7 142.9 142.9 140 140.7 4.861E+02 114.4 114.4 118.3 140.7 138.6 1750000 2000000 5.556E+02 113.8 113.8 115.9 138.7 138.7 137.1 6.944E+02 111.5 113 113.2 134.6 134.6 2500000 134.7 132.5 3000000 8.333E+02 110.8 112.5 112.6 132.5 132.6 3500000 9.722E+02 112.2 112.2 109.3 131.1 . 131.1 131.1 111.8 108.9 4000000 1.111E+03 111.8 129.6 129.6 129.6 5000000 1.389E+03 111 111 108.1 126.7 126.7 126.7 110.2 6000000 110.3 110.3 123.7 123.7 1.667E+03 123.7 7000000 1.944E+03 109.9 109.9 109.9 122.5 122.5 122.5 8000000 2,222E+03 109.6 109.6 109.6 121.4 121.4 121.4 2.500E+03 109.3 109.3 109.3 120.3 120.3 120.3 9000050 109 1000()050 2.778E+03 109 109 119.2 119.2 119.2

Subject Containment Aerosol and Iodine Removal Rates

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## 5 METHODOLOGY

### 5.1 NATURAL DEPOSITION

### 5.1.1 Aerosols

Natural deposition includes many phenomena (e.g., gravitational settling, thermophoresis, diffusiophoresis). This removal mechanism is considered valid only for aerosols; organic iodine and noble gases are non-reactive and therefore are not likely to be affected by these mechanisms.

A simplified natural deposition model for aeroscls was developed by Powers et. al. (Reference 6.4j). This model accounts for effects due to turbulence and to the multiple aerosol releases specified in NUREG-1465 (Reference 6.4g). To account for the uncertainties, a large number of calculations were performed with the modified mechanistic model, with specific values for the type of reactor containment, reactor power, and the source term release phase, while varying the values of the uncertain parameters. Typical uncertain parameters were the containment pressure during the various release phases, the floor and wall surface areas, the zirconium inventory, the ratio for containment volume to thermal power, and the properties of the concrete. These calculations resulted in a highly simplified model for aerosol decontamination using a first order removal rate coefficient ( $\lambda_{dep}$ ).

The first order removal rate coefficient was solved over the various release time intervals and for the different types of reactors and various operating power levels (P in MWt) using a Monte Carlo uncertainty analysis. The results of these analyses for PWR design basis accidents are summarized in Table 5-1.

Released Material	Time Interval (s)	Correlation (hr <sup>-1</sup> )
Gap	0-1,800	$\lambda_{dep}(90) = 0.0365 + 3.580 \times 10^{-6} P$
	(0 – 0.5 hr)	$\lambda_{dep}(50) = 0.0268 + 3.475 \times 10^{-6} P$
		$\lambda_{dep}(10) = 0.0182 + 3.260 \times 10^{-6} P$
gap	1,800 - 6,480	$\lambda_{dep}(90) = 0.1036 [1 - e^{-2.239 P/1000}]$
	(0.5 – 1.8 hr)	$\lambda_{dep}(50) = 0.0820 [1 - e^{-1.159 P/1000}]$
		$\lambda_{dep}(10) = 0.0645 [1 - e^{-0.938 P/1000}]$
early in-vessel	1,800 - 6,480	$\lambda_{dep}(90) = 0.0522 [1 - e^{-2.458 P/1000}]$
	(0.5 - 1.8  hr)	$\lambda_{dep}(50) = 0.0417 [1 - e^{-1.258 P/1000}]$
		$\lambda_{dep}(10) = 0.0326 [1 - e^{-0.910 P/1000}]$

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	Table 5-1 — C	Correlatio	on of PWR Effe Reactor Therm	ctive Nat al Power	tural D (Table	eposition Decor 36 of Reference	ntaminat e 6.4j)	ion Coef	ficients	with	]
	Released M	aterial	Time Inte	erval (s)		Co	rrelation	n (hr <sup>-1</sup> )			
	gap + early ir	n-vessel	6,480 -	13,680		$\lambda_{dep}(90) = 0$	.421 [ 1 -	-e <sup>-2.530 P/</sup>	1000]		1
			(1.8 – 3	.8 hr)		$\lambda_{dep}(50) = 0.$	.196 [ 1 -	- e <sup> 1.040 P/</sup>	<sup>1000</sup> ]		
			·····			$\lambda_{\rm dep}(10)=0.$	.094 [ 1 -	-e <sup>-0.869 P/</sup>	1000]		
	gap + early in	n-vessel	13,680	49,680		$\lambda_{\rm dep}(90)=0.$	.1920 – 1	.35 x 10 <sup>-6</sup>	P		
			(3.8 – 13	3.8 hr)		$\lambda_{\rm dep}(50)=0.$	.1382 + 6	6.85 x 10"	°P		
						$\frac{\lambda_{dep}(10) = 0}{\lambda_{dep}(10)}$	$\frac{0811 + 1}{1010}$	0.15 x 10	р° Р		
	gap + early in	i-vesse!	49,680 -	80,000		$\lambda_{dep}(90) = 0,$	.1010				
			(13.8 - 22	2.22 m)		$\lambda_{dep}(30) = 0.$	0912 0960 F 1	-2.384 F	/10001		
	Per Regulatory release phase. A second time per metals are prese rates weighted follows:	Guide 1. All isotop riod, both ent; there by the rel	183 (Reference 6 e groups have an the gap and earl fore the removal ease rate for eacl	b.4e, Tab. early in- y in-vess rate coel h phase p	le 2) on -vessel i sel relea fficient i ser NUF	ly the halogens a release phase. D se phase aerosol is a combination EG/CR-6604 (I	and alkal uring the s for the of the in Reference	i metals h 1,800 – ( halogens idividual e 6.4k, pa	ave a g 5,480 and alk release ge 200)	ap cali as	
	$\lambda_{eff} = 0$	$\lambda_{gap}  imes r_{gap}$	$\frac{1}{r_{iv} \times r_{iv}} + r_{iv}$				F	Quation	5-1		
	Where:										
	λ <sub>eff</sub> λ <sub>sop</sub> λiv r <sub>sop</sub> Γiv	is the eff is the ga is the ear is the rel is the rel	fective natural de p phase natural de rly in-vessel pha ease rate (fractione ease rate (fractione)	eposition leposition se natura on of core on of core	rate (hr n rate fo l deposi e per ho e per ho	<sup>-1</sup> ) or the 1,800 – 6, ition rate for the ur) during the ga ur) during the ea	480 s tim 1,800 – ap phase arly in-ve	e period 6,480 s ti ssel phas	me peri e	od	
5.1.2	Elemental Io Removal of elem 6.5.2 (Reference	dine mental io e 6.4f). Fi	dine by wall dep rom SRP 6.5.2 S	osition m ection II	nay be e [.4.c.(1)	stimated using t , the removal ra	he metho te is give	odology o n by:	f SRP		
	$\lambda_{v} = \frac{K}{2}$	$\frac{K_w \cdot A}{V}$					E	quation	5-2		

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Containment Aerosol and Iodine Removal Rates Subject

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Where:

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- 2. is the first-order removal coefficient by wall deposition
- is the wetted surface area A
- v is the containment building net free volume
- K., is a mass-transfer coefficient

### 5.2 SPRAY REMOVAL RATES

### 5.2.1 Aerosol

Aerosol removal by sprays is determined using the Powers model from NUREG/CR-5966 (Reference 6.4i). The extent to which sprays will decontaminate an aerosol-laden atmosphere depends on the number of spray droplets falling through the atmosphere and the distance they fall. The water flux into the containment atmosphere is time dependent and the fall distance is dependent upon the containment design. The Powers model is a mechanistic model of aerosol removal by sprays based upon how a single falling droplet would scavenge particles. Fowers suggested that many of the properties and phenomena affecting the process are not accurately predictable. To account for these uncertainties, a large number of calculations were performed with the mechanistic model (with specific values for the height and water flux) and varying the uncertain parameters. Typical uncertain parameters were the containment pressure, aerosol particle size, the water droplet distribution, the dynamic shape factors. and the properties of the water. In all, 20 parameters that were related to the phenomena were varied. An uncertainty analysis was performed using a Monte Carlo method to sample all of the calculations.

The results of the uncertainty analysis were used to construct simplified expressions for spray removal coefficients. The model input parameters are the spray water flux Q (cm<sup>3</sup> H<sub>2</sub>0/cm<sup>2</sup>-s) and the fall height of the spray droplets H (cm). Since the model was developed from an uncertainty study, three percentile levels are suggested by Powers. The best estimate value is associated with the 50<sup>th</sup> percentile, or median values; the lower bound is associated with the 10<sup>th</sup> percentile; and the reasonable upper bound, or largest decontamination factor, with the 90<sup>th</sup> percentile.

The model was developed using values for the spray water flux ranging from 0.001 to 0.25 cm<sup>3</sup>  $H_{20}/$ cm<sup>2</sup>-s and fall heights ranging from 500 to 5,000 cm. The model should not be used for spray water fluxes and fall heights outside of these ranges.

The aerosol removal coefficient is dependent on the fraction of the aerosol suspended in the atmosphere,  $m_{f_1}$  which is defined as the aerosol mass in the atmosphere at a given time, t. divided by the total aerosol mass released into the compartment atmosphere until this time. This aerosol removal coefficient can be used in a simple differential equation to calculate decontamination (NUREG/CR-5966 [Reference 6.4i] page 149):

 $\frac{dm_f}{dt} = -\lambda(Q, H, m_f) \cdot m_f$ 

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**Equation 5-3** 

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	Where $\lambda(Q, height H (cn))$ the ratio $\lambda(m)$	H, $m_j$ ) is the h), and aero h)/ $\lambda(m_j=0.9$	e aerosol removal sol mass fraction )). The aerosol re	l coefficier <i>m<sub>f</sub></i> . Power moval coe	nt for a rs deve fficien	given water flu loped correlatio t is then:	x Q (cm <sup>3</sup> ns for $\lambda$ (g	H <sub>2</sub> 0/ cm 2, <i>H</i> , m <sub>f</sub> =	<sup>2</sup> -s), fall = 0.9) au	l nd	
	<i>л(</i> Q	$(H,m_f) =$	$\lambda(Q,H,m_f=0.$	$9) \frac{\lambda(m)}{\lambda(m_f)} =$	<u>7)</u> = 0.9)		E	quation	5-4		
	The correlati NUREG/CR	ion for λ( <u>12</u> , -6604 [R.3fe	H, $m_f = 0.9$ ) is generated by the formula of the second	iven by (N ation 6, pag	UREC ge 197	G/CR-5966 [Refa ):	erence 6.	4i] page :	153 and		
	$\lambda(Q,H,m_f)$	= 0.9) = ex	$\exp[A + B \ln Q + C]$	$CH + DQ^2$	$^{2}H + 1$	$EQH^2 + FQ + Q$	$GQ^2H^2$	Equ	ation 5	-5	
	The correlati	ion for $\lambda(m_j)$	)/λ(m <sub>f</sub> =0.9) is gi	ven by (NI	UREG	/CR-5966 [Refe	rence 6.4	i] page 1	54):		
											1
	$\frac{1}{\lambda(m)}$	$\frac{l(m_f)}{l_f = 0.9} =$	$\left[a+b\log_{10}Q\right]$	$-\left(\frac{m_f}{0.9}\right)^c$	$\left]+\left(\frac{n}{0}\right)$	$\left(\frac{n_f}{1.9}\right)^c$		Equatio	n 5-6		
	$\frac{1}{\lambda(m)}$ The constant The above m where there is aerosols. The release stops	$\frac{l(m_f)}{l_f = 0.9} =$ is A, B, C, I nodel was on is a continue e model has	$\begin{bmatrix} a+b\log_{10}Q\\ 1\end{bmatrix}$	$-\left(\frac{m_f}{0.9}\right)^c$ and c are detended for a purize distribution this case	$\left  + \left( \frac{n}{0} \right) \right  + \left( \frac{n}{0} \right)$	$\left(\frac{n_f}{1.9}\right)^c$ below in Table : ase of aerosol in vill continually t tting the mass fr	5-2. to a system renew $m_{\rm raction}$	Equation f = 1 untipotential equations of the formula of the f	n 5-6 ose case injected l the	s 1	
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E&TS DEPARTMENT ICCN NO./ **CALCULATION SHEET** PRELIM. CCN NO. PAGE OF **CCN CONVERSION:** CCN NO. CCN Project or DCP/FCN/ECP N/A N-6030-001 Calc No. Containment Aerosci and Iodine Removal Rates Subject Sheet 34 of 281 ORIGINATOR ORIGINATOR DATE IRE DATE REV DATE IRE DATE REV INDICATOR **F.EV** D. T. Dexheimer 8/15/2003 J. Schulz 8/15/2003 . 0 As discussed above,  $\lambda(Q, H, m_f = 0.9)$  is dependent on the spray flux and the drop height. Individual  $\lambda(Q, H, m_f = 0.9)$  are calculated for each spray header and spray header ring. The overall  $\lambda(Q, H, m_f = 0.9)$ 0.9) is then the sum of the individual spray header ring aerosol removal rates. **Time Dependent Aerosol Removal Rates** 5.2.1.1 The expression for the aerosol removal rate constant as shown in Equation 5-4 is dependent on the mass fraction, mr. Therefore, Equation 5-4 in conjunction with Equation 5-6 will be calculated as a function of  $m_f$ . The time to reach the mass fraction is then calculated assuming that the removal rate is constant over a small time period  $\Delta t$  and for an initial mass release at t=0. The basic equation is:  $m_f(t_2) = m_f(t_1)e^{-\lambda\Delta t}$ Equation 5-7 Equation 5-7 is then solved for  $t_2$ , noting that  $\Delta t = t_2 - t_1$ ,  $t_2 = t_1 - \frac{\ln\left(\frac{m_f(t_2)}{m_f(t_1)}\right)}{\lambda(m_f)}$ **Equation 5-8** Average Aerosol Removal Rate 5.2.1.2 The program LocaDose, NE319 (Reference 6.6a) treats the removal rates as constants for any given time period; therefore, to model the time dependency, average removal rates are calculated for specified LocaDose time periods. The determination of an average removal for a specific time period begins by assuming that over that time period the removal rate  $\lambda$  behaves as an exponential of the form:  $\lambda(t) = \lambda_1 e^{-\alpha(t-t_1)}$ Equation 5-9 Therefore, at time  $t_2$ , the removal rate is given by:  $\lambda_2 = \lambda_1 e^{-\alpha(\iota_1 \cdots \iota_1)}$ Equation 5-10 The constant  $\alpha$  for the  $t_1$  to  $t_2$  time interval can be calculated from the above equation to be:

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$\alpha = -\frac{\ln\left(\frac{\lambda_2}{l_1}\right)}{(l_2 - l_1)}$ Equation 5-11												
Integrating Equation 5-9 between times $t_1$ to $t_2$ yields:												
	$\int \lambda(t) dt = \int_{t_1}^{t_2} \lambda_1 e^{-\alpha(t-t_1)} dt$ Equation 5-12											
$\int \lambda(t) dt = -\frac{\lambda_1}{ct} \left  e^{-\alpha(t-t_1)} \right _{t_1}^{t_2}$ Equation 5-13												
	$\int \lambda(t) dt = -\frac{\dot{\lambda}_1}{c \tau} \left[ e^{-\alpha(t_2 - t_1)} - 1 \right]$							Equation 5-14				
Inserting Equation 5-10 and Equation 5-11 into Equation 5-14 yields the following time integrated removal rate for the $t_1$ to $t_2$ time interval:												
	$\lambda I(\Delta t) = \int \lambda(t) dt = \frac{\lambda_2 - \lambda_1}{\ln\left(\frac{\lambda_2}{\lambda_1}\right)} (t_2 - t_1)$						Equation 5-15					
Equation 5-15 is calculated for small time increments between times $T_1$ and $T_2$ , the LocaDose time interval. The results are then summed together and divided by this time interval to develop the average removal rate:												
	$\overline{\lambda}(T_1 \to T_2) \approx \frac{\sum_j \lambda I_j(\Delta t_j)}{T_2 - T_1}$						Equation 5-16					
5.2.2	Elemental Io	dine										
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Elemental iodine removal rates by sprays are calculated using the Bechtel Standard Computer Program <i>REMOVE</i> , NE305 (Reference 6.6b). <i>REMOVE</i> is a computer program used to calculate spray removal rate constants for elemental, particulate, and organic iodines. A spectrum of drop sizes produced by the SPRACO 1713A nozzle is used in the model to determine a spray removal rate constant.												

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	<ul> <li>Characteristics of each drop size such as diameter, terminal velocity, fall time, Reynolds number, Sherwood number, saturation fraction and removal rate constant are calculated and printed. The total spray removal rate constant for removal of iodine is the sum of the individual removal rates for each drop size.</li> <li><i>REMOVE</i> incorporates the models of SRP 6.5.2 (Reference 6.4f) and NUREG/CR-0009 (Reference 6.4h) to determine the iodine spray removal coefficients.</li> <li>For this calculation, the <i>REMOVE</i> code was executed on a Dell Latitude D400 personal computer (Bechtel ID No. BSII <i>99279</i>). Use of the <i>REMOVE</i> code on this computer has been verified and validated as required by SONGS Procedures SO123-XXIV-7.15 (Reference 6.5a) and SO123-XXIV-5.1 (Reference 6.5b). The validation cases provided with the code package were run and compared to the results provided and shown to be identical.</li> <li>For the purposes of this calculation the elemental iodine removal rates calculated by REMOVE are used. Although <i>REMOVE</i> calculates particulate iodine removal rates are calculated using the methodology presented in Section 5.2.1, and the organic iodine removal rates are conservatively neglected in this analysis.</li> <li>Spray removal rates are calculated for each spray header and each ring individually, and then added together to determine an overall elemental iodine spray removal rate.</li> <li>52.2.2 Partition Coefficients and DF Values</li> <li>The partition coefficients are calculated using the Bechtel Standard Computer Program <i>ICONC</i>, NE316 (Reference 6.6:). <i>ICONC</i> calculates the partition coefficient of iodine between water and air using the methodology developed by L. P. Parsly in ORNL-TM-2412 Part IV (Reference 6.6e). The input parameters needed to execute <i>ICONC</i> are as follows:</li> <li>Water temperature in TF</li> <li>Water pH value</li> <li>Volume of input phase in cubic feet</li> <li>Volume of input phase in cubic feet</li> </ul>											
	• Equ For this calcula (Bechtel ID No validated as req 5.1 (Reference the results prove	tion, the <i>l</i> . BSII 292 uired by 5 6.5b). The ided ard s	CONSTRUCT STATES CONSTRUCTED CONC code was 279). Use of the SONGS Procedu e validation case shown to be ider	s executed iCONC c ires SO12 s provide itical.	d on a I code on 23-XXI cd with	Dell Latitude D4 this computer h V-7.15 (Referen the code packag	00 perso as been v ce 6.5a) e were ru	nal compu verified an and SO12 in and cor	nter id 3-XXI npared	V- to		
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calculate equilibrium constants at intermediate temperatures, an exponential interpolation is used as follows:

$$K(T) = K(T_1) \left( \frac{K(T_2)}{K(T_1)} \right)^{\left[ \frac{T_1 - T_2}{T_1 - T_2} \right]}$$

Equation 5-18

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	6.1d	Unit 2 d Analysi	Unit 2 & 3 Calculation N-4080-026, Revision 1 (including CCNs 4 & 5), Containment P-T Analysis for Design Basis LOCA.												
	6.1e	Unit 2 d Analysi	& 3 Calcı is for Des	lation N-4080-0 ign Basis MSLB	)27, Revi	sion 1 (	including CCNs	4 & 5),	Containme	nt P-T					
	6.1f	Unit 2 a Results	& 3 Calcu	lation N-6097-0	01, Revi	sion 0, 1	SO23 Alternativ	e Source	Term – OF	RIGEN	<i>'-S</i>				
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6.2	DRAW	INGS													
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	6.2b	Unit 2 & Arrange	& 3 Draw ement	ing 23000, Revi	sion 5 (in	cluding	DCN 3), Conta	inment S	Structure G	eneral	,				
	6.2c	Unit 2 & 3 Drawing 23116, Revision 12 (including DCNs 14 to 16), Containment Interior Struct. Reinforced Concrete North Partial Plan, El. 63' – 6"													
	6.2d	Unit 2 & South P	& 3 Draw Partial Pla	ing 23117, Revi 20, <i>El. 63' – 6"</i>	sion 18, 0	Contain	ment Interior St	ruct. Rei	nforced Co	ncrete					
	6.2e	P & I D a) b)	iagranı, C Unit 2 D Unit 3 D	Containment Spr rawing 40114B, rawing 40114BS	ay Syster Revision 503, Rev	n, Syste 17 ision 14	m No. 1206								

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6.3	<i>Corr</i> None	Burlington, Mass., drawing EXKN16532, December 1969). RRESPONDENCE ne GULATORY DOCUMENTS												
6.4	REGU	GULATORY DOCUMENTS												
	6.4a	San Onofre Unit 2 Facility Operating License NPF-10, Amendment 189												
	6.4b	San On	ofre Unit	3 Facility Operation	ating Lice	ense NP	F-15, Amendm	ent 180						
	6.4c	San On	ofre Unit	2 Technical Spe	cification	ns,								
		i)	LCO 3.5	i.4	page 3.5-	9 [Åme	ndment 127]							
	6.4d	San On	ofre Unit	3 Technical Spe	cification	ns,					i			
		i)	LCO 3.5	i.4	page 3.5-	9 [Ame	ndment 116]							
	6.4e	Regula Design	tory Guid <i>Basis Ac</i>	e 1.183, Revisio cidents at Nucle	n 0, Alter ar Power	rnative I Reacto	Radiological So rs, USNRC, Jul	urce Teri y 2000.	ms for Eve	aluating	g			
	6.4f	NURE Produc	G-0803, S t Cleanup	Standard Review System, USNR	Plan 6.5. C, Decen	.2, Revi aber 198	sion 2, <i>Contain</i> 38.	ment Spr	ay as a Fi	ssion				
	6.4g	NURE( Februar	G-1465, <i>A</i> ry 1995.	Accident Source	Terms for	r Light-1	Water Nuclear I	Power Pl	ants, USN	IRC,				
	6.4h	NURE Contan	G/CR-000 ninants in	)9, Technologica Containment Vé	al Bases f essels.	or Mod	els of Spray Wa	shout of I	Airborne					
	6.4i	NUREG/CR-5966, A Simplified Model of Aerosol Removal by Containment Sprays, USNRC, June 1993.												
	6.4j	NURE( Contair	G/CR-618 uments, U	89, A Simplified I SNRC, July 199	Model of 6.	Aerosoi	Removal by No	atural Pr	ocesses in	Reacto	or			
	6.4k	NUREG/CR-6604, RADTRAD: A Simplified Model for <u>RAD</u> ionuclide <u>T</u> ransport and <u>R</u> emoval <u>A</u> nd <u>D</u> ose Estimation												

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	6.5b SO123-XXIV-5.1 Revision 4, Engineering and Technical Services Software Quality Assurance.												
6.6	OTHER DOCUMENTS												
	<ul> <li>OTHER DOCUMENTS</li> <li>6.6a LocaDose Computer Program, Bechtel Standard Computer Program NE319, Version 6.01, September 2002.</li> </ul>												
	<ul> <li>September 2002.</li> <li>6.6b Remove Computer Program, Bechtel Standard Computer Program NE305, Version 4.0, December 1991.</li> </ul>												
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	CFR										
	DBA Design Basis Accident										
	DBA Design Basis Accident DBE Design Basis Event										
	DE Design Basis Event DCN Document Change Notice										
	DCP Design Change Package										
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## **8** COMPUTATIONS

#### 8.1 TIME PERIODS

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The natural deposition and spray removal rates are time dependent. These removal rates will be used to determine releases and subsequent doses from the facility using the Bechtel Standard Computer Program *LocaDose*, NE319 (Reference 6.6a). *LocaDose*, NE319 treats the removal rates as constants for any given time period; therefore, to model the time dependency, average removal rates are calculated for specified *LocaDose* time periods. The specified time periods are presented in below:

	Table 8-1 — Time Periods Used in the Removal 1	<b>Rate Calculation</b>	
Time	Description	LocaDose Time-Step	S
30sec	Gap release onset	0.0000E+00-8.3333E-0	3 hr
1 1min	Containment spray system (CSS) actuation	8.3333E-03-1.6667E-02	2 hr
5min	Alternate containment spray system actuation time	1.6667E-02-8.3333E-02	2 hr
20min	Recirculation phase begins for two CSS trains operating	8.3333E-02-3.3333E-0	l hr
30min	Potential ESF recirculation phase start time	3.3333E-01-5.0000E-0	l hr
30.5min	Gap release termination, early in-vessel release begins	5.0000E-01-5.0833E-0	l hr
2,497.4sec	Spray injection phase ends, recirculation phase begins	5.0833E-01-6.9372E-0	l hr
lhr	Intermediate time-step	0.694-1	hr
6,480.0sec	End of early in-vessel release	1	hr
2hr	x/Q change - CSS system secured manually (optional)	1.8-2	hr
13,680sec	Aerosol deposition rate change	2.000-3.8	hr
4hr	CSS system secured manually (optional)	3.8 4	hr
8hr	$\chi$ /Q change - CSS system secured manually (optional)	48	hr
49,680sec	Aerosol deposition rate change	8-13.8	hr
80,000sec	Aerosol deposition rate change	13.8-22.2	hr
24hr	x/Q change - CSS system secured manually (optional)	22.2-24	hr
48hr	CSS system secured manually (optional)	24-48	hr
96hr	x/Q change - CSS system secured manually (optional)	4896	hr
720hr	End of analysis	96-720	hr

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		1,800 6,480 13,680 49,680	$\begin{array}{r} 0 - 1,800 \\ 0 - 6,480 \\ 0 - 13,68 \\ 0 - 49,68 \\ 0 - 80,00 \end{array}$	A.88E-02           1.04E-01           30         4.21E-01           30         1.87E-01           30         1.01E-01	3.87E-0 8.05E-0 1.91E-0 1.62E-0 9.12E-0	)2 2.9 )2 6.1 )1 8.9 )1 1.1 )2 8.6	4E-02 9E-02 3E-02 6E-01 0E-02	5.22E-0	2 4.1	IE-02	3.12E-02		
	The follo	owing e The 109 explicitl	xamples 6ile natu ly using t	show how Table ral deposition rather correlation o	e 8-2 was ite for the f Table 5-	construg gap rele	cted. ease pha	ase for 0	- 1,800 I of 3,4	s is cal 38 MW	culated	-	

 $\lambda_{den}(10) = 0.0182 + 3.260 \times 10^4 P = 0.0182 + 3.260 \times 10^6 \times 3,438 = 0.0294$ 

2. The 10% ile natural deposition rate for the gap release phase for 1,800 - 8,640 s is calculated explicitly using the correlation of Table 5-1 and a core power level of 3,438 MWt:

 $\lambda_{den}(10) = 0.0645 [1 - e^{-0.938 P/1000}] = 0.0645 [1 - e^{-0.938 \times 3438/1000}] = 0.0619$ 

3. The 10% ile natural deposition rate for the early in-vessel release phase for 1,800 - 8,640 s is calculated explicitly using the correlation of Table 5-1 and a core power level of 3,438 MWt:

 $\lambda_{dep}(10) = 0.0326 [1 - e^{-0.910 P/1000}] = = 0.0326 [1 - e^{-0.910 \times 3438/1000}] = 0.0312$ 

The natural deposition rate for time periods less than 1,800 seconds and for time periods greater than 6,480 seconds for all aerosol groups is taken from the gap release columns of Table 8-2. For the 1,800 to 6,480 second time period, the effective natural deposition rate is calculated using Equation 5-1. The deposition rates for halogens, alkali metals, and other particulates are shown on Table 8-3 through Table 8-5.

For example, for halogens the 10% ile natural deposition rate is determined as follows:

From Design Input 4.2, the release fraction of halogens is 0.05 for the gap phase and 0.35 for the early in-vessel phase.

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	From 1 release	Design Ing phase is	put 4.3, the gap 1 1.3 hours.	release ph	ase dur	ation is 0.5 hour	s, and th	e early in	-vessel			
	The release rate during the gap phase is then $0.05/0.5$ hr = 0.1 fraction/hour											
	The release rate during the early in-vessel phase is then $0.35/1.3 = 0.269$ fraction/hour											
	Using Equation 5-1, the halogen removal rate is then:											
	$\lambda_{ran} \times r_{ran} + \lambda_{iv} \times r_{iv} = 0.0619 \times 0.1 + 0.0312 \times 0.269$											
	$\lambda_{eff} = \frac{\lambda_{gap} \times r_{gap} + \lambda_{iv} \times r_{iv}}{r_{gap} + r_{iv}} = \frac{0.0619 \times 0.1 + 0.0312 \times 0.269}{0.1 + 0.269} = 0.0395 hr^{-1}$											
	A second exam	nple, for a	lkali metals, the	10%ile n	atural d	eposition rate is	determir	ned as foll	lows:			
	From I for the	Design Inp early in-v	out 4.2, the releavessel phase.	se fractio	n of alk	ali metals is 0.0	5 for the	gap phase	e and O.	25		
	From I release	Design Ing phase is 1	out 4.3, the gap 1 1.3 hours.	elease ph	ase dur	ation is 0.5 hour	s, and th	e early in-	vessel			
	The rel	lease rate	during the gap p	hase is th	en 0.05	/0.5 hr = 0.1 fra	ction/hou	ır				
	The rel	lease rate	during the early	in-vessel	phase i	s then 0.25/1.3 =	= 0.192 f	raction/ho	ur			
	Using	Equation :	5-1, the alkali m	etal remo	val rate	is then:						
	λ.π =	$\lambda_{gap} \times r_{g}$	$_{ap} + \lambda_{iv} \times r_{iv} =$	0.0619 >	× 0.1+	0.0312 × 0.192	$\frac{1}{2} = 0.04$	17 hr <sup>-1</sup>				
· ·	ĘIJ	r <sub>sa</sub>	$_{p}+r_{iv}$		0.1+	0.192						
				هبدزز عد	·····	· · · · · · · · · · · · · · · · · · ·						
			Table 8-3 –	– Haloge Rate	en Natu s (hr <sup>-1</sup> )	ral Deposition						
}	Time Period (s) 90%ile Mean 10%ile											
			0-1,80	0 4.8	8E-02	3.87E-02 2.94	E-02					
			1,800-6,48	0 6.6. 80 4.2.	1E-02 1E-01	5.18E-02 3.95	E-02					
1			13,680-49,6	80 1.8	7E-01	1.62E-01 1.16	E-01		•		1 1	
1			49,680-80,0	00 1.0	1E-01	9.12E-02 8.60	E-02					

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			Time Period 0- 1,80 1,800- 6,48 6,480- 13,6 13,680- 49,6 49,680- 80,0	Ra (s) 90 00 4.8 30 6.9 580 4.2 580 1.8 500 1.0	ntes (hi %ile 8E-02 8E-02 1E-01 7E-01 1E-01	Mean 3.87E-02 5.46E-02 1.91E-01 1.62E-01 9.12E-02	10% 2.94F 4.17F 8.93F 1.16F 8.60F	ile -02 -02 -02 -02 -01 -02					
			Table 8-	5 — Oth Depositi	er Par on Rat	ticulates l tes (hr <sup>-1</sup> )	Natural						
Í			Time Period	<u>1 (s) 90</u>	%ile	Mean	10%i	le					
1		$0-1,800 \qquad N/A \qquad N/A \qquad N/A \\ 1,800-6,480 \qquad 5.22E-02 \qquad 4.11E-02 \qquad 3.12E-02 \\ 1.800-6,480 \qquad 5.22E-02 \qquad 5.22E-02 \\ 1.800-6,480 \qquad 5.22E-02 \qquad 5.22E-02 \\ 1.800-6,480 \qquad 5.22E-02 \qquad 5.22E-02 \\ 1.800-6,480 \qquad 5.200-6,480 \qquad 5.200-6,480 \\ 1.800-6,480 \qquad 5.200-6,480 \\ 1.800-6,480 \qquad 5.2$											
1			6.480-13.0	680 4.2	1E-01		8.93E-	02					
1			13,680-49,	680 1.8	7E-01	1.62E-01	1.16E-	01					
								· .					

#### 8.2.2 Elemental Iodine

Natural deposition of elemental iodine is calculated using Equation 5-2. From Design Input 4.5, the mass transfer coefficient,  $K_w$ , is 0.137 cm/sec. From Design Input 4.6, the primary containment free air volume, V, is 2,284,000 ft<sup>3</sup>. From Design Input 4.9, the wetted surface area, A, is 601,519 ft<sup>2</sup>. The natural deposition rate for elemental iodine is then:

$$\lambda_{w} = \frac{K_{w} \cdot A}{V} = 0.137 \, cm/\sec 3,600 \sec/hr \frac{601,519 \, ft^{2}}{2,284,000 \, ft^{3} \times 30.48 \, cm/ft} = 4.26 \, hr^{-1}$$

#### 8.3 SPRAY REMOVAL RATES

#### 8.3.1 Aerosol Removal Fates

#### 8.3.1.1 Applicability of the Powers Aerosol Removal Rate Model

As discussed in Section 5.2.1, the Powers model of aerosol removal is valid for total water flux between 0.001 to 0.25 cm<sup>3</sup> H<sub>2</sub>0/ cm<sup>2</sup>-s and a fall height between 500 to 5,000 cm. In the following subsections, the total spray flux and the range of fall heights for the SONGS spray system are calculated to determine if they fall within the range of applicability of the Powers model.

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#### 8.3.1.1.1 Total Spray Flux

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As discussed in Section 5.2.1, the Powers model of aerosol removal is valid for total water flux between 0.001 to 0.25 cm<sup>3</sup> H<sub>2</sub>0/ cm<sup>2</sup>-s. The total flux is defined as the spray system volumetric flow rate divided by the floor coverage area.

From Design Input 4.10, the minimum spray system flow rate for one header is 1,600 gpm. This translates to:

 $F = 1,600 gpm \times 3.78624 l/gal \times 1,000 cm^3 / l/60 s / min = 1.010 \times 10^5 cm^3 / s$ 

The floor coverage area is taken to be the area of a circle given by the inner diameter of the containment. The inne: diameter of the containment, from Design Input 4.8 is 150 ft. Therefore, the floor area is:

$$A = \pi \times \left(\frac{150 \, ft \times 30.48 \, cm \, / \, ft}{2}\right)^2 = 1.642 \times 10^7 \, cm^2$$

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The total flux is then:

$$Q = \frac{F}{A} = \frac{1.010 \times 10^5 \text{ cm}^3/\text{s}}{1.642 \times 10^7 \text{ cm}^2} = 0.00615 \text{ cm}^3 H_2 O/\text{cm}^2 - \text{s}$$

This flux is within the range of applicability for the Powers model.

#### 8.3.1.1.2 Maximum and Minimum Fall Heights

From Design Input 4.11, the minimum spray ring plant elevation is 143' - 3 11/16'', and the maximum spray ring elevation is 181' - 11 11/16''. From Design Input 4.7, the operating floor plant elevation is 63' - 6''.

The minimum fall height is then:

$$H_{\min} = \left(143 + \left(\frac{3+11/16}{12}\right)ft - 63.5 ft\right) \times 30.48 \, cm/ft = 2,433 \, cm$$

The maximum fall height is then:

$$H_{\max} = \left(181 + \left(\frac{11 + 11/16}{12}\right)ft - 63.5 ft\right) \times 30.48 \, cm/ft = 3,611 \, cm$$

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	These fall heig 8.3.1.2 In	ghts are v/i dividual f	ithin the range of Spray Ring Aer	f applicati osol Rem	bility of t	the Powers mod	lel.					
	Since each spr aerosol remov determined, th each ring in a time depender	ay ring is al rates vi- ien the $\lambda(\underline{C})$ spray hear nt aerosol	located at a diffe ill be determined ), $H$ , $m_f = 0.9$ ) is der are summed removal rate.	erent heig l. For each calculate together,	ht, and y h spray r d using and the	vill have differe ing, the fall hei Equation 5-5. T lowest header v	ent cover ght, H, a he aeros value is u	age areas, nd spray f ol remova sed to det	indi flux, il rate ermir	vidual Q, is as for the the		
	Per Design In	put 4.11 ւհ	iere are 116 noz:	zles per s	pray hea	der (20+40+56)	). Per De	sign Input	4.10	) the		

minimum flow rate per header is 1,600 gpm, therefore the minimum average flow per nozzle is 13.79 gpm.

#### 8.3.1.2.1 Spray Header 1 Removal Rate Calculation

Spray header 1 consists of three concentric rings designed to provide full spray coverage. The calculation of the spray fall height, spray flux, and resultant aerosol removal rates is shown on Table 8-6 through Table 8-8. Representative sample calculations are provided.

Fall height for ring 05?-2 1/2"-C-KEO:

From Design Input 4.11, the centerline plant elevation of this ring is  $180^{\circ} - 11 \frac{3}{16^{\circ}}$  (180.93 ft). From Design Input 4.7, the operating floor plant elevation is  $63^{\circ} - 6^{\circ}$ , therefore the fall height is:

 $H = (180.93 ft - 63.5 ft)(30.48 cm/ft) = 117.43 ft \times 30.48 cm/ft = 3,579 cm$ 

This value is in excellent agreement with the value shown on Table 8-6.

Spray flow for ring 052-21/2"-C-KEO:

From Design Input 4.11, the number of nozzles for this ring is 20. As calculated above, the flow per nozzle is 13.79 gpm. The total spray flow for this ring is then 275.86 gpm.

 $F = 275.86 gpm \times 3.786241/gal \times 1,000 cm^3/l/60 s/min = 1.741 \times 10^4 cm^3/s$ 

This value is in excellent agreement with the value shown on Table 8-6.

Coverage area for ring 052-2 <sup>1</sup>/<sub>2</sub>"-C-KEO:

This ring has nozzles oriented vertically downward and nozzles oriented at a 45° angle downward. The coverage area forms an annular region. The inner and outer radii of this annulus are determined as follows:

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SCE 26-4	From I build radius From I nozzle radius is then From I offset I 15.2 cf The co The co This va Spray flux for 1 The spray flux $Q = \frac{F}{A}$ This value is in <u>Aerosol Remov</u> The aerosol ref above, and the 10 <sup>th</sup> percentile	Reference is defined Design Inj centerlind by 9.5 free 25.5 + 9. Design Inj by 4 feet f m. overage arc $A = \pi (r)$ alue is in e tring 052-2 is the tota $T = \frac{1.741}{3.57}$ n excellent val Rate C noval rate constants level is ca	6.2f, the spray r ore, the outer rad by the 45° down out 4.13, the vert c. Therefore, the t. From Design 1 5 = 35 feet, or 1, out 4.13, the 45° rom the nozzle of ea is then: $\frac{2}{outer} - r_{inner}^2 = \pi$ excellent agreement $2 \frac{1/2"-C-KEO:}{1}$ I flow rate divid $\times 10^4 \text{ cm}^3 / \text{sec} = \frac{1}{75 \times 10^6 \text{ cm}^2}$ agreement with coefficient, $\lambda(O, O)$ i coefficient is caprovided in Table lculated: O(123-XXIV-7.15)	nozzles ar ius is defi- nward ori ical nozz outer rad (nput 4.1 066.8 cm downwar centerline (1,066.8 <sup>2</sup> ent with the ed by the = 4.870× the value $H_{m_{f}=:0}$ Iculated the le 5-2. As	e orient ined by ented n les have lius of t 1, the rate orient The in -15.2 the value covera $10^{-3}$ cr e shown <u>9) for t</u> using E s an exa	ed towards the of the vertically of ozzles. e a coverage are he coverage ann dius of this ring ted nozzles have mer radius is the $(2) = 3.575 \times 10^{\circ}$ te shown on Table ge area: $m^3 H_2O/cm^2 - 10^{\circ}$ n on Table 8-6. ing 052-2 ½"-C quation 5-5, the imple, the remov	center of friented normalized in the friented normalized is of 19 for ulus is of is $25.5 \text{ fr}$ is $25.5 $	the containon the containon the containon the content of the cont	inment d the in ed on th the rin outer rad of 21 feet 0.5 feet	iner g dius et , or	

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$\lambda(Q, H, m_f =$ This value is in	= 0.9) = ex = ex = ex = ex	$p[A + B \ln Q + 0]$ $p[5.5750 + 0.9]$ $-7.327 \times 10^{-1}$ $+3.555 \times 10^{-1}$ $p[0.5053] = 1.60$ t agreement with	CH + DQ 4362ln(4 -7 × 4.87( -6 × (4.87 6 hr <sup>-1</sup> 1 the value	$P^{2}H + H$ 4.870× 0×10 <sup>-3</sup> 0×10 <sup>-3</sup> e showr	$EQH^{2} + FQ + (10^{-3}) - 6.9821$ × $(3,579)^{2}$ · $(3,579)^{2}$ · $(3,579)^{2}$ • on Table 8-6.	<i>GQ</i> <sup>2</sup> <i>H</i> <sup>2</sup> <10 <sup>-3</sup> ×(	4.870×1	0 <sup>-3</sup> ) <sup>2</sup> ×	3,579	
505 25 426 PEV 2 (PEE		0122 XXIV-7 151				· · · · · · · · · · · · · · · · · · ·	- -	N.60	30.001 80	

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		Table	8-6 — Contain	ment Spi	ray Head	er 1 Ring 05	2-2 ½"-C-	KEO		1
		Nunh	er of nozzles		20		Design In	put 4.11		1
		Ty	pe A (Vertical)		10		Design In	put 4.11		
		Ty	pe B (45°)		10		Design In	put 4.11		
		Flowr	ate per nozzle		13.	79 gpm	Calculate	ed in the second s		
	•	Spray	ring radius		25.	5 feet	Design In	put 4.11		
		Spray	Header Elevation		180.	9 fect	Design In	put 4.11		1
		Fall heigh	t Calculation							
		Operat	ting Deck Elevatio	n	63.	5 feet	Design In	put 4.7		
		Fall he	eight		117.	43 feet	Calculate	d		
	•				3,579	cm	Calculate	ed		
		Spray Rin	g Flow Calculati	0n	075	0	Calandara			
		Total	Flow		275.	9 gpm	Calculate	d		
					17.	41 Isec <sup>-</sup>	Calculate	ed j		
					<u>1.741</u> E	$+04 \mathrm{cm}^3 \mathrm{sec}^{-1}$	Calculate	ed		
		Coverage	Area Calculation	l				1		
		Norzle	е Туре А							
		Co	verage Diameter		19	feet	Design In	put 4.13		
		Uff Novel	iset from centerlin	e	0	ieet	Design In	put 4.13		
		Nozzie	: Type B		<b>21</b>	faat	Decign In			
			fset from centerlin	-	21	feet	Design In	iput 4.13		
		Outer	Coverage Radius	•	35.	0 feet	Calculate	d		
			B+		1066.	8 cm	Calculate	ed and		
•		Inner (	Coverage Radius		0.	5 feet	Calculate	d		
			-		15.	2 cm	Calculate	d		
		Covera	nge Area		3.575E	+06cm <sup>2</sup>	Calculate	d		
		Resultant	Spray Flux		4.8701	E-03 cm <sup>3</sup> /cm <sup>2</sup> -s	Calculate	ed		
		Resultant	λ(m <sub>f</sub> ≈0.9)			<u></u>				
		Me	edian		4.0	0 hr <sup>-1</sup>	Calculate	d j		
		909	%ile		8.8	6 hr <sup>-1</sup>	Calculate	d		
		109	%ile		1.6	6 hr <sup>-1</sup>	Calculate	d		
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		1											
	[	Tabl	e 8-7 — Contain	nment S <sub>l</sub>	pray He	ader	·1 Ring 05	j1-4"-C-]	KEO	]			
		Nunib T	er of nozzles ype A (Vertical)		•	40 20		Design I Design I	nput 4.11 nput 4.11				
		T Flow 1 Spray Spray	ype C (Horizontal ate per nozzle ring radius Header Elevation	)	· : 1	20 13.79 43 71.6	gpm feet feet	Design In Calculate Design In Design In	nput 4.11 ed nput 4.11 nput 4.11				
	F	Fall height Opera Fall he	Calculation ting Deck Elevatic tight	 m	11	63.5 08.11 95	feet feet cm	Design In Calculate Calculate	nput 4.7 ed ed				
	Š	<b>pray Ring</b> Total I		5: 3.482	51.7 34.82 2E+0	gpm 2 l sec <sup>-1</sup> 4 cm <sup>3</sup> sec <sup>-1</sup>	Calculate Calculate Calculate						
	c	Coverage A Nozzle C	rea Calculation Type A overage Diameter iffset from centerli	ne		19 0	feet feet	Design In Design In	nput 4.13 nput 4.13	-			
		Nozzie C O Outer (	e Type C overage Diameter ffset from centerli Coverage Radius	ne	:	24 7 52.5	feet feet feet	Design In Design In Calculate	nput 4.13 nput 4.13 ed				
		Inner (	Coverage Radius		160 30	00.2 12 55.8	cm feet cm	Calculate Calculate Calculate	ed ed ed				
		Covera	ige Area		7.624		$\frac{6 \text{ cm}^4}{2}$	Calculate	ed 	-			
	(R	tesuitan: S	pray Flux		4.56	/E-0.	3 cm <sup>-</sup> /cm <sup>-</sup> -s	Calculate	2d	-			
	R	lesultan': λ Μ οι		3	.77	իr <sup>-)</sup> իr <sup>-1</sup>	Calculate Calculate	ed 2d					
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# Table 8-8 --- Containment Spray Header 1 Ring 049-4"-C-KEO

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56		Design Input 4.11
20		Design input 4.11
28	60.00	Design Input 4.11
13.19	gpm feet	Design Input 4 11
143.3	feet	Design Input 4.11
63.5	feet	Design Input 4.7
79.81	feet	Calculated
2,433	cm	Calculated
772.4	gpm	Calculated
48.74	l sec <sup>-1</sup>	Calculated
4.874E+0	4cm <sup>3</sup> sec <sup>-1</sup>	Calculated
	- <u> </u>	······································
19	feet	Design Input 4.13
0	feet	Design Input 4.13
21	feet	Design Input 4.13
4	feet	Design Input 4.13
75.0	feet	Calculated
2286.8	cm	Calculated
41.5	feet	Calculated
1264.9	cm	Calculated
1.139E+0	7cm <sup>2</sup>	Calculated
4.279E-0	3 cm <sup>3</sup> /cm <sup>2</sup> -s	Calculated
		<u></u>
3.60	hr-1	Calculated
7.86	hr <sup>-1</sup>	Calculated
	56 28 28 13.79 66.5 143.3 63.5 79.81 2,433 772.4 48.74 4.874E+0 19 0 21 4 75.0 2286.8 41.5 1264.9 1.139E+0 4.279E-0 3.60 7.86	$\begin{array}{c} 56\\ 28\\ 28\\ 13.79 \text{ gpm}\\ 66.5 \text{ feet}\\ 143.3 \text{ feet}\\ \end{array}$ $\begin{array}{c} 63.5 \text{ feet}\\ 79.81 \text{ feet}\\ 2,433 \text{ cm}\\ \end{array}$ $\begin{array}{c} 772.4 \text{ gpm}\\ 48.74 \text{ 1 sec}^{-1}\\ 4.874\text{ E+04 cm}^{3} \text{ sec}^{-1}\\ \end{array}$ $\begin{array}{c} 19 \text{ feet}\\ 0 \text{ feet}\\ 21 \text{ feet}\\ 4 \text{ feet}\\ 75.0 \text{ feet}\\ 2286.8 \text{ cm}\\ 41.5 \text{ feet}\\ 1264.9 \text{ cm}\\ 1.139\text{ E+07 cm}^{2}\\ \end{array}$ $\begin{array}{c} 4.279\text{ E-03 cm}^{3}/\text{ cm}^{2}\text{ -s}\\ \end{array}$

1.51 hr<sup>-1</sup>

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#### 8.3.1.2.2 Spray Header 2 Removal Rate Calculation

Spray header 2 consists of three concentric rings designed to provide full spray coverage. The calculation of the spray fall height, spray flux, and resultant aerosol removal rates is shown on Table 8-9 through Table 8-11. Representative sample calculations are provided.

Fall height for ring 04:-4"-C-KEO:

From Design Input 4.11, the centerline plant elevation of this ring is 149' - 03/16'' (149.0 ft). From Design Input 4.7, the operating floor plant elevation is 63' - 6'', therefore the fall height is:

 $H = (149.0 ft - 63.5 ft)(30.48 cm/ft) = 85.52 ft \times 30.48 cm/ft = 2,607 cm$ 

This value is in excellent agreement with the value shown on Table 8-11.

Spray flow for ring 043-4"-C-KEO:

From Design Input 4.11, the number of nozzles for this ring is 56. As calculated above, the flow per nozzle is 13.79 gpm. The total spray flow for this ring is then 772.41 gpm.

 $F = 772.41 gpm \times 3.786241/gal \times 1,000 cm^3/l/60 s/min = 4.874 \times 10^4 cm^3/s$ 

This value is in excellent agreement with the value shown on Table 8-11.

#### Coverage area for ring 043-4"-C-KEO;

This ring has nozzles oriented 10° downward and nozzles oriented at a 45° angle downward. The coverage area forms an annular region. The inner and outer radii of this annulus are determined as follows:

From Reference 6.2f, the spray nozzles are oriented towards the center of the containment building; therefore, the outer radius is defined by the 10° downward oriented nozzles, and the inner radius is defined by the 45° downward oriented nozzles.

From Modeling Assumption 3.7, the nozzles oriented  $10^{\circ}$  downward are assumed to have the same coverage parameters as the vertical nozzles. From Design Input 4.13, the vertical nozzles have a coverage area of 19 feet centered on the nozzle centerline. Therefore, the outer radius of the coverage annulus is offset from the ring radius by 9.5 feet. From Design Input 4.11, the radius of this ring is 63.5 feet. The outer radius is then 63.5 + 9.5 = 73 feet, or 2,225.0 cm.

From Design Input 4.13, the 45° downward oriented nozzles have a coverage area of 21 feet offset by 4 feet from the nozzle centerline. The inner radius is then 63.5 - 21 - 4 = 38.5 feet, or 1,173.5 cm.

SCE 2	26-426 REV. 2 [REFERENCIE: SO123-XXIV-7.15] N-6030-001 Rev
	This value is in excellent agreement with the value shown on Table 8-11.
1	$[+3.333 \times 10^{-1} \times (4.340 \times 10^{-1}) \times (2,007)]$
	$= \exp \left[ -\frac{1.32}{\times 10^{-6}} \times \frac{4.340 \times 10^{-3}}{(4.340 \times 10^{-3})^2} \times \frac{(2.607)^2}{(2.607)^2} \right]$
	$5.5750 + 0.94362 \ln (4.340 \times 10^{-3}) - 6.9821 \times 10^{-3} \times (4.340 \times 10^{-3})^2 \times 2,607$
	$\lambda(Q, H, m_f = 0.9) = \exp[A + B \ln Q + CH + DQ^2 H + EQH^2 + FQ + GQ^2 H^2]$
	The aerosol removal rate coefficient is calculated using Equation 5-5 and the parameters determined above and the constants provided in Table 5-2. As an example, the removal rate coefficient for the 10 <sup>th</sup> percentile level is calculated:
	Aerosol Removal Rate Coefficient, $\lambda(Q, H, m_f = 0.9)$ for ring 043-4"-C-KEO:
	This value is in excellent agreement with the value shown on Table 8-11.
	$Q = \frac{F}{A} = \frac{4.874 \times 10^4 \text{ cm}^3 \text{ / sec}}{1.123 \times 10^7 \text{ cm}^2} = 4.340 \times 10^{-3} \text{ cm}^3 H_2 O/\text{ cm}^2 - \text{sec}$
	The spray flux is the total flow rate divided by the coverage area:
	Spray flux for ring 043-4"-C-KEO:
	This value is in excellent agreement with the value shown on Table 8-11.
	$A = \pi \left( r_{outer}^2 - r_{inner}^2 \right) = \pi \left( 2,225.0^2 - 1,173.5^2 \right) = 1.123 \times 10^7  cm^2$
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			· · ·						1		
		Table	8-9 — Contain	ment Sp	ray Hea	der 2 Ring 04	6-2 ½"-C	-KEO			
	<b>`</b>	Numb	er of nozzles		20	)	Design II	nput 4.11	]		ĺ .
		Ty	pe A (Vertical)		10	J	Design Input 4.11		ł		
		Ty Flow	pe B (45°)		10	) 170 mm	Design In	nput 4.11			ļ
		Spray	ring radius		2	22.5 feet Desig		ea 2001 4 11			
		Spray	Header Elevation		182	2.0 feet	Design In	nput 4.11			1
		Fall heigh	t Calculation								
		Operat	ting Deck Elevatio	n	63	3.5 feet	Design I	nput 4.7	ļ		
		Fall he	eight		2.61	3.47 feet	Calculate	ed od			
							Culcular		1		
		Spray Hin Total I	ig Flow Calculati Flow	on	27	5.9 gpm	ed				
			•••		1	1.41   sec <sup>-1</sup>	ed.				
		ĺ			1.741	E+04 cm <sup>3</sup> sec <sup>-1</sup>	Calculate	ed			
ł		Coverage	Area Calculation						1		
ļ		Nozzle	e Type A						ļ		
			verage Diameter	_	19	feet	Design In	nput 4.13	ł		
ĺ		Nozzle	Type B	e	,	1661	Design II	iput 4.13			
ł		Co	verage Diameter		21	feet	Design Ir	nput 4.13			
		Ofi	fset from centerlin	e	4	feet	Design Ir	iput 4.13			
[		Outer	Coverage Radius		32	1.0 feet	Calculate	ed	{		
		Inner(	overage Radius		913	).4 CIII ) () feet	Calculate	ed •d	1		
]			Soverage Madras		(	).0 cm	Calculat	ed			
		Covera	ige Area		2.989	E+06cm <sup>2</sup>	Calculate	ed			
		Resultant	Spray Flux		5.825	E-03 cm <sup>3</sup> /cm <sup>2</sup> -s	Calculate	ed :			
ł		Resultant	 λ(m <sub>f</sub> =0.9)						İ		
1	:	Me	dian		4.	79 hr <sup>-1</sup>	Calculate	ed			
		909	%ile		10.	45 hr <sup>-1</sup>	Calculate	ed	1		
		109	%ile		1.	94 hr <sup>-1</sup>	Calculate	ed	1		
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#### SCE 26-426 REV. 2 [REFERENCI: SO123-XXIV-7.15]

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DCP/FCN/E Containmen	CP N'A		E&TS DEPARTMENT CALCULATION SHEET							<u> </u>			
Containmen	Project or DCP/FCN/ECP         N/A         Calc No.         N-6030-001         CCN I           Subject         Containment Aerosol and Iodine Removal Rates         S												
	t Aerosol a	and Iodine Remov	al Rates	<u></u>	·	. <u> </u>	She	et <u>56</u>	of	281			
RIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRI		DATE	ß			
J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003		,		<u> </u>			REV			
							I						
Γ	Tatle	8-10 — Contai	nment S	pray He	ader 2 Ring	045-4"-C-	KEO	7					
	Numb	er of nozzles ype A (Vertical)		4	10 20	Design I Design I	nput 4.11 nput 4.11	1					
ļ	Т	ype C (Horizontal	)	2	20	Design I	nput 4.11						
	Flow r	ate per nozzle		1	3.79 gpm	Calculat	ed						
	Spray:	ring radius		4	6 feet	Design I	nput 4.11	1.					
Ļ	Spray.	Gelevier Elevation				Design I		-					
F	all height. Operat	Calculation	m	6	3.5 feet	Design I	nput 4.7						
	Fall he	eight		10	5.83 feet	Calculat	ed						
					26 <b>c</b> m	Calculat	eđ	1					
S	pray Ring	Flow Calculation	p										
1	Total F	flow		55	1.7 gpm	Calculat	ed						
				3	4.82 1 sec <sup>-1</sup>	Calculat	ed						
L				3.482	E+04 cm <sup>3</sup> sec <sup>-1</sup>	Calculat	ed						
C	overage: A Nozzle	rea Calculation Type A											
	С	overage Diameter		1	9 feet	Design I	nput 4.13						
	0	ffset from centerli	ne		0 feet	Design I	nput 4.13						
		: 1ype C overage Diameter		2	4 feet	Design I	nnut 4 13						
	0	ffset from centerli	ne	2	7 feet	Design I	nput 4.13						
	Outer (	Coverage Radius		5	5.5 feet	Calculat	ed	ł					
	• -			169	1.6 cm	Calculat	ed						
	Inner C	Coverage Radius		· 1	5 feet	Calculat	ed od	1					
	Cale	000 Ates		40 8 222	7.2 UII F+06cm <sup>2</sup>	Coloula	eu od		1				
-	Coverage Area							1					
R	esultant S	pray Flux		4.178	SE-03 cm <sup>-</sup> /cm <sup>2</sup>	-s Calculat	ed		ļ				
R	esultant λ	(m,=0.9)											
	Μ	ledian		3.	,45 hr"	Calculat	ed	1		i			
	90	1%ile		7.	.69 hr <sup>-1</sup>	Calculat	ed						
L	10	)%ile		1.	.45 hr <sup>-1</sup>	Calculat	ed	]					
	R	Outer ( Outer ( Covera Resultant S Resultant A M 90	Outer From centerin Outer Coverage Radius Inner Coverage Radius Coverage Area Resultant Spray Flux Resultant λ(m <sub>f</sub> =0.9) Median 90%ile 10%ile	Outer Coverage Radius         Outer Coverage Radius         Inner Coverage Radius         Coverage Area         Resultant Spray Flux         Resultant λ(m=0.9)         Median         90%ile         10%ile	Outer Coverage Radius       5         169         Inner Coverage Radius       1         45         Coverage Area       8.333         Resultant Spray Flux       4.178         Resultant λ(m=0.9)       Median       3.         90%ile       7.       10%ile       1.	Outer Coverage Radius $7^{-1}$ feet         Outer Coverage Radius $55.5$ feet         1691.6 cm       1691.6 cm         Inner Coverage Radius       15 feet         457.2 cm       457.2 cm         Coverage Area $8.333E+06 \text{ cm}^2$ Resultant Spray Flux $4.178E-03 \text{ cm}^3/\text{cm}^2$ Resultant $\lambda(m_r=0.9)$ Median $3.45 \text{ hr}^{-1}$ 90%ile $7.69 \text{ hr}^{-1}$ 10%ile $1.45 \text{ hr}^{-1}$	Outer Coverage Radius7reetDesign IIOuter Coverage Radius55.5feetCalculate1691.6cmCalculate1691.6cmCalculate457.2cmCalculateCoverage Area $8.333E+06 \text{ cm}^2$ CalculateResultant Spray Flux $4.178E-03 \text{ cm}^3/\text{cm}^2$ -sCalculateResultant $\lambda(m_r=0.9)$ Median $3.45 \text{ hr}^{-1}$ Calculate90%ile7.69 \text{ hr}^{-1}Calculate10%ile $1.45 \text{ hr}^{-1}$ Calculate	Outsr Coverage Radius7reetDesign Input 4.13Outsr Coverage Radius55.5feetCalculatedInner Coverage Radius15feetCalculated457.2cmCalculatedCoverage Area $8.333E+06 \text{ cm}^2$ CalculatedResultant Spray Flux $4.178E-03 \text{ cm}^3/\text{cm}^2$ -sCalculatedResultant $\lambda(m_r=0.9)$ 3.45hr <sup>-1</sup> Calculated90%ile7.69hr <sup>-1</sup> Calculated10%ile1.45hr <sup>-1</sup> Calculated	Other from centerine7feetDesign input 4.13Outer Coverage Radius55.5feetCalculatedInner Coverage Radius15feetCalculated457.2cmCalculatedCoverage Area $8.333E+06 \text{ cm}^2$ CalculatedResultant Spray Flux $4.178E-03 \text{ cm}^3/\text{cm}^2$ -sCalculatedResultant $\lambda(m_f=0.9)$ Median $3.45 \text{ hr}^{-1}$ Calculated90%ile7.69 hr^{-1}Calculated10%ile $1.45 \text{ hr}^{-1}$ Calculated	Outset from centerine       7       feet       Design input 4.13         Outset Coverage Radius       55.5       feet       Calculated         Inner Coverage Radius       15       feet       Calculated         A57.2       cm       Calculated         Coverage Area       8.333E+06 cm <sup>2</sup> Calculated         Resultant Spray Flux       4.178E-03 cm <sup>3</sup> /cm <sup>2</sup> -s       Calculated         Resultant X(m=0.9)       Median       3.45       hr <sup>-1</sup> Calculated         90%ile       7.69       hr <sup>-1</sup> Calculated         10%ile       1.45       hr <sup>-1</sup> Calculated			

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# E&TS DEPARTMENT CALCULATION SHEET

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N-6030-001

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CCN CONVERSION:

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Sheet

Subject Containment Aerosol and Iodine Removal Rates

Project or DCP/FCN/ECP N/A

REV	ORIGINATOR	DATE	IRE	DATE	REV C	RIGINATOR	DATE	IRE	DATE	<u> </u>
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003		•				≩₹
				j			1	]	1	1 ~ Ē
		- <u></u>	· · · · · · · · · · · · · · · · · · ·					·		<b> </b>
	ſ	Table	e 8-11 — Contai	inment S	pray Head	er 2 Ring 0	43-4"-C-]	KEO		ĺ
		Numbe	er of nozzles		56		Design Ir	1put 4.11		
		ſy	/pe D (10°)		28		Design Ir	nput 4.11		1
		Ту	′pe B (45°)		28		Design Ir	1put 4.11		
		Flow r	ate per nozzle		13.7	9 gpm	Calculate	ed		l
		Spray i	ring radius		63.5	feet	Design Ir	1put 4.11		
		Spray 1	Header Elevation		149.0	feet	Design In	nput 4.11		
:	I	Fall height	Calculation			•				
		Operat	ing Deck Elevatio	n	63.5	feet	Design Ir	nput 4.7	1	
		Fall he	ight		85.6	U feet	Calculate	ed		
	Ļ				2,607	cm		ea		
	S	Spray Ring Total F	g Flow Calculatio Flow	n	772.4	gpm	Calculate	ed		
					48.7	4 l sec <sup>-1</sup>	Calculate	ed 🛛		
					4.874E+	04 cm <sup>3</sup> sec <sup>-1</sup>	Calculate	ed		
	Ċ	Coverage A Noz::le	Area Calculation Type D							
		Co	verage Diameter		19	feet	Design Ir	1put 4.13		
		lCi	fset from centerli	ne	0	feet	Design Ir	nput 4.13		
		Nozsle	Туре В			_				
	1	'Co	verage Diameter		21	feet	Design Ir	nput 4.13		
	(	iOi	tset from centerlin	ne	4	feet	Design Ir	1put 4.13		
		Outer	LUVEIAge Madius		13.U 2225 N	icel em	Calada	eu ad		
		Inner C	loverage Radius		38 5	feet	Calculate	ed a		
		2			1173.5	cm	Calculate	ed		
		Covera	ge Area		1.123E+	07 cm <sup>2</sup>	Calculate	ed		
	- A	Resultant S	Spray Flux		4.341E	03 cm <sup>3</sup> /cm <sup>2</sup> -s	Calculate	ed		
	F	Resultant λ	.(m <sub>f</sub> =0.9)							
		M	edian .		3.64	hr <sup>-t</sup>	Calculate	ed 🛛		
		90	%ile		7.96	hr-1	Calculate	ed		
		10	%ile		1.52	hr-1	Calculate	ed		

#### 8.3.1.2.3 Total Aerosol Removal Rate

In the previous subsections (8.3.1.2.1 and 8.3.1.2.2), the individual spray ring aerosol removal rate constants were determined. In this subsection these removal rates for each spray ring are added together for each of the spray headers to calculate a total aerosol spray removal rate. The lowest value

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		ULA	ARTMENT TION SH	EET		ICCN NO./ PRELIM. CCN		PAGEOF			
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Subje	ct Containmen	t Aeroscl a	and Iodine Remov	al Rates				She	et	<u>58</u> of	281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DATE	<u>ه</u>
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							CATO CATO
											L D
	is then used for CSS Header 1	r determir results in <b>Г</b>	the lowest total	endent ac aerosol re	erosol re emoval	emoval rate. Thi	s calcula Table 8	ition shov -12. 7	ving th	at	
		-	Table 8-12	Overall.	Aeroso	Spray Remov	al Rate	4			
		н Т	lesultant Aerosol	Spray h(	m <sub>1</sub> =0.9)	for Header 1		1			
			Median			11.37 hr			•		
			90%ile			25.06 hr					
		ŀ	10%ile		<u></u>	4.73 hr		-			
		F	tesultant Aerosol	Spray A(	m/==0.9)	for Header 2					
			Median			11.88 hr <sup>-1</sup>					
			90%ile			26.10 hr <sup>-1</sup>					
		-	10%ile			4.92 hr <sup>-1</sup>		1		•	
			finimum Resulta	nt Aeroso	l Sprav	λ(m <i>æ</i> 0.9)		1			
		ľ	Median			11.37 hr <sup>-1</sup>					
			90%ile			25.06 hr <sup>-1</sup>		1			
			10%ile			4.73 hr <sup>-1</sup>					
	As an example,	the medi	an aerosol spray	removal	rate for	spray header 1	is calcul	ated:			
		S	pray Ring	<u>s</u>	ource	Remova	l Rate (l	h <b>r</b> <sup>-1</sup> )			
		052-2	1/2"-C-KEO	'Ta	ble 8-6		4.00				
		051-4	"-C-KEO " C KEO	Ta Ta	ble 8-7		3.77				
		4	-C-REU	18	0-0-0 Tn	tal: 1	1.37	<del></del>			
	The aerosol spr agreement with	ay remov the value	al rate of 11.37 l presented in Ta	n <sup>-1</sup> for sp ble 8-12.	ray hea	der 1 calculated	above is	in excell	ent		
	8.3.1.3 Tim	e-Der en	dent Aerosol Ro	emova <sup>İ</sup> R	late						

The time-dependent aerosol removal rates for an initial mass release rate at t = 0 are determined by first calculating the removal rates as a function of  $m_f$  using Equation 5-4 and Equation 5-6. The calculation term  $\lambda(Q, H, m_f = 0.9)$  for the three percentile levels is presented in Section 8.3.1.2. Using the removal rates as a function of  $m_f$  thus calculated, the removal rates as a function of time are calculated using Equation 5-8. The results of these calculations are shown on Table 8-13.

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Projec	t or DCP/FCN/E	ECP N/A		 c	alc No	. N-6030-001		CCN CO CCN NO	NVERS	ION:	
Subjec	ct Containmen	t Aeroscil a	and Iodine Remov	al Rates				She	et	<u>9 of</u>	281
REV	ORIGINATOR	DATE .	IRE	DATE	REV	ORIGINATOR	DATE	IRI		DATE	- m
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							REV ICATO
											QNI
-	The spray flux summation of t and in Section Section 8.3.1.1 Spray I Sample calcula <u>Aerosol remov</u> Using Equation $\frac{\lambda(m_f)}{\lambda(m_f = 0.9)} =$	Q in Equa he individ 8.3.1.2 2 i .1, 6.15 x header 1: header 2: tions are p al rate for a 5-6 and i = $[a + l \cdot lop]$ = $[0.1108 \cdot 1.07]$	ation 5-6 is the to dual spray ring sp for spray header 10 <sup>-3</sup> cm <sup>3</sup> H <sub>2</sub> O/cr 4.870 x 10 <sup>-3</sup> + 4. 5.825 x 10 <sup>-3</sup> + 4. presented below the 10 <sup>th</sup> percention $m_f = 0.98$ and the $g_{10} Q \left[ 1 - \left( \frac{m_f}{0.9} \right) \right]$ $- 0.00201 \times \log 10^{-1}$	otal flux a pray fluxe 2. This is $n^2$ -s, is le 567 x 10 178 x 10 : ile and in e paramet $p^{c} + \left(\frac{m}{0}\right)^{c}$	as calcu es calcu s conser ss than ${}^{3} + 4.2$ $ass fracers for\frac{f}{9}^{\circ}$	Plated in Section plated in Section related in Section related in Section related in Section related in Section $79 \times 10^{-3} = 1.37$ $41 \times 10^{-3} = 1.43$ relation of 0.98 the 10 <sup>th</sup> percenti $1 - \left(\frac{0.98}{0.9}\right)^{0.8945}$	$8.3.1.1.1 \\8.3.1.2.1 \\total sprandividual x 10-2 cm x 10-2 cm x 10-2 cm le of Tab$	instead o for spray ay flux cal spray flu ${}^{3}$ H <sub>2</sub> O/cm ${}^{3}$ H <sub>2</sub> O/cm le 5-2:	f the header lculated xes: 2-s 2-s	r 1 1 in	
	Therefore, the results shown o	removal ra on Table 8	ate for $m_f = 0.98$ -13.	is 4.73 x	1.07 =	5.06, which is in	good ag	reement w	ith the		
	Time to reach n	<u>n<sub>f</sub> = 0.98 1</u>	for the 10 <sup>th</sup> perce	ntile leve	<u>1</u>						
	Using Equation	1 <b>5-8,</b> ). = :	$5.07, m_f(t_l) = 0.9$	9, and $t_i$	= 1.97 x	10 <sup>-3</sup> hr from Ta	ble 8-13	:			
	$t_2 = t_1 - \frac{\ln\left(\frac{m}{m}\right)}{\lambda(n)}$	$\frac{f(t_2)}{f(t_1)} = 1$	ln .97×10 <sup>-3</sup>	$\left(\frac{0.98}{0.99}\right)$ 5.07	≈3.97×	×10 <sup>-3</sup>					
	This value is in	good agro	eement with the	results sh		n Table 8-13.					
}											

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Subject Containment Aerosol and Iodine Removal Rates

REV	ORIGINATOR	DATE:	IRE	DATE	REV	ORIGINAT	OR DAT	E I	RE	DATE	Æ
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003	T						l ≩ š
										1	<u></u>
				<u> </u>							┠━━━━━┥
		Table	0.12 00:	· · · · · · · · · · · · · · · · · · ·					7		[· [
			8-13 11me d	epenaem	t Aeros	oi Kemova	I Rate Cal	culation	1		1
						Time to ]	Reach Mas	s Fraction			
		Mais Emotion	Aerosol Ren	oval Rate	e (hr')	000/310	(hrs) Madian	100/ 51.			
		A 0000	25.54	11.09	5 15	2 025 06	P 25E 06	1070110	4		
		0.9999	25.54	11.90	5.15	3.920-00	8.33E-00	1.948-05	1		
		9.99E-01	25.55	11.97	5.15	3.92E-03	8.30E-03	1.945-04	1		
		9.80E-01	25.45	11.86	5.07	7.93E-04	1.70E-03	3.97E-03	1		
		9.70E-01	25.40	11.80	5.03	1.20E-03	2.57E-03	6.01E-03	1	i	
		9.60E-01	25.35	11.74	4.99	1.61E-03	3.45E-03	8.09E-03			
		9.50E-01	25.30	11.68	4.94	2.02E-03	4.35E-03	1.02E-02	ļ		
		9.40E-01	25.26	11.62	4.90	2.44E-03	5.26E-03	1.24E-02			
		9.30E-01	25.21	11.56	4.86	2.86E-03	6.18E-03	1.46E-02	1		
		9.20E-01	25.16	11.49	4.82	3.29E-03	7.12E-03	1.68E-02	}		
		9.10E-01	25.11	11.43	4.78	3.73E-03	8.08E-03	1.91E-02			
		9.00E-01	25.06	11.37	4.73	4.17E-03	9.05E-03	2.14E-02	[		
		8.80E-01	24.96	11.25	4.65	5.07E-03	1.11E-02	2.63E-02	[		
		8.60E-01	24.86	11.12	4.57	5.99E-03	1.31E-02	3.13E-02	j		
		8.40E-01	24.76	10.99	4.48	6.94E-03	1.53E-02	3.65E-02			
		8.20E-01	24.65	10.86	4.40	7.92E-03	1.75E-02	4.20E-02			
		8.00E-01	24.54	10.73	4.31	8.93E-03	1.98E-02	4.78E-02	·		}
		7.80E-01	24.44	10.60	4.23	9.96E-03	2.22E-02	5.37E-02			
•		7.6019-01	24.32	10.47	4.14	1.10E-02	2.46E-02	6.00E-02			
		7.4015-01	24.21	10.33	4.05	1.21E-02	2.725-02	6.66E-02			1
		7.2015-01	24.10	10.20	3.91	1.55E-02	2.995-02	1.33E-02	}		[
		6 808-01	23.86	0 07	3.80	1.446-02	3.565-02	8 845-02			
		6.60E-01	23.00	9.72	3 71	1.57E-02	3 875-02	9.64E-02	1		
		6.40E-01	23.61	9.64	3.62	1.82F-02	4 19E-02	1.04E-02	ł		1
		6.20E-01	23.48	9.49	3.53	1.96E-02	4.52E-02	1.14E-01			
		6.00E-01	23.35	9.35	3.45	2.10E-02	4.87E-02	1.23E-01	1		
		5.80E-01	23.22	9.20	3.36	2.24E-02	5.24E-02	1.34E-01	Í		
		5.60E-01	23.08	9.05	3.27	2.40E-02	5.63E-02	1.44E-01			
	(	5.40E-01	22.94	8.89	3.18	2.55E-02	6.04E-02	1.56E-01	ļ		
		5.20E-01	22.79	8.74	3.09	2.72E-02	6.47E-02	1.68E-01		· •	
		5.00E-01	22.64	8.58	3.00	2.89E-02	6.93E-02	1.81E-01		1	
		4.80E-01	22.49	8.42	2.91	3.07E-02	7.41E-02	1.95E-01	{		
		4.6012-01	22.33	8.26	2.82	3.27E-02	7.93E-02	2.10E-01	1		
	· J	4.4012-01	22.17	8.09	2.73	3.47E-02	8.48E-02	2.26E-01	1	1	
	· · ·	4.2013-01	22.00	7.92	2.64	3.68E-02	9.06E-02	2.44E-01		[	Í
		4.0012-01	21.82	7.75	2.55	3.90E-02	9.69E-02	2.63E-01			
	ļ	3.80]2-01	21.64	7.57	2.46	4.14E-02	1.04E-01	2.84E-01	1		

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Subject Containment Aeroscl and Iodine Removal Rates

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINAT	OR DAT	E 11	RE	DATE	Æ
0	J. Schulz	8/15/200.3	D. T. Dexheimer	8/15/2003							CATC
					1					1	- ION
				<u> </u>	<u> </u>	<u></u>	I		~ ~ ~ ~		
		[							7		
		Table	8-13 — Time d	ependen	t Aeros	ol Remova	I Rate Cal	culation			
						Time to I	Reach Mass	s Fraction			
		Mais Encotion	Aerosol Ren	oval Rate	e (hr")	000/21-	(hrs)	100/ 11.			
		Praction	1 90%ile i	7 20	2 27	4 2012 02	INTEGIAN	2.075.01	ł		
		3.000.01	21.43	7.59	2.31	4.598-02	1.112-01	3.07E-01	1		
		3 20E.01	21.20	7.02	2.27	4.002-02	1.175-01	3.52E-01	1		
		3.00E-01	20.84	6.82	2.09	5.26E-02	1.37E-01	3.91E-01			
		2.80E-01	20.61	6.62	1.99	5.59E-02	1.47E-01	4.25E-01			
		2.60E-01	20.38	6.42	1.90	5.95E-02	1.59E-01	4.64E-01			
		2.40E-01	20.13	6.21	1.80	6.35E-02	1.72E-01	5.09E-01	1		
		2.20E-01	19.86	5.99	1.70	6.79E-02	1.86E-01	5.60E-01	1		
		2.00E-01	19.58	5.76	1.60	7.28E-02	2.03E-01	6.19E-01			
		1.80E-01	19.27	5.52	1.51	7.82E-02	2.22E-01	6.89E-01	ł		
		1.60E-01	18.94	5.27	1.40	8.45E-02	2.44E-01	7.73E-01			
	i	1.40E-01	18.58	5.01	1.30	9.16E-02	2.71E-01	8.76E-01			
		1.202-01	18.18	4.13	1.20	1.00E-01	3.04E-01	1.00E+00			1
		8 00F-01	17.75	4.45	1.10	1.100-01	3.45E-01	1.175+00			
		6.00E-02	16.58	3.75	0.88	1.25E-01	4 76E-01	1.40E+00			
		4.00E-02	15.77	3.33	0.76	1.66E-01	5.98E-01	2.25E+00			
		2.00E-02	14.59	2.81	0.64	2.14E-01	8.44E-01	3.33E+00			
		1.00E-02	13.61	2.47	0.58	2.65E-01	1.13E+00	4.53E+00			1
		9.90E-03	13.60	2.46	0.58	2.66E-01	1.13E+00	4.55E+00	ł	- 1	1
		9.80E-03	13.59	2.46	0.58	2.66E-01	1,13E+00	4.56E+00			
		9.70E-03	13.58	2.45	0.58	2.67E-01	1.14E+00	4.58E+00	]		(
		9.60E-03	13.56	2.45	0.58	2.68E-01	1.14E+00	4.60E+00			1
		9.50E-03	13.55	2.45	0.58	2.69E-01	1.15E+00	4.62E+00			
		9.402-03	13.54	2.44	0.57	2.098-01	1.155+00	4.648+00			- 1
		9.30E-03	13.52	2.44	0.57	2.70E-01	1.158+00	4.000000	1		- 1
		9.202-03	13.51	2.43	0.57	2.716-01	1.165+00	4.075700	<b>]</b> .		
		9 00F-03	13.48	2.42	0.57	2.72E-01	1.17E+00	4.0912100 4.71E+00			·
		8.80E-03	13.45	2.42	0.57	2.74E-01	1.18E+00	4.75E+00	( · )	1	1
		8.60E-03	13.43	2.41	0.57	2.76E-01	1.19E+00	4.79E+00		ĺ	
		8.40E-03	13.40	2.40	0.57	2.78E-01	1.20E+00	4.83E+00			
		8.20E-03	13.37	2.39	0.57	2.80E-01	1.21E+00	4.88E+00	Ì.		
		8.00E:-03	13.34	2.38	0.57	2.81E-01	1.22E+00	4.92E+00		-	
		7.80E-03	13.31	2.37	0.56	2.83E-01	1.23E+00	4.96E+00	J	1	
		7.60E-03	13.28	2.36	0.56	2.85E-01	1.24E+00	5.01E+00			{
		7.40E-03	13.25	2.35	0.56	2.87E-01	1.25E+00	5.06E+00			
	]	7.20E-03	13.21	2.35	0.56	2.89E-01	1.26E+00	5.11E+00	ł		

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Subject Containment Aerosol and Iodine Removal Rates

Project or DCP/FCN/ECP N/A

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINAT	OR	ATE	IR	Ε	DATE	1 8
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003								لي لي
			·									
											•	ł
		Table	8-13 — Time	depender	it Aeros	ol Remova	l Rate	Calcu	lation			
		1	1			Time to I	Reach M	ass F	raction			ł
		Mass	Aerosol Rei	noval Rat	e (hr <sup>-1</sup> )		(hrs	)				
		Fraction	n 90%ile	Median	10%ile	90%ile	Medi	n	10%ile			
		7.00E-03	3 13.18	2.34	0.56	2.92E-01	1.27E+	00 5	.16E+00			i
		6.80E-03	3 13.15	2.33	0.56	2.94E-01	1.29E+	00 5	21E+00			
		6.60E-03	3 13.11	2.32	0.56	2.96E-01	1.30E+	00 5	.26E+00			
		6.40E-03	3 13.08	2.31	0.55	2.98E-01	1.31E+	00 5	.32E+00			
		6.20E-03	3 13.04 .	2.30	0.55	3.01E-01	1.33E+	00 5	.38E+00			
		6.00E-03	3 13.01	2.29	0.55	3.03E-01	1.34E+	00 5	.44E+00			ł
		5.80E-03	3 12.97	2.28	0.55	3.06E-01	1.36E+	00 5	.50E+00			[
		5.60E-03	3 12.93	2.27	0.55	3.09E-01	1.37E+	00 5	.56E+00			
		5.40E-03	3 12.89	2.26	0.55	3.11E-01	1.39E+	00 5	.63E+00			í
		5.20E-03	3 12.85	2.25	0.55	3.14E-01	1.40E+	00 5	.70E+00			ł
		5.00E-03	3 12.81	2.24	0.54	3.17E-01	1.42E+	00 5	.77E+00			
		4.80E-03	3 12.77	2.22	0.54	3.21E-01	1.44E+	00 5	.84E+00			
		4.60E-03	3 12.73	2.21	0.54	3.24E-01	1.46E+	00 5	.92E+00			
		4.40E-03	3 12.68	2.20	0.54	3.28E-01	1.48E+	00 6	.01E+00			
		4.20E-03	3 12.63	2.19	0.54	3.31E-01	1.50E+	00 6	.09E+00			
		4.00E-03	3 12.58	2.18	0.54	3.35E-01	1.52E+	00 6	.18E+00			
		3.80E-03	3 12.53	2.17	0.54	3.39E-01	1.55E+	00 6	.28E+00			
		3.60E-03	3 12.48	2.15	0.53	3.43E-01	1.57E+	00 6	.38E+00			
		3.40E-03	3 12.43	2.14	0.53	3.48E-01	1.60E+	00 6	.49E+00			
		3.20E-03	12.37	2.13	0.53	3.53E-01	1.63E+	00 6	.60E+00			
		3.00E-03	12.31	2.12	0.53	3.58E-01	1.66E+	00 6	.72E+00			
		2.80E-03	12.25	2.10	0.53	3.64E-01	1.69E+	00 6	.85E+00	•		
		2.60E-03	12.18	2.09	0.53	3.70E-01	1.73E+	00 7	.00E+00			
		2.40E-03	12.11	2.07	0.52	3.77E-01	1.76E+	00 7	.15E+00			
		2.20E-03	12.04	2.06	0.52	3.84E-01	1.81E+	00 7	.31E+00			
		2.00E-03	11.96	2.04	0.52	3.92E-01	1.85E+	00 7	.50E+00			
		1.80E-03	11.88	2.03	0.52	4.01E-01	1.91E+	00 7	.70E+00		·	
		1.60E-03	11.79	2.01	0.52	4.11E-01	1.96E-	00 7	.93E+00			
		1.40E-03	11.69	1.99	0.52	4.22E-01	2.03E+	00 8	.19E+00			
		1.20E-03	11.57	1.97	0.51	4.35E-01	2.11E+	00 8	.48E+00			
		1.00E-03	11.45	1.95	0.51	4.51E-01	2.20E+	00 8	.84E+00			
		8.00E-04	11.30	1.93	0.51	4.71E-01	2.32E+	00 9	.28E+00			
		6.00E-04	11.13	1.91	0.51	4.97E-01	2.47E+	00 9	.84E+00			
		4.00E-04	10.91	1.88	0.51	5.34E-01	2.68E+	00 1	.06E+01			
		2.00E-04	10.58	1.84	0.51	6.00E-01	3.06E+	00 1	.20E+01			
		1.00E-04	10.31	1.82	0.50	6.67E-01	3.44E+	00 1	.34E+01			
		9.00E-05	10.27	1.82	0.50	6.77E-01	3.50E+	00 1	.36E+01			
		8.00E-05	5 10.23	1.82	0.50	6.89E-01	3.56E+	00 1	.38E+01			

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REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINAT	OR DA	TE	IRE	DATE	Tg
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003	, 1					1	128
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			<u> </u>	• • • • • • •	• • •	• • • • • • • • • • • • • • • • • • •	172.4.0.	• • •	٦		
		Table	8-13 11me (	lepenae	iit Aeros	OI Kemova	il Rate Ca	lculation	}		
				• 5	•1	Time to ?	Reach Mas	s Fraction			
		Mas:	Aerosol Ken	DOVAL KAN	le (hr`)	000/10	(hrs)	100/114			
		Fraction	<u>90%11e</u>	Median	10%110	90%110		10%110	4	I	
		7.00E-05	10.19	1.81	0.50	7.025-01	3.64E+UU		. 1	,	
		6.00E-05	10.14	1.81	0.50	7.178-01	3.72E+UU	1.44E+UI		,	
		5.00E-03	10.09	1.81	0.50	7,355-01	3.825+00		.	,	
		4.00E-03	10.02	1.80	0.50	7.576-01	3.955700	1.52E+01		,	
		3.00E-03		1.80	0.50	7.802-01	4.112+00	1.58E+UI		1	
		1.000 00	9.85	1.79	0.50	8.2/E-VI	4.335400	1.00E+UI		1	1
		1.000-05	9./1	1.17	0.20	8.995-01	4.720100	1.805701		1	l
	,		· <b>9.39</b>	1./8	0.50	1.145+00	0.020+00	2.255+01	1	I	[
	,	1.00E-07	9.23	1.77	0.50	1.395+00	7.315+00	2.71E+01	1	1	Į –
	ŗ	1.000-00	9.14	1.77	0.50	1.055+00	8.01E+00	3.176+01	1	1	
	1	1.001-07	9.09	1.77	0.50	1.90E+00	9.91E+00	3.62E+01	}	ļ	1
	,	1.00E-10	9.07	1.77	0.50	2.15E+00	1.12E+UI	4.08E+01	1	I	1
	1	1.00E-11	9.06	1.77	0.50	2.41E+00	1.25E+01	4.54E+01	1	, j	
	/	1.00E-12	9.05	1.77	0.50	2.66E+00	1.38E+01	5.00E+01	1		ł
	,	1.00E-13	9.05	1.77	0.50	2.92E+00	1.51E+01	5.45E+01	1	1	1
	• •	1.00E-14	9.04	1.77	0.50	3.17E+00	1.64E+01	5.91E+01	]	1	l i
	,	1.00E-15	9.04	1.77	0.50	3.42E+00	1.77E+01	6.37E+01		ļ	i i
		1.00E-16	9.04	1.77	0.50	3.68E+00	1.90E+01	6.82E+01	1	1	
	,	1.00E-17	9.04	1.77	0.50	3.93E+00	2.03E+01	7.28E+01		1	l
		1.00E-18	9.04	1.77	0.50	4.19E+00	2.16E+01	7.74E+01	1	1	l
		1.00E-19	9.04	1.77	0.50	4.44E+00	2.29E+01	8.20E+01	1	ļ	l
		1.00E-20	9.04	1.77	0.50	4.70E+00	2.42E+01	8.65E+01	1	1	1
	1	1.00E-21	9.04	1.77	0.50	4.95E+00	2.55E+01	9.11E+01		•	l
	· 1	1.00E-22	9.04	1.77	0.50	5.21E+00	2.68E+01	9.57E+01		1	l
	,	1.00E-23	9.04	1.77	0.50	5.46E+00	2.81E+01	1.00E+02	1	1	ł
		1.00E-24	9.04	1.77	0.50	5.72E+00	2.94E+01	1.05E+02			l
	1	1.00E-25	9.04	1.77	0.50	5.97E+00	3.07E+01	1.09E+02	1	1	1
	,	1.00E-26	9.04	1.77	0.50	6.23E+00	3.20E+01	1.14E+02	1	1	ł
	Į.	1.00E-27	9.04	1.77	0.50	6.48E+00	3.33E+01	1.19E+02	1	1	l
	)	1.00E-28	9.04	1.77	0.50	6.74E+00	3.46E+01	1.23E+02			
	,	1.00E-29	9.04	1.77	0.50	6.99E+00	3.59E+01	1.28E+02		1	

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7.24E+00 3.72E+01 1.32E+02

7.50E+00 3.85E+01 1.37E+02

7.75E+00 3.98E+01 1.41E+02

8.01E+00 4.11E+01 1.46E+02

8.26E+00 4.24E+01 1.51E+02

8.52E+00 4.37E+01 1.55E+02

8.77E+00 4.50E+01 1.60E+02

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1.00E-30

1.00E-31

1.00E-32

1.00E-33

1.00E-34

1.00E-35

1.00E-36

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0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003	<u>·</u>				REV
	using a semi- form:	log interpo	lation to constru	ct the follo	wing table. Th	e semi-log inte	erpolation is of the	e	
	$\lambda(t)$	$=\lambda(t_1)+[\lambda$	$\lambda(t_2) - \lambda(t_1)] \frac{\ln(t_2)}{\ln(t_2)}$	$\frac{t}{t_1}$			Equation 8-1		
	For example, the removal r	from Table ate at 0.509	e 8-13, the 10 <sup>th</sup> p 9 hours is 1.80 h	ercentile a r <sup>-1</sup> . The aer	erosol removal osol removal r	I rate at 0.464 I rate at 0.5 hours	nours is 1.90 hr <sup>-1</sup> , s is then:	and	

 $\lambda(0.5) = 1.90 + [1.80 - 1.90] \frac{\ln(0.5/0.464)}{\ln(0.509/0.464)} = 1.82 \text{ hr}^{-1}$ 

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This value is in excellent agreement with the value shown on Table 8-14.

Table 8-	Table 8-14 — Aerosol Removal Rate (hr <sup>-1</sup> )										
Time (hrs)	90%ile	Median	10%ile								
0	25.54	11.98	5.15								
1.00E-04	25.52	11.97	5.15								
1.00E-03	25.42	11.91	5.12								
2.00E-03	25.31	11.84	5.11								
3.00E-03	25.19	11.77	5.09								
4.00E-03	25.08	11.70	5.07								
5.00E-03	24.97	11.63	5.05								
6.00E-03	24.86	11.57	5.03								
7.00E-03	24.75	11.50	5.01								
8.00E-03	24.64	11.44	4.99								
9.00E-03	24.54	11.37	4.97								
1.00E-02	24.43	11.31	4.95								
2.00E-02	23.44	10.72	4.76								
3.00E-02	22.55	10.19	4.59								
4.00E-02	21.74	9.72	4.43								
5.00E-02	21.01	9.29	4.28								
6.00E-02	20.35	8.91	4.14								
7.00E-02	19.74	8.56	4.01								
8.00E-02	19.18	8.24	3.89								
9.00E-02	18.66	7.94	3.78								
1.00E-01	18.19	7.67	3.67								

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Subject Containment Aerosol and Iodine Removal Rates

Project or DCP/FCN/ECP N/A

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE	IRE	DATE	œ
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							Nº N
<u>`</u>						h					Ч Хол
┠╸╾╼╼┙┙		e	l	<u> </u>				L		1	
			Table 0.1	A				.1			
			1 able 8-1	4 — Aer	0501 Ke	movai K	ate (n <b>r</b>	1			ł
				000/11-	34	adian	100/				
			Time (brs)	90%ile	N	ealan	10%	ne			
			2.00E-01	14.91	•	5.8U A 776	2.8				
			3.00E-01	13.00	·	4.70	2.3				
			. 4,00C-01	11.00		4.10 2 66	.1.9				
			5.00E-01	10.58		3.00	1.0				
			0.00E-01	10.50		2.00	1.0				
			8.008-01	0.01		5.05 5 RQ	1.4	, l			
ł			0.00E-01	9.71		7 73	1.5	ž			
			1 002-01	0.57	-	2.75	1.20	ň I			
l I			1.500-100	0 10	-	2.01	1.2				
			2005+00	9.17 9.17		2.19	0.9.				
			2.00E+00	9.00	-	1 95	0.0	7			
			3.005+00	9.07 0.04		1.95	0.5	2			
			1 00E+00	9.0 <del>7</del> 9.04		1.80	0.0	í I			
			5 005+00	0.04		178	0.0				
t t			5.00E400	9.04		1.78	0.5	í l			
			6.000+00	9.04 0.04		1.70	0.5				
			7.005+00	9.04		1.78	0.5				
			7.00E+00	9.04		1.70	0.5				
			0.00E+00	9.04		1.77	0.5				
		•	1 208+01	9.04		1.77	0.5				
			2.005+01	9.04		1 77	0.5				
			2.002101 2.22E+01	9.04		1 77	0.5				
			3 00F+01	9.04		1.77	0.5				
			4 00F+01	9.04	1	1.77	0.5	5	2		
			4 62E+01	9.04	-	1.77	0.5 0.5	5			
			5.00E+01	9_04	-	1.77	0.5	5	:		
			6 00E+01	9.04	1	1 77	0.5				
			7 00F+01	9.04		1.77	0.5	ń			
			8 00	9.04	1	1.77	0.5				
			9.00E+01	9.04	1	1 77	0.5				
			9425+01	9.04	1	1 77	0.50	5		[	[
			1.00E+02	0.04		1.77	0.50				- 1
			2.005+02	9.04	1	1 77	0.50	ζ Ι	, 8		
			2.000-02	9.04	•	1.77	0.50	ζ I			1
			3.005TU2	0.04		1.77	0.50	Ś			{
			4.00ET02	9.04 Q ()/	נ י	1.77	0.30	ζ Ι			
			5.005102	5.04 0.04	1	1.77	0.50				
			0.000 TU2	9.04 0.0 <i>1</i>	1	1.//	0.50	ζ Ι			
			1.008+02	9.04		1.//	0.50	·			

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#### **E&TS DEPARTMENT** ICCN NOJ PRELIM. CCN NO. CALCULATION SHEET PAGE OF CCN CONVERSION: CCN NO. CCN Project or DCP/FCN/ECP N/A Calc No. N-6030-001 Containment Aerosol and Iodine Removal Rates Subject Sheet 67 of 281 ORIGINATOR DATE IRE DATE ORIGINATOR DATE DATE REV REV IRE REV INDICATOR J. Schulz 8/15/2003 D. T. Dexheimer 8/15/2003 0 Table 8-14 — Aerosol Removal Rate (hr<sup>-1</sup>) 90%ile Median 10%ile Time (hrs) 1.77 0.50 7.18E+02 9.04 8.00E+02 9.04 1.77 0.50 9.00E+02 9.04 1.77 0.50 1.00E+03 9.04 1.77 0.50 8.3.1.4 Average Aerosol Removal Rates for Specific Time Periods The methodology presented in Section 5.2.1.2 is used to determine the average aerosol removal rates for the LocaDose time periods presented in Table 8-1. First, the integrated removal rate using Equation 5-15 is calculated for the times used in Table 8-14. These are shown on Table 8-15.

As an example, a calculation for the 0.2 to 0.3 10<sup>th</sup> percentile level is performed. From Table 8-14, the removal rate at 0.2 hours is 2.88 hr<sup>-1</sup>, and at 0.3 hours is 2.39 hr<sup>-1</sup>. Therefore, the integrated removal rate for this time period is:

 $\lambda I(\Delta t) = \frac{\lambda_2 - \lambda_1}{\ln(\frac{\lambda_2}{\lambda_1})} (t_2 - t_1) = \frac{2.39 - 2.88}{\ln(2.39/2.88)} (0.3 - 0.2) = 0.263$ 

This value is in excellent agreement with the result provided on Table 8-15.

Table 8-15 — Interval Integrated Aerosol Removal Rates (hr <sup>-1</sup> · hr)											
Time Inter	val (hrs)	1	90%ile	Median	10%ile						
0 -	1.00E-04	Т	2.55E-03	1.20E-03	5.15E-04						
1.00E-04 -	1.00E-03		2.29E-02	1.07E-02	4.62E-03						
1.00E-03 -	2.00E-03		2.54E-02	1.19E-02	5.12E-03						
2.00E-03	3.00E-03		2.52E-02	1.18E-02	5.10E-03						
3.00E-03 -	4.00E-03		2.51E-02	1.17E-02	5.08E-03						
4.00E-03	5.00E-03		2.50E-02	1.17E-02	5.06E-03						
5.00E-03 -	6.00E-03		2.49E-02	1.16E-02	5.04E-03						
6.00E-03 -	7.00E-03		2.48E-02	1.15E-02	5.02E-03						
7.00E-03 -	8.00E-03		2.47E-02	1.15E-02	5.00E-03						
8 00E-03 -	9.00E-03		2.46E-02	1.14E-02	4.98E-03						
9.00E-03	1.00E-02		2.45E-02	1.13E-02	4.96E-03						
1.00E-02 -	2.00E-02		2.39E-01	1.10E-01	4.85E-02						
2.00E-02 -	3.00E-02		2.30E-01	1.05E-01	4.67E-02						
3.00E-02 -	4.00E-02		2.21E-01	9.95E-02	4.51E-02						

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		Table	8_15 Intomia	Inter	atod Aore	noi Removal I	ates (h=	1. 1.		
		14010	0-15 Interva	i miegi	aleu Aeri		Vales (III	nij		
		<u>'ſi</u>	ime Interval (hrs	2	<u>90%ile</u>	Median	10%	ile		
		4.00	E-02 - 5.00E	-02	2.14E-01	9.51E-02	4.35E	-02		
		5.00	E-02 - 6.00E	-02	2.07E-01	9.10E-02	4.21E	-02		1
		6.00	0E-02 - 7.00E	-02	2.00E-01	8.73E-02	4.08E	-02		
		7.00	E-02 - 8.00E	-02	1.95E-01	8.39E-02	3.95E	-02		
		8.00	1E-02 - 9.00E	02	1.89E-01	8.09E-02	3.835	-02		
		9.00	$E = 02 - 1.00E^{-1}$	01	1.842-01	1 7.80E-02	3.725	-02		
		1.00	E - 01 - 2.00E		1.052+0		3.205			
I		2.00	E - 01 = 3.00E		1.40570	J = J.20E-01	2.035			
		3.00		.01	1 12272400	סיייייייייייייייייייייייייייייייייייי	10/5			
		5.00	$E_{-01} = 5.00E_{-}$	.01	1.025+00	3.075-01	1.745			
		6.00	$E_{-01} = 0.00E_{-}$	.01	1.002100	) 3.49E-01	1.720	-01		{
		7 00	$E_{-01} = 7.00E_{-}$	.01	1012+00	2.99F-01	1 435			
		8.00	$E_{-01} = 9.00E_{-}$	01	9.81E-01	2.81E-01	1 335	5-01		
		9.00	$E-01 - 1.00E^{-1}$	-00	9.64E-01	2.67E-01	1.24F	-01		[ ]
		1.001	E+00 - 1.50E+	-00	4.69E+00	) 1.20E+00	5.36E	-01		
		1.501	E+00 - 2.00E+	-00	4.57E+00	) 1.05E+00	4.41E	-01		
		2.001	E+00 - 2.20E+	-00	1.81E+0	) 3.96E-01	1.59E	-01		
		2.201	E+00 - 3.00E+	-00	7.24E+00	) 1.52E+00	5.79E	-01		
		3.COI	E+00 - 4.00E+	-00	9.04E+00	) 1.82E+00	6.40E	-01		
		4.COE	E+00 - 5.00E+	-00	9.04E+00	) 1.79E+00	5.84E	-01		[
		5.COH	E+00 – 6.00E+	-00	9.04E+00	) 1.78E+00	5.51E	201		
		6.00E	E+00 – 6.20E+	-00	1.81E+0(	) 3.55E-01	1.08E	2-01		
		6.20E	E+00 – 7.00E+	-00	7.23E+00	) 1.42E+00	4.25E	-01		
		7.00E	E+00 – 8.00E+	-00	9.04E+00	) 1.77E+00	5.22E	-01		
		8.00E	E+00 - 9.00E+	00	9.04E+00	) 1.77E+00	5.15E	-01	1	
		9.00E	E+00 - 1.20E+	01	2.71E+01	5.32E+00	1.53E	+00		
		1.20E	2+01 - 2.00E+	01	7.23E+01	1.42E+01	4.04E	+00		
		2.COE	2+01 - 2.22E+	01	1.99E+01	3.90E+00	1.11E	+00		
		2.22E	5+01 - 3.00E+	01	7.05E+0	1.38E+01	3.93E	+00		
		3.COE	$4.00E^{+}$		9.04E+01	1.77E+01	5.04E	+00		
		4.COE	5+01 - 4.62E+		5.01E+0	1.10E+01	3.12E	+00		
		4.t2E	$\frac{1}{2} = 5.00E^{+}$		3.44E+01	0.74E+00	1.91E	+00		
		5.00E			- 9,04E+01		5.04E	+00		
		0.005			9.042+01	1.//E+U]	5.04E	+00		
I		0.00			2.04C+U	1.778401	5.04E			
		0.005			2 805101		3.00E			
		0/20		02	5.00ETUI	1 025-00	2.125	100		1
		9.4-2E		$\frac{1}{12}$	0.04D101		2.925	401		
		1 1.00E	TVZ - 2.00E+	02	7.046702	· 1.//ETU2	5.04E			

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نسره عجبه جبد										
		Table	8-15 — Interv	al Integra	ated Aeros	ol Removal R	ates (hr	<sup>1</sup> . hr)		
		Т	ime Interval (hi	rs)	90%ile	Median	10%	ile		
		2.00	E+02 - 3.00	E+02	9.04E+02	1.77E+02	5.04E	+01		ļ
		3.00	E+02 - 4.00	E+02	9.04E+02	1.77E+02	5.04E	+01		1
		4.00	E+02 - 5.00	E+02	9.04E+02	1.77E+02	5.04E	+01		Į
		5.00	E+02 - 6.00	E+02	9.04E+02	1.77E+02	5.04E	+01		ł
		6.00	E+02 - 7.00	E+02	9.04E+02	1.77E+02	5.04E	+01		
		7.00	E+02 - 7.18	E+02	1.65E+02	3.23E+01	9.17E	+00		
		7.18	E+02 - 8.00	E+02	7.40E+02	1.45E+02	4.12E	+01		
		8.00	E+02 - 9.00	E+02	9.04E+02	1.77E+02	5.04E	+01		
		9.00	E+02 - 1.00	E+03	9.04E+02	1.77E+02	5.04E	+01		

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Using the values presented above, the average removal rates for the LocaDose time periods are determined using Equation 5-16.

As discussed in Section 5.2.1, the model was originally developed for a puff release of aerosol into a system. In those cases where there is a continuous release, the size distribution will continually be renewed by the injected aerosols. The model has been extended for this case by setting the mass fraction  $m_f = 1$  until the release stops. The release continues until 1.8 hours after the onset of the LOCA per Design Input 4.3, therefore the aerosol removal rates for this period are held constant to the value at t = 0 from Table 8-14.

Since the aerosol removal rates are held constant for the first 1.8 hours, the time dependency shown on Table 8-14 and Table 8-15 is offset by 1.8 hours. For example, the LocaDose time period of 1.8 to 2 hrs is equivalent to the 0 to 0.2 time period of Table 8-15. Table 8-16 is constructed using Equation 5-16 and the information presented on Table 8-15.

Table 8-16 — Average Aerosol Removal Rates (hr <sup>-1</sup> )									
Time Period (hrs)	90%ile	Median	10%ile						
0	25.54	11.98	5.15						
1.8 — 2	18.89	8.08	3.79						
2 — 3.8	10.07	2.84	1.32						
3.8 — 4	9.07	1.98	0.79						
4 — 8	9.04	1.82	0.62						
8 — 13.8	9.04	1.77	0.52						
13.8 — 24	9.04	1.77	0.50						
24 48	9.04	1.77	0.50						
48 96	9.04	1.77	0.50						
96 — 720	9.04	1.77	0.50						

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0J. Schulz8/152003D. T. Dexheimer8/152003As an example, calculate the average acrosol removal rate for the LocaDose time period of 2 to 3.8 hours for the 10th percentile level. This time period corresponds to the 0.2 to 2.0 hour time period of Table 8-15. The interval integrated acrosol removal rates for this period are:Image acrosol removal rate for the LocaDose time period of 2 to 3.8 hours for the 10th percentile level. This time period corresponds to the 0.2 to 2.0 hour time period of Table 8-15. The interval integrated acrosol removal rates for this period are:Image acrosol removal rates for this period are:Image acrossol removal rate for the LocaDose time period of 2 to 3.8 hours for the 10th percentile level. This time period corresponds to the 0.2 to 2.0 hour time period of Table 8-15. The interval integrated acrossol removal rates for this period are:Image acrossol removal rate for this period are:Image acrossol removal rate for this period for 2 to 3.8 											
The values above are in good agreement with the values in Table 8-17.											

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	Table 8-17 — Elemental Iodine Mass Release									1
			Mo	lecular	Core M	ass Numbe	r Relea	ised		
		1	sotope W	/eight	(g)	of Mole	s Mo	les		
			I127	127	4.64E+0	03 1.83E+0	1 3.54E	5-01		
ļ	•		I128	128	1.87E-0	2 7.30E-0	5 1.42E	-06		
			I129	129	2.05E+	04 7.95E+0	1 1.54E	+00		
			I130	130	1.28E+(	00 4.92E-0	3 9.55E	2-05		
		1	-130M	130	8.27E-0	3.18E-0	5 6.17E	-07		
			I131 ·	131	7.55E+	02 <b>2.88E+0</b>	0 5.59E	5-02		
			I132	132	1.31E+0	01 4.96E-0	2 9.63E	-04		
			I133	133	1.75E+0	02 6.58E-0	1 1.28E	-02		
		1 1	-133M	133	1.58E-0	3 5.94E-0	6 1.1 <b>5E</b>	-07		
			I134	134	8.42E+0	00 3.14E-0	2 6.10E	-04		
		I	-134M	134	5.14E-0	2 1.92E-0	4 3.72E	-06		
			I—135	135	5.27E+(	)1 1.95E-0	1 3.79E	-03		
			I-136	136	9.24E-0	2 3.40E-0-	4 6.59E	-06		
		1	-136M	136	2.43E-0	2 8.93E-0	5 1.73E	-06		
			I137	137	2.82E-0	2 1.03E-0	4 2.00E	2-06		
			I138	138	3.75E-0	3 1.36E-0	5 <b>2.64</b> E	-07		
			I139	139	7.62E-0	4 2.74E-0	6 5.32E	2-08		
			<b>I140</b>	140	6.68E-0	5 2.39E-0	7 <u>4.63E</u>	-09		
			Total		2.61E+0	4 1.02E+0	2 1.97E	+00		

The total number of moles used in the *ICONC* runs (see Section 9.1) is 2.03 (based on a preliminary prediction of the core iodine inventory). This is greater than the 1.97 value shown in Table 8-17 by 3%. Since the partition coefficients decrease with increasing iodine available in the containment, the value of 2.03 is conservative and will be used in this calculation.

#### 8.3.2.2 Calculation of Partition Coefficients

As discussed in Section 5.2.2.2, the partition coefficients are calculated using the program *ICONC*. *ICONC* requires the following parameters:

• Water temperature in °F

During the injection phase, when RWST borated water is used, the minimum sump temperature is 40 °F (Design Input 4.17). The maximum temperature is determined from the post-LOCA sump temperature profiles (Design Input 4.18). The maximum temperature is 260.3 °F for case 7. To encompass all temperatures, a range from 40 °F to 280 °F is used in *ICONC*.
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	<ul> <li>W</li> <li>Peco</li> <li>pf</li> <li>Va</li> <li>Th</li> <li>Fr</li> <li>Va</li> <li>Va</li> <li>Th</li> <li>As</li> <li>ap</li> <li>ind</li> <li>Ini</li> <li>Th</li> <li>cal</li> <li>Eq</li> <li>Th</li> <li>cal</li> <li>Eq</li> <li>Th</li> <li>ter</li> <li>show</li> <li>K<sub>1</sub></li> <li>K<sub>1</sub></li> </ul>	ater pH v. r Design 1 efficients I level in the plume of generating the revolume of 1 the volume of 1	alue Input 4.14, the suincrease with increase with increase with increase with increase output in this calculation gaseous phase in of the gaseous phase in response of the gaseous phase in current of the liquid phase in current of the liquid phase in current of the liquid phase in current of the liquid phase in current of the liquid phase in current of the liquid phase in current of the liquid phase in current of the liquid phase in current of the liquid phase in current of the liquid phase in current of the liquid phase in current of the liquid phase in current of the liquid phase in current of the liquid phase in current of the liquid phase in current of the partition coefficient of the second stants K <sub>1</sub> and its constants K <sub>1</sub> and its presented able 8-18. Therefole 8-18 temperate equilibrium content of the second stant of the se	timp is macreased p cubic fee shase is take the free ai abic feet ase is take on since I ficient. ater in mo s assume n Section d K <sub>3</sub> and K <sub>3</sub> a l on Table fore, Equa ture value astants K <sub>1</sub> $\frac{K_1}{39}$ $-\frac{T}{-\tau_2}$ = 61	aintaine H; there it ken to l r volume arge	d at a minimum efore, it is conset be the free air volume is 2,284,000 f the minimum su is 46,647 ft <sup>3</sup> . The olumes will reta the elemental io vided on Table 4 e in °C and do n 18 is used to int are calculated a <u>berature (°C)</u> 30 40 $\frac{30-37.78}{30-40}$ = 43.08	pH level rvative to olume of t <sup>3</sup> . ump volu in more i dine avai -6 (Desig ot match erpolate at 100 °F <u>K3</u> 8.4E-13 2.1E-12	the contained of 7. The contained of 7. The contained of 7. The contained of the contained of the contained of the constant (37.78 °C)	r partition ninimut inment. fodelin volume s release, .15). The s used a nts K <sub>1</sub> z	on m g s is and	
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l   . 	K <sub>2</sub>	is then:					[	<u> </u>		[	
	K	$_{2}(T) = K_{2}$	$\left(T_1\right)\left(\frac{K_2(T_2)}{K_2(T_1)}\right)^{\left[\frac{1}{2}\right]}$	$\frac{T_1-T_2}{T_1-T_2}\Big]=8.$	4×10 <sup></sup>	$13 \cdot \left(\frac{2.1 \times 10^{-12}}{8.4 \times 10^{-13}}\right)$	$\left[\frac{\frac{30-37.78}{30-40}}\right]$	=1.71×	10 <sup>-12</sup>		
	Th	ese value:	s are in excellent	t agreeme	nt with	the values show	n on Tal	ble 8-18.			
	These values w output is shown <i>ICONC</i> are pre shown on Figure temperature be	rere then u n on Secti sented on re 8–2. As ginning; fr	used to develop t on 9.1.2. The pa Table 8-18. The s shown on this f om 60 °F.	the ICON rtition co partition figure, the	C input efficien coeffic partiti	file shown on S ts and the decon cients as a function coefficient in	ection 9. taminati on of ter creases v	1.1. The <i>l</i> on factors nperature with increa	CONC from are also asing	>	
			·								
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Schulz	8/15/2003	D. T. Dexheime Table 8-18	Element <u>K1</u> 241.34 173.00 120.00	al Iodine F <u>K3</u> 6.61E-14	Partition Coe Partition Coefficient	fficients			
		Sump           Temperature           (°F)           40           50           60           70	Element <u>K1</u> 241.34 173.00 120.00	al Iodine F <u>K3</u> 6.61E-14	Partition Coe Partition Coefficient	fficients			
		Sump           Temperature           (°F)           40           50           60           70	Element <u>K1</u> 241.34 173.00	al Iodine F <u>K3</u> 6.61E-14	Partition Coe Partition Coefficient	fficients DF			
		40 50 60 70	241.34 173.00	6.61E-14	475 3				4
		50 60 70	173.00	1 205 12		10.71			
		60 70	100.00	1.2UE-13	427.2	9.73			
		70	129.00	2.14E-13	419.8	9.57			
			95.15	3.77E-13	430.2	9.79			l
		80	69.76	6.26E-13	445.1	10.09			
		90	55.23	1.03E-12	511.4	11.45			
		100	43.08	1.71E-12	603.0	13.32			
		110	34.16	2.77E-12	726.0	15.83			ļ
		120	27.38	4.38E-12	880.2	18.98			ļ
		130	22.71	6.65E-12	1,076	22.97			
		140	19.00	1.00E-11	1,324	28.03			
		150	16.91	1.55E-11	1,791	37.58			
		160	15.11	2.37E-11	2,415	50.32			
		170	13.76	3.44E-11	3,165	65.63		[	
		180	12.40	4.99E-11	4,111	84.97			
		190	11.01	7.24E-11	5,273	108.7			
		200	9.97	1.02E-10	0,705	137.9			
		210	9.10	1.416-10	8,490 11 220	174.5		(	
		220	8.33 8.26	2.025-10	11,558	202.0		ł	
		230	7 80	3 72F-10	19 002	389 1			
		250	7.05	5.07E-10	23 391	478 7			
		260	6.62	6.63E-10	28,707	587.3		ſ	
		270	6.27	8.58E-10	35,172	719.3		4	
		280	· 6.04	1.09E-09	43.029	879.8			
			140 150 160 170 180 190 200 210 220 230 240 250 260 270 280	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	140         19.00         1.00E-11           150         16.91         1.55E-11           160         15.11         2.37E-11           170         13.76         3.44E-11           180         12.40         4.99E-11           190         11.01         7.24E-11           200         9.97         1.02E-10           210         9.16         1.41E-10           220         8.55         2.02E-10           230         8.36         2.70E-10           240         7.80         3.72E-10           250         7.05         5.07E-10           260         6.62         6.63E-10           270         6.27         8.58E-10           280         6.04         1.09E-09	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	140 $19.00$ $1.00E-11$ $1,324$ $28.03$ $150$ $16.91$ $1.55E-11$ $1,791$ $37.58$ $160$ $15.11$ $2.37E-11$ $2,415$ $50.32$ $170$ $13.76$ $3.44E-11$ $3,165$ $65.63$ $180$ $12.40$ $4.99E-11$ $4,111$ $84.97$ $190$ $11.01$ $7.24E-11$ $5,273$ $108.7$ $200$ $9.97$ $1.02E-10$ $6,705$ $137.9$ $210$ $9.16$ $1.41E-10$ $8,496$ $174.5$ $220$ $8.55$ $2.02E-10$ $11,338$ $232.6$ $230$ $8.36$ $2.70E-10$ $14,797$ $303.2$ $240$ $7.80$ $3.72E-10$ $19,002$ $389.1$ $250$ $7.05$ $5.07E-10$ $23,391$ $478.7$ $260$ $6.62$ $6.63E-10$ $28,707$ $587.3$ $270$ $6.27$ $8.58E-10$ $35,172$ $719.3$ $280$ $6.04$ $1.09E-09$ $43,029$ $879.8$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	140 $19.00$ $1.00E-11$ $1,324$ $28.03$ $150$ $16.91$ $1.55E-11$ $1,791$ $37.58$ $160$ $15.11$ $2.37E-11$ $2,415$ $50.32$ $170$ $13.76$ $3.44E-11$ $3,165$ $65.63$ $180$ $12.40$ $4.99E-11$ $4,111$ $84.97$ $190$ $11.01$ $7.24E-11$ $5,273$ $108.7$ $200$ $9.97$ $1.02E-10$ $6,705$ $137.9$ $210$ $9.16$ $1.41E-10$ $8,496$ $174.5$ $220$ $8.55$ $2.02E-10$ $11,338$ $232.6$ $230$ $8.36$ $2.70E-10$ $14,797$ $303.2$ $240$ $7.80$ $3.72E-10$ $19,002$ $389.1$ $250$ $7.05$ $5.07E-10$ $23,391$ $478.7$ $260$ $6.62$ $6.63E-10$ $28,707$ $587.3$ $270$ $6.27$ $8.58E-10$ $35,172$ $719.3$ $280$ $6.04$ $1.09E-09$ $43.029$ $879.8$

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E&TS DEPARTMENT

CALCULATION SHEET

NT CO20 001



Figure 8-2 — Elemental Iodine Partition Coefficient as a Function of Sump Temperature

### 8.3.2.3 Elemental Iodine Spray Removal Rates

As discussed in Section 5.2.2.1, the elemental icdine spray removal rates are calculated using the program *REMOVE*. The input parameters used by *REMOVE* are described in the following sections. Removal rates are calculated as a function of time for two phases, the injection phase and the recirculation phase. Farameters that are common to both are described in Section 8.3.2.3.1, parameters that apply to the injection phase are described in Section 8.3.2.3.2, and parameters that apply to the recirculation phase are described in Section 8.3.2.3.2.

Removal rates are calculated for each spray header and each individual ring within the spray header. The resultant spray nonval rates are then summed together for each spray header. The lowest total spray removal rate is then selected to represent the elemental spray removal rate capability of the spray system.

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Deject or DCP/FCN/ECP_N/A       Calc No.       N-6030-001       CCN CONVERSION: CCN NO. CCN         Deject       Containment Aeroso' and Iodine Removal Rates       Sheet		C	ALC	ULA	TION	N SHI	EET	ICCN NO./ PRELIM. CC	N NO.		PAGE			
bject       Containment Aerosci and Iodine Removal Rates       Sheet       76       of         EV       ORIGINATOR       DATE       IRE       DATE       REV       ORIGINATOR       DATE       IRE       DATE         b)       1. Schulz       \$V152001       D. T. Dexheimer       \$V152003       Image: Control of the second seco	ject	t or DC	P/FCN/E				Calc	No. <u>N-6030-00</u>	01	CCN CO CCN NO	NVERSI	ION:		
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D       J. Schulz       2152002       D. T. Dexheimer       5152003         B       J. Schulz       2152002       D. T. Dexheimer       5152003       Image: Schulz       Schulz       Schulz       2152002       Image: Schulz       Schul	V	ORIGI	NATOR	DATE	IF	RE	DATE RE		DATE	IR	E	DATE	:	
8.3.2.3.1 Common ParametersPer Design Input 4.11, the SONGS containment spray system is designed with SPRACO 1713A nozzles, therefore the drop size distribution for this nozzle, which is built into the REMOVE program, will be used (Table 1 of the REMOVE Theoretical Manual [Reference 6.6b]). This distribution contains 69 different size groups, of which the smallest drop size diameter is 0.00375 cm.The sprayed volume is the containment sprayed region. From Design Input 4.6, the containment sprayed region volume is 1,907,000 ft <sup>3</sup> .The plate out area is used by REMOVE to determine the elemental iodine deposition rates. Although the deposition rates calculated by REMOVE are not used in this calculation, the wall surface area from Design Input 4.9 of 601,519 ft <sup>2</sup> is entered.The spray system parameters used by REMOVE are shown on Table 8-19. The number of nozzles and the initial spray angle are obtained from Design Input 4.11. The fall height was calculated in previous sections and presented in the listed tables.Table 8-19 — Spray System Parameters used by REMOVE Spray RingAngle of NozzlesFall Height (ft)Source049-4"-C-KEO10287.86.0Table 8-19 — Spray System Parameters used by REMOVEOptimized in the listed tables.VERIDUE1The spray RingAngle of NozzlesFall Height (ft)Source049-4"-C-KEO10 <td col<="" td=""><td><math>\Box</math></td><td>J. S</td><td>chulz</td><td>8/15/2003</td><td>D. T. De</td><td>exheimer</td><td>8/15/2003</td><td></td><td>•</td><td></td><td></td><td></td><td>N</td></td>	<td><math>\Box</math></td> <td>J. S</td> <td>chulz</td> <td>8/15/2003</td> <td>D. T. De</td> <td>exheimer</td> <td>8/15/2003</td> <td></td> <td>•</td> <td></td> <td></td> <td></td> <td>N</td>	$\Box$	J. S	chulz	8/15/2003	D. T. De	exheimer	8/15/2003		•				N
8.3.2.3.1 Common ParametersPer Design Input 4.11, the SONGS containment spray system is designed with SPRACO 1713A nozzles, therefore the drop size distribution for this nozzle, which is built into the REMOVE program, will be used (Table 1 of the REMOVE Theoretical Manual (Reference 6.6b)). This distribution contains 69 different size groups, of which the smallest drop size diameter is 0.00375 cm.The sprayed volume is the containment sprayed region. From Design Input 4.6, the containment sprayed region volume is 1,907,000 ft <sup>3</sup> .The plate out area is used by REMOVE to determine the elemental iodine deposition rates. Although the deposition rates calculated by REMOVE are not used in this calculation, the wall surface area from Design Input 4.9 of 6C1,519 ft <sup>2</sup> is entered.The spray system parameters used by REMOVE are shown on Table 8-19. The number of nozzles and the initial spray angle are obtained from Design Input 4.11. The fall height was calculated in previous sections and presented in the listed tables.Table 8-19 — Spray System Parameters used by REMOVE by Remove frage of Nozzles fall Height (ft)Source049-4"-C-KEO10287.81Table 8-19 — Spray System Parameters used by REMOVENot for NozzlesFall Height (ft)Source049-4"-C-KEO10287.81Table 8-19 — Spray System Parameters used by REMOVENot for NozzlesFall Height (ft) <td< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>1</th><th></th><th>4</th></td<>											1		4	
the initial spray angle are obtained from Design Input 4.11. The fall height was calculated in previous sections and presented in the listed tables. Table 8-19 Spray System Parameters used by REMOVE         Initial       Number Angle       Fall Height of Nozzles       Fall Height (ft)       Fall Height Source         049-4"-C-KEO       10       28       79.81       Table 8-8         049-4"-C-KEO       10       28       79.81       Table 8-8         049-4"-C-KEO       10       28       85.60       Table 8-8         043-4"-C-KEO       10       28       85.60       Table 8-11         043-4"-C-KEO       45       28       85.60       Table 8-11         043-4"-C-KEO       0       20       105.83       Table 8-10         045-4"-C-KEO       0       20       105.83       Table 8-10         045-4"-C-KEO       90       20       105.83       Table 8-10         045-4"-C-KEO       90       20       108.11       Table 8-7		will be contain The spi sprayed	used (1 hs 69 dif rayed vo l region hte out a	able I or ferent size volume is th volume is rea is used	the REAL e groups he contai s 1,907,0 d by REAL	s, of whic inment sp 000 ft <sup>3</sup> .	h the smalles brayed region determine the	nual [Reference of st drop size diamon. From Design Line the elemental iodi	nput 4.6, th ne depositition, the w	ion rates. A	nent Althoug	h		
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051-4"-C-KEO     90     20     108.11     Table 8-7       052-2 ½"-C-KEO     0     10     117.43     Table 8-6       052-2 ½"-C-KEO     45     10     117.43     Table 8-6       046-2 ½"-C-KEO     0     10     118.47     Table 8-0		the dep Design The spithe init section	Sp 049-4 049-4 049-4 043-4 043-4 043-4 045-4 045-4 045-4 051-4 051-4 051-4	rates calcu 9 of 601, m parama angle arc esented in 'Ta ray Ring '-C-KEO	alated by 519 ft <sup>2</sup> i eters use e obtaine the liste ble 8-19	y REMOV is entered ed by REl ed from I ed tables. 9 Spra Initial Angle 10 45 10 45 10 45 0 90 0 90 0 90 0 45 0	MOVE are s Design Input y System P: Numbo of Nozz 28 28 28 28 28 20 20 20 20 20 10 10	hown on Table 8 4.11. The fall hei arameters used 1 er les Fall Heigl 79.81 79.81 85.60 105.83 108.11 108.11 117.43 117.43	-19. The nuight was can by <i>REMO</i> ht (ft)	umber of n alculated in VE Fall Heig Source Table 8 Table 8 Table 8 Table 8 Table 8 Table 8 Table 8 Table 8 Table 8 Table 8	eozzles a previo eht e -8 -8 11 11 10 10 -7 -7 -6 -6 -6 -0	and us		
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USI-4"-C-KISO 90 20 108.11 Table 8-7		the dep Design The spithe init section	Sp 049-4 043-4 043-4 045-4 045-4 051-4	rates calcu 9 of 601, angle ard esented in 'Ta 'Ca 'C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO	ulated by 519 ft <sup>2</sup> i eters use e obtaine i the liste ble 8-19	y REMOV is entered ed by RE ed from I ed tables. 9 Spra Initial Angle 10 45 10 45 10 45 0 90 0 90 0 90	MOVE are s Design Input y System P: Numbo of Nozz 28 28 28 28 28 28 20 20 20 20 20	hown on Table 8- 4.11. The fall hei arameters used 1 er les Fall Heigl 79.81 79.81 85.60 105.83 105.83 108.11 108.11	-19. The nuight was can by <i>REMO</i> ht (ft)	umber of n alculated in VE Fall Heig Source Table 8- Table 8- Table 8- Table 8- Table 8- Table 8- Table 8- Table 8- Table 8-	eozzles a previo ght e -8 -8 11 11 10 10 -7 -7	and us		
USI-4"-C-KISO 90 20 108.11 Table 8-7		the dep Design The spit the init section	Sp 049-4 043-4 043-4 043-4 043-4 043-4 043-4 043-4 045-4 045-4 045-4	rates calcu 9 of 601, angle arc esented in 'Ta 'C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO	ulated by 519 ft <sup>2</sup> i eters use e obtaine i the liste ble 8-19	y REMOV is entered ed by RE ed from I ed tables. 9 Spra Initial Angle 10 45 10 45 10 45 0 90 0 90	MOVE are s Design Input y System Pa 28 28 28 28 28 28 20 20 20 20 20	hown on Table 8 4.11. The fall hei arameters used 1 er les Fall Heigl 79.81 79.81 85.60 105.83 105.83 108.11 108.11	-19. The nu ight was ca by <i>REMO</i> ht (ft) 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	umber of n alculated in VE Fall Heig Source Table 8- Table 8-	ght -8 -8 -11 11 10 -7 -7	and us		
051-4"-C-KEO 90 20 108.11 1able 8-7 052-2.1/2"-C-KEO 0 10 117.43 Table 8-6		the dep Design The spithe init section	Sp 049-4 043-4 043-4 045-4 045-4 051-4 051-4	rates calcu 9 of 601, angle arc esented in 'Ta 'C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO	ulated by 519 ft <sup>2</sup> i eters use e obtaine the liste ble 8-19	y REMOV is entered ed by RE ed from I ed tables. 9 Spra Initial Angle 10 45 10 45 10 45 0 90 0 90 0 90 0	MOVE are s Design Input y System P: Numbo of Nozz 28 28 28 28 28 28 20 20 20 20 20 10	hown on Table 8 4.11. The fall hei arameters used 1 er les Fall Heigl 79.81 79.81 85.60 105.83 108.11 108.11 117.43	-19. The nuight was can by <i>REMO</i> ht (ft)	WE Fall Heig Source Table 8- Table 8-	sozzles a previo sht -8 -8 11 11 10 10 -7 -7 -7	and us		
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051-4"-C-KEO         90         20         108.11         Table 8-7           052-2 ½"-C-KEO         0         10         117.43         Table 8-6           052-2 ½"-C-KEO         45         10         117.43         Table 8-6		The spin the dep Design The spin the init section	Sp 049-4 043-4 043-4 043-4 043-4 043-4 043-4 043-4 045-4 045-4 051-4 051-4 051-4	rates calcu 9 of 601, angle arc esented in 'Ta ray Ring '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO '-C-KEO	alated by 519 ft <sup>2</sup> i eters use e obtaine i the liste ble 8-19	y REMOV is entered ed by REl ed from I ed tables. 9 — Spra Initial Angle 10 45 10 45 10 45 0 90 0 90 0 90 0 45	MOVE are s Design Input y System Pa of Nozz 28 28 28 28 28 20 20 20 20 20 10 10	hown on Table 8: 4.11. The fall hei arameters used 1 er les Fall Heigh 79.81 79.81 85.60 105.83 105.83 108.11 117.43	-19. The nuight was can by <i>REMO</i> ht (ft)	umber of n alculated in VE Fall Heig Source Table 8- Table 8-	ght -8 -8 11 10 10 -7 -7 -6 -6 -6	and us		
051-4"-C-KEO     90     20     108.11     Table 8-7       052-2 ½"-C-KEO     0     10     117.43     Table 8-6       052-2 ½"-C-KEO     45     10     117.43     Table 8-6       046-2 ½"-C-KEO     0     10     118.47     Table 8-9		the dep Design The spithe init section	osition 1 Input 4 ray syste ial spray s and pro- 049-4 043-4 043-4 043-4 043-4 043-4 043-4 043-4 045-4 045-4 051-4 051-4 051-4 052-2 052-2 052-2 046-2	rates calcu 9 of 601, angle ard esented in <b>Ta</b> <b>ray Ring</b> -C-KEO	alated by 519 ft <sup>2</sup> i eters use e obtaine the liste ble 8-19	y REMOV is entered ed by RE ed from I ed tables. 9 Spra Initial Angle 10 45 10 45 10 45 0 90 0 90 0 90 0 45 0 90	MOVE are s Design Input y System Provided and the system of Nozz 28 28 28 28 28 20 20 20 20 20 10 10 10 10	hown on Table 8 4.11. The fall hei arameters used 1 er les Fall Heigl 79.81 79.81 79.81 85.60 85.60 105.83 108.11 108.11 117.43 117.43 118.47	-19. The nuight was can by <i>REMO</i> ht (ft)	umber of n alculated in VE Fall Heig Source Table 8- Table 8-	cozzles a previo enterna enter	and us		

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#### **E&TS DEPARTMENT** ICCN NO./ PRELIM, CCN NO. CALCULATION SHEET PAGE OF CCN CONVERSION: CCN NO. CCN Project or DCP/FCN/ECP N/A Calc No. N-6030-001 Subject Containment Aerosol and Iodine Removal Rates Sheet 77 of 281 ORIGINATOR DATE DATE REV ORIGINATOR DATE REV IRE IRE DATE REV NDICATOR J. Schulz 8/15/2003 D. T. Dexheimer 8/15/2003 0 $A = \pi \left[ \left( \frac{0.375 in \cdot 2.54 cm/in}{2} \right)^2 - \left( \frac{0.30 in \cdot 2.54 cm/in}{2} \right)^2 \right] = 0.257 cm^2$ The flow per nozzle, from above, is 13.79 gpm = $52.22 \text{ lpm} = 870.4 \text{ cm}^3/\text{sec}$ . Therefore, the initial velocity is $870.4 \text{ cm}^3/\text{sec} \div 0.257 \text{ cm}^2 = 3,393 \text{ cm}/\text{sec}$ .

Spray Removal Rates as a Function of Air-Steam Temperature

The removal rates are dependent on the temperature of the air-steam mixture in the containment; therefore, a parametric study is performed to determine the appropriate temperatures that will result in conservative removal rate estimates. This parametric is arbitrarily performed on the 10° nozzles of ring 049-4"-C-KEO. The temperature range encompasses the range in temperature as provided in Design Input 4.18. From Table 4-8, the minimum containment air temperature is 89.9 °F (32.2 °C), and the maximum containment air temperature is 267.4 °F (130.8 °C). The input files for the parametric study are shown in Section 9.2.1.1. The results of this parametric study are presented on Table 8-20 and on Figure 8-3.

Table 8-20 — Elem Rate	iental Iodine Spray Removal e Parametrics
Containment	Course Descours Date (byth
Temperature (C)	Spray Removal Rate (nr )
30	4.5685
40	4.7679
50	4.9357
60	5.0724
70	5.1780
75	5.2192
80	5.2527
85	5.2787
90	5.2974
95	5.3091
100	5.3141
105	5.3129
110	5.3058
120	5.2755
130	5.2279

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	02222	instian R	lane Parameter		I			<u> </u>				-
	The injection p minutes (with to operation). Partition Coeff During the inje NUREG/CR-0	whase beginstream	ins with initiation in operation) to se, borated wate prence 6.4h page	n of spray a maxim r from the 61) a par	y and las tum of a e RWSI tition co	ts from a minim pproximately 40 is used in the s pefficient of 200	oum of aj ) minutes pray syss for bori	pproximates (with one tem. Per c acid solu	ely 20 e train	) in is		
	used. <u>Air-Steam Mix</u>	ture Tem	perature					·				
	From Design In °F. (86.8 to 129 removal rate at be used to calcu	nput 4.18, 9.9 °C). Fi 85 °C or ulate the s	, the temperature rom Table 8-20 i even 90 °C, then spray removal ra	range in t can be s efore the tes for th	the 30 s seen that upper te e injecti	ec to 40 min tir the removal rate emperature of th on phase.	ne period te at 130 is time p	l is 188.3 ( °C is lowe eriod (129	to 265 er thar 9.9 °C)	5.9 n the ) will		
	8.3.2.3.3 Ra To determine the of Design Input containment and temperatures for temperature his	ecirculati he partitio t 4.18 nee d sump to or these ti story resu	tion Phase Param on coefficients and eds to be expanded emperatures at 2, mes are linearly lts are presented	neters ad the air ad to incl 4, 8, 13. interpola on Table	-steam r ude the 8, 24, 4 ted from 8-21 w	nixture tempera <i>LocaDose</i> time- 8, 96, and 720 h a adjacent tempe ith the added tim	ture, the steps. In ours are eratures f ne steps 1	temperatu particular needed. T rom Table highlighte	re pro , he : 4-8. 1 d.	ofile The		
	For example, th	ne vapor t	emperature for c	ase 1 at 4	4 hours (	(14,400 sec) is c	alculated	i:				
	T(14,4	100)= 21	7.7 °F +(215.7	°F−21	7.7 °F)	<u>14,400 – 12,50</u> 15,000 – 12,50	$\frac{0}{0} = 216$	.2 °F				
	This value is in	excellen	agreement with	the valu	e shown	on Table 8-21.						

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Subject Containment Aeros 21 and Iodine Removal Rates Sheet 80 of 281 ORIGINATOR REV DATE IRE DATE REV ORIGINATOR DATE **IRE** DATE rev Indicator J. Schulz 8/15/2003 D. T. Dexheimer 8/15/2003 0 Table 8-21 — Containment Atmosphere and Water Sump Temperature **Profile with Added Time-steps** Vapor Temperature (°F) Time Sump Temperature (°F) Case 1 Case 4 Case 7 (sec) (hr) Case 1 Case 4 Case 7 0.000E+00 120 120 120 120 120 0.0 120 90.5 89.9 197.8 0.1 2.778E-05 111.8 206.4 216.1 0.2 5.556E-05 112.5 105 133.1 206.9 210.9 219.3 0.3 8.333E-05 127.4 116.7 146.1 211 213.9 217.7 0.4 1.111E-04 139.3 126.3 156 213.8 216.4 218.1 0.5 1.389E-04 135.3 163.9 215 218.3 148.8 218.2 0.6 1.667E-04 156.1 142.6 170.5 216.4 219.9 218.8 0.7 1.944E-04 162.6 148.1 176.2 217.6 220 218.6 0.8 2.222E-04 167.6 153.7 181.1 217.4 220.3 218.1 0.9 2.500E-04 172.8 158.1 185.4 217.4 220.9 218.9 178 162.1 189.1 218.4 220.6 1 2.778E-04 218.9 2. 5.556E-04 206.9 193 214.7 219.2 222.4 223.7 3 8.333E-04 221.9 210.2 230.5 222.5 225.3 230.9 4 1.111E-03 231.9 220.5 241.3 225.2 228 236.7 5 228 227.3 1.389E-03 239.8 249.3 231.1 241.4 6 1.667E-03 245.5 234.1 255.2 229.2 234.1 245.3 7 1.944E-03 250.4 239.2 260.1 230.5 236.6 246.9 243.5 247.6 8 2.222E-03 254.3 263.3 230.9 238.9 ç, 2.500E-03 257.3 247.2 265.1 230.5 241 248 258.9 250.5 10 2.778E-03 265.9 229.7 242.5 248.3 11 3.056E-03 260.3 253.3 266.7 229.4 243.5 248.6 12 260.8 255.4 3.333E-03 267.4 229.8 244.4 248.7 13 3.611E-03 260.7 257 266.8 230.4 245.1 248.9 260.3 258 14 3.889E-03 266.2 230.7 245.9 249 15 259.8 230 4.167E-03 258.6 265.7 246.6 249.1 16 4.444E-03 259.3 258.7 265.4 229.1 247.1 249.2 17 4.722E-03 258.8 258.9 265.1 228.2 247.5 249.3 18 5.000E-03 258.6 258.6 227.3 264.8 247.8 249,4 19 5.278E-03 258.6 258.2 264.7 226.5 247.9 249.5 20 5.556E-03 258.9 257.8 264.6 225.7 248 249.5 22 6.111E-03 259 257.8 264.6 221.4 248 249.7 24 6.667E-03 258.8 258.6 264.5 217.1 242.7 249.8 26 7.222E-03 258.9 258.8 264.4 213.4 236.7 249.9 28 7.778E-03 259.1 259.1 264.3 210:2 231.7 250 30 8.333E-03 259.3 259.5 264.2 207.3 227.5 250.1 32 8.889E-03 259.7 260 264 205.8 223.9 250.1 34 9.444E-03 260.1 260.5 263.9 204.5 220.8 250.2

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					L-nord							┽╾╼┙
-		Table 3-2	21 — Containm Pro	ent Atm. file with	osphere Added	and Wa Time-ste	eps	np Tem	perature			
			Time	Vapor '	lempera	ture (°F)	Sump	Tempera	ture (°F)			
		<u>(sei:)</u>	<u>(br)</u>	Case 1	Case 4	Case 7	Case I	Case 4	Case 7	-		
	1	36	1.000E-02	260.3	261	263.7	203.3	218.1	250.3			
		38	1.0568-02	200.5	201.3	203.0 262 1	202.2	212.1 212.6	250.3			
i	1	40 10	1.1110-02	260.5	261.4	263.4	201.2	213.0	250.4	1		
		44	1.222E-02	259.7	261	263.5	199.4	210	250.5			
		46	1.278E-02	258.9	260.3	263.3	198.6	208.4	250.5			
		48	1.333E-02	258	259.5	263.1	197.9	207.1	250.6			
		50	1.389E-02	256.9	258.6	262.9	197.2	205.8	250.6	i i		
		52	1.444E-02	255.8	257.7	262.8	196.6	204.7	250.7			1 1
		54	1.500E-02	255.8	256.6	262.6	196	203.6	250.7			
		56	1.556E-02	255.7	256.1	262.5	195.5	202.6	250.8			
		58	1.611E-02	255.7	256.1	262.3	195	201.8	250.8			
		60	. 1.667E-02	255.7	256.1	262.1	194.5	201	250.9			
		62	1.722E-02	255.6	256.1	261.9	194.1	200.3	250.9			
		<b>64</b>	1.778E-02	255.5	256	261.7	193.7	199.7	251			
		<b>6</b> 6	1.833E-02	255.5	256.1	261.6	193.4	199.1	251.2	1		
		68	1.889E-02	255.5	256	261.4	193	198.5	251.4			
		7()	1.944E-02	255.5	256.1	261.2	192.7	198	251.6			1
		72	2.000E-02	255.4	256.1	261	192.5	197.6	251.8			
		72.	2.056E-02	255.4	256.1	260.9	192.4	197.2	252			
		76	2.111E-02	255.3	256.2	200.7	192.4	190.8	252.1			
		16- 96-	2.1076-02	255.4	250.1	200.0	192.5	190.5	252.5	ļ		
		80 80	2.222E-02 2.278E-02	255.0	256.2	200.4	192.0	105 0	252.5	}		
		82. 84	2.278E-02 2 333E-02	256.1	256.2	260.5	192.8	195.6	252.8			1 1
		86	2.389E-02	256.3	256	260	192.9	195.4	253			
	1	88	2.444E-02	256.4	256	259.8	193	195.3	253.1	Ĩ		
		90	2,500E-02	256.8	256	259.7	193.1	195.2	253.3	· ·		
		92:	2.556E-02	256.9	256.4	259.6	193.1	195.2	253.4			
		94	2.611E-02	257.1	256.6	259.4	193.2	195.4	253.6			
	ļ	96	2.667E-02	257.3	257	259.3	193.3	195.6	253.7	)		
		98	2.722E-02	257.5	257.1	259.2	193.4	195.7	253.9			
		100	2.778E-02	257.7	257.3	259.1	193.5	195 <b>.</b> 9	254			
	{	105	2.917E-02	258.2	257.8	258.8	193.7	196.2	254.3			
	·	110	3.056E-02	258.6	258.2	258.5	193.9	196.6	254.7			1 1
		115	3.194E-02	259	258.5	258.3	194.1	197	255			
l		120	3.333E-02	259.5	258.8	258	194.3	197 <i>.</i> 4	255.3			1
	l	125	3.472E-02	259.8	258.9	257.8	194.5	197.7	255.5	1	•	

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		Table 8√	21 — Containm Pro	ent Atm file with	osphere Added	and Wa Time-sto	iter Sur eps	np Tem	perature			
			Time	Vapor 7	'empera	tare (°F)	Sump	Tempera	ture (°F)	ļ		
1		(sec)	(hr)	Case 1	Case 4	Case 7	Case 1	Case 4	Case 7			1
}		130	3.611E-02	260.2	259	257.6	194.7	198.1	255.8.	]		
	• •	135	3.750E-02	260.6	259.1	257.4	194.9	198.5	256.1			
		140	3.889E-02	260.9	259.2	257.2	195.1	198.9	256.3	ļ		
		145	4.028E-02	261.3	259.2	257	195.3	199.3	256.6			
}		150	4.167E-02	261.6	259.2	256.8	195.5	199.7	256.8			
		-155	4.300E-02	262	259.2	256.5	195.7	200.1	257	1		[
		160	4.444E-02 1 583E-02	202.5	239.2	250.2	195.9	200.4	231.3			1
		105	4.383E-02 4.722E-02	263	259.2	255.5	196.1	200.8	257.5			1
		175	4.861E-02	263.4	259.1	255.3	196.4	201.6	257.9			
1		180	5.000E-02	263.6	259	255	196.6	202	258.1		į	
		185	5.139E-02	264	258.9	254.8	196.8	202.5	258.3			
		190	5.278E-02	264.2	258.8	254.6	197	202.9	258.5			1
		195	5.417E-02	264.4	258.7	254.2	197.2	203.4	258.7			
		200	5.556E-02	264.7	258.6	253.8	197.4	204	258.9	1		
		205	5.694E-02	264.9	258.5	253.5	197.7	204.5	259.1			ĺ
		210	5.833E-02	265	258.4	253.2	198	205	259.2		•	
		215	5.972E-02	265.2	258.3	252.8	198.3	205.5	259.4	· .		
		220	6.111E-02	265.3	258.2	252.5	198.6	206	259.5			l I
		225	6.230E-02	203.4	230.1	252.1	198.9	200.5	259.0			
	•	230	6 528E-02	265.6	257 9	251.8	199.3	207 5	259.7			
1		240	6.667E-02	265.6	257.8	251.1	200.1	208	259.9	í		
		245	6.806E-02	265.7	257.7	250.8	200.6	208.5	260			
ł		250	6.944E-02	265.8	257.6	250.5	201	209	260			
		255	7.083E-02	265.8	257.5	250.2	201.4	210.3	260.1			
}		260	7.222E-02	265.9	257.3	249.9	201.9	211	260.1			
1		265	7.361E-02	265.9	257	249.6	202.4	211.4	260.2		i i i	
		27C	7.500E-02	265.9	256.8	249.3	202.8	211.9	260.2			
1		275	7.639E-02	265.9	256.6	249	203.3	212.3	260.2			
1		280	7.778E-02	265.8	256.4	248.7	203.8	212.8	260.3	}		
		285	7.917E-02	265.8	256.3	248.4	204.2	213.2	260.3			
]		290	8.036E-02	205.1	236.1	248.1	204.7	213.6	260.3	ļ		ļ
1		293	8.194E-UZ	203.0	233.9	241.8	203.2	214	200.5			l
[		300	0.333E-U2 8 611E-02	203.3	200.1 255 A	241.0	203.0	214.2	200.5			
1		220	0.0110-02 8 880E-07	264.0	222,4	241.1	200.0	213.3 212	200.3	1		
		33()	9.167E-02	264.5	255.1	246	207.4	216.8	260.2			
				•			•			•		

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Project or DCP/FCN/ECP N/A

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE	IRE	E DATE	ĸ
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003			Ι				S S
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l			L	<u>L</u>	. In succession of the second						
					·					1	
		Table 8-2	21 — Containm	ent Atm	osphere	and Wa	ter Sun	np Temp	perature	1	
			Pro	tile with	Added	Time-st	eps				
	1		Time	Vanor 7	<b>`emnera</b> i	ture (°F)	Sumn'	Temnera	ture (°F)		
		(sec)	(hr)	Case 1	Case 4	Case 7	Case 1	Case 4	Case 7		
		340	9.444E-02	264.1	254.5	245.5	208.3	217.5	260	1	
		350	9.722E-02	263.8	254.2	245.2	209.2	218.2	259.9		
		360	1.000E-01	263.4	253.9	244.7	210	218.9	259.8		
		370	1.028E-01	263.2	253.6	244.2	210.8	219.5	259.7		
		380	1.056E-01	262.9	253.2	243.7	211.6	220.2	259.5		
		390	1.083E-01	262.5	252.9	243.3	212.4	220.8	259.4		
		400	1.111E-01	262.2	252.7	242.8	213.1	221.4	259.2		
		420	1.167E-01	261.6	252.1	241.9	214.6	222.6	258.8		
		440	1.222E-01	260.9	251.5	241	215.9	223.7	258.3		
		460	1.278E-01	260.3	251	240.2	217.2	224.7	257.9		
	[	480	1.333E-01	259.8	250.5	239.3	218.4	225.7	257.4		
		500	1.389E-01	259.2	249.8	238.5	219.5	226.6	256.8		
		520	1.444E-01	258.6	249	237.7	220.6	227.4	256.3		
		540	1.500E-01	258	248.1	236.9	221.7	228.1	255.7		·
		. 560	1.556E-01	257.2	247.4	236.2	222.7	228.7	255.1	·	
	1	580	1.611E-01	256.4	246.6	235.4	223.6	229.3	254.6		
		600	1.667E-01	255.7	245.8	234.6	224.5	229.7	254		1
		650	1.806E-01	253.9	244.1	233	226.2	230.5	252.4		
		700	1.944E-01	252	242.3	231.2	227.4	230.9	250.9		
	4	750	2.083E-01	250.2	240.6	229.4	228.2	231.1	249.4		
		800	2.222E-01	248.4	239	227.7	228.7	231.1	247.8		
	1	850	2.361E-01	246.7	237.3	226.1	229	230.9	246.3		
		<b>90</b> 0	2.500E-01	245.5	235.8	224.5	229	230.5	244.8		
	1	950	2.639E-01	243.7	234.2	223	228.9	230.1	243.3		
		1,000	2.778E-01	242.1	232.9	221.4	228.6	229.6	241.8		
	1	1,050	2.917E-01	240.6	231.4	220.1	228.2	229	240.3		1
	1	1,100	3.056E-01	239.1	230	218.7	227.8	228.3	238.9		j
		1,150	3.194E-01	237.6	228.5	217.3	227.3	227.6	237.5		
		1,200	3.333E-01	236.2	227.2	215.9	226.7	226.9	236.1		
	1	1,220	3.389E-01	235.6	226.6	215.3	226.5	226.6	235.6		
		1,240	3.444E-01	235	226.1	214.7	226.2	226.3	235.1		1
	1	1,260	3.500E-01	234.5	225.5	214.2	226	226	234.6		
	ł	1,280	3.556E-01	234.2	225	213.7	225.7	225.7	234		
	1	1,300	3.611E-01	233.5	224.5	213.1	225.5	225.5	233.5		ł
		1,320	3.667E-01	233	224	212.6	225.3	225.2	233		1
	ł	1,340	3.722E-01	232.4	223.4	212	225	224.9	232.5		
	1	1,360	3.778E-01	231.9	222.9	211.5	224.7	224.6	232		
	.	1,380	3.833E-01	231.4	222.4	211	224.5	224.3	231.6		1
	•								•		

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Project or DCP/FCN/ECP N/A

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Subject Containment Aerosol and Iodine Removal Rates

0         J. Schulz         №152001         D. T. Deskeimer         №152001         №           0         J. Schulz         V152001         D. T. Deskeimer         № </th <th>REV</th> <th>ORIGINATOR</th> <th>DATE</th> <th>IRE</th> <th>DATE</th> <th>REV</th> <th>ORIGIN</th> <th>ATOR</th> <th>DATE</th> <th>IRE</th> <th>E DATE</th> <th>۶</th>	REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE	IRE	E DATE	۶
Table 8-21 — Containment Atmosphere and Water Sump Temperature Profile with Added Time-steps           Time (hr)         Case J Case	0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003			Ī				SAT
Table E-21 — Containment Atmosphere and Water Sump Temperature Profile with Added Time-steps         Time       Vagor Temperature ( $\Upsilon$ )         Sump Temperature ( $\Upsilon$ )         (fr)       Case 4 Case 7         1,400       3.889E-01       230.8       221.9       210.5       224.2       224       231.1         1,450       4.028E-01       229.5       220.7       202.2       223.6       223.2       229.9         1,500       4.167E-01       228.2       219.4       206.8       222.3       221.8       227.7         1,600       4.344E-01       225.6       217.2       205.6       221.6       224.6         1,700       4.831E-01       221.9       214.8       202       219.7       22.66         1,800       5.000E-01       120.7       21.6       20.17       20.5       21.6       21.7         1,900       5.278E-01       21.7       21.4       20.2       21.7       22.6       22.8         1,950       5.417E-01       21.7       20.8       21.7       21.6       22.17         1,900       5.278E-01       21.6       21.7       21.7       22.08       21.9       22.6 <td></td> <td>·</td> <td><u> </u></td> <td></td> <td><u> </u></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>- iq</td>		·	<u> </u>		<u> </u>							- iq
Table 5-21 — Containment Atmosphere and Water Sump Temperature Profile with Added Time-steps           Time         Vapor Temperature (°F)         Sump Temperature (°F)           (nec)         Case 1         Case 1 <th< td=""><td></td><td></td><td><u> </u></td><td></td><td><u>.</u></td><td>L.,</td><td>······</td><td></td><td>1</td><td></td><td></td><td></td></th<>			<u> </u>		<u>.</u>	L.,	······		1			
Table 2-21 — Containment Atmosphere and water Sump Temperature Profile with Added Time-stepsTime (sec)Vapor Temperature (*F) Case 1Sump Temperature (*F) Sump Temperature (*F) 221.91,4003.839E-01230.8221.9210.5224.2224.4Case 71,4003.839E-01220.5220.7200.2223.6223.2229.91,5004.167E-01228.2219.6207.9222.9223.6223.61,5004.444E-01225.6217.2205.6221.6221.1226.61,6004.444E-01225.6217.2205.6221.6221.8220.41,7004.722E-01223.1214.8202.2204.9223.61,8005.039E-01219.7214.8202.2219.7219.7224.61,7004.52E-01217.4201.492.7217.5217.220.81,8005.139E-01219.7211.4199.7218.5216.3219.92,0005.556E-01216.2208.1195.5216.2215.1218.22,1105.833E-01214.2207.2195.3214.4217.42,1505.972E-01217.2215.4216.5218.22,1005.139E-01217.4207.2195.3214.9213.8216.62,2106.114E-01211.8201.1193.3214.9213.8216.62,2106.21E-01206.		Ĩ						4 C	- <b>T</b>		1	
Trune Water Tunces tepsTimeVagor Temperature (F)(sec)(hr)Case ICase ICase ICase 71,4003.889E-01230.8221.9210.5224.2224231.11,4504.028E-01229.5220.7209.2223.6221.2224.91,5004.167E-01228.2219.6207.9222.9222.5228.81,5504.306E-01226.6217.2205.6221.1226.61,6004.444E-01225.6217.2205.6221.7219.2223.61,7004.722E-01223.1214.8202.2220.4219.7224.61,7504.861E-01221.9213.6221.9213.6217.7214.81,8005.000E-01220.7212.5200.8219.1218.3222.61,8005.030E-01217.7211.4199.7211.4216.2215.7216.32,9005.55E-01216.2208.1196.5216.7219.923.62,0005.55E-01216.2208.1196.5216.6215.1218.22,1105.833E-01214.2205.1193.3214.9213.8216.62,2106.111E-01211.8204.1192.3214.3213.2215.82,2106.250E-01216.7203.1193.3214.9213.8216.62,2106.258E-01206.6199.			Table 2-2	21 — Containm	ent Atm	osphere	and Wa	iter Sun	np 1emp	erature	[	
TimeVapor Temperature (°F)Sump Temperature (°F)(sec)(hr)Case 1Case 4Case 7Case 1Case 4Case 7Case 1Case 4Case 7Case 1Case 4Case 7Case 1Case 1 </td <td></td> <td></td> <td></td> <td>Pro</td> <td>ine wita</td> <td>Auueu</td> <td>1 nue-su</td> <td>eps</td> <td></td> <td></td> <td></td> <td></td>				Pro	ine wita	Auueu	1 nue-su	eps				
(sec)(hr)Case 1Case 4Case 7Case 7Case 7Case 7Case 71,4003.889E-01230.8221.9210.5224.2224.2231.11,5004.167E-01228.2219.6207.9222.3221.8227.71,6004.444E-01225.6217.2205.6221.6221.1226.61,5504.306E-01224.6218.4206.8222.3219.7224.61,6504.583E-01224.4216204.4221220.4225.61,7004.722E-01223.1214.8205.2200.4219.7219223.61,7004.722E-01223.1214.8202.2219.7219223.61,8005.000E-01207.7212.5200.8219.1218.2221.71,9005.278E-01218.5210.3198.6217.9217220.81,9505.417E-01217.4209.2197.5217.2216.3219.92,0505.694E-01215.1207.2195.4216.6215.72192,0505.694E-01212.8205.1195.3214.9213.8216.62,2106.338E-01214.2205.1195.3214.9213.2215.82,2106.338E-01206.6202190.3213.2212.2214.32,3106.338E-01206.6201.1185.3212.6215.5213.62,440 <td< td=""><td></td><td></td><td></td><td>Time</td><td>Vapor I</td><td>empera</td><td>tare (°F)</td><td>Sump 7</td><td><b>Fempera</b></td><td>ture (°F)</td><td></td><td></td></td<>				Time	Vapor I	empera	tare (°F)	Sump 7	<b>Fempera</b>	ture (°F)		
1,400 $3.889E-01$ $230.8$ $221.9$ $210.5$ $224.2$ $224.2$ $223.2$ $223.2$ $223.9$ $1,450$ $4.028E-01$ $229.5$ $220.7$ $203.6$ $223.2$ $223.2$ $223.8$ $1,550$ $4.306E-01$ $226.9$ $218.4$ $206.8$ $222.3$ $221.1$ $226.6$ $1,600$ $4.44E-01$ $225.6$ $211.2$ $204.6$ $221.1$ $226.6$ $1,700$ $4.722E-01$ $223.1$ $214.8$ $203.2$ $219.7$ $224.6$ $1,700$ $4.722E-01$ $223.1$ $214.8$ $203.2$ $219.7$ $217.6$ $221.6$ $1,800$ $5.000E-01$ $221.7$ $212.5$ $200.8$ $217.9$ $217.6$ $221.7$ $1,800$ $5.000E-01$ $217.7$ $211.4$ $199.7$ $217.2$ $216.3$ $219.9$ $2,600$ $5.547E-01$ $218.5$ $210.6$ $215.7$ $219.9$ $2,000$ $5.556E-01$ $216.2$ $215.4$ $216.2$ $215.7$ $219.9$ $2,000$ $5.568E-01$ $216.2$ $215.4$ $216.2$ $215.7$ $219.9$ $2,000$ $5.568E-01$ $216.2$ $215.7$ $218.2$ $21.7$ $2,100$ $5.33E-01$ $214.2$ $206.1$ $193.3$ $214.4$ $217.4$ $2,100$ $5.238E-01$ $206.2$ $193.3$ $214.4$ $215.4$ $215.8$ $2,200$ $6.250E-01$ $210.7$ $203.1$ $193.3$ $213.7$ $212.6$ $215.8$ $2,200$ $6.258E-01$ $206.5$ </td <td></td> <td>ł</td> <td>(sec)</td> <td>(hr)</td> <td>Case 1</td> <td>Case 4</td> <td>Case 7</td> <td>Case 1</td> <td>Case 4</td> <td>Case 7</td> <td></td> <td></td>		ł	(sec)	(hr)	Case 1	Case 4	Case 7	Case 1	Case 4	Case 7		
1,450 $4.167E-01$ $229.5$ $220.7$ $202.2$ $222.5$ $222.8$ $222.9$ $222.5$ $228.8$ $1,500$ $4.306E-01$ $226.9$ $218.4$ $206.8$ $222.3$ $221.8$ $227.7$ $1,600$ $4.444E-01$ $225.6$ $217.2$ $205.6$ $221.6$ $221.1$ $226.6$ $1,650$ $4.583E-01$ $224.4$ $2012$ $202.4$ $221.6$ $221.7$ $222.6$ $1,700$ $4.722E-01$ $221.9$ $213.6$ $202.2$ $219.7$ $218.3$ $222.6$ $1,800$ $5.00E-01$ $220.7$ $212.5$ $200.8$ $219.7$ $214.8$ $222.6$ $1,800$ $5.00E-01$ $220.7$ $212.5$ $200.8$ $219.7$ $214.8$ $222.6$ $1,800$ $5.00E-01$ $210.7$ $212.5$ $200.8$ $219.7$ $214.8$ $222.6$ $1,900$ $5.278E-01$ $218.5$ $210.3$ $198.6$ $217.9$ $217.6$ $220.8$ $1,950$ $5.478E-01$ $217.4$ $202.2$ $197.5$ $217.2$ $216.5$ $212.7$ $2,000$ $5.564E-01$ $215.1$ $207.2$ $195.4$ $216.6$ $215.7$ $219$ $2,000$ $5.564E-01$ $215.1$ $207.2$ $195.4$ $216.2$ $215.1$ $218.2$ $2,100$ $5.838E-01$ $206.6$ $201.1$ $193.3$ $214.3$ $213.2$ $215.8$ $2,200$ $6.250E-01$ $210.7$ $209.6$ $202.17.7$ $212.2$ $214.3$ $2,210$ $6.528E-01$ $207.2$			1,400	3.889E-01	230.8	221.9	210.5	224.2	224	231.1		
			1,450	4.028E-01	229.5	220.7	209.2	223.6	223.2	229.9		
			1,500	4.167E-01	228.2	219.6	207.9	222.9	222.5	228.8		
			1,550	4.306E-01	226.9	218.4	206.8	222.3	221.8	227.7		
1,650 $4.583E-01$ $224.4$ $216$ $204.4$ $221$ $220.4$ $225.6$ $1,700$ $4.722E-01$ $223.1$ $214.8$ $203.2$ $220.7$ $219.7$ $224.6$ $1,750$ $4.861E-01$ $221.9$ $212.5$ $200.8$ $219.7$ $218.3$ $222.6$ $1,850$ $5.109E-01$ $219.7$ $211.5$ $217.6$ $217.7$ $210.5$ $217.6$ $211.7$ $1,900$ $5.278E-01$ $217.7$ $210.5$ $217.6$ $217.7$ $219.9$ $2,000$ $5.556E-01$ $216.2$ $208.1$ $196.5$ $216.6$ $215.7$ $219$ $2,000$ $5.556E-01$ $214.2$ $208.1$ $196.5$ $216.6$ $215.7$ $219$ $2,000$ $5.565E-01$ $214.2$ $208.1$ $196.5$ $216.6$ $215.7$ $219$ $2,000$ $5.562E-01$ $214.2$ $208.1$ $196.3$ $215.4$ $214.4$ $217.4$ $2,100$ $5.833E-01$ $214.2$ $214.3$ $213.7$ $212.6$ $215.8$ $2,200$ $6.250E-01$ $212.8$ $205.1$ $193.3$ $214.9$ $213.2$ $214.3$ $2,300$ $6.389E-01$ $209.6$ $202$ $190.3$ $213.2$ $212.2$ $214.3$ $2,400$ $6.722E-01$ $207.2$ $199.7$ $188$ $211.8$ $210.7$ $212.8$ $2,400$ $6.678E-01$ $207.2$ $199.7$ $188$ $211.8$ $210.7$ $212.8$ $2,400$ $6.6338E-01$ $206.5$ $199.8$ $211.5$ $2$			1,600	4.444E-01	225.6	217.2	205.6	221.6	221.1	226.6		
			1,650	4.583E-01	224.4	216	204.4	221	220.4	225.6		
			1,700	4.722E-01	223.1	214.8	203.2	220.4	219.7	224.6		
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$			1,750	4.861E-01	221.9	213.6	202	219.7	219	223.6		
1,850 $5.139E-01$ $219.7$ $211.4$ $199.7$ $218.5$ $217.9$ $217.9$ $221.7$ $1,900$ $5.278E-01$ $218.5$ $210.3$ $198.6$ $217.9$ $217.9$ $220.8$ $1,950$ $5.417E-01$ $217.4$ $209.2$ $197.5$ $217.2$ $216.3$ $219.9$ $2,000$ $5.56E-01$ $216.2$ $208.1$ $196.5$ $216.6$ $215.7$ $219$ $2,050$ $5.694E-01$ $215.1$ $207.2$ $195.4$ $216$ $215.1$ $218.2$ $2,110$ $5.8972E-01$ $212.8$ $206.1$ $194.3$ $213.4$ $213.8$ $216.6$ $2,220$ $6.250E-01$ $211.8$ $204.1$ $192.3$ $214.3$ $213.2$ $215.8$ $2,240$ $6.250E-01$ $201.7$ $203$ $191.3$ $213.7$ $212.6$ $215.5$ $2,300$ $6.389E-01$ $209.6$ $202.1$ $190.3$ $213.2$ $214.3$ $213.6$ $2,440$ $6.677E-01$ $207.2$ $199.7$ $188.3$ $212.6$ $211.5$ $213.6$ $2,440$ $6.778E-01$ $206.5$ $199.3$ $188.3$ $211.7$ $210.8$ $212.7$ $2,440$ $6.778E-01$ $206.5$ $199.3$ $188.3$ $211.7$ $210.8$ $212.7$ $2,440$ $6.778E-01$ $206.5$ $199.3$ $188.3$ $211.6$ $210.4$ $212.6$ $2,500$ $6.944E-01$ $205.8$ $198.4$ $186.9$ $211.5$ $210.3$ $212.4$ $2,600$ $7.222E-01$ $204$ <td></td> <td>[</td> <td>1,800</td> <td>5.000E-01</td> <td>220.7</td> <td>212.5</td> <td>200.8</td> <td>219.1</td> <td>218.3</td> <td>222.6</td> <td></td> <td></td>		[	1,800	5.000E-01	220.7	212.5	200.8	219.1	218.3	222.6		
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$			1,850	5.139E-01	219.7	211.4	199.7	218.5	217.6	221.7		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		ſ	1,900	5.278E-01	218.5	210.3	198.6	217.9	217	220.8		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			1,950	5.417E-01	217.4	209.2	197.5	217.2	216.3	219.9	1	
2,050 $5.694E-01$ $215.1$ $207.2$ $195.4$ $216$ $215.1$ $218.2$ $2,100$ $5.833E-01$ $214$ $206.1$ $194.3$ $215.4$ $214.4$ $217.4$ $2,150$ $5.972E-01$ $212.8$ $205.1$ $193.3$ $214.9$ $213.8$ $216.6$ $2,210$ $6.11E-01$ $211.8$ $204.1$ $192.3$ $214.3$ $213.2$ $215.8$ $2,250$ $6.250E-01$ $210.7$ $203$ $191.3$ $213.7$ $212.6$ $2115$ $2,300$ $6.389E-01$ $209.6$ $202$ $190.3$ $213.2$ $212$ $214.3$ $2,340$ $6.528E-01$ $207.5$ $200.1$ $188.3$ $212.6$ $211.5$ $213.6$ $2,440$ $6.677E-01$ $207.5$ $200.1$ $188.3$ $211.7$ $212.8$ $2,440$ $6.778E-01$ $206.5$ $199$ $187.6$ $211.6$ $210.4$ $212.6$ $2,440$ $6.778E-01$ $206.5$ $199$ $187.6$ $211.6$ $210.4$ $212.6$ $2,460$ $6.833E-01$ $206.5$ $199$ $187.6$ $211.6$ $210.3$ $212.5$ $2,500$ $6.944E-01$ $205.8$ $198.4$ $186.9$ $211.5$ $210.3$ $212.4$ $2,600$ $7.722E-01$ $204$ $196.5$ $187.9$ $211.3$ $210.1$ $212.4$ $2,600$ $7.778E-01$ $205.7$ $199$ $191$ $211.1$ $209.7$ $211.4$ $3,000$ $8.333E-01$ $200.1$ $203.2$ $195.7$ $210.8$ <td></td> <td></td> <td>2,000</td> <td>5.556E-01</td> <td>216.2</td> <td>208.1</td> <td>196.5</td> <td>216.6</td> <td>215.7</td> <td>219</td> <td>  1</td> <td></td>			2,000	5.556E-01	216.2	208.1	196.5	216.6	215.7	219	1	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	,		2,050	5.694E-01	215.1	207.2	195.4	216	215.1	218.2		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		1	2,100	5.833E-01	214	206.1	194.3	215.4	214.4	217.4	ł I	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		ł	2,150	5.972E-01	212.8	205.1	193.3	214.9	213.8	216.6		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$			2,2(0	6.111E-01	211.8	204.1	192.3	214.3	213.2	215.8		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		1	2,250	6.250E-01	210.7	203	191.3	213.7	212.6	215		
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$			2,3(0	6.389E-01	209.6	202	190.3	213.2	212	214.3		1
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		(	2,350	6.528E-01	208.6	201.1	189.3	212.6	211.5	213.6		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		1	2,4(0	6.667E-01	207.5	200.1	188.3	212	210.9	212.9		J
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			2,42.0	6.722E-01	207.2	199.7	188	211.8	210.7	212.8		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		ļ	2,44.0	6.778E-01	206.8	199.3	188.3	211.7	210.5	212.7		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		]	2,460	6.833E-01	206.5	199	187.6	211.6	210.4	212.6		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		ł	2,480	6.889E-01	206.1	198.7	187.2	211.6	210.3	212.5		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			2,500	6.944E-01	205.8	198.4	186.9	211.5	210.3	212.4		
2,700       7.500E-01       203.4       196.5       187.9       211.3       210       211.9         2,800       7.778E-01       205.7       199       191       211.1       209.9       211.6         2,900       8.056E-01       207.8       201.3       193.5       211       209.7       211.4         3,000       8.333E-01       209.1       203.2       195.7       210.9       209.7       211.2         3,100       8.611E-01       210.5       204.8       197.6       210.8       209.6       211.1         3,200       8.839E-01       211.6       206.2       199.1       210.8       209.5       210.9         3,300       9.167E-01       212.7       207.4       200.4       210.7       209.5       210.8         3,400       9.444E-01       213.6       208.4       201.6       210.7       209.5       210.6         3,500       9.722E-01       214.4       209.3       202.6       210.6       209.4       210.5         3,600       1.000E+00       215.1       210.1       203.6       210.6       209.4       210.4         3,700       1.028E+00       215.7       210.8       204.4       210.			2,6(10	7.222E-01	204	196.9	185.5	211.3	210.1	212.1		
2,800       7.778E-01       205.7       199       191       211.1       209.9       211.6         2,900       8.056E-01       207.8       201.3       193.5       211       209.7       211.4         3,000       8.333E-01       209.1       203.2       195.7       210.9       209.7       211.2         3,100       8.611E-01       210.5       204.8       197.6       210.8       209.6       211.1         3,200       8.889E-01       211.6       206.2       199.1       210.8       209.5       210.9         3,300       9.167E-01       212.7       207.4       200.4       210.7       209.5       210.8         3,400       9.444E-01       213.6       208.4       201.6       210.7       209.5       210.6         3,500       9.722E-01       214.4       209.3       202.6       210.6       209.4       210.5         3,600       1.000E+00       215.1       210.1       203.6       210.6       209.4       210.4         3,700       1.028E+00       215.7       210.8       204.4       210.6       209.4       210.3			2,700	7.500E-01	203.4	196.5	187.9	211.3	210	211.9		
2,900       8.056E-01       207.8       201.3       193.5       211       209.7       211.4         3,000       8.333E-01       209.1       203.2       195.7       210.9       209.7       211.2         3,100       8.611E-01       210.5       204.8       197.6       210.8       209.5       210.9         3,200       8.889E-01       211.6       206.2       199.1       210.8       209.5       210.9         3,300       9.167E-01       212.7       207.4       200.4       210.7       209.5       210.8         3,400       9.444E-01       213.6       208.4       201.6       210.7       209.5       210.6         3,500       9.722E-01       214.4       209.3       202.6       210.6       209.4       210.5         3,600       1.000E+00       215.1       210.1       203.6       210.6       209.4       210.4         3,700       1.028E+00       215.7       210.8       204.4       210.6       209.4       210.3		l	2,8()0	7.778E-01	205.7	199	191	211.1	209.9	211.6		1
3,000       8.333E-01       209.1       203.2       195.7       210.9       209.7       211.2         3,100       8.611E-01       210.5       204.8       197.6       210.8       209.6       211.1         3,200       8.889E-01       211.6       206.2       199.1       210.8       209.5       210.9         3,300       9.167E-01       212.7       207.4       200.4       210.7       209.5       210.8         3,400       9.444E-01       213.6       208.4       201.6       210.7       209.5       210.6         3,500       9.722E-01       214.4       209.3       202.6       210.6       209.4       210.5         3,600       1.000E+00       215.1       210.1       203.6       210.6       209.4       210.4         3,700       1.028E+00       215.7       210.8       204.4       210.6       209.4       210.3			2,900	8.056E-01	207.8	201.3	193.5	211	209.7	211.4		
3,100       8.611E-01       210.5       204.8       197.6       210.8       209.6       211.1         3,200       8.889E-01       211.6       206.2       199.1       210.8       209.5       210.9         3,300       9.167E-01       212.7       207.4       200.4       210.7       209.5       210.8         3,400       9.444E-01       213.6       208.4       201.6       210.7       209.5       210.6         3,500       9.722E-01       214.4       209.3       202.6       210.6       209.4       210.5         3,600       1.000E+00       215.1       210.1       203.6       210.6       209.4       210.4         3,700       1.028E+00       215.7       210.8       204.4       210.6       209.4       210.3			3,000	8.333E-01	209.1	203.2	195.7	210.9	209.7	211.2		
3,200       8.889E-01       211.6       206.2       199.1       210.8       209.5       210.9         3,300       9.167E-01       212.7       207.4       200.4       210.7       209.5       210.8         3,400       9.444E-01       213.6       208.4       201.6       210.7       209.5       210.6         3,500       9.722E-01       214.4       209.3       202.6       210.6       209.4       210.5         3,600       1.000E+00       215.1       210.1       203.6       210.6       209.4       210.4         3,700       1.028E+00       215.7       210.8       204.4       210.6       209.4       210.3			3,100	8.611E-01	210.5	204.8	197.6	210.8	209.6	211.1		
3,300       9.167E-01       212.7       207.4       200.4       210.7       209.5       210.8         3,400       9.444E-01       213.6       208.4       201.6       210.7       209.5       210.6         3,500       9.722E-01       214.4       209.3       202.6       210.6       209.4       210.5         3,600       1.000E+00       215.1       210.1       203.6       210.6       209.4       210.4         3,700       1.028E+00       215.7       210.8       204.4       210.6       209.4       210.3			3,200	8.889E-01	211.6	206.2	199.1	210.8	209.5	210.9		
3,4009.444E-01213.6208.4201.6210.7209.5210.63,5009.722E-01214.4209.3202.6210.6209.4210.53,6001.000E+00215.1210.1203.6210.6209.4210.43,7001.028E+00215.7210.8204.4210.6209.4210.3		1	3,300	9.167E-01	212.7	207.4	200.4	210.7	209.5	210.8		
3,5009.722E-01214.4209.3202.6210.6209.4210.53,6001.000E+00215.1210.1203.6210.6209.4210.43,7001.028E+00215.7210.8204.4210.6209.4210.3			3,400	9.444E-01	213.6	208.4	201.6	210.7	209.5	210.6		1
3,600 1.000E+00 215.1 210.1 203.6 210.6 209.4 210.4 3,700 1.028E+00 215.7 210.8 204.4 210.6 209.4 210.3		l	3,500	9.722E-01	214.4	209.3	202.6	210.6	209.4	210.5		1
3,7)0 1.028E+00 215.7 210.8 204.4 210.6 209.4 210.3			3,600	1.000E+00	215.1	210.1	203.6	210.6	209.4	210.4		
		]	3,71)0	1.028E+00	215.7	210.8	204.4	210.6	209.4	210.3		1

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Subject Containment Aeroscl and Iodine Removal Rates

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE	IRE	DATE	
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003	1 1			]			
			<sup>_</sup>								1
					<u> </u>						1-
											ļ
		Table 8-2	21 — Containm	ent Atm	osphere	and Wa	ter Sun	np Temp	erature		ļ
			Pro	file with	Added	Time-ste	eps				Į
			Time	Vapor	ampara	ture (T)	Suma	Tompore	tore (°E)		ļ
		(eec)	(hr)	Case 1	Coro A	Case 7	Core 1	Case d	Case 7		
		2 800	1.0565+00	2163	2115	205.2	2105	200 4	210.3		
		3,000	1.0502+00	216.8	211.5	205.2	210.5	209.4	210.5		
		4 000	1.005E+00	2173	212.1	206.5	210.5	209.4	210.1		
		4,000	1.250E+00	219.3	215	209	210.6	209.6	209.9		
		5.000	1.389E+00	220.4	216.6	210.8	210.7	209.8	209.9		
		5.500	1.528E+00	221.1	217.6	211.8	210.9	210.2	209.9		
		6.000	1.667E+00	221.6	218.1	212.4	211.1	210.5	210		
	:	6.5(10	1.806E+00	221.7	218.4	212.8	211.3	210.9	210.1		
		7.0(0	1.944E+00	221.5	218.4	212.9	211.5	211.2	210.3		
			E. C. Materiala								
		7.5()0	2.083E+00	221.1	218.2	213.3	211.8	211.6	210.1		ļ
		8.0(10	2.222E+00	220.7	218.1	213.9	212.1	211.9	209.7		
		8,500	2.361E+00	220.5	217.9	214.4	212.4	212.2	209.3		
		9.000	2.500E+00	220.1	217.8	214.7	212.6	212.4	209.1		
		9,500	2.639E+00	219.8	217.6	215	212.9	212.7	208.8		
		10,000	2.778E+00	219.4	217.4	215.2	213.1	212.9	208.6		
		12,500	3.472E+00	217.7	216.2	215.3	213.7	213.8	207.7		ļ
			The Million and State	- <b>S</b> 1985 - S		143.5	216.65	-	at the same		
		15,000	4.167E+00	215.7	214.5	214.3	213.8	214.1	207		
		17,500	4.861E+00	213.2	212.2	212.5	213.5	214	206.2		
		20,000	5.556E+00	210.8	210	210.6	212.8	213.6	205.3		
		22,500	6.250E+00	208.9	208.2	209	211.9	212.8	204.3		
		25,000	6.944E+00	207.1	206.5	207.5	210.8	211.9	203.2		[
		27,500	7.639E+00	205.2	204.6	205.9	209.7	210.9	202.1		
			心下使其前的影响。	i ken	De la set	5 (24 S R S			2.6		
		30,000	8.333E+00	203.2	202.7	204.1	208.5	209.8	200.9		
		35,000	9.722E+00	199.1	198.6	200.4	205.9	207.4	198.5		
		40,000	1.111E+01	195.4	194.9	. 197	203.2	204.8	195.9		
,		45,000	1.250E+01	192.2	191.7	194,2	200.6	202.3	193.5		
					- 121350	18,658		Section 2			
		50,(100	1.389E+01	189.4	188.7	191.6	198.3	200	191.2		
		55,000	1.528E+01	186.4	185.6	189.1	196.1	197.7	189.1		
		60,(100	1.667E+01	183.9	183	187	194	195.7	187.1		
		65,000	1.806E+01	181.7	180.8	185	192.1	193.8	185.4		
		70,000	1.944E+01	179.7	178.7	183.1	190.5	192.1	183.8		
		. 75,000	2.083E+01	177.8	176.7	181.4	189	190.6	182.3		l
		80,000	2.222E+01	176.2	175	180	187.6	189.3	181		
		85,000	2.361E+01	.174.6	173.3	178.7	186.4	188	179.8		

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Subject Containment Aeroscl and Iodine Removal Rates

V	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE		DATE
Τ	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003	·			·		
	······			[						
		£		<u> </u>	<u>a</u>	L		<u> </u>		
	1				,					
		Table 8-2	21 — Containm	ent Atm	osphere	and Wa	iter Sur	np Temp	erature	
	ĺ		Pro	tile with	Added	Time-st	eps			
	ł		Time	Vapor 'I	'empera	ture (°F)	Sump	Temperat	ure (°F)	
		(sec)	(hr)	Case 1	Case 4	Case 7	Case 1	Case 4	Case 7	
			Section Section			1.16	Server .			
	ſ	90.000	2.500E+01	173.2	171.8	177.6	185.3	186.9	178.8	
		95,000	2.639E+01	171.9	170.5	176.6	184.2	185.9	177.8	
		100,000	2.778E+01	170.8	169.3	175.7	183.3	184.9	177	
		125,(00	3.472E+01	166.2	164.7	171.7	179.8	181.5	173.9	
		150,(100	4.167E+01	162	160.4	168.1	177.1	178.7	171.3	
	· · •				19285			S & Sala		
	ł	175,000	4.861E+01	158	156.1	164.5	174.6	176.1	168.8	
		200,000	5.556E+01	154.7	152.7	161.6	172.3	173.9	166.7	
	ł	225,000	6.250E+01	151.7	149.8	159.1	170.5	172.1	164.9	[
		250,000	6.944E+01	149	146.8	156.5	168.8	170.4	163.2	ł
		275,000	7.639E+01	146.5	144.1	154.2	167.3	168.8	161.6	
	l.	300,000	8.333E+01	144.4	141.9	152.4	166	167.5	160.3	
	Į.	400.000		126.5	122 7	145 6	161 4	1(2.0	166.0	
	1	500,000	1.1116+02	130.5	1076	145.0	157.8	150 /	152.9	
		600,000	1.567E+02	126	127.0	136.6	157.0	1567	152.4	
		700,000	1.007E+02	121.6	120	132.6	152.8	154.6	147.6	
		800,000	2.222E+02	119.9	118.3	130.5	151.6	152.5	146 1	
		900,000	2.500E+02	118.2	114.8	128.4	150.2	150.2	144.8	
		1,000,000	) 2.778E+02	117	114	126.2	148.3	148.1	143.5	
		1,250,000	3.472E+02	113	115.7	123	145.2	145.1	141.5	
		1,500,000	) 4.167E+02	112.3	112.2	120.7	142.9	142.9	140	
		1,750,000	) 4.861E+02	114.4	114.4	118.3	140.7	140.7	138.6	
		2,000,000	) 5.556E+02	113.8	113.8	115.9	138.7	138.7	137.1	
		2,500,000	) 6.944E+02	111.5	113	113.2	134.6	134.6	134.7	
		1.288 0.0	生物和自动和非常		的之中。		(*************************************	A 18 12 1		
		3,000,000	8.333E+02	110.8	112.5	112.6	132.5	132.5	132.6	
		3,500,000	) 9.722E+02	112.2	112.2	109.3	131.1	131.1	131.1	1
	1	4,000,000	) 1.111E+03	111.8	111.8	108.9	129.6	129.6	129.6	ł
		5,000,000	) 1.389E+03	111	111	108.1	126.7	126.7	126.7	
	Í	6,000,000	1.667E+03	110.3	110.2	110.3	123.7	123.7	123.7	]
		7,000,000	1.944E+03	109.9	109.9	109.9	122.5	122.5	122.5	ł
	1	8,000,000	2.222E+03	109.6	109.6	109.6	121.4	121.4	121.4	1
	ĺ	9,000,050	2.500E+03	109.3	109.3	109.3	120.3	120.3	120.3	
	ļ	10.000.05	0 2.778E+03	109	109	109	119.2	119.2	11921	

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0         1.00000         1.1000000         1.100000         1.1000000         1.100000000000000000000000000000000000	- A	L Schulz	8/15/2003	D T Devh	eimer 8	/15/2003					<u> </u>		DAIL	ATOR
Using Table 8-21 and the LocaDose time periods defined on Table 8-1, the maximum and minimum temperatures are determined for each of the LocaDose time periods. The maximum temperatures are shown on Table 8-22. The minimum temperatures are shown on Table 8-23. Table 8-22 — Maximum Temperatures $Table 8-22 - Maximum Temperatures (T) Sump Temperature (T) Time Period Case 1 Case 4 Case 7 Case 1 Case 4 Case $		<b>J.</b> <u>Johnsz</u>							<u>_</u>				<u> </u>	
		Using Table 8- temperatures a shown on Tabl	21 and th re determ e 8-22. [[] 30 min - 2 hr - 4.] 4 hr - 8.] 8 hr - 13 13.8 hr - 24 hr - 4 48 hr - 9 96 hr - 7 7 Time 30 min - 2 hr - 4.] 4 hr - 8.] 8 hr - 13. 13.8 hr - 2 hr - 4.] 4 hr - 8.] 8 hr - 13. 13.8 hr - 2 hr - 4.] 4 hr - 7 96 hr - 7	e LocaDos ined for each he minimum Ta e Period 2 hr ar .8 hr 24 hr 8 hr 6 hr 20 hr .8 hr 24 hr 8 hr 24 hr 8 hr 24 hr 8 hr 24 hr 8 hr 24 hr 8 hr 20 hr	e time p ch of th m temp ble 8-2 221.7 203.2 189.4 173.2 158.0 136.5 Vapo Case 1 105.4 105.1 105.1 105.1 87.4 78.4 70.0 58.1	eriods e <i>Local</i> eratures 2 — Ma r Tempe 2 218 214 202 188 171 156 133 r Tempe 103 103 103 101 94.1 87. 77. 68.9 56.1	defined Dose tir are sho erature e 4 Ca 4 2 2 2 3 2 3 2 7 19 8 1° 1 16 7 14 erature e 4 Ca 6 16 4 10 8 9 1 8 7 8 9 7 5 6	I on T me per own o n Ten (°F) ase 7 13.1 15.3 14.3 04.1 91.6 77.6 64.5 45.6 (°C) ase 7 00.6 01.8 01.3 95.6 8.7 0.9 3.6 3.1	able 8-1, riods. The n Table 8 nperatur 218.5 213.8 208.5 198.3 185.3 174.6 161.4 Sump 7 Case 1 103.6 101.0 101.0 98.1 92.4 85.2 79.2 71.9	the maximum e maximum 3-23. res Cemperatu Case 4 217.6 214.1 209.8 200.0 186.9 176.1 162.9 Cemperatur Case 4 103.1 101.1 101.2 98.8 93.3 86.1 80.1 72.7	re (°F) Case 7 221.7 210.1 207.0 200.9 191.2 178.8 168.8 155.9 re (°C) Case 7 105.4 98.9 97.2 93.8 88.4 81.6 76.0 68.8	minimur atures a	m re	

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			Ta	hla 9 1	2. M		m Ter	nperotur			]		
l			14	DIC 0-4			in ten	прегация 1	<del>C</del> 3		Į		
ł				Vapo	or Tempe	eratur	e (°F)	Sumpl	Cemperat	ure (°F)	ļ		
		Tim	e Period	Case	1 Case	<u>4</u> (	Case 7	Case 1	Case 4	Case 7			
İ.		30 min -	2 hr	203.4	4 196	.5	85.5	210.5	209.4	209.9	Í		
	•	2 hr - 41	hr	216.2	2 214	.9 2	213.3	211.8	211.6	207.2	ļ		
		4 hr - 8 l	br	204.2	2 203	.6 2	205.0	209.1	210.3	201.5			
		8 hr - 13	.8 hr	189.6	5 188	<b>.9</b> :	191.8	198.4	200.1	191.3			
		13.8 hr -	24 hr	174.2	2 172	.9	178.4	186.1	187.7	179.5			
		24 hr - 4	8 hr	158.4	4 156	.5	64.8	174.8	176.3	169.0	ł		
		48 hr - 9	6 h <b>r</b>	140.8	8 138	.2	149.3	163.9	165.4	158.3			
		96 hr - 7	20 hr	111.4	4 112	2	113.1	134.2	134.2	134.3			
				Vapo	or Tempe	ratur	e (°C)	Sump 7	Temperati	ire (°C)			
		Tim	Period	Case	1 Case	<u>4</u> C	Case 7	Case 1	Case 4	Case 7		1	
· ·		30 min -	2 hr	95.2	91.	4	85.3	99.2	98.6	98.8			
		2 hr - 4 l	ır	102.3	3 101	.6 )	100.7	99.9	99.8	97.3			
		4 hr - 81	ır	95.6	95.	3	96.1	98.4	99.1	94.2			
		8 hr - 13	.8 hr	87.5	87.	2	88.8	92.5	93.4	88. <i>5</i>			
1		13.8 hr -	24 hr	79.0	78.	3	81.3	85.6	86.5	82.0			
		24 hr - 4	8 hr	70.2	69.	2	73.8	79.3	80.2	76.1	1		
		48 hr - 9	6 hr	60.4	59,0	0	65.2	73.3	74.1	70.2			- 1
		96 hr - 7	20 hr	44.1	44.	6	45.0	56.8	56.8	56.8			

## Air-Steam Mixture Temperature

The maximum and minimum temperatures encompassing each of the three cases presented above are summarized on Table 8-24. The air steam mixture temperature for use by *REMOVE* is determined using the information from Table 8-20 is also presented on this table based on the lowest removal rate consideration.

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							•			DNI
			Table 8-24 -	- Air-Stean	1 Temperat	ure Rang	e			
			Time Period	Minimum	Maximum	Used in REMOV	E			
			30 min - 2 hr	85.3	105.4	85.3	4			
			2 hr - 4 hr	100.7	105.1	100.7				
			4 hr - 8 hr	95.3	102.1	95.3	1			
			8 hr - 13.8 hr	87.2	95.6	87.2	1			
			13.8 hr - 24 hr	78.3	88.7	78.3				
			24 hr - 48 hr	69.2	80.9	69.2				
			48 hr - 96 hr	59.0	73.6	59.0	1			
1			96 hr - 720 hr	44.1	63.1	44.1				
			. <u> </u>							

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As an example of the methodology used to determine the air-steam mixture temperature, the methodology used to determine the appropriate temperature for the 4-8 hour time period is described. Reviewing the values presented on Table 8-20 shows that the lower temperature (95.3 °C) has a lower removal rate than the upper temperature (102.1 °C), therefore the lower value is used in the REMOVE runs.

## Partition Coefficients

As shown on Figure 8-2, partition coefficients increase with increasing sump temperature after about 60 °F. As shown on Table 8-22 and Table 8-23, the sump temperatures are always above 60 °F post LOCA. Therefore, the minimum temperatures are used to determine the appropriate partition coefficients for use by REMOVE. The partition coefficients and the DFs are calculated using a linear interpolation between the values presented on Table 8-18. These values are then truncated to two significant digits. The results are presented on Table 8-25.

Table 8-25 Ele	mental Iodine Part	ition Coeffic	ients and	l Decontami	nation Factors
Time Period	Minimum Sump Temperature (°F)	Partition Coefficient	DF	Truncated Partition Coefficient	Truncated DF
30 min - 2 hr	209.4	8,389	172.30	8,300	170
2 hr - 4 hr	207.2	7,989	164.13	7,900	160
4 hr - 8 hr	201.5	6,969	143.30	6,900	140
8 hr - 13.8 hr	191.3	5,466	112.63	5,400	110
13.8 hr - 24 hr	179.5	4,066	84.04	4,000	84
24 hr - 48 hr	169.0	3,092	64.13	3,000	64
48 hr - 96 hr	158.3	2,309	48.15	2,300	48
96 hr - 720 hr	134.2	1,180	25.10	1,100	25

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0J. Schulz8/15/2003D. T. Dexheimer8/15/2003As an example, the partition coefficient for the 4 – 8 hour time period is calculated: From Table 8-18, the partition coefficient at 200 °F is 6,705, and the partition coefficient at 210 °F is 8,495. The partition coefficient at 201.5 °F is then: $PF(201.5) = 6,705 + (8,496 - 6,705) \frac{201.5 - 200}{210 - 200} = 6,974$ This value is in good agreement with the result shown on Table 8-25. The difference (less than 0.1%) is due to the accuracy used by Excel to calculate the values and the accuracy of the hand calculation shown above.
As an example, the partition coefficient for the 4 – 8 hour time period is calculated: From Table 8-18, the partition coefficient at 200 °F is 6,705, and the partition coefficient at 210 °F is 8,495. The partition coefficient at 201.5 °F is then: $PF(201.5) = 6,705 + (8,496 - 6,705) \frac{201.5 - 200}{210 - 200} = 6,974$ This value is in good agreement with the result shown on Table 8-25. The difference (less than 0.1%) is due to the accuracy used by Excel to calculate the values and the accuracy of the hand calculation shown above.
As an example, the partition coefficient for the 4 – 8 hour time period is calculated: From Table 8-18, the partition coefficient at 200 °F is 6,705, and the partition coefficient at 210 °F is 8,495. The partition coefficient at 201.5 °F is then: $PF(201.5) = 6,705 + (8,496 - 6,705) \frac{201.5 - 200}{210 - 200} = 6,974$ This value is in good agreement with the result shown on Table 8-25. The difference (less than 0.1%) is due to the accuracy used by Excel to calculate the values and the accuracy of the hand calculation shown above.
As a second example, the DF for the 24 – 48 hour period is calculated: From Table 8-18, the DF at 160 °F is 50.32, and the DF at 170 °F is 65.63. The DF at 169.0 °F is then: $DF(169.0) =: 50.32 + (65.63 - 50.32) \frac{169.0 - 160}{170 - 160} = 64.10$ This value is in good agreement with the result shown on Table 8-25. The difference (less than

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•.			 Table	8-26 Elem	ental Iodin	e Spray R	emoval Rate	s (hr <sup>.1</sup> )			
		Nozzla					Recircula	ation Phase			
	Header	Angle	Injection	30 <u>min - 2</u> br	2 - 4 hr	4 - 8 hr	8 - 13.8 hr	13.8 - 24 hr	24 - 48 hr	48 - 96 hr	96 - 720 hr
049-4"-C-KEO	1	10	0.2853	5.2509	5.1578	4.7970	4.1359	3.3524	2.6564	2.0745	1.0122
049-4"-C-KEO	1	45	0.2865	5.3183	5.2355	4,9155	4.2049	3,4494	2.6985	2.1091	1.0270
043-4"-C-KEO	2	10	0.2885	5.3945	5.3378	5.0145	4.2624	3.4322	2.7186	2.1218	1.0310
043-4"-C-KEO	2	45	0.2906	5.5567	5.4826	5.0483	4.3825	3,5138	2.7913	2.1770	1.0553
045-4"-C-KEO	2	0	0.2140	4.4990	4.4490	4.0605	3.4988	2.7736	2.1810	1.6891	0.8099
045-4"-C-KEO	<b>2</b> ·	90	0.2174	4.8015	4.7077	4.3762	3.7124	2.9840	2.3075	1.7805	0.8513
051-4"-C-KEO	1	0	0.2145	4.4441	4.4033	4.1072	3.4661	2.8056	2.1611	1.6736	0.8019
051-4"-C-KEO	1	90	0.2179	4.8255	4.7341	4.4252	3.7304	3.0140	2.3155	1.7894	0.8530
052-2.5"-C-KEO	1	0	0.1088	2.3503	2.3273	2.1722	1.8212	1.4712	1.1260	0.86955	0.41473
052-2.5"-C-KEO	1	45	0.1092	2.4032	2.3730	2.2163	1.8577	1.5002	1.1473	0.88558	0.42180
046-2.5"-C-KEO	2	0	0.1089	2.3607	2.3377	2.1838	1.8285	1.4783	1.1296	0.87213	0.41577
046-2.5"-C-KEO	2	45	0.1093	2.4147	2.3844	2.2280	1.8656	1.5072	1.1513	0.88838	0.42295
Spray Header 1 To	otal		1.2221	24.5923	24.2310	22.6334	19.2162	15.5928	12.1048	9.4017	4.5306
Spray Header 2 To	otal		1.2288	25.0271	24.6992	_22.9113_	19.5502	15.6891	12.2793	9.5289	4.5862
Minimum Spray I	Removal Ra	te (br <sup>·1</sup> ):	1.22	24.59	24.23	22.63	19.22	15.59	12.10	9.40	4.53
Adjusted Spray I	Removal Ra	te (hr <sup>-1</sup> ):	1.02	20.49	20.19	18.86	16.01	12.99	10.09	7.83	3.78

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8.4	Total Rem In the previous calculated. In removal rates rates as a fun- including oth The natural depercentile leve and 10 <sup>th</sup> percentile leve and 10 <sup>th</sup> per	<i>OVAL RAT</i> us sections this sections for use in ction of time relation of	the natural deponent on the individual dose assessment ne for four group s, alkali metals, a ates and spray re- ercentile, the reas ower bound value is used for all three s calculated by co- ural deposition ra- odine natural dep- ay removal rates odine spray remova- ne elemental iodi- 20 hr <sup>-1</sup> . Standard that spray remova- hr and the 2 hr to mined for the spr total removal rates ed containment re- sultant total conta- ile level, on Tabl 32 for the 10 <sup>th</sup> pe	sition rem removal r calculations are deter and all off moval rationable up the. For election percention ombining attes from the position rates of the spray of a rate be to 4 hr time ayed and the consists egion the ainment reference and percentile 1	noval ra rates wi ons usin ermined her parti- tes for a pper bor- emental tile leve the ind Table 8 ate calcu- le 8-16 from Ta- remova Plan 6.: limited he perior the uns of a co total re emoval ad Table evel.	tes and the spray ll be combined i ing the program <i>I</i> : elemental iodin iculates. erosols are provue and value; 50 <sup>th</sup> p iodine removal, els. ividual removal able areas for the able able 8-26 I rates for the 30 5.2 (Reference 6 to a maximum of to a maximum of s. prayed containne moval rate cons rates are shown e 8-30 for the 50	y remova nto total <i>locaDosi</i> ies, parti- ided for ercentile only one rates from e 8-5 8.2.2 min to 2 .4f, Section f 20 hr <sup>-1</sup> ment regi tural dep ists only on Table "percentile"	l rates we containm e. Individu culate iod three diffe , the medi e value wa m the follo the nut the ion III.4.c ; therefore ons. In the osition an of the nat e 8-27 and tile level,	re ent ial rem ines erent ian valu as owing e 2 hr t .(1)) e, 20 hr e spraye d spray ural i Table and on	oval 1e, <sup>-1</sup> is ed	

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REV INDICATOR

D. T. Dexheimer 8/15/2003

I age D -	Time Ster-			Elemental Wall	Iodine		P	articulate Io Wall	dine		Alkali Meta Wall	als	Other Particulates Wall		
LocaDos	se time-Steps		Spray	Deposition	Total	DF	Spray	Deposition	Total	Spray	Deposition	Total	Spray	Deposition	Total
0.00002+00	- 8.3333E-03	nr	0	0	0	N/A	0	0	0	0	0	0	0	0	0
8.3333E-03	— 1.6667E-02	hr	0	4.26	4.26	110	0	4.88E-02	4.88E-02	0	4.88E-02	4.88E-02	0	0	0
1.6667E-02	- 8.3333E-02	hr	1.02	4.26	5.28	110	25.54	4.88E-02	25.59	25.54	4.88E-02	25.59	25.54	0	25.54
8.3333E-02	— 3.3333E-01	hr	1.02	4.26	5.28	110	25.54	1.88E-02	25.59	25.54	4.88E-02	25.59	25.54	0	25.54
3.3333E-01	- 5.0000E-01	hr	1.02	4.26	5.28	110	25.54	4.88E-02	25.59	25.54	4.88E-02	25.59	25.54	0	25.54
5.0000E-01	— 5.0833E-01	hr	1.02	4.26	5.28	110	25.54	6.61E-02	25.60	25.54	6.98E-02	25.61	25.54	5.22E-02	25.59
5.0833E-01	— 6.9372E-01	hr	1.02	4.26	5.28	110	25.54	6.61E-02	25.60	25.54	6.98E-02	25.61	25.54	5.22E-02	25.59
0.694	<u> </u>	ħr	20.00	4.26	24.26	170	25.54	6.61E-02	25.60	25.54	6.98E-02	25.61	25.54	5.22E-02	25.59
1	- 1.8	hr	20.00	4.26	24.26	170	25.54	6.61E-02	25.60	25.54	6.98E-02	25.61	25.54	5.22E-02	25.59
1.8	<b>—</b> 2	hr	20.00	4.26	24.26	170	18.89	4.21E-01	19.3 <b>1</b>	18.89	4,21E-01	19.31	18,89	4.21E-01	19.31
2.000	- 3.8	hr	20.00	4.26	24.26	160	10.07	4.21E-01	10.49	10.07	4.21E-01	10.49	10.07	4.21E-01	10.49
3.8	4	hr	20.00	4.26	24.26	160	9.07	1.87E-01	9.26	9.07	1.87E-01	9.26	9.07	1.87E-01	9.26
4	- 8	hr	18.86	4.26	23.12	140	9.04	1.87E-01	9.23	9.04	1.87E-01	9.23	9.04	1.87E-01	9.23
8	- 13.8	hr	16.01	4.26	20.27	110	9.04	1.87E-01	9.23	9.04	1.87E-01	9.23	9.04	1.87E-01	9.23
13.8	22.2	hr	12.99	4.26	17.26	84	9.04	1.01E-01	9.14	9.04	1.01E-01	9.14	9.04	1.01E-01	9.14
22.2	24	hr	12.99	4.26	17.26	84	9.04	0	9.04	9.04	0	9.04	9.04	0	9.04
24	- 48	hr	10.09	4.26	14.35	64	9.04	0	9.04	9.04	0	9.04	9.04	0	9.04
48	- 96	hr	7.83	4 26	12.10	48	9.04	0	9.04	9.04	0	9.04	9.04	0	9.04
96	- 720	hr	2 70	4.26	904	75	0.04	0	0.04	0.04	0	0.04	0.04	0	0.04

8/15/2003

J. Schulz

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Ι.							· · · · ·										
					Table	e 8-28 — U	nspray	ed Cont	tainmen	nt Region 9	0 <sup>th</sup> Percen	tile Rei	moval Rate	s (br <sup>-1</sup> )			
				!		Elemental Wall	lodine		P	articulate Io Wall	dine		Alkali Meta Wali	als		Other Partic	ulates
	LocaDe	ose Time	-Steps		Spray	Deposition	Total	DF	Spray	Deposition	Total	Spray	Deposition	Total	Spray	Deposition	Total
	0.0000E+00	- 8.333	3E-03	hr	0	0	0	N/A	0	0	0	0	0	0	0	0	0
	8.3333E-03	- 1.666	57E-02	hr	0	4.26	4.26	110	0	4.88E-02	4.88E-02	0	4.88E-02	4.88E-02	0	0	0
	1.6667E-02	- 8.333	33E-02	hr	0	4.26	426	110	0	4.88E-02	4.88E-02	0	4.88E-02	4.88E-02	0	0	0
	8.3333E-02	- 3.333	33E-01	hr	0	4.26	426	110	. 0	4.88E-02	4.88E-02	0	4.88E-02	4.88E-02	0	0	0
	3.3333E-01	- 5.000	00E-01	hr	0	4.26	426	110	0	4.88E-02	4.88E-02	0	4.88E-02	4,88E-02	0	0	0
	5.0000E-01	- 5.083	33E-01	ħr	0	4.26	4.26	110	0	6.61E-02	6.61E-02	0	6.98E-02	6.98E-02	0	5.22E-02	5.22E-02
1	5.0833E-01	- 6.933	72E-01	hr	0	4.26	4.26	110	0	6.61E-02	6.61E-02	0	6.98E-02	6.98E-02	0	5.22E-02	5.22E-02
	0.694	- 1		hr	0	4.26	4.26	170	0	6.61E-02	6.61E-02	0	6.98E-02	6.98E-02	0	5.22E-02	5.22E-02
	1	- 1.8		hr	0	4.26	4.26	170	0	6.61E-02	6.61E-02	0	6.98E-02	6.98E-02	0	5.22E-02	5.22E-02
	. 1.8	<b>—</b> 2		hr	0	4.26	4.26	170	0	4.21E-01	4.21E-01	0	4.21E-01	4.21E-01	0	4.21E-01	4.21E-01

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Subjec	t Containmer	nt Aerosol ;	and Iodin <del>e</del> Remov	al Rates		······································	- <u></u>	Sheet	<u>95</u> of	281
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		Tal	ble 8-29 — S	Sprayed	l Conta	inment	Region 50	<sup>th</sup> Percenti	ile Rem	oval Rates	(hr <sup>.1</sup> )			
			Elemental Wall	Iodine		P.	articulate Io Wall	dine		Alkali Meta Wall	als	C	other Particu Wall	lates
LocaDose Time-St	eps	Spray	Deposition	Total	DF	Spray	Deposition	Total	Spray	Deposition	Total	Spray	Deposition	Total
0.0000E+00 — 8,3333E	03 hr	0	0	0	N/A	0	. 0	0	0	0	0	0	0	0
8.3333E-03 - 1.6667E-	02 hr	0	4.26	4.26	110	0	3.87E-02	3.87E-02	o	3.87E-02	3.87E-02	0	0	0
1.6667E-02 - 8.3333E	02. hr	1.02	4.26	5.28	110	11.98	3.87E-02	12.02	11.98	3.87E-02	12.02	11.98	0	11.98
8.3333E-02 — 3.3333E-	01 hr	1.02	4.26	5.28	110	11.98	3.87E-02	12.02	11.98	3.87E-02	12.02	11.98	0	11.98
3.3333E-01 - 5.0000E-	01 hr	1.02	4.26	5.28	110	11.98	3.87E-02	12.02	11.98	3.87E-02	12.02	11.98	. 0	11.98
5.0000E-01 - 5.0833E-	01 hr	1.02	4.26	5.28	110	11.98	5.18E-02	12.03	11.98	5.46E-02	12.03	11.98	4.11E-02	12.02
5.0833E-01 - 6.9372E-	01 hr	1.02	4.26	5.28	110	11.98	5.18E-02	12.03	11.98	5.46E-02	12.03	11.98	4.11E-02	12.02
0.694 — 1	hr	20.00	4.26	24.26	170	11.98	5.18E-02	12.03	11.98	5.46E-02	12.03	11.98	4.11E-02	12.02
1 - 1.8	hr	20.00	4.26	24.26	170	11.98	5.18E-02	12.03	11.98	5.46E-02	12.03	11.98	4.11E-02	12.02
1.8 - 2	hr	20.00	4.26	24.26	170	8.08	1.91E-01	8.27	8.08	1.91E-01	8.27	8.08	1.91E-01	8.27
2.000 — 3.8	ħr	20.00	4.26	24.26	160	2.84	1.91E-01	3.03	2.84	1.91E-01	3.03	2.84	1.91E-01	3.03
3.8 4	hr	20.00	4.26	24.26	160	1.98	1.62E-01	2.14	1.98	1.62E-01	2.14	1.98	1.62E-01	2.14
4 — 8	hr	18.86	4.26	23.12	140	1.82	1.62E-01	1.98	1.82	1.62E-01	1.98	1.82	1.62E-01	1.98
8 — 13.8	hr	16.01	4.26	20.27	110	1.77	1.62E-01	1.94	1.77	1.62E-01	1.94	1.77	1.62E-01	1.94
13.8 - 22.2	hr	12.99	4.26	17.26	84	1.77	9.12E-02	1.87	1.77	9.12E-02	1.87	1.77	9.12E-02	1.87
22.2 - 24	hr	12.99	4.26	17.26	84	1.77	0	1.77	1.77	0	1.77	1.77	0	1.77
24 48	hr	10.09	4.26	14.35	64	1.77	0	1.77	1.77	0	1.77	1.77	0	1.77
48 — 96	hr	7.83	4.26	12.10	48	1.77	0	1.77	1.77	0	1.77	1.77	0	1.77
96 - 720	hr	3.78	4.26	8.04	25	1.77	0	1.77	1.77	0	1.77	1.77	0	1.77

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Su	ibject <u>Co</u>	ntainment	Aeroso	ol ar	nd Iodine l	Removal R	lates				Sh	eet _	<u>96</u> of	281			
F		INATOR	DATE		IRE		DATE	REV	ORIGINAT	OR DATE	1	RE	DATE	~			
	0 J.S	Schulz	8/15/2003	3	D. T. Dexi	neimer 8/1	5/2003							S 10			
					•									HOIN			
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					Table	• 8-30 —	Unspra	yed Co	itainme	nt Region 5	0 <sup>°®</sup> Percen	itile Re	moval Ra	tes (hr <sup>-</sup> ')	1 .		•
						Elementa Wall	al lodine	•		articulate lo Wall	dine	[	Alkali Mo Wall	etais		Jther Partic Wall	ulates
•	LocaD	ose Time-	Steps		Spray	Deposition	e Tota	l DF	Spray	Deposition	Total	Spray	Deposition	r Total	Spray	Deposition	Total
	0.0000E+00	- 8.333	3E-03	hr	0	0	0	N/A	0	0	0	0	0	0	0	0	0
	8.3333E-03	- 1.666	7E-02	hr	0	4.26	4.26	110	0	3.87E-02	3.87E-02	0	3.87E-02	3.87E-02	0	0	0
	1.6667E-02	- 8.333	3E-02	hr	0	4.26	4,26	110	0	3.87E-02	3.87E-02	0	3.87E-02	3.87E-02	0	0	0
	8.3333E-02	- 3.333	3E-01	hr	0	4.26	4.26	110	0	3.87E-02	3.87E-02	0	3.87E-02	3.87E-02	0	0	· 0
	3.3333E-01	5.000	0E-01	hr	0	4.26	4.26	110	0	3.87E-02	3.87E-02	0	3.87E-02	3.87E-02	0	0	Ů
	5.0000E-01	- 5.083	3E-01	hr	0	4.26	4.26	5 110	0	5.18E-02	5.18E-02	0	5.46E-02	5.46E-02	0	4.11E-02	• 4.11E-02
	5.0833E-01	- 6.937	2E-01	hr	0	4.26	4.26	5 110	0	5.18E-02	5.18E-02	0	5.46E-02	5.46E-02	0	4.11E-02	4.11E-02
	0.694	- 1		hr	0	4.26	4.26	170	0	5.18E-02	5.18E-02	0	5.46E-02	5.46E-02	0	4.J1E-02	4.11E-02
	1	- 1.8		hr	0	4.26	4.26	i 170	0	5.18E-02	5.18E-02	0	5.46E-02	5.46E-02	0	4.11E-02	4.11E-02
	1.8	- 2		hr	0	4.26	4.26	170	0	1.91E-01	1.91E-01	0	1.91E-01	1.91E-01	:0	1.91E-01	1.91E-01
	2.000	- 3.8		br	0	4.26	4.26	160	0	1.91E-01	1.91E-01	0	1.91E-01	1.91E-01	0	1.91E-01	1.91E-01
	3.8	4		hr	0	4,26	4.26	160	0	1.62E-01	1.62E-01	0	1.62E-01	1.62E-01	0	1.62E-01	1.62E-01
	4	- 8		hr	0	4.26	4.26	140	0	1.62E-01	1.62E-01	0	1.62E-01	1.62E-01	0	1.62E-01	1.62E-01
	8	- 13.8		hr	0	4.26	4.26	110	0	1.62E-01	1.62E-01	.0	1.62E-01	1.62E-01	0	1.62E-01	1.62E-01
	13.8	22.2		hr	0.	4.26	4.26	84	0	9.12E-02	9.12E-02	0	9,12E-02	9.12E-02	0	9.12E-02	9.12E-02
	22.2	- 24		hr	0	4.26	4.26	84	0	0	0	0	0	0	0	0	0
ł	24	48		hr	0	4.26	4.26	64	0	0	0	0	0	0	0	0	0
	48	96		hr	0	4.26	4.26	48	0	0	0	O	0	0	0	0	0

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Sut	ject <u>Co</u>	ntainmen	nt Aerosol	and Iodin	e Remova	I Rates				Sh	eet	<u>97</u> of	281			
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. 0	J. 5	Schulz	8/15/2003	D. T. De	exheimer	8/15/2003							REV INDICATO			
			<u>.</u>	  	able 8-31 Eleme	Spray	yed Cor	itainmen   F	t Region 10 Particulate Id	<sup>th</sup> Percent	ile Rem	oval Rate	es (hr <sup>-1</sup> )	(	Other Partic	ulates
	LocaD	ose Time	Steps	Spray	Wal Deposi	l L <mark>ion T</mark> ot	al Di	Spray	Wall Deposition	Total	Spray	Wall Deposition	Total	Spray	Wall Deposition	Total
	0.0000E+00	- 8.33	33E-03 h	r o	0	0	N//	x 0	0	0	0.	0	0	0	0	0
	8.3333E-03	- 1.66	67E-02 h	r 0	4.26	4.2	6 11	0	2.94E-02	2.94E-02	0	2.94E-02	2.94E-02	0	0	0
11	1.6667E-02	- 8.33	33E-02 H	r 1.02	4,26	5.2	8 11	5.15	2.94E-02	5.18	5.15	2.94E-02	5.18	5.15	0	5.15
	8.3333E-02	- 3.33	33E-01 h	r 1.02	4.26	5.2	8 11	5.15	2.94E-02	5.18	5.15	2.94E-02	5,18	5.15	0	. 5.15
11	3.3333E-01	- 5.00	00E-01 h	u 1.02	4.26	5.2	8 11	5.15	2.94E-02	5.18	5.15	2.94E-02	5.18	5.15	Û	5.15
	5.0000E-01	- 5.08	33E-01 H	r 1.02	4.26	5.2	8 11	5.15	3.95E-02	5.19	5.15	4.17E-02	5.19	5.15	3.12E-02	5.18
	5.0833E-01	- 6.93	72E-01 ł	r 1.02	4.26	i 5.2	8 11	5.15	3.95E-02	5.19	5.15	4.17E-02	5.19	5.15	3.12E-02	5.18
{	0.694	- 1	1	r 20.00	4.26	i 24.:	26 17	5.15	3.95E-02	5.19	5.15	4.17E-02	5.19	5.15	3.12E-02	5.18
	1	- 1.8	ŀ	r 20.00	4.26	5 24.:	26 17	5.15	3.95E-02	5.19	5.15	4.17E-02	5.19	5.15	3.12E-02	5.18
	1.8	- 2	ŀ	r 20.00	4.26	i 24.3	26 17	3.79	8.93E-02	3.88	3.79	8.93E-02	3.88	3.79	8.93E-02	3.88
	2.000	- 3.8	ł	r 20.00	4.26	i 24.1	26 16	1.32	8.93E-02	1.41	1.32	8.93E-02	1.41	1.32	8.93E-02	1.41
11	3.8	. 4	ł	r 20.00	4.26	24.2	26 16	0 0.79	1.16E-01	0.91	0.79	1.16E-01	0.91	0.79	1.16E-01	0.91
	4	- 8	ł	r 18.86	4.26	23.	12 14	0 0.62	1.16E-01	0.73	0.62	1.16E-01	0.73	0.62	1.16E-01	0.73
	8	- 13.8	1	u 16.01	4.26	20.3	27 11	0.52	1.16E-01	0.63	0.52	1,16E-01	0.63	0.52	1.16E-01	0.63
	13.8	- 22.2	. 1	IT 12.99	4.26	i 17.3	26 84	0.50	8.60E-02	0.59	0.50	8.60E-02	0.59	0.50	8.60E-02	0.59
	22.2	- 24	i	ur   12.99	4.26	5 17.:	26 84	0.50	0	0.50	0.50	0	0.50	0.50	0.	0.50
	24	- 48	3	ur   10.09	4.26	5 14.:	<b>35 6</b> 4	0.50	0	0.50	0.50	0	0.50	0.50	0	0.50
	48	96	ł	r 7.83	4.26	i 12.	10 48	0.50	0	0.50	0.50	0	0.50	0.50	0	0.50
	96	- 720	h	IT 3.78	4.26		4 24	0.50	0	0.50	0.50	. 0	0.50	0.50	0	0.50

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#### E&TS DEPARTMENT ICCN NO/ **CALCULATION SHEET** PRELIM. CCN NO. PAGE OF CCN CONVERSION: CCN NO. CCN Project or DCP/FCN/ECP Calc No. N-6030-001 Subject Containment Aerosol and Iodine Removal Rates Sheet 98 of 281 REV ORIGINATOR DATE IRE DATE ORIGINATOR REV DATE IRE DATE REV INDICATOR 8/15/2003 D. T. Dexheimer 8/15/2003 J. Schulz 0 Table 8-32 --- Unsprayed Containment Region 10th Percentile Removal Rates (hr<sup>-1</sup>) **Elemental Iodine** Particulate Iodine **Alkali** Metals **Other Particulates** Wall Wall Wall Wall LocaDose Time-Steps Sprav Deposition Deposition Tetal DF Spray Deposition Total Spray Deposition Total Spray Total 0.0000E+00 - 8.3333E-03 hr Û 0 0 N/A 0 0 0 0 0 0 0 0 0 8.3333E-03 - 1.6667E-02 hτ 0 4.26 4.26 110 0 2.94E-02 2.94E-02 0 2.94E-02 2.94E-02 0 0 0 1.6667E-02 - 8.3333E-02 hr 0 4.26 110 4,26 0 2.94E-02 2.94E-02 0 2.94E-02 2.94E-02 0 ۵ 0 8.3333E-02 - 3.3333E-01 hr 0 4.26 4.26 110 2.94E-02 2.94E-02 0 2.94E-02 2.94E-02 0 0 0 .0 3.3333E-01 - 5.0000E-01 hr 0 4.26 4.26 110 0 2.94E-02 2.94E-02 0 2.94E-02 2.94E-02 0 0 0 - 5.0833E-01 5.0000E-01 hr 0 4.26 4.26 110 0 3.95E-02 3.95E-02 0 4.17E-02 4.17E-02 0 3.12E-02 3.12E-02 5.0833E-01 - 6.9372E-01 hr 0 4.26 426 110 0 3.95E-02 3.95E-02 0 4.17E-02 4.17E-02 0 3.12E-02 3.12E-02 0.694 - 1 hr 3.12E-02 0 Ô 3.95E-02 0 4.26 426 170 3.95E-02 4.17E-02 4.17E-02 0 3.12E-02 - 1.8 hr 1 0 4.26 170 3.95E-02 0 4.17E-02 3.12E-02 3.12E-02 4.26 0 3.95E-02 4.17E-02 0 1.8 - 2 hr 4.26 8.93E-02 8.93E-02 8.93E-02 8.93E-02 . 0 8.93E-02 8.93E-02 ٥ 4.26 170 0 0 2.000 - 3.8 hr 8.93E-02 0 4.26 4.26 160 0 8.93E-02 0 8.93E-02 8.93E-02 0 8.93E-02 8.93E-02 3.8 4 hr 0 4.26 1.16E-01 1.16E-01 4.26 160 0 0 1.16E-01 1.16E-01 0 1.16E-01 1.16E-01 4 - 8 hr 0 4.26 4.26 140 0 1.16E-01 1.16E-01 0 1.16E-01 1.16E-01 0 1.16E-01 1.16E-01 - 13.8 Ŕ hr 0 4.26 4.26 110 0 1.16E-01 1.16E-01 0 1.16E-01 1.16E-01 0 1.16E-01 1.16E-01 - 22.2 13.8 hr 0 8.60E-02 8.60E-02 0 8.60E-02 8.60E-02 8.60E-02 4.26 4.26 84 0 0 8.60E-02 22.2 -- 24 hr 0 4.26 4.26 84 0 0 0 0 0 0 0 0 0 24 - 48 hr 0 4.26 4.26 64 0 0 0 0 0 0 0 0 Ô 48 - 96 hr 0 4.26 4.26 48 0 0 0 0 0 0 0 0 0 96 - 720 hr

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Concentration of HIO-1.2508E-06 moles/liter Concentration of H2OI-1.7679E-12 moles/liter Concentration of I-=1.2507E-06 moles/liter												
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Res Ten Wat Equ Equ Equ Ini Vol	sults of iodir mperature= 100 cer pH value= bilibrium cons dilibrium cons dilibrium cons dilibrium cons tial iodine i tume of gaseou tume of liquid	NG - Wate 0.00 Deg 7.00 stant K1= stant K2= stant K4= nventory sphase=4 1 phase=4	r partition coe F 43.08 586.3 1.7100E-12 1.6600E-11 in water= 2.03 2.2840E+06 ft** .6647E+04 ft**3	fficient 0 mol 3	calcula les	ations					
Concentration of 12 liquid=1.0154E-07 moles/lite: Concentration of HIO=1.3196E-06 moles/liter Concentration of H2OI=1.2773E-12 moles/liter Concentration of I-=1.3196E-06 moles/liter Concentration of I3-=7.0555E-11 moles/liter Concentration of total aqueous iodine=1.4213E-06 moles/liter Partition coefficient= 603.0 Total iodine inventory in containment= 2.030 moles The iodine decontamination factor DF= 13.32 Iodine concentration in gas phase=2.3570E-09 moles/liter											
Bech (c) Orig Proj Subj	ntel Standard 1990 ginator Jorge ject SONGS ject SONGS Ic	Compute: Schulz dine Pa:	Program Date 14 tition Factors	ICONC , Jun 2003	NE316 Calc I Job No Sheet	Version 3.0 No. N-6030-00 R D. 16575-167 No. 9	ev No. 0	=			
Res Tem Wat Equ Equ Ini Vol Vol Vol Com Com	wilts of iodin mperature= 110 for pH value= milibrium cons milibrium <pre>A + Wate: .00 Deg : 7.00 tant K1= tant K2= tant K4= itant K4= itant K4= itant K4= 2 a -</pre>	r partition coe F 34.16 532.5 2.7700E-12 1.8600E-11 in water= 2.03 2.2840E+06 ft** .6647E+04 ft**3 4 id=6.7736E-08 m 718E-06 moles/1 1846E-13 moles/1 17E-06 moles/1 475E-11 moles/1	fficient 0 mol 3 oles/lite iter liter ter iter	calcul es	ations						
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Concentration of total Partition coefficient= Total iodine inventory The iodine decontaminat Iodine concentration in Bechtel Standard Compute (c) 1990 Originator Jorge Schulz Project SONGS Subject SONGS Iodine Pa Equilibrium constant KI Equilibrium of 12 lic Concentration of 12 lic Concentration of I2-1.4 Concentration of I3-3.3 Concentration of I3-3.3 Concentration of I3-3.3 Concentration of I3-3.4 Concentration of I3-3.4 Concentration of I3-3.5 Concentration aqueous iodine=1 726.0 in containment= ion factor DF= 1 gas phase=1.982 r Program Date 14 rtition Factors r partition coe F * 27.38 * 487.7 *4.3800E-12 * 2.0600E-11 y in water= 2.03 * 2.2840E+06 ft** 4.6647E+04 ft**3 3 nid=4.5281E-08 m *104E-06 moles/11 0.140E-13 moles/1 0.140E-13 moles/1 103E-06 moles/11 1143E-11 moles/1 aqueous iodine=1 380.2 In containment= ion factor DF= 1 gas phase=1.653 r Program Date 14 rtition Factors er partition coe F = 22.71 = 450.2 = 6.6500E-12 = 2.2840E+06 ft** 4.6647E+04 ft**3	.4396E-06 2.030 5.83 9E-09 mol ICONC , Jun 2003 Ifficient 0 mol 3 coles/lite iter liter liter 2.030 8.98 8E-09 mol ICONC , Jun 2003 ICONC , Jun 2003	s moles moles moles es/lit. NE316 Calc Job N Sheet calcul es r moles es/lit. NE316 Calc Job N Sheet calcul calcul sheet	/liter er Version 3.0 No. N-6030-00 R o. 16575-167 No. 10 ations / /liter er Version 3.0 No. N-6030-00 R o. 16575-167 No. 11 ations	ev No. 0	- -						

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**E&TS DEPARTMENT** ICCN NO./ **CALCULATION SHEET** PRELIM. CON NO. PAGE \_OF \_ CCN CONVERSION: CCN NO. CCN Project or DCP/FCN/ECP Calc No. N-6030-001 Sheet 112 of 281 Subject Containment Aerosol and Iodine Removal Rates REV DATE ORIGINATOR 1RF DATE REV ORIGINATOR DATE IRE DATE REV INDICATOR D. T. Dexheimer 8/15/2003 J. Schulz 8/15/2003 | 0 Bechtel Standard Compute: Program ICONC , NE316 Version 3.0 (c) 1990 Calc No. N-6030-00 Rev No. 0 Date 14 Jun 2003 Originator Jorge Schulz Project SONGS Subject SONGS Iodine Partition Factors Job No. 16575-167 Sheet No. 17 Results of iodine - Water partition coefficient calculations Temperature= 190.00 Deg F Water pH value= 7.00 Equilibrium constant K1= 11.01 Equilibrium constant K2= 320.7 Equilibrium constant K3=7.2400E-11 Equilibrium constant K4=3.4600E-11 Initial iodine inventory in water= 2.030 moles Volume of gaseous phase=2.2840E+06 ft\*\*3 Volume of liquid phase=4.6647E+04 ft\*\*3 Number of iterations= 3 Concentration of I2 liquid=3.1792E-09 moles/liter Concentration of HIO=1.5193E-06 moles/liter Concentration of H2OI=7.2399E-14 moles/liter Concentration of I-=1.5193E-06 moles/liter Concentration of I3-=1.5488E-12 moles/liter Concentration of total aqueous iodine=1.5225E-06 moles/liter Partition coefficient= 5273. Total iodine inventory in containment= 2.030 moles The iodine decontamination factor DF= 108.7 Iodine concentration in gas phase=2.8875E-10 moles/liter Bechtel Standard Computer Program \_\_\_\_ ICONC , NE316 Version 3.0 (c) 1990 Calc No. N-6030-00 Rev No. 0 Date 14 Jun 2003 Originator Jorge Schulz Project SONGS Job No. 16575-167 Subject SONGS Iodine Partition Factors 18 Sheet No. #1:e##\$\$\$CCC22222255########### Results of iodine - Watter partition coefficient calculations Temperature= 200.00 Deg F Water pH value= 7.00 Equilibrium constant K .= 9.970 Equilibrium constant K2= 309.2 Equilibrium constant K3=1.0200E-10 Equilibrium constant K4=3.6600E-11 Initial iodine inventory in water= 2.030 moles Volume of gaseous phase=2.2840E+06 ft\*\*3 Volume of liquid phase=4.6647E+04 ft\*\*3 Number of iterations= 3 Concentration of I2 liquid=2.2682E-09 moles/liter Concentration of HIO-1.5233E-06 moles/liter Concentration of H2OI=5.4500E-14 moles/liter Concentration of I-=1.5233E-06 moles/liter

SCE 26-426 REV. 2 [REFERENCE: SO123-XXIV-7.15]

Project or DCP/FCN/ECP       Calc No.       N-6030-001       CCN CONVERSION: CCN NO. CCN         Subject       Containment Acrosol and Iodine Removal Rates       Sheet       113       of         New       ORIGINATOR       DATE       IRE       DATE       Rev       ORIGINATOR       DATE       IRE       DATE         0       J. Schulz       \$/15/2003       D. T. Dexheimer       \$/15/2003       D. Dexheimer       \$/15/2003       D. T. Dexheimer       \$/15/2003       D. T. Dexheimer       \$/15/2003       D. T. Dexheimer       \$/15/2003       D. T. Dexheimer       \$/15/2003       D. T. Dexheimer       \$/15/2003       D. T. Dexheimer       \$/15/2003       D. T. Dexheimer       \$/15/2003       D. T. Dexheimer       \$/10       D. Dexheimer	OF	PAGEOF		10.	ICCN NO./ PRELIM. CCN N		EET	ARTMENT TION SH	TS DEP/		
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0       J. Schulz       8/15/2003       D. T. Dexheimer       8/15/2003         Concentration of I3-=1. )682E-12 moles/liter         Concentration of total squeous iodine=1.5255E-06 moles/liter         Partition coefficient- 5705.         Total iodine inventory in containment= 2.030 moles         The iodine decontamination factor DF= 137.9         Iodine concentration in gas phase=2.2750E-10 moles/liter         Bechtel Standard Computer Program       ICONC , NE316 Version 3.0         (c) 1990       Calc No. N-6030-00 Rev No. 0         Originator Jorge Schulz       Date 14 Jun 2003         Project SONGS       Job No. 16575-167         Subject SONGS Iodine Partition Factors       Sheet No. 19         Temperature= 210.00 Deg F       Water pH value= 7.00	ATE g	DATE	IRE	DATE	ORIGINATOR	REV	DATE	IRE	DATE	ORIGINATOR	REV
Concentration of 13-=1.3682E-12 moles/liter Concentration of total aqueous iodine=1.5255E-06 moles/liter Partition coefficient= 5705. Total iodine inventory in containment= 2.030 moles The iodine decontamination factor DF= 137.9 Iodine concentration in gas phase=2.2750E-10 moles/liter Bechtel Standard Computer Program ICONC , NE316 Version 3.0 (c) 1990 Calc No. N=6030-00 Rev No. 0 Originator Jorge Schulz Date 14 Jun 2003 Project SONGS Job No. 16575-167 Subject SONGS Iodine Partition Factors Sheet No. 19 Example a state of iodine - Water partition coefficient calculations Temperature= 210.00 Deg F Water pH value= 7.00	NDICAT		<b></b>			·	8/15/2003	D. T. Dexheimer	8/15/2003	J. Schulz	0
<pre>Equilibrium constant K1= 9.160 Equilibrium constant K2= 299.5 Equilibrium constant K4=3.8600E-11 Initial iodine inventory in water= 2.030 moles Volume of gaseous phase=2.2840E+06 ft**3 Volume of liquid phase=4.6647E+04 ft**3 Number of iterations= 3 Concentration of I2 liquid=1.6472E-09 moles/liter Concentration of H2OI=4.1660E-14 moles/liter Concentration of H2OI=4.1660E-14 moles/liter Concentration of H2OI=4.1660E-14 moles/liter Concentration of J=-1.5262E-06 moles/liter Concentration of J=-1.5262E-06 moles/liter Concentration of J=-1.5262E-06 moles/liter Concentration of J=-1.5262E-06 moles/liter Concentration of J=-1.5262E-06 moles/liter Concentration of J=-1.5262E-06 moles/liter Concentration of J=-1.5262E-06 moles/liter Concentration of total agueous iodum=1.5279E=06 moles/liter Partition coefficient= 8496. Total iodine decontamination factor DP= 174.5 Todine concentration in gas phase=1.7983E=10 moles/liter Dechtel Standard Computer Program ICONC , NE316 Version 3.0 (c) 1990 Calc No. N=6030=00 Rev No. 0 Originator Jorge Schulz Date 14 Jun 2003 Project SONGS Iodine Furtition Factors Sheet No. 20 Termetatione====================================</pre>			-	ev No. 0	<pre>/liter // iter //</pre>	moles, moles es/lite NE316 Y Calc I Job No Sheet r moles, moles es/lite NE316 Y Calc I Job No Sheet calcula	iter .5255E-00 2.030 37.9 0E-10 mol ICONC , Jun 2003 fficient 0 mol 3 0 br>1 mol 3 0 1 mol 3 0 1 mol 3 0 1 mol 3 0 1 mol 3 0 1 mol 3 0 1 mol 3 0 1 mol 3 0 1 mol 3 0 1 mol 3 0 1 mol 3 0 1 mol 3 0 1 mol 3 1 1 mol 3 1 1 mol 3 1 1 mol 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	682E-12 moles/1 queous iodine=1 705. n containment= on factor DF= 1 gas phase=2.275 Program Date 14 tition Factors r partition coe F 9.160 299.5 1.4100E-10 3.8600E-11 in water= 2.03 2.2840E+06 ft** .6647E+04 ft**3 3 id=1.6472E-09 m 262E-06 moles/1 1660E-14 moles/1 160E-14 moles/1 160E-13 moles/1 1902E-13 moles/1 100E-14 moles/1 100E-14 moles/1 100E-14 moles/1 100E-14 moles/1 100E-14 moles/1 100E-14 moles/1 100E-14 moles/1 100E-14 moles/1 100E-14 moles/1 100E-14 moles/1 100E-14 moles/1 100E-15 moles/1 100E-16 moles/	I31.) total a cient- 6 entory i taminatL tion in Computer Schulz dine Par schulz dine Par e - Wate .00 Deg 7.00 tant K1- tant K2= tant K4= nventory s phase=4 ions- i2 licu HIO=1.5 H2OI=4.: I37.5 total a cient- 8 entory in taminati tion in taminati tion in computer Schulz dine Part schulz dine Part schulz dine Part cient- 8 entory i taminati tion in computer Schulz dine Part computer Schulz dine Part computer schulz dine Part taminati tion in computer schulz dine Part computer Schulz	oncentration of oncentration of artition coeffi- otal iodine inva- he iodine concentra- chtel Standard ) 1990 iginator Jorge oject SONGS oject SONGS for esults of iodin emperature= 210 ater pH value= guilibrium cons guilibrium cons guilibrium cons guilibrium cons guilibrium cons guilibrium cons guilibrium cons fullibrium cons fullibrium cons fullibrium cons fullibrium cons fullibrium cons fullibrium of gaseou olume of liquid umber of iterat poncentration of poncentration of pon	C C C P T T T Be (C O P T Sul R T W E E E E I I V V NCC C C C C C P T T T Be (C O P T Sul R T W E E E E I I V V NCC C C C C C P T T T Sul E E E E E E I I E E E E E E E E
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	<u>z</u> .
60.0       - Air-steam temperature (degC)         60.0       - Droplet temperature (degC)         3333       - Initial velocity (m/sec)         10       - Initial velocity (m/sec)         11       - Sprey fall height (t) - 049-4"-C-KEO         2       - Intrajectory, 2-landa         399       - Intrajectory, 2-landa         2       - Autore organic Iodine removal (laryes, 2-mo)         31.79       - Flow per nozzle (gpm)         28       - Number of nozzles         1       - Temperature difference between air and wall (degC)         601513       - Strayed volume         2       - Autore case? (laryes, 2-mo)         9:2.1.1.5       12-70.int         8       - Temperature Parametrics         300705       Schulz         50x05       Schulz         50x05       Schulz         50x05       - Air-steam temperature (defC)         70.0       - Droplet temperature (defC)         70.0       - Air-steam temperature (defC)	

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#### **E&TS DEPARTMENT** ICCN NOJ **CALCULATION SHEET** PRELIM. CCN NO. PAGE OF CCN CONVERSION: CCN NÓ. CCN Project or DCP/FCN/ECP Calc No. N-6030-001 Subject Containment Aerosol and Iodine Removal Rates Sheet 123 of 281 **FEV** ORIGINATOR DATE IRE DATE REV ORIGINATOR DATE IRE DATE REV INDICATOR 8/15/2003 8/15/2003 D. T. Dexheimer J. Schulz 0 SONGS 16575-167 N-6030-001 0 1 9 2 - Number of size groups 69 - Mean drop diameter (cm) 0.00375 - Air-steam temperature (degC) - Droplet temperature (degC) 95.0 95.0 - Initial velocity (cm/sec) 3393 10 - Initial angle 79.81 - Spray fall height (ft) - 049-4"-C-KEO - 1-Trajectory, 2-lambda - Print individual drop parameters 2 2 - 1-NRC E model, 2- Entered E value 1 - Elemental Iodine partition coefficient 8389 - Calculate organic iodine removal (1=yes, 2=no) 2 13.79 - Flow per nozzle (gpm) - Number of nozzles 28 - Temperature difference between air and wall (degC) 1 - Effective plateout area 601519 - Sprayed volume 1907000 - Another case? (1=yes, 2=no) 2 9.2.1.1.11 I2-100.in 8 I2-100.out 12 Spray Temperature Parametrics Jorge Schulz BONGS 16575-167 N-6030-001 Ö 1 9 2 69 - Number of size groups 0.00375 - Mean drop diameter (cm) - A:.r-steam temperature (degC) 100.0 - D::oplet temperature (degC) 100.0 3393 - Initial velocity (cm/sec) 10 - Initial angle 79.81 - Spray fall height (ft) - 049-4"-C-KEO - 1 - Trajectory, 2-lambda 2 2 - P::int individual drop parameters - 1 NRC E model, 2= Entered E value 1 - Elemental Iodine partition coefficient 8389 - Calculate organic iodine removal (1=yes, 2=no) 2 13.79 - Flow per nozzle (gpm) - Number of nozzles 28 - Tomperature difference between air and wall (degC) 1 601519 - Effective plateout area - Sprayed volume 1907000 - Another case? (1=yes, 2=no) 2 9.2.1.1.12 I2-105.in 8

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#### **E&TS DEPARTMENT** ICCN NO./ **CALCULATION SHEET** PRELIM. CON NO. PAGE OF **CCN CONVERSION:** CCN NO. CCN **Project or DCP/FCN/ECP** Calc No. N-6030-001 Subject Containment Aerosol and Iodine Removal Rates Sheet 124 of 281 REV ORIGINATOR DATE REV ORIGINATOR DATE IRE DATE IRE DATE REV INDICATOR 8/15/2003 D. T. Dexheimer 8/15/2003 0 J. Schulz I2-105.out **I2** Spray Temperature Parametrics Jorge Schulz SONGS 16575-167 N-6030-001 ٥ 1 9 2 - Number of size groups 69 0.00375 - Maan drop diameter (cm) - Air-steam temperature (degC) 105.0 105.0 - Droplet temperature (degC) 3393 - Initial velocity (cm/sec) - Initial angle 10 - Spray fall height (ft) - 049-4"-C-KEO 79.81 2 - 1=Trajectory, 2=lambda - Print individual drop parameters 2 - 1=NRC E model, 2= Entered E value 1 8389 - Elemental Iodine partition coefficient - Calculate organic iodine removal (1=yes, 2=no) 2 13.79 - Flow per nozzle (gpm) 28 - Number of nozzles - Temperature difference between air and wall (degC) 1 601519 - Effective plateout area 1907000 - Sprayed volume - Alother case? (1=yes, 2=no) 2 9.2.1.1.13 12-110.in 8 I2-110.out 12 Spray Temperature Parametrics Jorge Schulz SONGS 16575-167 N-6030-001 0 1 9 2 69 - Number of size groups 0.00375 - Mean drop diameter (cm) 110.0 - Air-steam temperature (degC) - Droplet temperature (degC) 110.0 - Initial velocity (cm/sec) 3393 . 10 - Initial angle 79.81 - Spray fall height (ft) - 049-4"-C-KEO - 1-Trajectory, 2-lambda - Print individual drop parameters 2 2 1 - 1-NRC E model, 2= Entered E value 8389 - Elemental Iodine partition coefficient - Calculate organic iodine removal (1=yes, 2=no) 2 13.79 - Flow per nozzle (gpm) - Number of nozzles 28 - Temperature difference between air and wall (degC) 601519 - Effective plateout area 1907000 - Sprayed volume - Another case? (1=yes, 2=no) 2

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190 2	7000	- Sp - An	rayed volume other case? {1=	yes, 2-nd	<b>b</b> )						
	9.2.1.2 Inj	ection Ph	ase Input File (	i2-boric.i	in)						
8 12-	boric.out										
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129	.9	- Ai - Dr	r-steam tempera oplet temperatu	ture (deg re (degC)	gC) )				•		
339	3	- In	itial velocity	(cm/sec)							
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2	~	~ 1=	Trajectory, 2=1	ambda							
2		- Pr - 1=	int individual ( NBC E model, 2=	drop para Entered	meters E valu	•					
200		- E1	emental Iodine	partitic	coeff:	icient					
2	79	- Ca - Fl	lculate organic ow per nozzle (	iodine 1 TOB)	removal	(1=yes, 2=no)					
28		- Nu	mber of nozzles	3.51							
1	<b>5</b> 10	- Fei	mperature diffe: fective plateou:	rence bet	tween a:	ir and wall (deg	JC)				
190	7000	- Sp	rayed volume	L GACA							
1		- An	other case? {1=;	yes, 2=n.c	<b>&gt;)</b>				•		
69		- Nu	mber of size gro	oups							
0.0	0375	- Me. - Ai	an drop diamete: r-stear tempera:	r (cm) ture (dec							
129	.9	- Dr	oplet temperatu	re (degC)				1	,		
339	3	- In - In	itial velocity	(cm/sec)							
79.	81	- Sp:	ray fall height	(ft) - 0	049-4"-0	C-KEO					
2		- 1=: - Pr	Trajectory, 2=1 int individual (	ambda iron nara	meters						
1		- 1=	NRC E model, 2=	Entered	E valu	2	•				
200		- El:	emental Iodine p loulete organic	partiticr	coeff:	(leves 2=po)					
13.	79	- Fl	ow per nozzle (	gpm)	Lemovar	(x-343) z-110)					
28		- 'Nu	mber of nozzles	rence hat		and usl) (day				i	
601	519	- Ef:	fective plateou	t area	MCCII di	r ann wart (dei	9-01				
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69	^^ <b>^</b>	- Nur	mber of size gro	oups							
0.0	.9	- Mea - Ai:	an drop diameter r-steam temperat	ture (deo	(Or						
129	.9	- Dr	oplet temperatu:	re (degC)							
339	з.	- In:	itial velocity	(cm/sec)							
85.	60	- 5p:	ray fall height	(ft) - 0	)43-4"-(	C-REO					
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$\begin{array}{c} 2\\ 2\\ 2\\ 1\\ 200\\ 2\\ 3\\ 28\\ 1\\ 601\\ 1\\ 90\\ 1\\ 2\\ 9\\ 0.0\\ 129\\ 339\\ 45\\ 85\\ 2\\ 2\\ 1\\ 200\\ 2\\ 13\\ 2\\ 69\\ 0.0\\ 129\\ 339\\ 0.0\\ 129\\ 339\\ 0.0\\ 129\\ 339\\ 0.0\\ 129\\ 339\\ 105\\ 2\\ 1\\ 200\\ 129\\ 339\\ 89\\ 105\\ 2\\ 2\\ 1\\ 200\end{array}$	79 519 7000 0375 .9 3 60 79 519 7000 0375 .9 3 .83 79 519 7000 0375 .9 3 .83 79 519 7000 0375 .9 3 .83 .83 .83 .83	- 1= - Fr. - Fr. - F1. - Ca. - F1. - Vui - F1. - Vui - F1. - Sp - Fn. - Vui - Fr. - F1. - F1	Trajectory, 2=1. int individual in NRC E model, 2= emental Iodine j lculate organic ow per nozzle ( mber of nozzles mperature diffe factive plateour rayed volume other case? (1=) mber of size grant oplet temperatur itial velocity itial angle ray fall height Trajectory, 2=1. int individual of NRC E model, 2= emental Iodine j lculate organic ow per nozzle ( mber of nozzles mperature diffe; fective plateour itial velocity itial angle rayed volume other case? (1=) mber of size grant oplet temperatur itial velocity itial angle ray fall height frajectory, 2=1. int individual of NRC E model, 2= mber of size grant oplet temperatur itial velocity itial angle rayed volume other case? (1=) her of size grant mperature diffe; fective plateour resteam temperatur itial velocity itial angle rayed volume other case? (1=) her of size grant mperature diffe; fective plateour resteam temperatur itial velocity itial angle rayed volume other case? (1=) mber of size grant mperature diffe; fective plateour rayed volume other case? (1=) mber of size grant mperature diffe; fective plateour rayed volume other case? (1=) mber of size grant rayed volume other case? (1=) mber of size grant mperature diffe; fective plateour rayed volume other case? (1=) mber of size grant matter diffe; fective plateour rayed volume other case? (1=) mber of size grant ray fall height frajectory, 2=1. int individual of NRC E model, 2= emental Iodine plateour rayed volume other case? (1=)	ambda drop pars Entered partition iodine j rence bet t area yes, 2=nc oups r (cm) ture (degC) (ft) - () ambda drop pars Entered partition iodine j gpm) rence bet t area yes, 2=nc oups r (cm) ture (degC) (ft) - () ambda drop pars Entered partition iodine j gpm) rence bet t area yes, 2=nc oups r (cm) ture (degC) (ft) - 0 ambda drop pars Entered partition iodine j gpm) rence bet t area yes, 2=nc oups r (cm) ture (degC) (ft) - 0 ambda gpm) rence bet t area yes, 2=nc oups r (cm) ture (degC) (ft) - 0 ambda iodine j gpm) rence bet t area yes, 2=nc oups r (cm) ture (degC) (ft) - 0 ambda iodine j gpm) rence bet t area yes, 2=nc oups r (cm) ture (degC) (ft) - 0 ambda iodine j gpm)	meters E value (coeff. emoval (ween a) (C) (43-4"-( meters E value (coeff. emoval (ween a) (c) (45-4"-( meters E value (coeff. emoval (coeff.) (coeff.) (coeff.)	e icient (1=yes, 2=no) ir and wall (de C-KEO icient (1=yes, 2=no) ir and wall (de C-KEO e icient (1=yes, 2=no) ir and wall (de C-KEO e icient (1=yes, 2=no) ir and wall (de C-KEO e icient (1=yes, 2=no) ir and wall (de	gC) gC)					

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REV           0           2           13.           200           1           601           190           1           20           13.           20           129           339           0           108           2           13.           200           13.           200           13.           200           129           339           108           2           108           2           108           2           13.           200           2           13.           200           2           13.           200           201           202           13.           201	ORIGINATOR J. Schulz 79 519 7000 0375 .9 .9 3 .11 79 519 7000 0375 .9 3 .11	DATE &/15/2003 - Ca. - FJ. - Nut - Tei - Sp. - Au - Mu - Me - Ai - Nut - Nut - In - In - In - In - In - Sp. - Au - Nut - Ei - Cai - FL - Nut - Ei - Cai - FL - Nut - Ei - FL - Cai - Sp. - Au - Nut - Sp. - Au - Nut - Sp. - Au - Nut - Ei - Sp. - Au - Nut - Ei - Sp. - Au - Nut - Sp. - Au - Nut - Ei - Sp. - Au - Nut - Ei - Sp. - Au - Nut - Ei - Sp. - Au - Nut - Sp. - Au - Sp. - In - In - Sp. - In - Ei - Cai - FL - Cai - FL - Cai - FL - Nut - Ei - Sp. - Au - Nut - Ei - Cai - FL - Au - Nut - Ei - Sp. - Au - Nut - Ei - Cai - FL - Dr - In - Ei - Sp. - Au - Nut - Ei - Sp. - Au - Nut - Nut	IRE D. T. Dexheimer D. e of nozzles mperature differ fective plateour rayed volume other case? (1=) mber of size group itial velocity itial angle ray fall height Trajectory, 2=1: int individual G NRC E model, 2= emental Iodine p lculate organic ow per nozzle (mber of size group rayed volume other case? (1=) mber of size group and drop diameter rayed volume other case? (1=) mber of size group itial velocity itial angle ray fall height Trajectory, 2=1: int individual G NRC E model, 2= emental Iodine p lculate organic ow per nozzle (g mber of nozzles)	DATE 8/15/2003 iodine r gpm) rence bet t area yes, 2=nc oups r (cm) ture (degC) (ft) - C ambda drop parse Entered partition iodine r gpm) rence bet t area yes, 2=nc oups r (cm) ture (degC) (ft) - C ambda drop parse Entered partition ture (degC) (cm/sec) (ft) - C ambda indice parse Entered partition iodine r gpm)	REV REV removal rween a p) (C) (C) (C) (C) (C) (C) (C) (C	C-KEO c-KEO c-KEO c-KEO c-KEO c-KEO c-KEO c-KEO c-KEO c-KEO c-KEO c-KEO c-KEO c-KEO c-KEO c-KEO c-KEO	gC)	IRE	DATE	REV INDICATOR
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1 69 0.0 129 339 0 117 2 1 200 2 13. 10 1	0375 .9 .9 3 .43	- And - Nuu - Mea - Ai: - In: - In: - Sp: - 1= - F1: - F1: - Ca: - F1: - F1: - F1: - Tei	other case? (1=) mber of size gra an drop diameter r-steam temperator litial velocity itial angle ray fall height Trajectory, 2-14 int individual of NRC E model, 2= emental Iodine p loulate organic ow per nozzle (g mber of nozzles mperature differ	yes, 2-nd oups r (cm) ture (degC) (cm/sec) (ft) - 0 ambda drop para Entered partition iodine r gpm) rence bet	) 52-2.5 meters E valu coeff. removal	"-C-KEO e icient (1=yes, 2=no) ir and wall (de	gC)			

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601519	- Effective plateout area	
1907000	- Sprayed volume	
1	- Another case? (1=yes, 2=no)	
2		
69	- Number of size groups	
0.00375	- Mean drop diameter (cm)	
129.9	- Air-steam temperature (degC)	
129.9	- Droplet temperature (degC)	
3393	- Initial velocity (CM/Sec)	
40	- Inicial angle - Sorow fall beight (ft) - (152-2 5"-C-KEC	
2	- 1=Trajectory, 2=lambda	
2	- Print individual drop parameters	
1	- 1=NRC E model, 2= Entered E value	
200	- Elemental Iodine partition coefficient	
2 .	- Calculate organic iodine removal (1=yes, 2=no)	
13.79	- Flow per nozzle (gpm)	
10	- Number of nozzles	
1	- Temperature difference between air and wall (degC)	
601519	- Effective plateout area	
1907000	- Sprayed volume	
1	- Another case? (1=yes, 2=n0)	
2	- Number of size groups	
07	- Number of Size groups - Mean dron diameter (cm)	
129 9	- Bir-steam temperature (derC)	
129.9	- Droplet temperature (degC)	
3393	- Initial velocity (cm/sec)	
0	- Initial angle	
118.47	- Spray fall height (ft) - 046-2.5"-C-KEO	•
2	- 1=Trajectory, 2=lambda	
2	- Print individual drop parameters	
1 .	- 1=NRC E model, 2= Entered E value	
200	- Elemental Iodine partition coefficient	
2	- Calculate organic iodine removal (1=yes, 2=no)	
13.79	- riow per nozzie (gpm)	
10	- Number of Nozzles - Temperature difference between aim and wall (dorc)	·
± 601519	- remperature attretence between alt and wall (degc)	
1907000	- Spraved volume	
1	- Another case? (1=ves, 2=no)	
2	······································	
69	- Number of size groups	
0.00375	- Nean drop diameter (cm)	
129.9	- Air-steam temperature (degC)	
129.9	- Eroplet temperature (degC)	
3393	- Initial velocity (cm/sec)	
45	- Initial angle	
118.47	- Spray fall height (it) - 046-2.5"-C-KEO	
2	- J=Trajectory, Z=lambda	
2	- Frint individual drop parameters	
200 T	- J-WRU & ROUGL, 24 Enlered & Value - Elemental Todine partition coefficient	
200	- falculate organic indine removal (leves (levo)	
13.79	- Flow per nozzle (dom)	
10	- Fumber of $nozzles$	
1	- Temperature difference between air and wall (decc)	
601519	- Effective plateout area	
1907000	- Spraved volume	
2	- Inother case? (1-yes, 2=no)	
2	· · · ·	
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D. T. Dexheimer 8/15/2003

DATE

8/15/2003

Project or DCP/FCN/ECP

ORIGINATOR

J. Schulz

Subject

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Subjec	t Containmen	t Aeroso'.	and Iodine Remov	al Rates	•	¢	······································	She	et <u>1</u>	30 <b>of</b>	281
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8 - I2- JJONN 165 N-6 0 1 9 2 9 0.0 85.339 10 2 2 1 830 2 3.28 1 6010 1 2 9 0.5.339 479.2 2 1 830 2 1 830	9.2.1.3 30 1 max01.out Spray Max Temp ge Schulz GS 75-167 030-001 0375 3 3 81 0 79 519 7000 0375 3 3 81 0 79 519 7000 0375 3 3 60	min to 2: $\frac{1}{2}$ 30 min - Nue $\frac{1}{2}$	hr Input File (2 2 hr 2 hr an drop diamete r-steam temperatu itial velocity itial angle ray fall height Trajectory, 2=1 int individual NRC E model, 2= emental Iodine y lculate organic ow per nozzle ( mber of nozzles mperature differ fective plateour rayed volume other case? (1=) mber of size gra an drop diameter r-steam temperatu itial velocity itial angle ray fall height Trajectory, 2=1 int individual NRC E model, 2= emental Iodine y lculate organic ow per nozzle (1=) mber of nozzles mperature differ fective plateour rayed volume other case? (1=) mber of nozzles mperature differ fective plateour rayed volume other case? (1=) mber of size gra an drop diameter r-steam temperatu itial velocity itial angle ray fall height Trajectory, 2=1;	oups r (cm) ture (deg re (degC) (ft) - ( ambda drop para Entered partition jgpm) rence best t area yes, 2=nc oups r (cm) ture (degC) (cm/sec) (ft) - ( ambda drop para Entered partition iodine 1 gpm) rence best t area yes, 2=nc oups r (cm) ture (degC) (cm/sec) (cm/sec) (ft) - ( ambda drop para Entered partition iodine 1 gpm) rence best t area yes, 2=nc oups r (cm) ture (degC) (cm/sec) (ft) - ( ambda	(n) (n) (1) (1) (1) (1) (1) (1) (1) (1	C-KEO cicient (1=yes, 2=no) ir and wall (de c-KEO cicient (1=yes, 2=no) ir and wall (de c-KEO	gC)				

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CCN CONVERSION: CCN NO. CCN Project or DCP/FCN/ECP Calc No. N-6030-001 Sheet 131 Containment Aerosol and Iodine Removal Rates Subject of 281 REV ORIGINATOR DATE IRE DATE REV ORIGINATOR DATE IRE DATE REV INDICATOR J. Schulz 8/15/2003 D. T. Dexheimer 8/15/2003 0 2 - Print individual drop parameters 1 - :=NRC E model, 2= Entered E value 8300 - Elemental Iodine partition coefficient - Calculate organic iodine removal (1=yes, 2=no) 2 13.79 - Plow per nozzle (gpm) 28 - Humber of nozzles - Memperature difference between air and wall (degC) - Effective plateout area 601519 1907000 - Sprayed volume - Junother case? (1=yes, 2=no) - Humber of size groups 69 0.00375 - Hean drop diameter (cm) - hir-steam temperature (degC) 85.3 - Droplet temperature (degC) 85.3 3393 - ::nitial velocity (cm/sec) 45 - Initial angle 85.60 - Spray fall height (ft) - 043-4"-C-KEO - 1=Trajectory, 2=lambda 2 2 - Print individual drop parameters - 1=NRC E model, 2= Entered E value 1 8300 - Elemental Iodine partition coefficient - Calculate organic iodine removal (1=yes, 2=no) 2 13.79 - Flow per nozzle (gpm) - Number of nozzles 28 - 'Temperature difference between air and wall (deqC) 1 601519 - Effective plateout area 1907000 - Sprayed volume - Another case? (1=yes, 2=no) 2 - Number of size groups 69 0.00375 - Mean drop diameter (cm) 85.3 - Air-steam temperature (degC) - Droplet temperature (degC) 85.3 - Initial velocity (cm/sec) - Initial angle 3393 - Spray fall height (ft) - 045-4"-C-KEO 105.83 - l=Trajectory, 2=lambda 2 2 - Print individual drop parameters - 1-NRC E model, 2= Entered E value 1 8300 - Elemental Iodine partition coefficient - Calculate organic iodine removal (1=yes, 2=no) 2 13.79 - Flow per nozzle (gpm) - Number of nozzles 20 - Temperature difference between air and wall (degC) 1 - Sffective plateout area 601519 1907000 - 3prayed volume - Another case? (1=yes, 2=no) 1 2 69 - Number of size groups 0.00375 - Mean drop diameter (cm) - Air-steam temperature (degC) 85.3 85.3 - Droplet temperature (degC) 3393 - Initial velocity (cm/sec) 89 - Initial angle 105.83 - Spray fall height (ft) - 045-4"-C-KEO - 1=Trajectory, 2=lambda 2 2 - Print individual drop parameters - 1=NRC E model, 2= Entered E value 1 - Elemental Iodine partition coefficient 8300 - Calculate organic iodine removal (1=yes, 2=no) 2

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	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003						2 X
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1						۰.				1
13.	.79	- Fl	ow per nozzle (	dbur)					•	1
20	•	- NU - Te	moerature diffe	rence hei	Ween a	ir and wall (de	onC.)			
601	519	- Ef	fective plateou	t area			.907			
190	7000	- Sp	rayed volume							
1		- An	other case? (1=	yes, 2-no	5)				i	
2	•									
69	0275	- Nu	mber of size gr	oups						
85.	.3	- Ai	r-steam tempera	ture (dec	(Dr					
85.	3	- Ir	oplet temperatu	ce (degC)	,-,					
339	3	- In	itial velocity	(cm/sec)						
0		- In	itial angle							
108	9.11	- Sp	ray fall height	(ft) - (	)51-4"-(	C-KEO			1	
2		- 15	int individual	amoua aron nar:	matore					
		- 1=	NRC E model. 2=	Entered	E valu	e				
830	0	- F:1	emental Iodine	partition	1 coeff:	icient				
2		- (a	lculate organic	iodine :	removal	(1=yes, 2=no)				
13.	79	- 1.7	ow per nozzle (	Jpm)						
20		- 1/u	mber of nozzles							
1 601	510	- 7'6'	mperature diffe:	rence Dei	tween a	ir and wall (de	gC)			
190	519 7000	- 50	raved volume	Larea						
1 1		- hn	other case? (1=	ves. 2=n:	<b>&gt;</b>					
2			••••	,,						
69		- 11u	mber of size gro	oups						
0.0	0375	- 11e	an drop diamete:	r (CIR)						
85.	3	- 11	r-steam tempera	ture (deg	3C)					
330	3	- 11	opiet temperatu:	ce (degu) (cm/sec)	1					
89		- ::n:	itial angle	(0						
108	.11	- Sp:	ray fall height	(ft) - (	)51-4"-(	C-KEO				
2		- :1=1	Trajectory, 2=1	ambda						
2		- 1?r.	int individual of	drop para	meters					
1 1		- [[=]	NRC E model, 2=	Entered	E valu	e isisst				
2	iu	- 1510	emental logine j loulate organic	iodine a	l COEIL. cemoval	(laves, 2mno)				
13.	79	- 71	ow per nozzle (	m)		(1-909) 2-10)				
20		- 1900	mber of nozzles							
1		- '[ei	mperature diffe:	cence bet	ween a	ir and wall (de	igC)			
601	.519	- "Ef:	fective plateou	t area						
190	7000	- Sp:	rayed volume							
		40	other caser (1=)	yes, 2=0.0	21					
69		- Nim	mber of size ar	oups						
0.0	0375	- Me	an drop diamete:	r (cm)						
85.	3	- Ai:	r-steam temperat	ture (deg	JC)					
85.	3	- Dr	oplet temperatu:	ce (degC)	•					
339	13	- In:	itial velocity	(cm/sec)				•		
117	. 43	~ 1n: _ Co:	tilal angle ray fall hoight	(f+) = f	52-2 F	*-C-KEO				
2	• "3 of	- əp. - 1='	Trajectory. 2ml	ambda	,,,,,,,,	A-WEA			1	
2		- Pr:	int individual	drop pana	meters				1	
1		- 1=1	NRC E model, 2=	Entered	E valu	e			1	
830	0	- El	emental Iodine	partition	n coeff:	icient			,	
2		- Ca.	lculate organic	iodine 1	emoval	(1-yes, 2-no)			1	
13.	79	- Fl	ow per nozzle (	JDW)						
1 10		- NUI - 71-11	MDET OI NOZZIĖS MDETRINIS diffe	renne hai		in and wall in	ac.)			
607	519	- 10 - Ef	fective plateou	t area	.WCON 8.	rr ann warr (de	y~)			
1			Paulovu							•
L										

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		<u></u> ,	l			L	l			
190	7000	- Sp	raved volume							
1		- An	other case? (1=	yes, 2=no	;)					
2			when of size on							
0.0	0375	- Mu	an drop diamete	r (cmt)					•	
85.	3	- A:.	r-steam tempera	ture (deg	)C)					
85.	3	- D::	oplet temperatu	re (degC)		•				
339	3	- In	itial velocity	(cm/sec)						
45	. 43	- 111 - 50	rav fall height	(ft) = 0	52-2.5	"-C-KEO				·
2	• • •	- 10	Trajectory, 2-1	ambda		•	•	•		
2		- P::	int individual	drop para	meters					
1 830	0	- 1::) - 2:	NRC E Model, 2=	Entered	E valu	e icient				
2	v	- Ca	lculate organic	iodine 1	emoval	(1=ves, 2=no)				
13.	79	- Fi.	ow per nozzle (	gpn)						
10		- NIE	mber of nozzles						. · ·	
	610	- Tel	mperature diffe	rence bet	ween a	ir and wall {de	gC}			
190	7000	- <u>5</u>	raved volume	c alea				•		
1		- An	other case? (1=	yes, 2=no	;)					
2										[
69	A225	- N11	mber of size gr	oups						
85.	3	- AS	r-steam tempera	r (CM) ture (dec	:C)					
85.	3	- D::	oplet temperatu	re (degC)		•		·		
339	3	- In:	itial velocity	(cm/sec)						
0		- In.	itial angle	(6-)						
2 118	.47	- Sp: - 1	ray Tall neight Trajectory, 2ml	) - (JI) amhda	46-2.5	"-C-KEO				
2		- P:::	int individual	drop para	meters					
1		- 1…	NRC E model, 2=	Entered	E valu	e				
830	0.	- E.L	emental Iodine	partition	. coeff	icient				
13.	79	- Ca. - Eli	ow per nozzle (	rogine i Togine i	emoval.	(1=yes, 2=no)				
10		- Nu	mber of nozzles	9F)						
1		- Tei	mperature diffe	rence bet	ween a	ir and wall (de	gC)	•		
100	519	- Elli	rective plateou	t area				•		- 1
1	/000	- An	other case? (1-	yes, 2=nd	»)				I	
2					-					
69		- Nut	mber of size gro	oups						
85.	3	- MO - A.	an drop diamete: r-steam tempera	r (cm) ture (dec	(C)					- 1
85.	3	- D:::0	oplet temperatu	re (degC)	~			1 1		[
339	3	- In:	itial velocity	(cm/sec)			÷			
45	47	- In:	itial angle					4		
2	.4/	- Spi - 1::*	ray fall neight Trajectory, 2=1	ambda - u	40-2.0	-C-KEO		· 1		
2		- P:::	int individual (	drop para	meters				1	ł
1		- 1]	NRC E model, 2=	Entered	E valu	e		•		
830	D	- E.L.	emental Iodine p	partition	coeff:	icient				
2 13.1	79	- ca. - Fli	ow per nozzle (	Tourne I	emovar	(r=As2' S=UO)				
10	•	- Nin	mber of nozzles							
1		- Ter	mperature diffe:	rence bet	ween a	ir and wall (de	gC)			l
601	519	- E.	fective plateou	t area						
2 2	/000	- Sju - And	other case? (1=	ves, 2=nr	.1					
2					-					1
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Subjec	t Containmen	t Aerosol a	and lodine Remov	al Rates	•			She	et <u>1</u>	34 of	281
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	I Schulz	8/15/2003	D T Dexheimer	8/15/2003		ONIGINATOR					A K
· ·						· · ·	· · · · · · · · · · · · · · · · · · ·				Ë
0 8 12- 12 Jor SON 165 N-6 0 1 9 2 69 0.0 100 100 100 100 100 100 100	<b>9.2.1.4 2 t o</b> <b>9.2.1.4 2 t o</b> <b>Spray Max Temp</b> <b>ge</b> Schulz <b>GS</b> <b>75-167</b> <b>030-001</b> <b>0375</b> <b>.7</b> <b>3</b> <b>81</b> <b>0</b> <b>79</b> <b>519</b> <b>7000</b> <b>0375</b> <b>.7</b> <b>.7</b> <b>3</b> <b>81</b> <b>0</b> <b>79</b> <b>519</b> <b>7000</b> <b>0</b> <b>79</b> <b>519</b> <b>7000</b> <b>0</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>79</b> <b>519</b> <b>7000</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b> <b>70</b>	<ul> <li>8/15/2003</li> <li>4 hr Inp</li> <li>2 - 4 hr</li> <li>3 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -</li></ul>	mber of size grand and File (i2-maxing) and the file (i2-maxing) and th	<pre>0/15/2003 0/2.in) 0/2.in) 1/2.i</pre>	C) 49-4"-( weeters E value coeff: removal ween a: ) (C) (49-4"-( weters E value coeff: removal value (C)	C-KEO icient (1=yes, 2=no) ir and wall (deg icient (1=yes, 2=no) ir and wall (deg	gC)				
1 2 69	- Another case? (1=yes, 2=no) - Number of size groups										
0.0	0375 .7	- Mea - Air	an drop diamete: -steam temperat	r (cm) ture (deg	(2)						1
100	.7 3	- Dro - Ini	oplet temperatu: itial velocity	re (degC) (cm/sec)							
10	-	- Ini - Sri	itial angle	(ft) = (	43-4"-1						
2		- 5f1 - 1=1	Frajectory, 2-1	ambda							
2 1		- Pri - 1•1	NRC E model, 2=	Entered	E valu	\$					

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Project or DCP/FCN/ECP

\_\_\_\_Calc No.

No. <u>N-6030-001</u>

CCN CONVERSION: CCN NO. CCN

Subject Containment Aerosol and Iodine Removal Rates

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REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	g
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003					1	₿Š
<u>`</u>									+	Ē
						·	ļ	L		
790	0	- E]	emental Todine	partition	coeff:	icient				
2	v	- Ca	lculate organic	10dine 1	emoval	(1=yes, 2=no)				
13.	79	- Fl.	ow per nozzle (	gpm)		-				
28		- N\0	mber of nozzles			· · · · · · · · · · · · · · · · · · ·	- 01			
1 601	510	- T0	mperature dille	rence bet Farea	ween a	ir and wall (de	gc)		1	
190	7000	- Sp	raved volume	c arca						
1		- An	other case? (1=	yes, 2=nc	•)				•	
2										
69	A375	- N(u	mber of size gr	oups			. •	· .		
100	-7	- At.	r-steam tempera	ture (dec	C)			•		
100	.7	- D::	oplet temperatu	re (degC)	• - •			• •		
339	3	- In	itial velocity	(cm/sec)						
45	~~	- In:	itial angle	15	43-48-4	7. YEA				
85.	60	- Sp - 11	ray fall neight Trajectory, 2=1	(IC) - ( ambda	43-4-1	-reo				
2		- P:::	int individual	drop para	uneters					
1		- 14	NRC E model, 2-	Entered	E valu	2				
790	0	- E1	emental Iodine	partition	coeff:	icient				
13	70	- Ca.	iculate organic	1001ne 1	emoval	(TeAe2' Setto)				
28	19	- Nu	mber of nozzles	3 pm						
. 1		- Tel	mperature diffe	rence bet	ween a	ir and wall (de	gC)			
601	519	- Et:	fective plateou	t area						
190	7000	- S;D:	rayed volume							
2		- 5.6	other caser (1-	yes, 2-m.	~					
69		– N.M	mber of size gr	oups						
0.0	0375	- Ma	an drop diamete:	r (cm)						i I
100	.7	- AL	r-steam tempera	ture (deg	(C)					
339	., 3	- DC - In	itial velocity	(cm/sec)						l i
0	•	- In:	itial angle							
105	.83	- Sp:	ray fall height	(ft) - 0	45-4"-0	C-KEO				
2		- 1= - Dr	int individual (	ampda Aron nara	meters				•	
1		- 1=	NRC E model, 2=	Entered	E valu	e .				
790	0	- E1	emental Iodine	partition	coeff:	icient		•		
2		- Cal	lculate organic	iodine r	emoval	(1=yes, 2=no)				
13.	79	- F10	ow per nozzie () mber of nozzies	(mg						
1		- Ter	mperature diffe:	rence bet	ween a	ir and wall (de	gC)	•		
601	519	- Ef:	fective plateou	t area			-			
190	7000	- Sp:	rayed volume							
2		- An	other case? (1=)	yes, 2=no	))					
69		–' Nur	mber of size gro	oups						
0.0	0375	– Mea	an drop diamete:	r (cm)						
100	.7	- Ais	r-steam temperat	ture (deg	(C)					
100	.7 3	- Dro	oplet temperatu: itial velocity	ce (degC) (cm/sec)						
89		- In:	itial angle	(20) 9569						
105	.83	- Spi	ray fall height	(ft) - 0	45-4"-(	C-KEO				
2		- 1-	Trajectory, 2-1	ambda						
2		- Fr:	INE INDIVIDUAL (	rop para	meters	<b>A</b>				
1 190	0	- 1=1 - Flo	emental Todine 1	artirion	coeff:	icient				
2	-	- Ca	lculate organic	iodine r	emoval	(1-yes, 2-no)				
13.	79	- F1(	ow per nozzle (	IDM) .						
20		- Kw	mber of nozzles							1

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F:EV	ORIGINATOR	DATE	IRE	DATE	REV	. ORIGINATOR	DATE	· IRE	DAT	E g	
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003						¥ğ	
	· · · · · ·	<u> </u>	Í		<u> </u>		<u> </u>			<u> </u>	
1 601 190	519 7000	- Te - Ef - Sp	mperature diffe fective plateou rayed volume	erence be it area	tween a	ir and wall (de	egC)				

1	- Temperature difference between air and wall (degC)
601519	- Effective plateout area
1907000	- Spraved volume
1	- Another case? $(1 = yes, 2 = no)$
2	
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	$\sim$ Number of size groups
0 00375	Near dron diamater (m)
0.00375	
100.7	- All-Steam temperature (degl)
100.7	~ Iroplet temperature (degt,
3393	- Initial velocity (cm/sec)
0	- Initial angle
108.11	- Spray fall height (ft) - 051-4"-C-KEO
2	- 1=Trajectory, 2=Lanbda
2	- Irint individual drop parameters
1	- ]=NRC E model, 2= Entered E value
7900	- Elemental Iodine partition coefficient
2	- Calculate organic iodine removal (1=yes, 2=no)
13.79	- Flow per nozzle (gpm)
20	- Number of nozzles
1	~ Jemperature difference between air and wall (degC)
601519	- Effective plateout area
1002010	<pre> (intaved volume</pre>
1907000	- The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address - The address -
1	- Milotiler Case: (1-yes, 2-115)
. 2	
69	- Humber of size groups
0.00375	- Nean drop diameter (cm)
100.7	- hir-steam temperature (degC)
100.7	- Droplet temperature (degC)
3393	- Initial velocity (cm/sec)
89	- Initial angle
108.11	- Spray fall height (ft) - 051-4"-C-KEO
2	- 1-Trajectory, 2=lambda
2	- Print individual drop parameters
ī	- 1=NRC E model, 2= Entered E value
7900	- Elemental Indine partition coefficient
2	- (alculate organic jodine removal (javes, 2-no)
13.79	- [low per nozzle (gpm)
20	- Humber of nozzles
1	""""""""""""""""""""""""""""""""""""""
501519	
1007000	
1907000	
1	- Milother Cases (1-yes, 2-ho)
2	Number of disc groups
69	- Number of size groups
0.00375	- nean drop diameter (cm)
100.7	- Air-Steam temperature (degC)
100.7	- Droplet temperature (degC)
3393	- :(nitial velocity (cm/sec)
0	- Initial angle
117.43	- Spray fall height (ft) - 052-2.5"-C-KEO
2	- leTrajectory, 2=lambda
2	- Print individual drop parameters
1	- L=NRC E model, 2= Entered E value
7900	- Elemental Iodine partition coefficient
2	- Calculate organic jodine removal (laves, 2=no)
13 79	- They per nozzle (com)
10	
10	- Ruiwet of Notites
	- respectative difference between all did wall (dege)
POIDIA	- Directive plateout area
1907000	- Sprayed Volume
1	- Another case? (1=yes, 2=r.o)
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## **E&TS DEPARTMENT**

#### ICCN NOJ CALCULATION SHEET PRELIM. CCN NO. PAGE OF **CCN CONVERSION:** CCN NO. CCN Calc No. Project or DCP/FCN/ECP N-6030-001 Sheet Subject Containment Aerosol and Iodine Removal Rates 137 of **FEV** ORIGINATOR DATE IRE DATE REV ORIGINATOR DATE IRE DATE D. T. Dexheimer 8/15/2003 J. Schulz 8/15/2003 0 2 69 - Number of size groups 0.00375 - Mean drop diameter (cm) - Air-steam temperature (degC) 100.7 - Droplet temperature (degC) 100.7 - Iritial velocity (cm/sec) 3393 - Iritial angle 45 117.43 - Spray fall height (ft) - 052-2.5"-C-KEO - 1-Trajectory, 2=lambda 2 - Print individual drop parameters 2 - 1=NRC E model, 2= Entered E value 1 7900 - Elemental Iodine partition coefficient - Calculate organic iodine removal (1=yes, 2=no) 2 - Flow per nozzle (gpm) 13.79 - Number of nozzles 10 - Temperature difference between air and wall (degC) 1 601519 - Effective plateout area 1907000 - Sprayed volume - Another case? (l=yes, 2=no) 1 2 69 - Number of size groups 0.00375 - Mean drop diameter (cm) - Air-steam temperature (degC) 100.7 - Droplet temperature (degC) 100.7 3393 - Initial velocity (cm/sec) - Initial angle 0 118.47 - Spray fall height (ft) - 046-2.5"-C-KEO - 1\*Trajectory, 2=lambda 2 2 - Print individual drop parameters - 1=NRC E model, 2= Entered E value 1 7900 - Elemental Iodine partition coefficient - Calculate organic iodine removal (1=yes, 2=no) 2 13.79 - Flow per nozzle (gpm) - Number of nozzles 10 - Temperature difference between air and wall (degC) 601519 - Elfective plateout area - Sprayed volume 1907000 - Another case? (1=yes, 2=no) 1 69 - Number of size groups 0.00375 - Mean drop diameter (cm) - A:r-steam temperature (deg2) 100.7 - D::oplet temperature (degC) 100.7 3393 - Initial velocity (cm/sec) - Initial angle 45 118.47 - Spray fall height (ft) - 046-2.5"-C-KEO - 1"Trajectory, 2=lambda 2 - Print individual drop parameters 2 - 1 NRC E model, 2= Entered E value 1 7900 - Elemental Iodine partition coefficient - Calculate organic iodine removal (1=yes, 2=no) 2 13.79 - Flow per nozzle (gpm) 10 - Number of nozzles - Temperature difference between air and wall (degC) 1 601519 - Effective plateout area - Sprayed volume 1907000 - Another case? (1=yes, 2=no) 2 2

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REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	· IR	E	DATE	¥	
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Ĩ		~ 1=	NRC E model, 2=	Entered	E value	•						
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			· · ·							- <u>2</u>				
		<u>,                                     </u>	L	1		·	<u></u>							
690	0	- EJ	emental Iodine	partition	coeff:	icient								
2	70	- Ca	lculate organic	iodine 1	emoval	(1=yes, 2=no)								
28	19	- PJ.	mber of nozzles	ցչույ										
1		- Te	- Temperature difference between air and wall (degC)											
601	519	- El:	- Enfective plateout area											
190	/000.	- An	- Another case? (1=yes, 2=no)											
· 2														
69	0375	- Nu - Mu	- Number of size groups - Muan drop diameter (cm)											
95.	3	- A:,	- Mean drop diameter (Cm) - Alr-steam temperature (deoC)											
95.	3	- D::	oplet temperatu	re (degC)										
339	3	- In - Tu	itial velocity	(CTR/SEC)										
85.	60	- III - Sp	ray fall height	(ft) - 0	43-4"-	C-KEO								
2		- 1.	Trajectory, 2-1	ambda										
2		- P::	int individual	drop para	meters	•								
690	0	- El	emental Iodine	partition	Coeff.	icient								
2	-	- Ca	lculate organic	iodine 1	emoval	(1=yes, 2=no)								
13.	79	- F.L	ow per nozzle (	gpm)										
28		- N- - T-2	- Number of nozzles											
601	519	- Ef	- Effective plateout area											
190	7000	- Sp	- Sprayed volume											
		- A1	other case? (1=	yes, 2=nd	>}									
69	•	- Na	mber of size gr	oups										
0.0	0375	- Me	an drop diamete	r (cm)					•					
95.	3	- Ai	r-steam tempera	ture (deg	JC)									
339	3	- In	itial velocity	(cm/sec)										
0		- In	itial angle	·										
105	.83	- Sp	ray fall height Trajectory, 2=1	(ft) - ( ambda	)45-4"-	C-KEO								
2		- Pr	int individual	drop para	meters									
1		- 1=	NRC E model, 2=	Entered	E valu	e .								
690 2	0	- El - Ca	emental lodine	partition indine	l COEII removal	(1=ves, 2=po)								
13.	79	- F1	ow per nozzle (	gpm)		(1-300) 1 10)								
20		- Nu	mber of nozzles			• • •• <i>•</i> •	-							
1 601	510	- 1e - Ff	mperature diffe	rence bei t area	ween a	ir and wall (de	igc)							
190	7000	- Sp	rayed volume											
1		- An	other case? (1=	yes, 2-n	>)									
2		- 111	mbar of size or	0000										
0.0	0375	- Ne	an drop diamete	r (cm)										
95.	3	- Fi	r-steam tempera	ture (de	7C)									
95.	3	- Lur	oplet temperatu	re (degC)										
89	2	- ]n	itial angle	(CIR/ 86C)										
105	.83	- \$p	ray fall height	(ft) - (	045-4"-	C-KEO								
2		- 1-	Trajectory, 2=1	ambda										
2		- Fr - 1=	INC INCIVICUAL	crop para Entered	E valu	e								
690	0	- El	emental Iodine	partitic	n coeff	icient								
2		- Ca	lculate organic	iodine :	cemoval	(1=yes, 2=no)			•	l i				
13.	79 <sub>.</sub>	- F1 - P2	ow per nozzle (	dbw)										
20		- 114	1999'94 VI MV&&IC3											
1									· · · ·					

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						in	-01			
	519	+ Te - Ef	mperature dirie fective plateou	rence Dem t area	ween a	ir and wall (de	gc)			1
190	7000	- Sp	rayed volume							<b>I</b> 1
1		- Ar	other case? (1=	yes, 2=nd	) <b>)</b>					
2										
69		- N(d	mber of size gr	oups						
0.0	0375	- Me	an drop diamete	r (cm)						}
95.	.3	- Al.	r-steam tempera	cure (aeg	(C)				•	•
95.	3	- 11	itial velocity	(cm/sec)						
0	5	- In	itial angle				•			
108	.11	- St.	ray fall height	(ft) - (	51-4"-(	C-KEO		·		
2		- 1=	Trajectory, 2=1	ambda						
2		– Pr:	int individual	drop para	meters					
1		- 1=1	NRC E model, $2=$	Entered	E valu	e				
690	0	- E3.	emental Iodine	partition	coeff:	icient				
2		- Cei	iculate organic	10dine 1	emoval.	(1=yes, 2=no)				
13.		- Fl.	ow per nozzie ( mber of nozzie	វីស្រាវ)					-	
20		- NU	mperaturo diffe	rence het	ween a	in and wall (do	<i>a</i> C)	·		
601	519	- Ef:	fective plateou	t area		er and warr (de	90)		ľ	
190	7000	- Sp	rayed volume							
1		- Ario	other case? (1=	yes, 2=nc	)					
2										
69		- Nur	mber of size gro	oups			•			
0.0	0375	- Mei	an drop diamete:	c (cm)						
95.	3	- Aj.	r-steam tempera	ture (deg	(C)					
95.	3	- Dre	oplet temperatu:	ce (degC) (an loog)						
335	3	- 111	ttial verocity	(CRI/SEC)						
109	11	- 510	rav fall height	(ft) - (	51-4"-1	C-KEO				
2		- 1=	Trajectory, 2=1a	mbda						
2	•	- Pri	int individual	irop para	meters					
1		- 1**	NRC E model, 2=	Entered	E value	e				
690	0	- El.e	emental Iodine j	artition	.coeff:	icient	.•			
2		- Cal	Lculate organic	iodine :	emoval	(1-yes, 2-no)			·	
13.	79	- FJ.C	by per nozzie (	ibm)		•				
20		- 700	merature diffe	rence het	veen a	ir and wall ide	<b>a</b> C)	•		
601	519	- E11	fective plateou	area		r una mure 146	901			
190	7000	- SDI	rayed volume							
1		- And	other case? (1-	yes, 2=no	)	•				
2										
69		- N10	aber of size gro	oups						
0.0	0375	- Meia	an drop diameter	: (CM)	~					
95.	3	- AJ.I	c-steam temperat	ure (deg	C)					
95.	3	- Di.C	itial velocity	(cm/sec)						
	5	- Inj	itial angle							
117	.43	- Spr	ay fall height	(ft) - 0	52-2.5	-C-KEO			1	
2		- 1-1	Trajectory, 2=1a	mbda						
2		– P::i	int individual (	irop para	meters					
1		- 1**	NRC E model, 2=	Entered	E value	8				
690	0	- E].e	emental Iodine p	artition	coeffi	icient				
2		- Cal	culate organic	lodine :	emoval	(l=yes, 2≖no)				
13.	79	= Fl.C	w per nozzie ((	(թա)						
10			WEI OL NOZZIØS Meratura diffa	ence het	veen »4	r and wall id-	aC)			
	510	- 201	fective plateout	Area		r and wart (de	901			
1001	7000	- Spr	aved volume							
1		- And	ther case? (1-)	es, 2=no	)					
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'			<u> </u>	L		·····	L					<u> </u>
540	0	- E]	emental Iodine	partition	coeff	icient						
13.	79	- Ca - Fl	ow per nozzle (	gpm)	CEMOVAL	(1=yes, 2=no)						
28		- Nu	mber of nozzles			fm and reall (do						
601	519	- 10 - Ef	fective plateou	t area	ciaeett a	IT AND WALL (De	gcj					ļ
190	7000	- Sp	rayed volume	_		•	•					
1 2		- Ar	other case? (1=	yes, 2-no	)							Į
69		- Nu	mber of size gr	oups				•				
0.0	0375	- Me	an drop diamete	r (cm)								1
87.	2	- A3. - D1	r-sceam tempera oplet temperatu	re (deaC)	<b>;</b> ;;)							
339	3	- In	itial velocity	(cm/sec)								
45	60	- In - Su	itial angle ray fall beight	1941 - 0	113-4"-	C-KEO						ł
2	00	- 1•	Trajectory, 2=1	ambda	<b>,,,</b>	C-REO						
2		- Pr	int individual	drop para	uneters	_						
1 540	0	- 1** - El	NRC E model, 2= emental Iodine	entered partition	s valu coeff	e icient						1
2	•	– Ca	lculate organic	iodine r	enoval	(1=yes, 2=no)						
13.	79	- F].	ow per nozzle (	gpa)								
1		- Te	mperature diffe	rence bet	ween a	ir and wall (de	gC)					
601	519	- E1	fective plateou	t area			-					í
190	/000	- sp - An	rayed volume other case? (1=	ves, 2=nd	5)							1
2					•							1
69	0375	- Nu - Mo	mber of size gr an drop diamete	oups								1
87.	2	- A:.	r-steam tempera	ture (deg	JC)							
87.	2	- D::	oplet temperatu	re (degC)	)							
0	3	- In - In	itial angle	(CIII/SEC)								
105	.83	- Sp	ray fall height	(ft) - 0	045-4"-	C-KEO						
$\frac{2}{2}$		- 1" - Pi	int individual	ambda drop para	meters						1	
1		- 1	NRC E model, 2-	Entered	E valu	6			•			
540	0	- E. - Ca	emental Iodine lculate organic	partition indine r	n coeff. removal	(1=ves, 2=po)						
13.	79	- F.	ow per nozzle (	gpm)		(1 )00/ 0						
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601	519	- E:	fective plateou	t area	ween a	ti anu wati (de	gu)					
190	7000	- Sp	rayed volume	•	•							
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69		- N(1	mber of size gr	oups								
0.0	0375 2	- Me - Ai	an drop diamete r-steam tempera	r (cm) ture (dec	rC)		•					
87.	2	- D.:	oplet temperatu	re (degC)								
339	3	- In - Th	itial velocity	(cm/sec)								
105	.83	- Sp	ray fall height	(ft) - 0	45-4"-0	C-KEO		с. 				
2		- 1=	Trajectory, 2-1	ambda								
2		- P.: - 3#	int individual ( NRC E model, 2=	urop para Entered	meters E value		• •					
540	0	- El	emental Iodine	partition	coeff	icient						
2	70	- Ca	lculate organic	iodine r	emoval	(1=yes, 2=no)						
20	17	- 14 - Nj	mber of nozzles	Abau)						•		
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$\begin{array}{c} 1 \\ 601 \\ 190 \\ 1 \\ 2 \\ 69 \\ 0.0 \\ 87. \\ 87. \\ 339 \\ 0 \\ 108 \\ 2 \\ 2 \\ 1 \\ 540 \\ 2 \\ 13. \\ 20 \\ 1 \\ 190 \\ 1 \\ 2 \\ 69 \\ 0.0 \\ 87. \\ 339 \\ 99 \\ 108 \\ 2 \\ 1 \\ 540 \\ 2 \\ 13. \\ 20 \\ 1 \\ 69 \\ 0.0 \\ 87. \\ 339 \\ 0 \\ 1 \\ 190 \\ 1 \\ 540 \\ 2 \\ 1 \\ 540 \\ 2 \\ 1 \\ 190 \\ 1 \\ 190 \\ 1 \\ 190 \\ 1 \\ 190 \\ 1 \\ 190 \\ 1 \\ 190 \\ 1 \\ 190 \\ 1 \\ 190 \\ 1 \\ 190 \\ 1 \\ 190 \\ 1 \\ 190 \\ 1 \\ 190 \\ 1 \\ 100 \\ 1 \\ 190 \\ 1 \\ 100 \\ 1 \\ 190 \\ 1 \\ 100 \\ 1 \\ 100 \\ 1 \\ 100 \\ 1 \\ 100 \\ 1 \\ 1$	519 7000 0375 2 3 .11 0 79 519 7000 0375 2 3 .11 0 79 519 7000 0375 2 3 .11 0 79 519 7000 0375 2 3 .11	- Tet - Tet - Ef - Sp - Ar. - Nul - Mek - Ad. - Dr. - Inn - Inn - Sp - Inn - F. - Cal - C	mperature diffe fective plateou rayed volume other case? (1=) mber of size gr an drop diamete r-steam temperatu itial velocity itial angle ray fall height Trajectory, 2=1. int individual of more of nozzles mperature diffe fective plateou other case? (1=) mber of size gr an drop diamete ray fall height Frajectory, 2=1. int individual of mber of nozzles mperature diffe fective plateou rayed volume other case? (1=) mber of size gr an drop diamete ray fall height Frajectory, 2=1. int individual of mber of nozzles mperature diffe fective plateou rayed volume other case? (1=) mber of size gr an drop diamete rayed volume other case? (1=) mber of size gr an drop diametes fective plateou rayed volume other case? (1=) mber of nozzles mperature diffes fective plateou cay fall height frajectory, 2=1. int individual of mber of nozzles mperature diffes fective plateou cay di nozzles mperature diffes fective plateou cay di nozzles mperature diffes fective plateou fective pla	rence bet t area yes, 2=nc oups r (cm) ture (degc) (cm/sec) (ft) - 0 ambda drop para Entered partition iodine r gpm) rence bet t area yes, 2=nc oups r (cm) ture (degc) (cm/sec) (ft) - 0 ambda drop para Entered partition iodine :: gpm) rence bet t area yes, 2=nc oups r (cm) ture (degC) (cm/sec) (ft) - 0 ambda Entered partition iodine :: gpm) rence bet t area yes, 2=nc oups r (cm) ture (degC) (cm/sec) (ft) - 0 ambda Entered partition iodine :: gpm) rence bet t area yes, 2=nc oups r (cm) ture (degC) (cm/sec) (ft) - 0 ambda Entered partition iodine r gpm)	(C) (C) (C) (C) (C) (C) (C) (C) (C) (C)	<pre>Ir and wall (def C-KEO C-KEO icient (1=yes, 2=no) ir and wall (def C-KEO cient (1=yes, 2=no) ir and wall (def C-KEO cient (1=yes, 2=no) ir and wall (def cient (1=yes, 2=no) ir and wall (def cient (1=yes, 2=no)</pre>	gC) gC) gC)					

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## E&TS DEPARTMENT **CALCULATION SHEET**

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Project or DCP/FCN/ECP

Calc No. N-6030-001

CCN NO. CCN

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Subject Containment Aerosol and Iodine Removal Rates

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CCN CONVERSION:

0       J. Schulz       \$152003       D. T. Dexheimer       \$152003         2	REV ORIGINA	NATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	я
2         69       - Number of size groups         0.00375       - Mean drop diameter (cm)         87.2       - Air-steam temperature (degC)         3393       - Initial velocity (cm/sec)         45       - Initial angle         117.43       - Spiray fall height (ft) - 052-2.5"-C-KEO         2       - Print individual drop parameters         1       - Spiray fall height (ft) - 052-2.5"-C-KEO         2       - Print individual drop parameters         1       - Spiray fall height (ft) - 052-2.5"-C-KEO         2       - Print individual drop parameters         1       - Spiray fall height (ft) - 052-2.5"-C-KEO         2       - Print individual drop parameters         1       - Initial velocity (zm/sec)         2       - Cilculate organic indime inerval (1=yes, 2=no)         3.79       - F.ow per nozzle (gpm)         10       - Number of nozzles         1       - Tomperature difference between air and wall (degC)         601519       - E:fective plateout area         1907000       - Spirayed volume         1       - Another case? (1=yes, 2=no)         2       - Number of size groups         0.00375       - Mean drop diameter (cm)         69       - Number of s	0 J. Schu	hulz	8/15/2003	D. T. Dexheimer	8/15/2003						₹§
2         69       - Number of size groups         0.00375       - Mean drop diameter (cm)         87.2       - Air-steam temperature (degC)         3393       - Initial velocity (cm/sec)         45       - Initial angle         117.43       - Spray fall height (ft) - 052-2.5"-C-KEO         2       - Print individual drop parameters         1       - Intrajectory, 2-lambda         2       - Print individual drop parameters         1       - Calculate organic iodine removal (leyes, 2-mo)         5400       - Elemental Iodine partition coefficient         2       - Calculate organic iodine removal (leyes, 2-mo)         13.79       - F.ow per nozzle (gpm)         10       - Number of nozzles         1       - Tumperature difference between air and wall (degC)         601519       - E:fective plateout area         1907000       - Sprayed volume         1       - Auother case? (leyes, 2-mo)         2       - Number of size groups         0.00375       - Nean drop diameter (cm)         87.2       - Air-steam temperature (degC)         87.2       - Air-steam temperature (degC)         87.2       - D:roplet temperature (degC)         87.2       - D:roplet temperatu		····	1							1	
115400- Elemental Iodine partition coefficient2- Calculate organic iodine removal (1-yes, 2=no)13.79- Flow per nozzle (gpm)10- Number of nozzles1- Tamperature difference between air and wall (degC)601519- Effective plateout area100000- Sprayed volume1- Another case? (1-yes, 2=no)2- Number of size groups0.00375- Mican temperature (degC)87.2- Air-steam temperature (degC)87.2- Dorplet temperature (degC)8333- Initial angle118.47- Spray fall height (ft) - 046-2.5"-C-KEO2- Print individual drop parameters1- Tarajectory, 2-Lambda2- Calculate organic iodine removal (1-yes, 2=no)13.79- Elow per nozzle (gpm)10- Number of nozzles1- Tarajectory, 2-Lambda2- Calculate organic iodine removal (1-yes, 2=no)13.79- Elow per nozzle (gpm)10- Number of nozzles1- Temperature difference between air and wall (degC)10.51519- Effective plateout area1907000- Sprayed volume2- Another case? (1-yes, 2=no)2- Another case? 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0.00375 - Mean drop diameter (cm) 78.3 - Air-steam temperature (degC)											
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28		- 'Su	mber of nozzles							i	
1 601	519 <sup>.</sup>	- Fei - Ef:	mperature diffe fective plateou	rence bet t area	ween a:	ir and wall (de	gC)				
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69	0775	- Nui	mber of size gr	oups							
78.	78.3 - Air-steam temperature (degC)										
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13. 20	2 - Galculate organic fourie femoval (1-yes, 2=no) 13.79 - Flow per nozzle (gpm) 20 - Number of nozzles											

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0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003						] ⊉∄
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										┼──
1		- 70	monaratura diffe	rence het	ween a	ir and wall (de	aC.)			ľ
601	519	- Ef	fective plateou	t area	.ween a	II dilu wali jue	901			
1907	7000	- Sp	rayed volume							ļ
1		- An	other case? (1=	yes, 2=no	))				•	1
2		- 51	mber of size an	פמווס						1
0.00	0375	- Ke	an drop diamete	r (cm)			•			
69.2	2	- Ai	r-steam tempera	ture (deg	lC)					
69.2	2	- Cr	oplet temperatu	re (degC)						
3393	3	- In - In	itial velocity	(cm/sec)			,	• .		
108.	.11	- Sp	rav fall height	(ft) - (	>51-4"-(	C-KEO				
2		- 1=	Trajectory, 2=1	ambda					•	1
2		- Fr	int individual	drop para	meters					1
1	•	- 1=	NRC E model, 2=	Entered	E Value	e icient				
2		- CA	lculate organic	iodine )	emoval:	(1=ves, 2=no)			••	
13.7	79	- E1	ow per nozzle (	gpm)		(- 100),				1
20		- Nu	mber of nozzles							
1		- Te	mperature diffe	rence bet	ween a	ir and wall (de	gC)			
6015	519	- Eİ	fective plateou	t area						
190	1000 -	- sp - An	other case? (1=	ves. 2=co	2)					
2	•		other case: (r-	yes, 2-m	••					
69		- Nu	mber of size gr	oups		•				1
0.00	0375	- Me	an drop diamete.	r (cm)						
69.2	2	- Ai	r-steam tempera	ture (dec	(C)					1
69.2	2	- Dr	oplet temperatu	re (degC) (m (aag)		•				l I
3393	3	- In - In	itial verocity	(cm/sec)						1
108.	.11	- Sp	rav fall height	{ft} - (	)51-4"-(	C-KEO				
2		- 1=	Trajectory, 2-1	ambda						
2	·	- Pr.	int individual	drop para	meters					
1		- 1-	NRC E model, 2-	Entered	E value	e Laisan				
2000	J	- E1 - Ca	emental locine p lculate organic	iodine 1	a coein emoval	(1=ves, 2=no)				ļ
13.1	79	- F1	ow per nozzle (	apm)		(- 1,,				
20	-	- Nu	mber of nozzles							1
1	•	- Te	mperature diffe:	rence bet	ween ai	ir and wall (de	gC)	•		
6015	519	- Ef:	fective plateou	t area	-			·		
190		- sp. - An	cayed volume other case? (1=)	ves. 2=nd						
2			· · · · · · · · · · · · · · · · · · ·				-	·		l
69		- No	mber of size gro	oups						1
0.00	0375	- Me	an drop diamete:	c (cm)						1
69.2	2	- Ai:	r-steam temperat	ture (deg	(C)					
3202	2	- Dro	opiet temperatu:	te (degC) (cm/eac)						
0		- 10. - 10.	itial angle	(						
117.	.43	- Sp:	ray fall height	(ft) - (	52-2.5	"-C-KEO				
2		- 1=	Trajectory, 2=1	ambda						}
2		- Pr:	int individual	irop para	meters	_				1
1	n	- 1=)	NKC E model, 2=	Entered	E Value	<del>c</del> icient				1
2	U	- Ca	lculate organic	iodine 1	. coeili	(1=ves, 2=no)				
13.3	79	- Flo	ow per nozzle (	ipa)		(- ], =)				
10	-	- Nu	mber of nozzles							
1	•	- Tei	mperature diffe	rence bet	ween ai	ir and wall (de	gC)			
6015	519	- Ef:	fective plateou	t area						
	7000	- Sp:	raved volume							1
1907				100 0						ł

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REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	۶ g
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003	, ,		1	T		<u>≩</u> §
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		·	<u></u>	<u> </u>	I	<u></u>	<u> </u>			╂────
2			- ·			• .		•		
69 0 (	10375	- Niz	mber of size gr	oups						
69.	0315	- A:	an urop utamete	ture (de	aC)					
69.	.2	- D::	oplet temperatu	re (degC)	)				1	1
339	i3 <sup>.</sup>	- In	itial velocity	(cm/sec)						
45	-	- In	itial angle							1
117	.43	- Sp	ray fall height	(ft) - (	152-2.5	"-C-KEO			· /	1
2		- Dr	Trajectory, 2=1	anoua dron nar/	emotore				4	1
		- 11 - 11	NRC E model, 2=	Entered	E valu	•	•			1
300	0	- El	emental Iodine	Dartition	n coeff	icient			,	1
2	-	- Ca	lculate organic	iodine r	removal	(1=yes, 2=no)				ł
13.	79	- F.L	ow per nozzle (	gpm)						
10		- Nip	mber of nozzles	·····					• 1	l '
		- TO	mperature dille	rence Det	ween a	ir and wall (de	;gC}			
100	519	- E	ISCLINE DISTERNE	t area						
1	7000	- An	other case? (1=	ves. 2=n(	6)					1
2	•			<b>/···</b> /						<b>I</b> .
69		- Nur	mber of size gr	oups						[
0.0	0375	- Me	an drop diamete	r (cm)					,	ł
69.	2	- A:L!	r-steam tempera	ture (dec	(C)				1	1
67. 279	2	- Dare - Th	oplet temperatu.	re (degu)	1					l
0	د	- In	itidi veruuriy Affal angle	(Chi/ Sec)						ł
118	47	- Sp	rav fall height	(ft) - (	046-2.5	-C-KEO				1
2	•••	- 1-	Trajectory, 2=1	ambda	••	•				
2		- P.C	int individual (	drop para	imeters					1
1		- 1:-7	NRC E model, 2-	Entered	E valu	e				1
300	0	- E.L	emental Iodine	partitior	i coeff	icient				l
2		- C.L	lculare organic	iodine :	.emoval	(1=yes, 2=no)				1
10	79	- N'r	OW per nucces a	3bur)			•			1
ī		- Te	mperature diffe	rence bet	tween a	ir and wall (de	aC)			
601	519	- Ef:	fective plateou	t area			yc,			
190	7000	- Sp	rayed volume	-					1	1
1		- And	other case? (1=)	yes, 2≃n¢	.)}			•		1
2		- N·*	when of eigh ar	~~~~					1	1
0.0	1775	- Ma	an dron diameter	v (cm)					1	l
69.	2	- AL	r-steam tempera	ture (dec	aC)				1	1
69.	2	- Dc/	oplet temperatu	re (degC)	l l				1	1
339	3	- In/	itial velocity	(cm/sec)						1
45	· <b>-</b>	- Inf	itial angle						I	
118	.47	- 5;77	ray fall height	(ft) = U	46-2.5	"-C-KEO				
2		- 1	TTAJECTORY, 2-10	imbua dron nari	maters				1	<b>i</b> '
ĩ		- 1:=/	NRC E model, 2=	Entered	E valu	A			1	1
300	0	- El	emental Iodine ;	Dartition	a coeff	icient				ł
2	•	- Ca	lculate organic	iodine r	removal	(1-yes, 2=no)				1
13.	79	- Fle	ow per nozzle (	gpm)		· •			(	1
10		- N.I	mber of nozzles	• • •		· · · · · · ·				l ,
	•	- Ter	mperature differ	rence bet	ween as	ir and wall (de	gC)		. 1	1 '
100	519	- 50	fective plateout	: area					· · · · · · · · · · · · · · · · · · ·	1
290	7000	- 20/ - 20/	Tayen vorume	vae. 2000	•1					
2			Jenoz 60300. (- ]	1007	1					1
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Projec	t or DCP/FCN/E	CP	•	C	alc No.	N-6030-001		CCN CO CCN NO	NVER	sion: <b>N</b>		•
Subjec	t Containmen	t Aerosol a	and Iodine Remov	al Rates	•			She	et _	154	of	281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DA	TE	ទ
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003				<u> </u>				REV
					I							E
8 12- 12 2 JON 165 N-6 0 1 9 2 9 0 5 9 10 2 1 2 0 5 9 10 2 1 2 10 2 10 5 9 10 5 9 10 5 9 10 5 9 10 5 9 10 5 9 10 5 9 10 5 9 10 5 9 10 5 9 10 5 9 10 5 9 10 5 9 10 5 9 10 5 9 10 5 9 10 5 9 10 5 9 10 5 9 10 5 9 10 10 2 12 13 10 10 10 10 10 10 10 10 10 10	9.2.1.9 48 1 max07.out Spray Max Temp ge Schulz GS 75-167 030-001 0375 0 0 3 81 0 79 519 7000 0375 0 0 3 81 0 0 79 519 7000 0 3 81 0 0 3 81 60	to 96 hr I 48 - 96 - Non - Non - Non - Mai - Ai - In - In - In - In - In - In - In - In - Ca - Fli - Ca - Fli - Ca - Fli - Ca - Fli - Ca - Fli - Ca - Spi - And - Non - Mea - Air - In - Spi - In - In - Spi - In - Spi - In - In - Spi - In - In - Spi - In - Spi - In - In - Spi - In - In - Spi - In - In - Spi - In - In - Spi - In - In - Spi - In - In - Spi - In - Spi - In - In - Spi - In - In - Spi - In - In - Spi - In - In - Spi - In - In - Spi - In - In - Spi - In - In - In - In - Spi - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In - In -	mber of size gra an drop diamete: r-steam temperatu: itial velocity itial angle ray fall height Trajectory, 2=1: int individual G NRC E model, 2= emental Iodine p lculate organic ow per nozzle (9 mber of nozzles mperature diffe; fective plateouf rayed volume other case? (1=9 mber of size gra an drop diameter r-steam temperature itial velocity itial angle ray fall height Trajectory, 2-12 int individual G NRC E model, 2= emental Iodine p lculate organic ow per nozzle (9 mber of nozzles mperature diffe; fective plateout rayed volume other case? (1=9 mber of size gra an drop diameter r-steam temperature other case? (1=9 mber of size gra an drop diameter r-steam temperature itial velocity (1=9 mber of size gra an drop diameter r-steam temperature itial angle ray fall height frajectory, 2=18 int individual co NRC E model, 2=	ax07.in) ax07.in) ax07.in) ture (deg r (cm) ture (degC) (cm/sec) (ft) - ( ambda drop parse Entered partition iodine 1 gpm) rence bet t area yes, 2=nco oups r (cm) ture (degC) (cm/sec) (ft) - () ambda irop parse iodine 3 gpm) rence bet = area yes, 2=nco oups c (cm) ture (degC) (cm/sec) (ft) - () ambda irop parse c (cm) ture (degC) (cm/sec) (ft) - () ambda indine 3 gpm) rence bet = area yes, 2=nco oups c (cm) ture (degC) (cm/sec) (ft) - 0 ambda indine 3 yes, e (C) (49-4"-( (meters E value (coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coeff: coef	C-KEO Lcient (1=yes, 2=no) Lr and wall (dec c-KEO Licient (1=yes, 2=no) Lr and wall (dec c-KEO C-KEO	gC)						

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0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003	1		11			l ≩ ₹
<u>`</u>					<b></b> -			·· ·· ·· ·		" Ž
				<u> </u>	L	!	<u> </u>			
230	0	- El	emental Iodine	partitio	n coeff	icient '				1 1
2	70	- Ca	lculate organic	iodine :	renoval	. (1=yes, 2=no)				
28	73	- P1 - Nu	aber of nozzles	d bia)						
1		- Te	mperature diffe	rence be	tween a	ir and wall (de	:gC)			1 1
601	519 7000	- Ef	fective plateou	t area						
1	/000	- Sp. - An	(ther case? (1=	yes, 2=n	o)					f 1
2				-						
69	0375	- Nu	uber of size gr	oups r (cm)			•			1
59.	0	- A1	N-steam tempera	ture (de	gC)					
59.	0	- Dr	oplet temperatu	re (degC	5				•	1
339	3	- In:	tial velocity	(cm/sec)						
85.	60	- 11. - SD	ay fall height	(ft) - (	043-4*-	C-KEO			• •	1
2		- 1-	rajectory, 2=1	anbda						1 .
2		- Pr:	int individual	drop para	ameters					1
230	0	- 1-	emental Iodine	partitio	n coeff	icient				
2		- Ca	iculate organic	iodine	removal	(1-yes, 2=no)				ł
13.	79	- F1	w per nozzle (	gpa)						
1		- Nu - Te:	nder of nozzles moerature diffe	rence bei	tween a	ir and wall (de	2001			1
601	519	- Ef	fective plateou	t area						1
190	7000	- Sp	rayed volume	· · · ·						1
2		- An:	other case? (1-	yes, z=no	0)					1
69		- Nu:	nber of size gr	oups						
0.0	0375	- Mei	an drop diamete	r (cm)						
59. 59.	0	- A1)	r-steam tempera oplet temperatu	cure (deg re (degC)	gC} \					
339	3	- Ini	Ltial velocity	(cm/sec)	•					
0		- Ini	itial angle							1
105	.83	- Spi - 1=7	ray fall height Frajectory, 2=1	(It) - ( ambda	045-4"-	C-REO		•		1
2		- Pri	int individual	drop para	emeters				•	
1	· ·	- 1-1	NRC E model, 2=	Entered	E valu	le Matura		•		1
230	0	- Ele - Cal	emental Iodine   Iculate organic	iodine s	n COEII removal	(leves, 2=no)				í
13.	79	- Flo	ow per nozzle (	gpn)						
20		- Nur	mber of nozzles			•	-			1
601	519	- Tep - Efi	perature dille Fective plateou	rence dei t area	ween a	rr and wall (de	egC)	i.		
190	7000	- Spa	rayed volume							
1		- Ar.c	other case? (1=	yes, 2=no	<b>b)</b>					
2 69		- Nur	wher of size ar	oups				1		1
0.0	0375	~ Mea	an drop diamete	r (cm)						
59.	0	- Ai.	r-steam tempera	ture (de	3C)					1
59.	3	- Dro - Thi	oplet temperatu	re (degC) (cm/sec)	}					1 .
89	-	– Ini	itial angle	, sm, scol						
105	.32	- Spi	ay fall height	(ft) - (	045-4"-	C-KEO				1
2		- 1**7 _ D·**	rajectory, 2-1	ambda dron nam	amatara	,	•			
1		- 191	RC E model, 2=	Entered	E valu	ė				{
230	0	- E.Le	emental Iodine	partitio	a coeff	icient				
•2	70	- Cal	lculate organic	iodine :	removal	(1=yes, 2=no)				1
20	13	- F.LC - N'JR	ther of nozzles	AFrin)					•	
										1

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Calc No. N-6030-001

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Subject Containment Aerosol and Iodine Removal Rates

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REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	×
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003						₽₹
										Ĩ DE
<u> </u>	l		L		L	·				
1	1 - Temperature difference between air and wall (degC)									
601	519	- Ef	fective plateou	t area						
130	1000	- 2p - An	other case? (1=	yes, 2-n	<b>)</b>					
2										
69	0375	– Ku	mber of size gr	oups						
59.	0	- re - ri	r-steam tempera	ture (de	IC)					
59.	0	- Ir	oplet temperatu	re (degC						
339	3	- In	itial velocity	(cm/sec)						
108	.11	- 10 - 5p	ray fall height	(ft) - (	051-4"-0	C-KEO			:	
2		- 1=	Trajectory, 2=1	ambda						
2		- Er	int individual	drop par	meters	•				
230	0	- J=	emental Iodine	Dartitio	n coeff:	- icient				ĺ
2	-	- Ca	lculate organic	iodine	removal	(1=yes, 2=no)				
13.	79	- F1	ow per nozzle (	gpm)		,				
20		- ľu - ľu	mber of nozzles moerature diffe	rence hel	ween a	ir and wall (de	n(1)			
601	519	- EIÍ	fective plateou	t area		000 0012 100	90)			
190	7000	- \$p	rayed volume							
		- I.n	other case? (1=	yes, 2=n:	)					
69		- Nu	mber of size gr	oups						
0.0	0375	– Ne	an drop diamete	r (cm)						
59.	0	- 3.1. 	r-steam tempera	ture (de	JC)					
59. 339	3	- Dr - Jp	oplet temperatu itial velocity	re (aegu) (cm/sec)						
89	•	- מנ	itial angle						•	
108	.11	- Sp	ray fall height	(ft) - (	051-4"-(	C-KEO				
2		- ].="	Trajectory, 2-1 int individual	ambda drop pari						
i		- 1=	NRC E model, 2-	Entered	E valu	e			ì	
230	0	- 1:1	emental Iodine	partition	n coeff:	icient				
2	79	- Ca.	iculate organic	iodine : ma)	cemoval	(1-yes, 2=no)				
20	15	- 11 - 111	mber of nozzles	Aler's						
1		- 1'ei	mperature diffe	rence bet	ween a	ir and wall (de	gC)			
601	519	- Bf	fective plateou	t area						
190	7000	- In	other case? (1=	ves, 2=nd	5)					
2										
69	0395	- tiu	mber of size gro	oups						
59.	0375	- 11	r-steam temperat	ture (dec	C)					ł
59.	Ō	- Dr	oplet temperatu	re (degC)	1					
339	3	- 11n	itial velocity	(cm/sec)						
117	. 43	- 1.n: - 50	itial angle rav fall height	(ft) = 0	152-2.5	-C-XEO		1		
2		- :=	Trajectory, 2=1a	ambda		0 1100				
2		- Pr	int individual of	irop para	meters					
1 220	0	- 11	NRC E model, 2=	Entered	E valu	e icient				
230	v	- (a)	lculate organic	iodine 1	emoval	(1=yes, 2=no)				
13.	79	- F1	ow per nozzle (	(mqt						
10		- 131	mber of nozzles				~~~)			
601	519	- :rei - 12f	mperature diffe fective plateout	tence Det tarea	ween a:	rt and wart (de	ge)			
190	7000	- Sp:	rayed volume							
1		- An	other case? (1=)	yes, 2≃no	<b>&gt;</b> }					
l										

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Subject Containment Aerosol and Iodine Removal Rates

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	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003					Ţ	ĕ₹
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							•			
2			mbor of size or							
0.0	0375	- 11u - 11e	an dron diamete	r (cm)						
59.	0	- hi	r-steam tempera	ture (dea	(C)					
59.	ò	- Dr	oplet temperatu	re (degC)	•					
339	3.	- ::n	itial velocity	(cm/sec)						
45		- ::n	itial angle			•				
117	.43	- Sp	ray fall height	(ft) - (	52-2.5	"-С-КЕО				
2		- 1=	Trajectory, 2-1	ambda			•			
2		- Pr	int individual (	arop para	meters	•	•	• .		
220	0		emental Todine	Dartition	coeff	e icient		•		
2	v	- Ca	lculate organic	iodine :	emoval	(1=yes, 2=no)				
13.	79	- 11	ow per nozzle (	gpm)		• • • • • • • • •			•	
10		- 11u	mber of nozzles	•						
1		- ::e	mperature diffe	rence bet	ween a	ir and wall (de	gC)			
601	519	. – D£	fective plateou	t area						•
190	7000 .	- Sp	rayed volume						•	
		- nn	other case? (1=	yes, 2=n(	2				•	
69		- 10	mber of size ar	ວນວຽ						•
0.0	0375	- lie	an drop diamete	r (cm)						
. 59.	0	– hi	r-steam tempera	ture (deg	(C)					
59.	0	- Dr	oplet temperatu	re (degC)						
339	3	- ::n	itial velocity	(cm/sec)						
0	~~	- In	itial angle		AC 2 6	*-CKDO				
2110	.4/	= sp	ray fail neight Traisctory 2=1	(IC) - L amhda	40-2.3	-0-450				
2		- Pr	int individual	drop para	meters					
ī		- 1=	NRC E model, 2=	Entered	E valu	e				
230	0	- El	emental Iodine	partition	coeff.	icient				
2		- Ca	lculate organic	iodine :	emoval	(1=yes, 2=no)				
13.	79 <sup>-</sup>	- 171	ow per nozzle (	gpm)						
10		- IIU	mber of nozzles	ranca hai		in and wall (do				
601	519	- 12f	fective plateou	t area	ween a	TT AND WAIT (De	guj			
190	7000	- Sp	rayed volume							
] 1		- Jin	other case? (1-	yes, 2=no	)					
2								•		
69		- 11u	mber of size gr	oups						
0.0	0375	- 11e	an drop diamete	Fire (day	~ \					
59.	0	- <u>AI</u>	onlet temperatu	care (degC)						
339	3	- :In	itial velocity	(cm/sec)						
45		- :[n	itial angle							
118	.47	- Sp	ray fall height	(ft) - 0	46-2.5	"-C-KEO				
2		- 1-	Trajectory, 2-1	ambda						
2		- Pr.	int individual	irop par	meters	_				
1 1 2 2 0	•	- <u>1</u> =, - 121,	NRC E MODEL, 2ª	Entered	E Valu	e icient				
230	v	- 12	lculate organic	iodine v	emoval:	(1=ves, 2=no)				
13.	79	- 31	ow per nozzle (	ipni)		(- ]				
10		- 190	mber of nozzles							
1		~ '[e:	mperature diffe	rence bet	ween a	ir and wall (de	gC)			
601	519	- Ef	fective plateou	t area						
190	7000	- Sp	rayed volume							
2		- HD	other case? (1=	yes, 2=n:	)					
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0.0 44. 44. 339 10 85. 2 1	0375 1 1 3 60	- Fair - Mer - Jin - Dre - Jin - Jin - Spp - Jef - Pr: - Jef	an drop diamete: r-steam temperatu: itial velocity itial angle ray fall height Trajectory, 2-1: int individual of NRC E model, 2-	r (cm) ture (deg re (degC) (cm/sec) (ft) ~ 0 ambda drop para Entered	C) 943-4"-( meters E value	С-кео					

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1100 2 13.79 28 1 601519 1907000 1 2 69 0.00375 44.1 44.1 3393 45 85.60 2 1 1 100 2 13.79 28 1 601519 1907000 1 2 69 0.00375 44.1 44.1 3393 0 105.83 2 1 100 2 13.79 20 1 100 2 13.79 20 1 100 2 13.79 20 1 100 2 13.79 20 1 100 2 13.79 20 1 100 2 13.79 20 1 100 2 13.79 20 1 100 2 13.79 20 1 100 2 13.79 20 1 100 2 13.79 20 1 100 2 13.79 20 1 100 2 13.79 20 1 100 2 13.79 20 1 100 2 13.79 20 1 100 2 13.79 20 1 100 2 13.79 20 1 100 2 13.79 20 1 100 2 13.79 20 1 100 2 13.79 20 1 100 2 105.83 2 2 1 100 2 5 44.1 44.1 3393 0 105.83 2 2 1 100 2 2 1 100 2 2 1 100 2 2 1 100 2 2 1 100 2 2 1 100 2 2 1 100 2 2 1 100 2 2 1 100 2 2 1 100 2 2 1 100 2 2 1 100 2 2 1 100 2 2 1 100 2 2 1 100 2 2 1 100 2 2 1 100 2 2 2 1 100 2 2 2 1 100 2 2 2 1 100 2 2 2 1 100 2 2 2 1 100 2 2 2 1 100 2 2 2 1 100 2 2 2 2 1 100 2 2 2 2 1 100 2 2 2 2 1 100 2 2 2 2 1 100 2 2 2 2 2 1 1 100 2 2 2 2 1 1 100 2 2 2 2 1 1 100 2 2 2 2 1 1 100 2 2 2 2 1 1 100 2 2 2 2 1 1 100 2 2 2 2 1 1 100 2 2 2 2 1 1 100 2 2 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1	= EI = Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Cai + Ca	emental Icdine ; Iculate organic ow per nozzle ( inber of nozzles nperature diffe fective plateou cayed volume other case? (1=) nber of size grand an drop diameter r-steam temperatu itial velocity itial angle ray fall height Trajectory, 2=1. int individual ( NRC E model, 2= emental Iodine ) Iculate organic ow per nozzle ( mber of nozzles mperature diffe; fective plateou rayed volume other case? (1=) mber of size grand an drop diameter r-steam temperature itial velocity itial angle ray fall height Trajectory, 2=1. int individual ( NRC E model, 2= emental Iodine ) Iculate organic ow per nozzle (0 mber of nozzles mperature diffe; fective plateou rayed volume other case? (1=) mber of nozzles mperature diffe; fective plateou rayed volume other case? (1=) mber of size gra an drop diameter ray fall height rajectory, 2=1. int individual ( NRC E model, 2= emental Iodine 1 Iculate organic ow per nozzle (2 mber of nozzles) mother case? (1=) mber of size gra an drop diameter ray fall height rajectory, 2=1. int individual ( NRC E model, 2= emental Iodine 1 Iculate organic ow per nozzle (2 mber of nozzles)	partition iodine r gpm) rence bet t area yes, 2=nc oups r (cm) ture (degC) (cm/sec) (ft) - 0 ambda drop para Entered partition iodine r gpm) rence bet t area yes, 2=nc oups r (cm) ture (degC) (cm/sec) (ft) - 0 ambda drop para Entered partition iodine r gpm) rence bet t area yes, 2=nc oups r (cm) ture (degC) (cm/sec) (ft) - 0 ambda frop para Entered partition iodine r gpm) rence bet t area yes, 2=nc oups r (cm) ture (degC) (cm/sec) (ft) - 0 ambda Entered partition iodine r gpm) rence bet t area yes, 2=nc oups r (cm) ture (degC) (cm/sec) (ft) - 0 ambda Entered partition iodine r gpm)	a coeff removal ween a b) ()43-4"-( aneters E valu a coeff removal ween a b) (C) (45-4"-( aneters E valu a coeff removal sween a coeff removal coeff removal coeff removal	icient (1=yes, 2=no) ir and wall (de c-KEO e icient (1=yes, 2=no) ir and wall (de c-KEO e icient (1=yes, 2=no) ir and wall (de c-KEO c-KEO c-KEO	gC)				

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			I				1			
1	-10	- Te	mperature diffe	rence be	tween a	ir and wall (de	gC)			1
190	519	- E: - SD	rective plateou	t area						[
ĩ		– An	other case? (1=	yes, 2=n	o)					
2										
69		- N'I	mber of size gr	oups						
0.0	0375	- Ne	an drop diamete	r (cm) ture (de	nC1					
44.	1	- D::	oplet temperatu	re (deaC)	)				•	
339	3	- In	itial velocity	(cm/sec)						
0		- In	itial angle							
108	.11	- Sp - 1m	ray fall height Trainctory 2-1	(IC) — ( ambda	051-4"-0	C-KEO				
		- 1" - P:	int individual	drop par	ameters					
1		- 1=	NRC E model, 2=	Entered	E valu	e				
110	0	- E.L	emental Iodine	partitio	n coeff:	icient				
2	20	- Ca	lculate organic	iodine :	removal	(1¤yes, 2≖no)				•
13.	79	- F.L	ow per nozzie ( mber of nozzies	gbw)						
1 1		- Te	moerature diffe	rence be	tween a	ir and wall (de	aC)			
601	519	- Ef	fective plateou	t area		• • • • •				
190	7000	- Sp	rayed volume							
1		- A:)	other case? {1=	yes, 2-n	5)					•
69		- N°2	mber of size gr	oups						
0.0	0375	- M-3	an drop diamete	r (cm)						
44.	1	- Al	r-steam tempera	ture (de	JC)					
44.	1	- D:	oplet temperatu	re (degC	)				•	
339	3	- In - Tn	itial velocity	(cm/sec)						
108	.11	- SD	rav fall height	(ft) - (	051-4"-0	C-REO				
2		- 1.	Trajectory, 2-1	ambda	•					
2		- P.C	int individual	drop par	ameters					
1	•	- 10	NRC E model, 2=	Entered	E valu	é I al cat				
2	U	- Ci	lculate organic	iodine :	removal	(1=ves, 2=no)				
13.	79	- F.L	ow per nozzle {	gpa)						
20		- N a	mber of nozzles							
1	E1 0	- Tel	mperature diffe	rence be	tween a	ir and wall (de	gC)		1	
190	2000	- 53	raved volume	Larea						
1		- An	other case? (1=	yes, 2=n	<b>)</b>					
2				-						
69	0075	- N 1	mber of size gr	oups						•
U.0 ⊿∡	US/S 1	- M3	an grop glamete r-steam tempera	r (CM) ture (dea	TC)					
44.	1	- Dr	oplet temperatu	re (degC	, }					
339	3	- In.	itial velocity	(cm/sec)						
0		~ In:	itial angle							
	.43	- Sp	ray fall height	(It) - ( mbda	052-2.5	"-C-KE				
2		- Te.	int individual	irop par	ameters					
ĩ		- 1-	NRC E model, 2=	Entered	E valu	e				
110	0	- E1	emental Iodine	partitio	n coeff:	icient				
2	~~	- Ca	lculate organic	iodine 1	removal	(1=yes, 2=no)				
13.	79	- FL	ow per nozzle (	(mq						
1 10		- พม - พพ	mperature diffe	rence be	tween a	ir and wall (de	σC)			
601	519	- Ef.	fective plateou	t area		""" """ (40	341			
190	7000	- Sp	rayed volume					•		
1		- Aa	other case? (1=	yes, 2=n:	o)					

SCE 26-426 REV. 2 [REFERENCE: SO123-XXIV-7.15]

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Subject Containme	nt Aerosol :	and Iodine Remov	al Rates	•			Sh	eet	_161	of	28
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0 J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003								REV
2 69 0.00375 44.1 3393 45 117.43 2 1 1100 2 13.79 10 1 601519 1907000 1 2 69 0.00375 44.1 44.1 3393 0 118.47 2 1 100 2 13.79 10 118.47 2 1 100 2 13.79 10 1 18.47 2 1 100 2 13.79 10 1 100 2 13.79 10 1 100 2 13.79 10 1 100 2 13.79 10 1 100 2 13.79 10 1 100 2 13.79 10 1 100 2 13.79 10 1 100 2 13.79 10 1 100 2 13.79 10 1 100 2 13.79 10 1 100 2 13.79 10 1 100 2 13.79 10 1 100 2 13.79 10 1 100 2 13.79 10 1 1 100 2 13.79 10 1 100 2 13.79 10 1 1 100 2 13.79 10 1 1 100 2 13.79 10 1 1 100 2 2 2 1 1 100 2 2 2 2 1 1 100 2 2 2 2 1 1 100 2 2 2 2 2 2 2 2 2 2 2 2 2	- Mu - Mu - Mu - Mu - Mi - Sp - Sp	mber of size gr an drop diamete r-steam temperatu itial velocity itial angle ray fall height Trajectory, 2-1 int individual NRC E model, 2- emental Iodine lculate organic ow per nozzle ( mber of nozzles mperature diffe fective plateou rayed volume other case? (1= mber of size gr an drop diamete: r-steam temperatu itial velocity itial angle ray fall height Trajectory, 2=1: int individual of NRC E model, 2- emental Iodine j lculate organic ow per nozzle ( mber of nozzles mperature diffe: fective plateou rayed volume other case? (1=) mber of size gr an drop diamete: r-steam temperatu; itial velocity itial angle ray fall height Trajectory, 2=1: int individual of nor f size gr an drop diamete: r-steam temperatu; itial velocity itial angle ray fall height Trajectory, 2=1: int individual of nor f nozzles mperature diffe: fective plateou rayed volume other case? (1=)	oups r (cm) ture (degC) (cm/sec) (ft) - ( ambda drop para Entered partition iodine 1 gpm) rence bet t area yes, 2=nc oups r (cm) ture (degC) (cm/sec) (ft) - ( ambda drop para Entered partiticr iodine 1 gpm) rence bet t area yes, 2=nc oups r (cm) ture (degC) (cm/sec) (ft) - ( ambda drop para Entered partiticr iodine 1 gpm) rence bet t area yes, 2=nc oups r (cm) ture (degC) (cm/sec) (ft) - ( ambda drop para Entered partiticr iodine 2 gpm) rence bet t area yes, 2=nc	(C) (D) (D) (D) (C) (C) (C) (C) (C) (C) (C) (C	<pre>"-C-KE e icient (l=yes, 2=no) ir and wall (de "-C-KEO ir and wall (de "-C-KEO clicient (l=yes, 2=no) ir and wall (de clicient (l=yes, 2=no) ir and wall (de</pre>	gC) gC)	· ·			· · ·	

SCE 26-428 REV. 2 [REFERENCE: SO123-XXIV-7.15]

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			Standard Comp NE305 REMOVE for the IBM	uter Prov Version PC/XT/A	gram 4.0 T							
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	AL	stract:										
	Th Sp di	ne REMOVE Dray renov lameter of	program calcul val rate consta r drop trajecto	ates the nts and ; ries	contain a mean (	oment drop .			•			
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Bechtel	Standard	Computer	Program	REMOVE ,	NE305 V	Version 4.0						
(c) 199 Origina	1 tor Jorge	Schulz	Date 14	Jun 2003	Calc I Check	No. N-6030-00 F ed Date	ev No. (	)				
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Di Di Di Sc Gr Tr	ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of hmidt number f hmidt number f ashof number= y mean diamete	elemental methyl I2 elemental methyl I2 or elemen or methyl 2.59335E r= 8.430	I2 in air-stea in air-steam m I2 in droplet in droplet lig tal iodine= 1 iodine= 1.33 +12 32E-02	m mixture dixture= liquid= uid= 1.5 .7426 44	8-5 .1119 1.4783 59648E-	7445E-02 sq. cm 8 sq. cm/se 3E-05 sq. cm/se 05 sq. cm/sec	N/SEC IC				
Dr	op parameters (For )	tor elemen mean drop	ntal >								
I	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff ( M/SEC	5 T. CM/	V. drop no SEC	•				
34	8.4303E-02	6.124	194.9	12.29	34	5.4 270.1				•	
Ĩ	Diameter : CM	Sherwood	Time S	at. Frac.	. М.Т. С	Coeff L Remov M/SEC /HF	ral t				
34	8.4303E-02	4.176	5.0952E-02	.3352	1.1	538E-03 4.567	1				
**	**************************************	REMOVAL	RATES**********	*							
То	tal elemental :	removal c	onstant= 4.56	65 pe	er hour						ĺ
Pa	rticulate iodi:	ne remova.	l constant= .	59268	per h	our					ł
Tc	tal organic re	moval con	stant= .00000	per	hour					•	ļ
**	***REMOVAL DUE	TO WALL	DEPOSITION*****								
El	emental remova	l rate du	e to wall depos	ition =	4.721	I per hour					1
Or	ganic removal :	rate due	to wall deposit	10n= .U	20000	per nour					
ne	an arop aramet	8I <b>-</b> 0.4)	UJ2E-U2								

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Bec (C) Orij Pro Sut	9.2.2.1.2 I2 chtel Standard ) 1991 Lginator Jorge oject SONGS oject I2 Spray	Computer Schulz Tempera	Program 2 Date 14 Cure Parametric	REMOVE , Jun 2003	, NE305 Calc M Checke Job Ne Sheet	Version 4.0 No. N-6030-00 R d Date 0. 16575-167 No. 1	ev No. 0	-			
			Standard Compu NE305 REMOVE for the IBM	Nter Prog Version PC/XT/AT	/::am 4.0			·			
	Ab Th sp di	stract: e REMOVE ray remov ameter or	program calcula al rate constan drop trajector	tes the d ts and a ies	contain mean d	ment rop					
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Tem Pre Tem Den Vis Den Vis Dif Dif Sch	perature of air soure of air-st perature of dro sity of air-ste cosity of air-ste cosity of droplet cosity of droplet f. coeff. of el f. coeff. of me f. coeff. of me midt number for	-steam mi eam mixtu plet ligu am mixtu team mixtu team mixtu eliguide et liguide et liguide thyl I2 s elementa elementa	ixture= 30.000 ire= 1.0592 iid= 30.000 re= 1.21538E-03 rure= 1.81599E- .99529 G, i= 8.01072E-03 i2 in air-steam in air-steam min i2 in droplet liquid in droplet liquid li iodine= 1.7	D Deg Atm. Degree 3 G/CC -04 Poise /CC Poise mixture= toure= tquid= 1 id= 1.59 /426	gree C C B.574 .11198 .478335 0648E~05	145E-02 sq. cm/ sq. cm/sec c-05 sq. cm/sec sq. cm/sec	/sec :				
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Sci Gra Tr	nmidt number f ashof number= y mean diamete	or methyl 2.593355 r= 8.430	iodine= 1.33 (12 32E-02	44						:	
Dro	op parameters : (For )	for element mean drop	ntal 								
I	Diameter : CM	Fall Time SEC	Reynolds M. Ci	I.Coeff G M/SEC	5 T. CM/	V. drop no. SEC	•		•	•	
34	8.4303E-02	6.124	194.9	12.29	34	5.4 270.1					
I	Diameter : CM	Sherwood	Time S.	at. Frac.	M.T.C	Coeff L Remova M/SEC /HR	31				
34	8.4303E-02	4.176	5.0952E-02	.3352	1.1	538E-03 4.567		•			
***	*********SPRAY	REMOVAL :	RATES*********	*					•		
Tot	tal elemental :	removal c	onstant= 4.56	85 pe	er hour						
Par	cticulate iodi	he removal	L constant= .!	59268	per h	our					
Tot	tal organic re	moval cons	stant= .00000	per	hour						
***	***REMOVAL DUE	TO WALL I	DEPOSITION*****				•				
Ele	emental removal	l rate du	e to wall depos:	ition =	4.721	1 per hour					
Org	Janic removal :	rate due 1	to wall deposit:	ion= .0	0000	per hour					
Mea	in drop diamete	er= 8,430	JJZE-UZ								
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Be (C Or Su Be (C Or	0       J. Schlig       BIJANO       D. J. Dekienie BJJANO         9       J. Schlig       D. J. Dekienie BJJANO       D. J. Dekienie BJJANO         9       J. Schlig       D. J. Dekienie BJJANO       D. J. Dekienie BJJANO         9       J. Schlig       Distribution       Distribution         9       J. J. Dekienie BJJANO       Distribution       Distribution         9       Distribution       Distribution       Distribution       Distribution         1       Standard Computer Program       Distribution       Distribution       Distribution         1       Standard Computer Program       Standard Computer Program       Distribution       Distribution         1       Standard Computer Program       NE305 REMOVE Version 4.0       Distribution       Distribution         1       Mission       Standard Computer Program       Distribution       Distribution         2       Abstract:       The REMOVE program calculates the containment spray removal rate constants and a mean drop diameter or drop trajectories       Distribution       Distribution         0       Output in file I2-50.out       was created on 14 Jun 2003 at 10:55:123       Deschiel Standard Computer Program       REMOVE , NE305 Version 4.0       Distribution Calculates the contained to propresent the contained to program <td< th=""></td<>											
Su === Te	bject 12 Spray	Tempena 	ture Parametric:	s ====================================	Sheet	No. 2	2 y y <b>4</b> 4 9 y a	-				
Pr Te De Vi Di Di Di Sc	essure of air-s mperature of di nsity of air-st scosity of dropt scosity of dropt ff. coeff. of e ff. coeff. of e ff. coeff. of m ff. coeff. of m hmidt number fo	team m:xt coplet .i. seam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam mixt steam staat steam s	ture= 1.2061 guid= 50.000 ure= 1.26801E= kture= 1.854251 98761 id= 5.49585E=0 I2 in air-steam m I2 in droplet 1 in droplet light tal iodine= 1	Atm. Degree 03 G/CC E-04 Pois G/CC 3 Poise m mixture ixture- liquid= uid= 2.4 .7058	e C e 8.57 .11194 2.29696 18055E-0	252E-02 sq. cm sq. cm/se E-05 sq. cm/se 5 sq. cm/sec	/sec c c					
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Subject	Containmen	t Aerosol a	nd Iodine Remov	al Rates					She	et <u>1</u>	67 of	281		
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		<u> </u>								_		ž		
Schmi Grash Try m Drop	Schmidt number for methyl iodine= 1.3064 Grashof number= 3.17627E+12 Try mean diameter= 8.54446E-02 Drop parameters for elemantal (For mean drop)													
I	(For ) Diameter	mean drop Fall Time	) Reynolds M.	T.Coeff G	т.	V. di	rop no.	•						
	CM	SEC	C	M/SEC	CM/S	SEC			1			<b>[</b>		
34 8	.5445E-02	6.233	199.0	12.15	34	0.6	259.4			•		l		
I	Diameter : CM	Sherwood	Time 5	at. Frac.	M.T.(	Coeff L M/SEC	Remova /HR	1						
34 8	.5445E-02	2.695	7.8443E-02	.3621	1.7	688E-03	4.934				•			
*****	******SPRAY	REMOVAL I	RATES*********	*										
Total	elemental :	removal co	onstant= 4.93	57 pe	r hour									
Parti	culate iodin	ne removal	l constant= .	59268	per h	our								
Total organic removal constant= .00000 per hour														
*****	REMOVAL DUE	TO WALL I	DEPOSITION*****						•					
Eleme	ntal removal	l rate cu	e to wall depos	ition =	4.984	0 per	hour							
Organ	ic removal :	rate due 1	to wall deposit:	ion= .0	0000	per how	17							
Mean	drop diamete	er= 8.54	46E-02											
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Be (C Or Pr Su	9.2.2.1.4       I2-60.out         Bechtel Standard Computer Program       REMOVE       , NE305 Version 4.0         (c) 1991       Calc No. N-6030-00 Rev No. 0         Originator Jorge Schulz       Date 14 Jun 2003       Checked         Project SONGS       Job No. 16575-167         Subject I2 Spray Temperature Parametrics       Sheet No. 1													
	Standard Computer Program NE305 REMOVE Version 4.0 for the IBM PC/XT/AT													
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Pr Te De Vi De Vi Di Di Sc	essure of air-s mperature of dr nsity of air-st scosity of drople scosity of drople ff. coeff. of e ff. coeff. of m ff. coeff. of m ff. coeff. of m ff. coeff. of m	team mix coplet lid steam mixt steam rii t liquid blet liquid blemental hethyl 12 clemental hethyl 12 cr elemental	ture= 1.3145 quid= 60.000 pre= 1.31522E- rture= 1.85731 98289 id= 4.68809E-0 I2 in air-steam m I2 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in dro	Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise n mixture ixture liquid iquid 2.9 .6835	e C = 8.38 .10956 2.77606 9793E-0	3831E-02 sq. cm 3 sq. cm/se 5E-05 sq. cm/sec 55 sq. cm/sec	/sec c							

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Sci Gra Try Dro	nmidt number f ashof number- y mean diamete op parameters	or methyl 3.75337E r= 8.588 for eleme	iodine- 1.28 +12 42E-02 ntal	87			·				
I	(For: Diameter	mean drop Fall.Time	) Reynolds M.	T.Coeff ( M/SEC	5 T.V	. drop no	•				
74	8 58845-02	6.333	204-6	11.93	12	 5.4 255-5	1	ı			
	Diameter	Sherwood	Time S	at. Frac.	. M.T.(	Coeff L Remov	al		• .		
-	CM		2 DIN 2	~~, **an	a	I/SEC /HR					
34	8.58842-02	2.199	9,5346E-02	.3722	2.1	268E-03 5.071					ſ
**1	*********SPRAY	REMOVAL I	RATES*********	*							
Tot	al elemental	removal co	onstant= 5.07	24 pe	er hour				•		
Par	cticulate iodi	ne removaj	l constant= .	59268	per h	our					
Tot	al organic re	moval con:	stant= .00000	per	nour						
***	**REMOVAL DUE	TO WALL I	DEPOSITION*****								
Ele	emental remova	l rate dro	e to wall depos	ition =	5.104	) per hour					1
Org	janic removal :	cate due 1	to wall deposit	ion= .0	0000	per hour					1
Меа	an drop diamet	er- 8.5E	342E-02								
	9.2.2.1.5 1	2-70 out									
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Bec (c) Ori Pro Sub	chtel Standard 1991 .ginator Jorge oject SONGS oject I2 Spra	Computer Schulz y Temperat	Program 1 Date 14 ture Parametric	REMOVE , Jun 2003 S	NE305 Calc 1 Check Job No Sheet	version 4.0 No. N-6030-00 R dDate Date No. 1	ev No. 0		•		
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	l l		Standard Comp NE305 RENOVE	uter Prog Version	ram 4.0						
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Projec	t or DCP/FCN/E	CP		C	aic No.	N-6030-	-001		CCN CO CCN NO	NVERS . CCN	ION:	•	
Subjec	t Containmen	t Aerosol a	and Iodine Remov	al Rates	•				She	et _1	70 <b>of</b>	281	
FEV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINAT	OR	DATE	IR	-	DATE	g	
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003								REV	
		<u> </u> .							<u> </u>			Z	
The REMOVI: program calculates the containment spray removal rate constants and a mean drop diameter or drop trajectories Output in file I2-70.cut was created on 14 Jun 2003 at 10:55:47 Bechtel Standard Compute: Program REMOVE, NE305 Version 4.0 (c) 1991 Calc No. N-6030-00 Rev No. 0 Originator Jorge Schulz Date 14 Jun 2003 Checked Date Project SONGS Job No. 16575-167 Subject I2 Spray Temperature Parametrics Scheet No. 2 Temperature of air-steam mixture= 1.4590 Atm. Temperature of droplet liquid= 70.000 Degree C Pressure of air-steam mixture= 1.38315E-03 G/CC Viscosity of air-steam mixture= 1.38315E-03 G/CC Viscosity of droplet liquid= .97759 G/CC Viscosity of droplet liquid= .97759 G/CC Diff. coeff. of elemental I2 in air-steam mixture= .0539 Sq. cm/sec Diff. coeff. of methyl I2 in air-steam mixture= .10539 Diff. coeff. of methyl I2 in droplet liquid= 3.56436E-05 sq. cm/sec Schmidt number for elemental iodine= 1.2687													
SC SC Gr Tr Dr	hmidt number fo hmidt number fo ashof number- y mean diameter op parameters f	or element or methy.L 4.589873 = 8.623 for element	tal iodine= 1 iodine= 1.26 +12 31E-02 htal	.6588 87									
I	(For m Diameter I CM	all Time SEC	Reynolds M. C	T.Coeff G M/SEC	; Т.V См/5	7. dro SEC	op no.						
34	B.6238E-02	6.477	213.2	11.56	33(	0.6 2	:52.3						
I	Diameter S CM	sherwood	Time S	at. Frac.	M.T.C CN	Coeff L F M/SEC	lemova: /HR	L					
34	8.6238E-02	1.901	.1150	.3800	2.51	82E-03 5	.178		•				
**	*********SPRAY	REMOVAL 1	ATES*********	*									
<b>T</b> 0	tal elemental r	emoval co	onstant= 5.17	80 Pe	r hour								
Pa	rticulate iodir	e removal	. constant= .	59268	per ho	our		4					
To	tal organic rem	oval cons	stant00000	per	hour								
El	***REMOVAL DUE	TO WALL I . rate due	EPOSITION***** to wall depos	ition =	5.1040	per h	our						
			0400 1040 8 471					-					

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Subjec	t Containmen	t Aerosol a	and lodine Remov	al Rates	•	<u>,                                     </u>	<u> </u>	She	et <u>1</u>	<u>71</u> of	_281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DATE	<u>چ</u>
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							REV
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Or	ganic removal :	rate due	to wall deposit	ion= .	0000 <u>0</u>	per hour					
Mea	an drop diameto	er= 8.62	381E-02								
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Subject	t Containment	Aerosol	and Iodine Remov	al Rates	<u> </u>			She	et _ 17	2_ of	281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DATE	¥
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003	[]		<b> </b>				REV
Bec (c) Ori Prc Sub Bec (c) Ori Prc Sub	9.2.2.1.6 I2 chtel Standard 1991 ginator Jorge oject SONGS oject I2 Spray Ab Th sp di Output in fi chtel Standard 1991 ginator Jorge oject I2 Spray	-75.0u1 Compute: Schulz Tempera Stract: e REMOVE ray reno ameter of le 12-75 Compute: Schulz Tempel:a	Program Date 14 ture Parametric Standard Comp NE305 REMOVE for the IBM program calcul val rate consta r drop trajecto .out was cre Program Date 14 ture Parametric	REMOVE , Jun 2003 3 Uter Proof Version 1 PC/XT/AI ates the nts and a ries ated on 1 REMOVE , Jun 2003 S	NE305 Calc N Check Job No Sheet ram 4.0 Contair mean C Calc N Check Calc N Check Sheet	Version 4.0 No. N-6030-00 R d Date Date Date Date No. 1	ev No. 0				2
Tem Pre Tem Den Vis Den Vis Dif Dif Dif	aperature of air- saverature of air-st cosity of air-st cosity of air- sity of drople scosity of drop f. coeff. of m f. coeff. of m f. coeff. of m midt number fo	r-stean r team mixt oplet lic eam mixt steam mix t liquid- let liquid- lemental ethyl 12 lemental ethyl 12 r eleman	mixture= 75.0 ture= 1.5487 quid= 75.000 are= 1.42687E- kture= 1.84197 = .97473 id= 3.79951E-0 I2 in air-steam in air-steam m I2 in droplet in droplet lig tal iodine= 1	00 De Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture ixture= liquid= uid= 3.8 .6458	agree C ee C == 7.84 .10261 3.57950 16559E-C	376E-02 sg. cm sg. cm/se E-05 sg. cm/sec 5 sg. cm/sec	/sec c			-	
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Subje	ct Containme	ent Aerosol	and Iodine Remov	al Rates					Sh	eet	173	of <u>281</u>
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE	1	RE	DAT	E g
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003	ļ					<u></u>		DICAT
<b> </b>					<u> </u>							<sup>2</sup>
S G T	chmidt number rashof number= ry mean diamet	for methyl 5.125691 er= 8.639	iodine= 1.25 +12 26E-02	81								
D	rop parameters (For	for elene mean drop	ntal }									
	I Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff ( M/SEC	G T. CM/	V. Sec	drop no	•		•		
3	5 8.6393E-02	6.567	218.8	11.33	32	7.0	251.0					
	I Diameter CM	Sherwood	Time S	at. Frac	. М.Т. С	Coeff L M/SEC	Remov /HR	<b>al</b> .				
3	5 8.6393E-02	1.630	.1260	.3830	2.7	262E-03	5.219					
•	**************************************	Y REMOVAL	RATES*********	*								
т	otal elemental	removal c	onstant= 5.21	92 p	er hour							
P	articulate iod	ine remova	l constant= .	59268	per h	our						
т	otal organic r	emoval con	stant= .00000	per	hour							
*	****REMOVAL DU	E TO WALL	Deposition*****					•				
E	lemental remov	al rate da	e to wall depos	ition =	5.104	0 pe	r hour					
0	rganic removal	rate due	to wall deposit	ion= .	00000	per h	our				•	
м	ean drop diame	ter= 8.63	9266-02									
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Subject	Containment	t Aerosol :	nd lodine Remov		·	She	et _1	. <u>74</u> of	281				
REV	ORIGINATOR	DATE	IRE		DATE	~							
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003						1	REV ICATO		
9 Bech (c) Orig Proj Subj	<b>9.2.2.1.7 1</b> 2 ttel Standard 1991 jinator Jorge ect SONGS ect I2 Spray	<b>2-80.041</b> Computer Schulz	Program Date 14 ture Parametric	REMOVE , Jun 2003 S	, NE305 Calc 1 Checke Job No Sheet	Version 4.0 No. N-6030-00 R edDate Date No. 1	ev No. 0	-					
			Standard Comp NE305 REMOVE for the IBM	uter Prog Version PC/XT/AT	gram 4.0 C								
	Ab Th Sp di	ostract: he REMOV:S oray remov ameter o:	program calcul val rate consta c drop trajecto	ates the nts and a ries	contair a mean d	ument irop							
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Diff Diff Diff Schm	. COEFF. OF e . COEFF. OF m . COEFF. OF m . COEFF. OF m idt number fo	eremental hethyl 12 elemental hethyl 12 or element	12 in air-steam m in air-steam m I2 in droplet : in droplet liq cal iodine= 1	m mixture ixture liquid= uid= 4.1 .6326	9.93942 3.86934 7859E-0	3225-02 sq. cm 25-02 sq. cm/se 15-05 sq. cm/se 15 sq. cm/sec	/ sec c			70.001 5-	N 0 400		

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	CALC	ULA	<b>TION SH</b>	PRELIM. CC	N NO.	PAGEC				)F				
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Subjec	Subject Containment Aerosol and Iodine Removal Rates										of	281		
RIEV	ORIGINATOR	IR	E DATE		re	œ								
0	0 J. Schulz 8/15/2003 D. T. Dexheimer 8/15/2003													
Sc Gr Tr	Schmidt number for methyl iodine= 1.2472 Grashof number= 5.75187E+12 Try mean diameter= 8.65248E-02													
Dr	op parameters (For :	for eleme mean drop	ntal )											
I	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	; T. CM/:	V. drop SEC	no.							
35	8.6525E-02	6.673	225.4	11.06	32:	2.9 249	.8							
, I	Diameter CM	Sherwood	Time S	at. Frac.	M.T.C	Coeff L Rem M/SEC /	oval HR							
35	8.6525E-02	1.474	.1380	.3854	2.9	424E-03 5.2	52							
	************** SPRAY	REMOVAL	RATES*********	*		•								
То	tal elemental :	removal c	onstant= 5.25	27 pe	er hour									
Pa	rticulate iodi	ne removal	l constant= .	59268	per h	our								
То	tal organic rea	moval con	stant= .00000	per	hour									
,	***REMOVAL DUE	TO WALL	DEPOSITION*****											
El	emențal removal	l rate du	e to wall depos	ition =	5.104	0 per hou	r							
Or	ganic removal :	rate due	to wall deposit	ion0	0000	per hour				•				
Me	an drop diamet	er= 8.65	248E-02											
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ubject	Containmen	t Aerosol	and Iodine Remov	al Rates		· · · · · · · · · · · · · · · · · · ·	. <u>.</u>	Shee	t″ <u>17</u>	<u>6</u> of	281			
F.EV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	· IRE		DATE				
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003		······					P P P P P P P P P P P P P P P P P P P			
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Bech (c) Orig Proj Subj	tel Standard 1991 finator Jorge ect SONGS ect I2 Spra	Compute: Schulz y Tempera	Program Date 14 ture Parametric	REMOVE , Jun 2003	, NE305 Calc M Checke Job No Sheet	Version 4.0 No. N-6030-00 R d Date No No	ev No. O							
	-													
	       		Standard Comp NE305 REMOVE for the IBM	Version PC/XT/A	yram 4.0 r	       								
	Al Ti Si d:	bstract: he REMOVE pray remo lameter o	program calcul val rate consta r drop trajecto	ates the nts and a ries	contair a mean c	ment irop								
	Output in fi	ile 12-85	.out was cre	ated on 1	14 Jun 2	2003 at 10:56:	22	• •						
Bechi (C) Orig: Proj Subj	tel Standard 1991 inator Jorge ect SONGS ect I2 Spra	Computer Schulz y Tempera	Program Date 14 ture Parametric	REMOVE , Jun 2003 S	NE305 V Calc M Checke Job No Sheet	Version 4.0 No. N-6030-00 R edDate D. 16575-167 No. 2	ev No. 0							
Tempo Press Tempo Dens: Visc Dens: Visc Diff	erature of air- sure of air- erature of dr ity of air- sity of air- ity of drople osity of drop coeff. of d	ir-stean mix steam mix coplet li team mixt steam mixt steam mixt olet liquid plet liquid slemental methyl '12	mixture= 85.0 ture= 1.7723 quid= 85.000 ure= 1.53848E- xture= 1.82194 = .96862 id= 3.35520E-0 I2 in air-stea in air-steam m	00 pe Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture ixture	e C e C e 7.31 9.57870	266E-02 sq. cm 5E-02 sq. cm/se	/sec c							

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Subjec	t Containmen	nt Aerosol a	and Iodine Remov	al Rates	<u></u>			<u> </u>	She	et <u>1'</u>	<u>77</u> of	281		
F:EV	ORIGINATOR	DATE	· IRI	3	DATE	g								
0	J. Schulz	8/15/2003				DICAT								
Schmidt number for methyl iodine- 1.2363 Grashof number= 6.47834E+12 Try mean diameter= 8.66359E-02														
I	(For : Diameter	mean drop Fall Time	Reynolds M.	r.Coeff G	5 T.	v. dr	op no.							
	CM	SEC	CI	M/SEC	CM/S	SEC	•••		1					
35 I	8.6636E-02 Diameter CM	5.796 Sherwood	232.8 Time Si	10.76 at. Frac.	310 M.T.( Cl	8.2 Coeff L M/SEC	248.9 Remova /HR	1		•				
35	8.6636E-02	1.333	.1510	.3873	3.1	669E-03	5.278							
	**********SPRAY	REMOVAL	RATES*********	•						· ·	•	·		
То	tal elemental	removal c	onstant= 5.27	87 pe	r hour									
Pa	rticulate iodi	në remova	1 constant= .!	59268	per h	our								
То	tal organic re	moval ccn	stant= .00000	per	hour									
**	***REMOVAL DUE	TO WALL	DEPOSITION*****											
El	emental remova	l rate cu	e to wall depos:	ition =	5.104	0 per	hour							
Or	ganic removal :	rate due '	to wall deposit:	ion= .0	0000	per hou	ır			•				
Me	an drop diamet	er= 8.66	359E-02		•									
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Subjec	ct Containmen	t Aerosol a	and Iodine Remov	al Rates	•		·	She	et _1	<u>78</u> of	281	
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0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							REV	
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Be (C Or Su	9.2.2.1.9       I2-90.out         Bechtel Standard Computer Program       REMOVE , NE305 Version 4.0 Calc No. N-6303-00 Rev No. 0 Originator Jorge Schulz         Date 14 Jun 2003       Checked											
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I	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff ( M/SEC	G Т. См/3	V. d SEC	rop no	•					
35	8.6725E-02	6.937	241.2	10.43	31	3.0	248.1		•	•			
I	Diameter CM	Sherwood	Time S	at. Frac.	. M.T. C	Coeff L M/SEC	Remova /HR	al					
35	8.6725E-02	1.203	.1653	.3887	3.3	998E-03	5.296				•		
	*********SPRAY	REMOVAL	RATES********	*									
То	tal elemental	removal c	onstant= 5.29	74 pe	er hour								
Pa	rticulate iodi	ne remova	l constant= .	5926B	per h	our							
To	tal organic re	moval con	stant00000	per	hour								
**	***REMOVAL DUE	TO WALL	DEPOSITION*****										
El	emental removal	l rate du	e to wall depos	ition -	5.104	0 per	hour				•		
Or	ganic removal :	rate due	to wall deposit	ion= .(	00000	per ho	ur				•		
Me	an drop diamet	er= 8.6/	2466-02										
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D	op parameters (For	for eleme mean drop	ntal · )								. 
	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	т.1 См/3	/. drop no SEC	•		•		
3	8.6793E-02	7.099	250.4	10.07	30	7.2 247.5	•		•		
:	Diameter CM	Sherwood	Time S	at. Frac.	м.т.( С	Coeff L Remova 1/SEC /HR	<b>a</b> l				
3	8.6793E-02	1.085	.1811	.3895	3.6	10E-03 5.308			•		
•	**************************************	REMOVAL	RATES********	*							
T	tal elemental	removal c	onstant= 5.30	91 pe	r hour						
P	irticulate iodi	ne remova	l constant= .	59268	per h	our					
T	otal organic re	moval con	stant= .00000	per	hour						
· ·	***REMOVAL DUE	TO WALL	DEPOSITION*****								
E	emental remova	l rate du	e to wall depos	ition =	5.0750	) per hour					
01	ganic removal	rate due	to wall deposit	ion0	0000	per hour					
Me	an drop diamet	er= 8.67	925E-02								
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I	(For Diameter CM	mean drop Fall Time SEC	) Reynolds M. C	T.Coeff ( M/SEC	5 T. Cm/3	V. G	drop no	•					
35	8.6840E-02	7.283	260.5	9.695	30	0.8	247.1						
п	Diamater CM	Sherwood	Time S	at. Frac.	. M.T.( Ci	Coeff L M/SEC	Remova /HR	al .					•
35	8.6840E-02	.9773	.1984	.3899	3.8	905E-03	5.313						
	**************************************	REMOVAL	RATES********	*									
Тс	tal elemental	removal c	onstant- 5.31	41 pe	er hour								
Pa	rticulate iodi	ne remova	l constant-	59268	per h	our							
Тс	tal organic re	moval com	stant= .00000	per	hour								
	***REMOVAL DUE	TO WALL	DEPOSITION*****										
EI	emental remova	l rate di	e to wall depos	ition =	4.987	1 pe:	r hour						
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			Standard Comp NE305 REMOVE for the IBM	uter Prog Version PC/XT/An	gram 4.0 F			•	·		
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I	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff ( M/SEC	; T. CM/	v. d Sec	lrop no.	•				•	
35	8.6869E-02	7.490	271.4	9.298	29	3.9	246.9						
I	Diameter CM	Sherwood	Time S	at. Frac.	м.т. С	Coeff L M/SEC	Remova /HR	31					
35	8.6869E-02	.8790	.2174	.3898	4.1	484E-03	5.311						
**	**********SPRAY	REMOVAL	RATES*********	*			•						
То	tal elemental	removal c	onstant= 5.31	29 pe	er hour								
Pa	rticulate iodi	ne remova.	1 constant= .	59268	per h	our						:	
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**	***REMOVAL DUE	TO WALL	DEPOSITION*****			-							
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output in file I2-11 Bechtel Standard Computer (c) 1991 Originator Jorge Schulz Project SONGS Subject I2 Spray Tempera Temperature of air-steam mix Temperature of droplet Li Density of air-steam mix Viscosity of air-steam mix Viscosity of air-steam mix Density of droplet liquid Viscosity of droplet liquid Diff. coeff. of elemential Diff. coeff. of elemential Diff. coeff. of elemential Diff. coeff. of methyl 12 Schmidt number for element	0.out was created program 1 Date 14 of ture Parametrics mixture= 110.0 ture= 2.6998 quid= 110.00 ure= 2.01144E-0 xture= 1.769181 = .95110 ( id= 2.56770E-0 12 in air-steam mi 12 in droplet 1 in droplet 1iquital iodine= 1.	ated on 1 REMOVE , Jun 2003 s DO De Atm. Degne D3 G/CC E-04 Poiss G/CC 3 Poise m mixture= liquid= uid= 6.2 .5618	4 Jun 2 NE305 V Calc N Checke Job Ne Sheet Sheet Checke Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet She Sheet She Sh	2003 at 10:57: 2003 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 at 2000 a	17 ev No. 0 	•	14030-001 82	

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**E&TS DEPARTMENT** ICCN NO./ **CALCULATION SHEET** PRELIM. CCN NO. PAGE OF **CCN CONVERSION:** CCN NO. CCN Project or DCP/FCN/ECP Calc No. N-6030-001 Subject Containment Aerosol and Iodine Removal Rates Sheet 187 of 281 REV ORIGINATOR DATE IRE DATE REV ORIGINATOR DATE IRE DATE REV INDICATOR 8/15/2003 D. T. Dexheimer 8/15/2003 J. Schulz 0 ۰. 1.1877 Schmidt number for methyl iodine= Grashof number= 1.19729E+13 Try mean diameter= 8.68793E-02 Drop parameters for elemental (For mean drop) Diameter Fall Time Reynolds M.T.Coeff G T.V. drop no. ĩ SEC CM/SEC CM/SEC CM 35 8.6879E-02 7.722 283.0 8.888 246.8 286.5 Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal I CМ CM/SEC /HR 35 8.6879E-02 .7895 .2385 .3893 4.4147E-03 5.304 Total elemental removal constant= 5.3058 per hour Particulate iodine removal constant= .59268 per hour Total organic removal constant= .00000 per hour \*\*\*\*\*REMOVAL DUE TO WALL DEPOSITION\*\*\*\*\* Elemental removal rate due to wall deposition = 4.7547 per hour Organic removal rate due to wall deposition .C0000 per hour Mean drop diameter= 8.63793E-02

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35	8.6853E-02	8.263	308.1	8.050	27	0.5 247.0		•	•		
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35	8.6853E-02	.6349	.2876	.3871	4.9	722E-03 5.274				:	
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Sc Gi Tr	chmidt number f cashof number= cy mean diamete	or methyl 1.92271E r= 8.676	iodine= 1.16 +13 35E-02	56							
Dı	op parameters (For	for eleme mean drop	ntal )								1
3	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff ( M/SEC	5 T.V CM/3	V. drop : SEC	no.			-	{
35	8.6764E-02	8.916	334.8	7.220	25	3.2 247	.8	1	•		
I	Diameter CM	Sherwood	Time S	at. Frac.	. M.T.( Ci	Coeff L Rem M/SEC /I	oval HR				
35	8.6764E-02	.5089	.3476	.3836	5.5	636E-03 5.2	27				1
**	**************************************	REMOVAL	RATES*********	*							
Ťc	tal elemental	removal c	onstant= 5.22	79 pe	er hour				•		1
Pa	rticulate iodi	ne removal	l constant	59268	per h	our					l l
To	tal organic re	moval cor.	stant= .00000	per	hour						
**	***REMOVAL DUE	TO WALL	DEPOSITION*****								1
El	emental remova	l rate di	e to wall depos:	ition =	4.140	5 per hou	c				
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Ne	an drop diamet	er- 8.670	635E-02								
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REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	Ε	DATE	¥
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Tem Pre Tem Den Vis Den Vis Dif Dif Sch	perature of air- soure of air- perature of dr sity of air- sity of air- sity of drople cosity of drop f. coeff. of e f. coeff. of e f. coeff. of m midt number for	ir-stean nix steam mix: coplet lid steam mi:t: steam mi:t: steam mi:t steam ni: steam ni: steam ni:t steam ni:t steam ni:t steam ni:t steam ni:t steam ni:t steam ni:t steam ni:t steam ni:t steam nix steam n	mixture= 129. ture= 4.0108 quid= 129.90 µre= 2.67738E- xture= 1.75987 = .93509 id= 2.14844E-0 I2 in air-stean m I2 in droplet 1 in droplet lique tal iodine= 1	90 De Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise n mixture ixture Liquid- uid- 7.9 .5370	egree C ee C == 4.2 5.6390( 7.3285; 91426E-(	7657E-02 sq. cm DE-02 sq. cm/se BE-05 sq. cm/sec D5 sq. cm/sec	t∕sec c c				
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## EATS DEPARTMENT CALCULATION SHEET

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Project or DCP/FCN/ECP

Calc No. N-6030-001

CCN CONVERSION: CCN NO. CCN

Subject Containment Aerosol and Iodine Removal Rates

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	ORIGINATOR	DATE	IRE	DATE	KEV	URIGINA	TOR	DATE	IRE		DATE	8
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		1					]					<u>z</u>
Sc Gr Tr	hmidt number f ashof number= y mean diamete	or methyl 1.91833E r= .107	iodine= 1.16 +13 58	56							!	
Dr	op parameters (For	for eleme: mean drop	ntal )									
I	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	т. См/	V. d SEC	rop no.					
43	.1076	7.431	490.7	6.893	29	9.8	130.0	•				
I	Diameter CM	Sherwood	Time S	at. Frac.	M.T. C	Coeff L N/SEC	Remova /HR	1		:		
43	.1076	25.30	.1882	.8781	4.4	823E-03	.2853			•	·   ;	
**	**********SPRAY	REMOVAL	RATES********	*								Ċ
To	tal elemental	removal c	onstant= .285	26 pe	r hour						-	
Pa	rticulate iodi	ne remova	l constant= .	59268	per h	our						
То	tal organic re	moval con	stant= .00000	per	hour							
**	***REMOVAL DUE	TO WALL	DEPOSITION*****									
El	emental remova	l rate du	e to wall depos	ition =	4.143	9 per	hour					
Or	ganic removal	rate due	to wall deposit	ion= .0	0000	per ho	ur					
Me. Ter Ter Der Vi: Di Di Scl Scl Scl Tr	an drop diamet mperature of a essure of air- mperature of d nsity of air-s scosity of air scosity of drop f. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of fmidt number f ashof number= y mean diamete	er10 ir-steam mix steam mix toplet li team mix -steam mi elemental methyl 12 elemental methyl 12 for elemental nor methyl 1.910335 r103	758 mixture= 129. ture= 4.0108 quid= 129.90 ure= 2.67738E- xture= 1.75987 = .93509 id= 2.14844E-0 I2 in air-stea in air-steam m I2 in droplet in droplet lig tal jodine= 1 iodine= 1.16 +13 34	90 De Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture ixture- liquid- uid= 7.9 .5370 56	gree C a C a = 4.2 5.6390 7.3285 1426E-	7657E-02 0E-02 sq. 3E-05 sq. cm 05 sq. cm	sq. cm/sec cm/sec /sec	/sec 2				
Dr	op parameters (For	for eleme mean drop	ntal )									
I	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	T. Cm/	V. d SEC	rop no.					
43	.1083	7.670	496.7	6.881	30	1.4	255.7					
I	Diameter CM	Sherwood	Time S	at. Frac.	M.T. C	Coeff L M/SEC	Remova /HR	1				
43	.1083	25.43	.1916	.8819	4.4	508E-03	.2865					
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Subjec	t Containme	nt Aerosol a	and Iodine Remov	val Rates	•				She	et 19	<u>94</u> of	281
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0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003					<u>†</u>			CHO CHO
**	**********\$PRA	REMOVAL	PATES********	**			•					
To	tal elemental	removal c	cnstant .28	649 pe	er hour			·				1
Pa	rticulate iodi	ine remova	] constant=	.59268	per h	our						
то	tal organic re	emoval con	stant= .0000	) per	hour							
	***REMOVAL DUE	TO WALL	DEPOSITION****	•								
El	emental remova	l rate du	n to wall depos	sition -	4.143	9 per	r hour					
Or	ganic removal	rate due	l:o wall deposit	tion= .0	0000	per h	our					
Me Te Pr De Vi Di Di Di Sc Gr Tr I	an drop diamet mperature of a essure of air- mperature of of nsity of air- scosity of air- scosity of drop scosity of drop ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of hmidt number f hmidt number f ashof number- y mean diameter Op parameters {For Diameter CM .1087	er10 dr-steam mix- steam mixt- roplet li iteam mixt- steam mixt- steam mixt- steam mixt- elemental methyl li or elemental for elemental for elemental for elemental for elemental Fall Time SEC 7.954	<pre>H34 hixture= 129 fure= 4.0108 fuid= 129.90 hre= 2.67738E fure= 1.7598 = .93509 id= 2.14844E-( 12 in air-steam in air-steam in droplet lid tal iodine= 1.10 +13 68 htal } Reynolds M. ( 499.6</pre>	.90 De Atm. Degre -03 G/CC 7E-04 Pois G/CC D3 Poise mixture liquid= quid= 7.5 1.5370 656 .T.Coeff G CM/SEC 6.877	egree C ee C 5.6390 7.3205 11426E- CM/ 30	7657E-02 DE-02 sq 3E-05 sq 05 sq. cr 05 sq. cr SEC 2.1	sq. cm, cm/sec /sec drop no 379.3	/sec c				
I	Diameter	Sherwood	Time S	Sat. Frac.	. M.T.	Coeff L	Remova	al				
	UM 1097	95 50	1074	0001	C.	M/SEC	/HR					
43	.1087	25.50	.1974	.6985	4.4	309E-03	.2885				I	
	********SPRAY	REMOVAL	RATES				•					
TO	tal elemental	removal C	onstant= ,288	ssz pe	r nour							
Pa	rticulate iodi	ne remova.	L Constant=	63567	· per h	our						
То	tal organic re	moval con	stant= .00000	) per	hour							
1 **	***REMOVAL DUE	TO WALL	DEPOSITION****	•		_						
El	emental remova	l rate du	e to wall depos	sition =	4.143	9 pe:	r hour					
Or	ganic removal	rate due 1	to wall deposit	ion= .(	0000	per ho	bur					
He Te Pr	an drop diamet mperature of a essure of air-	er= .10 ir-steam n steam mix	868 nixture= 129. ture= 4.0108	,90 De Atm.	gree C				•			

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De Vi Di Di Di Sc Sc Sc Sc Sc	nsity of air-s scosity of air nsity of drop scosity of dro ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of thmidt number i ashof number- y mean diameter op parameters	team mixt -steam mi et liquid plet liqu elemental methyl I2 elemental methyl I2 or elemen cor methyl 2.36686E rr .108 for elemen	<pre>nre= 2.67738E- sture= 1.75987 .d= 2.14844E-0 I2 in air-steam in air-steam m I2 in droplet in droplet liq ;al iodine= 1 iodine= 1.16 +13 78</pre>	03 G/CC E-04 Pois G/CC 13 Poise m mixture ixture liquid 11quid 7.5 .5370 56	9e 5.6390 7.3285 91426E−0	7657E-02 s 0E-02 sq. 3E-05 sq. 05 sq. cm,	sq. cm cm/se cm/se cm/sec	/sec c		·		
1	(For Diameter	mean drop Fall Time	) Reynolds M.	T.Coeff G M/SEC	5 T. CM/3	V. di SEC	гор ло					
44	.1088	8.229	500.3	6.875	30:	2.3	501.7					
I	Diameter CM	Sherwood	Time S	at. Frac.	M.T.( Ci	Coeff L M/SEC	Remov. /HR	al				
44	.1088	25.51	.2039	.8946	4.4	328E~03	.2906					1
**	*********SPRAY	REMOVAL	RATES********	*								
Тс	tal elemental	removal c	onstant= .290	61 pe	n: hour						•	1
Pa	rticulate iodi	ne remova	l constant= .	63567	per h	our						
To	tal organic re	moval con	stant00000	per	hour							
**	***REMOVAL DUE	TO WALL	DEPOSITION*****									
El	emental remova	1 rate du	e to wall depos	ition -	4.143	9 per	hour					
Or	ganic removal	rate due f	to wall deposit	ion= .0	0000	per hou	ır					
Me Te De Di Di Di Di Sc Sc Gr	an drop diamet mperature of a essure of air- mperature of d nsity of air-s scosity of air-s scosity of drop scosity of drop ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of hmidt number f ashof number= y mean diamete	er= .104 ir-steam mixt roplet lid team mixt -steam mix et liquit plet liquit elemental methyl I2 or elemental or elemental 4.47279E r= .1100	878 mixture= 129. ture= 4.0108 guid= 129.90 ure= 2.67738E- xture= 1.75987 = .93509 id= 2.14844E-0 I2 in air-steam in air-steam m I2 in droplet in droplet liq tal iodine= 1.16 +13 38	90 De Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture ixture= liquid= 1iquid= 0.5370 56	Hyree C H= C H= 4.2 5.63901 7.32853 1426E−4	7657E-02 s 0E-02 sq. 3E-05 sq. 05 sq. cm/	sg.cm. cm/sec cm/sec /sec	/sec 2				
Dr	op parameters (For	nean drop	ilal )							•		

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**E&TS DEPARTMENT** ICCN NO./ CALCULATION SHEET PRELIM. CCN NO. PAGE \_ OF **CCN CONVERSION:** CCN NO. CCN Calc No. N-6030-001 Project or DCP/FCN/ECP Containment Aerosol and Iodine Removal Rates Sheet Subject 196 of 281 ORIGINATOR REV ORIGINATOR DATE IRE DATE REV DATE IRE DATE REV INDICATOR D. T. Dexheimer 8/15/2003 8/15/2003 J. Schulz 0 Fall Time Reynolds M.T.Coeff G T.V. drop no. I Diameter CM/SEC SEC CM/SEC CM .1104 9.857 513.3 6.853 305.7 990.8 44 Sat. Frac. M.T.Coeff L Removal Sherwood Time 1 Diameter CM CM/SEC /HR .9225 4.3686E-03 .2140 25.80 .2372 44 .1104 Total elemental removal constant= .21403 per hour .56136 per hour Particulate iodine removal constant= Total organic removal constant= .00000 per hour \*\*\*\*\*REMOVAL DUE TO WALL DEPOSITION\*\*\*\*\* Elemental removal rate due to wall deposition = 4.1439 per hour .00000 Organic removal rate due to wall deposition= per hour .1103B Mean drop diameter= Temperature of air-steam mixture= 129.90 Degree C Pressure of air-steam mixture= 4.0108 Atm. Temperature of droplet liquid= 129.90 Degree C Density of air-steam mixture= 2,67738E-03 G/CC Viscosity of air-steam mixture= 1.75987E-04 Poise Density of droplet liquid= .93509 G/CC Viscosity of droplet liquid= 2.14844E-03 Poise Diff. coeff. of elemental I2 in air-steam mixture= 4.27657E-02 sq. cm/sec Diff. coeff. of methyl I2 in air-steam mixture 5.63900E-02 sq. cm/sec Diff. coeff. of elemental I2 in droplet liquid 7.32853E-05 sq. cm/sec Diff. coeff. of methyl I2 in droplet liquid= 7.91426E-05 sq. cm/sec Schmidt number for elemental iodine= 1.5370 Schmidt number for methyl iodine= 1.1656 Grashof number= 4.47279E+13 Try mean diameter= .11076 Drop parameters for elemental (For mean drop) M.T.Coeff G . T.V. Ť Diameter Fall Time Reynolds drop no. CM/SEC CM/SEC SEC CM .1108 10.86 516.4 6.848 306.5 1476. 44 Time Sat. Frac. M.T.Coeff L Sherwood Removal Ι Diameter CM/SEC CM /HR 25.87 .2595 .9368 4.3535E-03 .2174 .1108 44 Total elemental removal constant= .21736 per hour Particulate iodine removal constant-.56136 per hour Total organic removal constant= .00000 per hour

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0	J. Schulz	8/15/2003	D. T. Dexhei	mer 8/15/2003								
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44 Tot Par Tot Elec Orç Mea Tem Der Vis Der Vis Dif	.1110 	25.92 Y REMOVAL removal c: ine removal emoval con E TO WALL al rate due rate due ter= .11. dir-steam in: diroplet 1. steam mixi: r-steam r-steam	.2607 RATES******* onstant= l constant= stant= .00 DEPOSITION** e to wall depo to wall depo to wall depo to wall depo to wall depo to wall depo to wall depo to wall depo to wall depo to a stant= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .00 puid= .	.9375 .10877 pe .31145 .0000 per .31145 .0000 per 	4.3 ex hour per h hour .4.143 00000 egree C se C se C se C se C se C	431E-03 Dur per h 9 per h	. 1088 r hour our , . cm/see	/sec				
Dif Sch Sch Gra Try	f. coeff. of midt number : midt number : shof number= mean diamete	tor methyl 12 for element for methyl 6.110682 er .1111	in droplet tal iodine= iodine= 1 13 07	liquid= 7.9 1.5370 1.1656	1426E-(	,2-03 sq )5 sq. c	m/sec	÷			•	
Dro	p parameters (For	mean drop	ntal I									
I	Diameter CM	Fall Tim: SEC	Reynolds	M.T.Coeff G CM/SEC	T.V CM/S	EC	drop no.					[
44	.1111	11.26	518.8	6.843	307	.0	3414.					Í
I	Diameter CM	Sherwood	Time	Sat. Frac.	M.T.( C)	coeff L I/SEC	Remova /HR	1				
44	.1111	25.93	.2675	.9413	4.34	14E~03	.1092					
***	********SPRAY	REMOVAL I	ATES******	****								1
Tot	al elemental	removal co	onstant= .	10921 pe	r hour							
Par	ticulate iodi	ne removal	. constant=	.31145	per ho	ur						
Tot	al organic re	moval cons	tant= .00	000 per	hour							
***	**REMOVAL DUE	TO WALL I	POSITION**	***								
Ele	mental remova	l rate due	to wall de	position =	4.1439	per	r hour					
Org	anic removal	rate due t	o wall depo	sition0	0000	per ho	our					

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Subject Containment Aerosol and Iodine Removal Rates

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EV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DAIE	5
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003						<b>A</b>
	······									2 2
Me Ter Pri De Vi De Vi Di Di Di Scl Scl Gra Tr	an drop diame mperature of a essure of air aperature of air scosity of air- scosity of drop scosity of drop ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of maidt number : ashof number= y mean diameter op parameters {For	ter1: air-steam min: droplet 1: steam min: r-steam min: r-steam min: let liquid oplet liquid oplet liquid clementa: methyl I: for elemen for methyl 6.274471: er= .11: for elemen mean drop	107 mixture= 129. ture= 4.0108 guid= 129.90 ure= 2.67738E- xture= 1.75987 = .93509 id= 2.14844E-0 I2 in air-stean m I2 in droplet in droplet lig tal iodine= 1 iodine= 1.16 +13 09 ntal )	90 De Atm, Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture ixture= liquid= uid= 7.5 .5370 56	egree C ee C = 4.2 5.6390 7.3285 1426E-	7657E-02 sg. cm 0E-02 sg. cm/se 3E-05 sg. cm/se 05 sg. cm/sec	/sec c		•	
I	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	т. См/:	V. drop no SEC	•			
44	.1111	11.06	519.1	6.843	30	7.1 3898.				
I	Diameter CM	Sherwood	Time S	at. Frac.	М.Т. С	Coeff L Remov M/SEC /HR	al			
44	.1111	25.93	.2628	.9387	4.3	407E-03 .1089				
***	**************************************	Y REMOVAL	RATES*********	*					•••	
To	tal elemental	removal co	onstant108	90 pe	r hour					
Par	rticulate iod	ine removal	l constant= .	31420	per h	our				
To	tal organic re	emoval con:	stant00000	per	hour					
**1	***REMOVAL DU	E TO WALL	DEPOSITION*****					ı		
Ele	emental remova	al rate du	e to wall depos	ition =	4.143	9 per hour				
Org	janic removal	rate due f	to wall deposit	ion= .0	0000	per hour		•		
Mea Ter Pre Der Vis Der Vis Di	an drop diamet aperature of a essure of air- mperature of c sity of air- scosity of air sity of drop scosity of drop f. coeff. of	ter11: air-steam mixi -steam mixi droplet 1.10 steam mixi r-steam mixi r-steam mixi tr-steam mixi elemental	109 mixture= 129. ture= 4.0108 quid= 129.90 ure= 2.67738E- xture= 1.75987 = .93509 id= 2.14844E-0 I2 in air-stear	90 De Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture	gree C e C = 4.2 5.6390	7657E-02 sg. cm )E-02 sg. cm/se	/sec			

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Subject Containment Aerosol and Iodine Removal Rates

DATE IRE DATE DATE IRE DATE ORIGINATOR REV ORIGINATOR REV REV INDICATOR 8/15/2003 | D. T. Dexheimer 8/15/2003 J. Schulz 0 Drop parameters for elemental (For mean drop) Diameter Fall Time Reynolds M.T.Coeff G T.V. I drop no. SEC CM/SEC CM/SEC CM 307.1 11.36 519.2 6.842 4380. .1111 44 Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal I CM/SEC /HR CM 25.94 .2697 .9424 4.3397E-03 .1093 44 .1111 Total elemental removal constant- .10934 per hour .31420 Particulate iodine removal constant= per hour per hour Total organic removal constant= .00000 \*\*\*\*\*REMOVAL DUE TO WALL DEPOSITION\*\*\*\*\* Elemental removal rate due to wall deposition = 4.1439 per hour Organic removal rate due to wall deposition= .00000 per hour Mean drop diameter= .11111

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Project o Subject	or DCP/FCN/E Containmen ORIGINATOR J. Schulz	CP t Aerosol a DATE 8/15/2003	Ind Iodine Remov	C al Rates	aic No.	,		CCN CO	NVERS	ION:	
Subject	Containmen ORIGINATOR J. Schulz	t Aerosol a DATE 8/15/2003	Ind Iodine Remov	al Rates		N-0030-001			. CCN		
REV 0	ORIGINATOR J. Schulz	DATE 8/15/2003	וסב		•			She	et _2	02 of	_ 281_
0	J. Schulz	8/15/2003	1 176	DATE	REV	ORIGINATOR	DATE	IR	Ε.	DATE	ĸ
 9			D. T. Dexheimer	8/15/2003							REV
9											JNI
Beck (C) Orig Proj Subj	9.2.2.3 30 m htel Standard 1991 ginator Jorge ject SONGS ject I2 Spray	<b>min to 2  </b> Computer Schulz 7 Max Temj	h <b>r Output File (</b> Program Date 14 o 30 min - 2 hr	<i>12- max0</i> REMOVE , Jun 2003	<b>I.out)</b> NE305 Calc 1 Checke Job No Sheet	Version 4.0 No. N-6030-00 R edDate_ 0. 16575-167 No. 1	ev No. O				
	           		Standard Comp NE305 REMOVE for the IBM	uter Prog Version PC/XT/AT	17am 4.0						
	. At Tr Sp di	ostract: ne REMOVE pray renov ameter o:	program calcula val rate constan r drop trajecto:	ates the nts and a ries	contain mean c	ment irop	·			-	
Bech (c) Orig Proj Subj	Output in finitel Standard 1991 ginator Jorge Ject SONGS Ject I2 Spray	le 12-man Computer Schulz Max Temp	x01.out was crea Program I Date 14 0 30 min - 2 hr	ated on 1 REMOVE , Jun 2003	4 Jun 2 NE305 ( Calc 1 Checke Job No Sheet	2003 at 11: 0: Version 4.0 No. N-6030-00 R edDate D. 16575-167 No. 2	58 ev No. O				
Temp Pres Temp Dens Visc Diff Diff Diff Diff	perature of air- soure of air-so perature of dr sity of air-st cosity of air- sity of drople cosity of drople cosity of drop cosity of drople cosity cosity of drople cosity cosity cosity cosity br>cosity cosity cosity cosity cosity cosity cosity cosity cosity cosity cosity	r-stean nixt coplet lid eam mixt steam mixt steam mix t liquid t liquid et liquid et liquid et niquid et n	mixture= 85.30 ture= 1.7800 quid= 85.300 tre= 1.54239E-( tture= 1.821271 = .96843 ( id= 3.34328E-0: 12 in air-steam mi 12 in droplet 1 in droplet light tal iodine= 1.	00 De Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise n mixture liture- liquid= 1id= 4.5 .6187	gree C e C 9.55596 4.18831 2306E-(	9496E-02 sq. cm 3E-02 sq. cm/se E-05 sq. cm/sec 15 sq. cm/sec	/sec c c				

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Subject Containment Aerosol and Iodine Removal Rates


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0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003						<u></u>
										N N
Sch Gra Try Dro	midt number shof number= mean diamet p parameters (For	for methyl 6.525322 er= 8.671 for elem: mean dros	iodine= 1.23 +12 79E-02 ntal							
I	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff G	T.V CM/S	drop n	0.		•	
35	8.6718E-02	6.798	233.7	10.74	318	.2 248.	2 '			[
r	Diameter CM	Sherwood	Time S	at. Frac.	M.T.C CM	coeff L Remo	val R	•		
35	8.6718E-02	1.340	.1514	.3894	3.17	79E-03 5.25	0		. •	
***	*********SPRA	Y REMOVAL	RATES*********	+						
Tot	al elemental	removal c	onstant= 5.25	.09 p€:	r hour				-	1
Par	ticulate iod	ine remova	1 constant= .	59268	per ho	ur				
Tot	al organic r	emoval con	stant= .00000	per	hour					
***	**REMOVAL DI	E TO WALL	DEPOSITION*****							1
510	montal roman		a to wall donor	ition -	5 1040	ner hour				
DIC	anentar remov	at tate du	e co wall depos	ion- A	0000	per hour				ļ
Mea Tem Pre Tem Den Vis Diff Diff Sch Gra Try Dro	n drop diame perature of ssure of air perature of sity of air cosity of air cosity of drop cosity of drop cosity of drop cosity of drop f. coeff. of f. coeff. of f. coeff. of midt number shof number mean diameter	ter= 8.67 air-stean 1 -steam mixt droplet 1 steam mixt r-stean mixt r-stean mixt clet liquid oplet liquid oplet liquid oplet liquid element.11 methyl 12 clement.11 for element for methyl 12 6.52532E er= 8.731	179E-02 mixture= 05.3 ture= 1.7600 quid= 05.300 ure= 1.54239E- xture= 1.82127 96843 id= 3.34328E-0 I2 in air-steam m I2 in droplet in droplet lic tal iodine= 1 iodine= 1.23 +12 48E-02 mtal	Atm. Degre- 03 G/CC E-04 Pois G/CC 3 Poise m mixture= liquid= uid= 4.5 .6187 57	gree C e C = 7.29 9.55598 4.18831 2306E-0	496E-02 sq. c E-02 sq. cm/s E-05 sq. cm/s 5 sq. cm/sec	m/sec ec ec	•		
220	for (For	mean drop	)							
I	Diameter CM	Fall Tine SEC	Reynolds M. C	T.Coeff G M/SEC	T.V CM/S	. drop n EC	0.			
35	8.7915E-02	7.044	239.7	10.71	322	.0 486.	3			[
I	Diameter CM	Sherwood	Time S	at. Frac.	м.т.с СМ	oeff L Remo SEC /H	val R			
35	8.7915E-02	1.354	.1527	.3944	3.13	465-03 5.31	6		•	
				نده وروز مروع	والمراجع المراجعين					

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Subje	ct Containmen	it Aerosol :	and lodine Remov	ral Rates	••			Shee	ət <u>204</u>	of	281
FÆV	ORIGINATOR	DATE	. IRE	DATE	REV	ORIGINATOR	DATE	IRE	: C	DATE	g
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003	<u> </u>						DCAT C
<b></b>		<u> </u>		L	<u> </u>	<u> </u>					Ž
	<pre>'************************************</pre>	REMOVAL removal (: he removal (: noval con TO WALL 1 rate due er= 8.79 ir-steam dis roplet 1: team mix: roplet 1: team mix: roplet 1: elemental plet liquid plet r>7.226 Sherwood I.359 REMOVAI removal con TO WALL liquid plet che du sec removal con to the du sec removal con to the du sec removal con to the du sec removal con to the du sec removal con to the du sec removal con to the du sec removal con to the du sec removal con to the du sec removal con to the du sec removal con to the du sec removal con to the du sec removal con to the du sec removal con to the du sec removal con to the du sec removal con to the du sec removal con to the du sec removal con to the du sec removal con to the du sec removal con to the du sec removal con to the du sec removal con to the du sec removal	RATES********* onstant= 5.31 l constant= . stant= .00000 DEPOSITION***** e to wall deposit 14BE-02 mixture= 05.33 ture= 1.7800 quid= 85.300 ure= 1.54239E- xture= 1.82127 = .96843 id= 3.34328E-0 I2 in air-steam in air-steam m I2 in droplet liq tal iodine= 1.23 +12 15E-02 ntal ) Reynolds M. C 241.7 Time S .1552 RATES********** onstant= 5.39 l constant= . stant= .00000 DEPOSITION***** e to wall deposit 115E-02 mixture= 85.3	<pre>*     83</pre>	er hour per h hour 5.104 00000 egree C ee C se e= 7.2 9.5559 4.1883 52306E- C C T. C M.T. C 3.1 0r hour per h hour 5.104 00000	our 0 per hour 9496E-02 sq. cm 8E-02 sq. cm/s 1E-05 sq. cm/sec V. drop n SEC 3.2 721. Coeff L Remon M/SEC /H 205E-03 5.39 our 0 per hour per hour	m/sec ec ec 4 vval R 3				
	ressure of air-	steam mi.x	ture= 1.7800	Atm.	-9-00 0					1	

Pressure of air-steam mixture= 1.7800

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		TS DEPA	RTMENT	EET		ICCN NO	)./ . CCN N	10.	<u> </u>	PAG	 SE	OF	
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Subjec	t Containmen	t Aerosol a	and Iodine Remov	al Rates				•	Sh	eet	205	of	
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINA	TOR	DATE	· IF	Æ	Т	DATE	ģ
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003									REV
	•												
Te De Vi Di Di Di Sc Gr Tr	emperature of di insity of air-s scosity of air- scosity of drop ff. coeff. of f ff. coeff. of f ff. coeff. of f ff. coeff. of f iff. coeff. of f indt number f ashof number= y mean diamete:	roplet 1i. team mixt -steam mix et liquid plet 1iqu elemental methyl 12 elemental methyl 12 or elemen or methyl 8.05102E r= 8.849 for elemen	guid= 85.300 nre= 1.54239E- cture= 1.62127 • .96843 id= 3.34328E-0 I2 in air-steam m I2 in droplet in droplet liq tal iodine= 1 iodine= 1.23 +12 47E-02 htal	Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture ixture- liquid- uid= 4.2 .6187 57	ee C se 9=: 7.2 5,55599 4,1883 52306E−1	9496E-02 8E-02 sq. 1E-05 sq. 05 sq. cm	cm/sec cm/sec	/sec c			•	-	
1	(For ) Diameter	mean drop: Fall Time	Reynolds M.	T.Coeff G	ЭТ.'	V- d	гор по	•			•		•
35	CM 8.8495E-02	SEC	Cl 242.7	M/SEC 10.70	CM/: 32:	SEC 3.8	954.2						•
l I	Diameter S CM	Sherwood	Time S	at. Frac.	M.T.C	Coeff L M/SEC	Remova	<b>a</b> 1					
35	8.8495E-02	1.361	.1615	.4121	3.1	L41E-03	5.556						
, , ,	*********SPRAY	REMOVAL I	RATES********	*									
То	tal elemental :	removal «	onstant= .5.55	67 pe	er hour								
Pa	rticulate iodin	ne removal	l constant= ,	63567	per h	our							
To	tal organic rem	moval con:	stant= .00000	per	hour								
**	***REMOVAL DUE	TO WALL	DEPOSITION*****										
El	emental removal	l rate die	e to wall depos.	ition -	5.104	) per	hour			•			
Or	ganic removal :	rate due 1	to wall deposit	ion= .(	0000	per ho	ur						
Me Te Pr Te De Vi Di Di Sc Sc Tr	an drop diameter mperature of air- sessure of air- sity of air- scosity of air- fic coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a hmidt number for ashof number= y mean diameter	er= 8.849 ir-steam mixtroplet lid team mixtroplet lid team mixtri- steam mixtri- steam mixtri- st liquid- plet liquid- plet liquid- lemental nethyl 12 elemental nethyl 12 or methyl 12 sor methyl 1.5214(Er= 8.889)	947E-02 mixture= 85.30 guid= 85.300 pre= 1.54239E-1 cture= 1.82127 cture= 1.82127 12 in air-steam in air-steam m 12 in droplet 1 in droplet 1 in droplet 1 iodine= 1 iodine= 1.23 13 22E-02	00 De Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture ixture= liquid= uid= 4.3 .6187 57	egree C ee C 9.55599 4.1883 2306E-4	9496E-02 ; BE-02 sq. IE-05 sq. IE-05 sq. cm.	59. cm, cm/sec cm/sec /sec	/sec 2		•			
Dr	op parameters i (For )	for eletter mean drop)	ital										

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Subject	t <u>Containmer</u>	t Aerosol a	nd Iodine Remov	al Rates	·		 	She	et _2(	) <u>6</u> of	281		
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DATE	~		
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							REV ICATO		
	·										0N N		
I	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	т. См/.	drop no SEC	» <b>.</b>						
36	8.8893E-02	9.060	244.7	10.68	32	5.0 1173.							
I	Diameter • CM	Sherwood	Time S	at. Frac.	M.T.( Ci	Coeff L Remon M/SEC /HE	ral K						
36 8.8893E-02 1.366 .1921 .4672 3.1001E-03 4.499													
*********SPRAY REMOVAL RATES************************************													
**********SPRAY REMOVAL RATES************************************													
Par	cticulate iodi	ne remova:	L constant= .	56136	per h	our .							
Tot	Particulate iodine removal constant= .56136 per hour Total organic removal constant= .00000 per hour												
***	***REMOVAL DUE	TO WALL I	EPOSITION*****			1							
Ele	emental remova	l rate due	to wall depos	ition -	5.104	) per hour							
Org	janíc removal :	rate due f	o wall deposit	ion= .C	0000	per hour							
Mea Ten Pre Ten Der Vis Dif Dif Dif Sch Gra Try	an drop diamet. aperature of a sssure of air- aperature of d sity of air-s cosity of air-s cosity of air-s cosity of drop cosity of drop f. coeff. of a f. f number f. shof number= a mean diameter	er= 8.889 ir-steam mixi team mixit -steam mixit -steam mixit -steam mixit -steam mixit -steam mixit et liquid- plet liquid- plet liquid- ethyl IC: or elemental methyl IC: or elemental 1.521441- r= 9.0198	332E-02         nixture=       85.3         cure=       1.7800         guid=       85.300         nre=       1.54239E-         cture=       1.82127         -       .96843         .d=       3.34328E-0         I2       in air-steam         I2       in droplet         in droplet       1iq         cal iodine=       1.23         13       30E-02	00 De Atm. Degre: 03 G/CC E-04 Pois: G/CC 3 Poise m mixture= ixture= liquid= uid= 4.5 .6187 57	gree C e C 9.5559 2306E-	9496E-02 sq. cm 8E-02 sq. cm/se 1E-05 sq. cm/sec 05 sq. cm/sec	a/sec ec	. •					
Dro	p parameters : (For )	for elemon mean drop)	ntal										
I	Diameter : CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	: T. CM/:	V. drop no SEC							
36	9.0198E-02	10.16	251.4	10.65	32	9.1 2331.							
I Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal CM CM/SEC /HR													
36	36 9.0198E-02 1.382 .2093 .4985 3.0553E-03 4.800												
***	***********SPRAY REMOVAL RATES********												
Tot	Total elemental removal constant- 4.8015 per hour												
Par	ticulate iodi	ne removal	constant= .	56136	per h	our		•					
Tot	al organic re	noval cons	stant= .00000	per	hour								
SCE 26-42	26 REV. 2 IREF	ERENCE: S	0123-XXIV-7.15				····		N-60	30-001 Re	v 0.doc		

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roject c	or DCP/FCN/E	ECP	•	ċ	aic No.	N-6030	-001	CCN CO CCN NO	NVERS	ion: I	•
ıbject	Containmen	t Aerosol ar	nd Iodine Remov	al Rates	•			She	et _2	07 <b>of</b>	_2
EV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINAT	OR DATE	IR	E	DATE	
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							] ⊉
	•										
Crga Mean Temp Pres Temp Dens Visc Dens Visc Diff Diff Diff Schm Gras Try Drop	a drop diameter erature of air- erature of air- erature of air- erature of air- ity of air- osity of air- ity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop cosity cosity of drop cosity cosity cosity cosity cosity cosity cosity cosity cosity cosity cosity cosity cosity cosity cosity cosity cosity cosity cosity cosity	rate due t rate due t er= 9.019 ir-steam m steam mixtr roplet liqui elemental elemental methyl I2 or element or methyl I2 or element 1.62191E+ r= 9.0513 for elemen	to wall deposit 80E-02 ixture= 85.3 ure= 1.7800 uid= 85.300 re= 1.54239E- ture= 1.82127 .96843 d= 3.34328E-0 I2 in air-steam in air-steam m I2 in droplet in droplet lice al iodine= 1.23 13 9E-02 tal	sicion = .0 100 De Atm. Degree 03 G/CC 03 G/CC 03 Poise m mixture 1iquid= 1iquid= 4.5 .6187 157	9.104 agree C e C = 7.2 9.5559 4.1883 2306E-6	9496E-02 sc BE-02 sq. c LE-05 sq. cm/s	iour c s. cm/sec m/sec cm/sec sec		-		
I	Diameter 1 CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	5 T.V CM/3	7. dro SEC	op no.				
36	9.0514E-02	9.120	253.0	10.64	33	).1 3	3493.				
I	Diameter S CM	Sherwooc.	Tine S	at. Frac.	M.T.( Cl	COEFF L F M/SEC	/HR				ĺ
36	9.0514E-02	1.386	.1865	.4614	3.0	146E-03 4	1.443				
****	*******SPRAY	REMOVAL R	ATES*********	*							
Tota	l elemental :	removal com	nstant= 4.44	41 pe	r hour					:	
Part	iculate iodi	ne removal	constant	57345	per h	bur					
Tota	l organic rem	moval cons	tant= .00000	per	hour						{
****	*REMOVAL DUE	TO WALL D	EPOSITION*****								
Elem	ental removal	l rate due	to wall depos	ition =	5.104	) per t	nour				
Orga Mean Temp Pres Temp Dens Visc Dens Visc Diff	nic removal a drop diamete erature of a: erature of di ity of air-s ity of air-s ity of air-s ity of air-s ity of air-s osity of air- ity of drop osity of drop . coeff. of e	cate due te ir-stean mixte roplet lig tean mixte -steam mixte t liguide plet liguide	o wall deposit 39E-02 1xture= 85.3 ure= 1.7800 uid= 85.300 re= 1.54239E- ture= 1.82127 .96843 d= 3.34328E-0 12 in air-stea	ion0 00 Ee Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture	90000 gree C e C e 7.23	per hour	د . متا/sec				
111U	. COMIL. OI D	EDENCE, SC	111 a11-500am m		3.00091		JR/ 56C				L

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Proiec	t or DCP/FCN/	ECP		C	aic No.	N-60	30-001		CCN CO CCN NÓ.	VERS CCN	ON:	
Subje	t <u>Containme</u>	nt Aerosol	and Iodine Remov	al Rates				······································	She	et _2(	08 of	281
<b>REV</b>	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE	IRE		DATE	~
0.	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003								CATOF
						=						- ION
Di Di Sc Sc Gr Tr Dr	ff. coeff. of ff. coeff. of hmidt number f hmidt number f ashof number= y mean diamete op parameters (For	elemental. methyl 12 for elemen for methyl 1.621913 r= 9.074 for eleme mean drop	I2 in droplet in droplet liq tal iodine= 1 iodine= 1.23 +13 11E-02 ntal )	liquid= uid= 4.5 .6187 57	4.1883 2306E-0	1E-05 sq. 05 sq. cm	. cm/sec	c				
1	Diameter CM	Fall Time SEC	Reynolds M. C	I.Coeff G M/SEC	т. См/:	V. C	irop no	•	•			
36	36 9.0741E-02 10.33 254.2 10.64 330.8 4649.											
, ''	Diameter CM	Sherwood	Tine S	at. Frac.	M.T.( Ci	Coeff L M/SEC	Remov. /HR	91 1				
36	9.0741E-02	1.388	.2101	.5010	3.0:	370E-03	4.825					
	*********SPRAY	REMOVAL	RATES*********	•								
ТС	tal elemental	removal c	onstant= 4.82	55 pe	r hour							
Pa	rticulate iodi	ne remova	1 constant= .	57345	per he	our						
To	tal organic re	moval con	stant= .00000	per	hour							
**	***REMOVAL DUE	TO WALL	DEPOSITION*****									
EI	emental remova	l rate du	e to wall depos	ition -	5.104	D per	r hour					
Or	ganic removal	rate due	to wall deposit	ion(	0000	per ho	our					
Me Te Pr De Vi Di Di Di Sc Sc	Mean drop diameter= 9.07411E-02 Temperature of air-steam mixture= 85.300 Degree C Pressure of air-steam mixture= 1.7800 Atm. Temperature of droplet liquid= 85.300 Degree C Density of air-steam mixture= 1.54239E-03 G/CC Viscosity of air-steam mixture= 1.62127E-04 Poise Density of droplet liquid= .96843 G/CC Viscosity of droplet liquid= 3.34328E-03 Poise Diff. coeff. of elemental I2 in air-steam mixture= 7.29496E-02 sq. cm/sec Diff. coeff. of elemental I2 in air-steam mixture= 9.55598E-02 sq. cm/sec Diff. coeff. of elemental I2 in droplet liquid= 4.18831E-05 sq. cm/sec Diff. coeff. of methyl 12 in droplet liquid= 4.52306E-05 sq. cm/sec Diff. coeff. of methyl 12 in droplet liquid= 4.55306E-05 sq. cm/sec Diff. coeff. of methyl 12 in droplet liquid= 4.55306E-05 sq. cm/sec											
Tr Dr	Try mean diameter= 9.000000000000000000000000000000000000											
г	(For Diameter	mean drop. Fall Time	Reynolds M.	C.Coeff G	1.5 CM/0	/. c	irop no	•				
36	9.0843E-02	9.947	254.B	10.64	331	1.1	5805					
I	Diameter CM	Sherwooi	Time Sa	at. Frac.	M.T.( C:	Coeff L 1/SEC	Remova /HR	21				

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SCE 26-426 REV. 2 [REFERENCE: SO123-XXIV-7.15]

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E&TS DEPARTMENT ICCN NOJ **CALCULATION SHEET** PRELIM. CON NO. PAGE OF **CCN CONVERSION:** CCN NO. CCN Calc No. N-6030-001 Project or DCP/FCN/ECP Subject Containment Aerosol and Iodine Removal Rates Sheet 209 of 281 DATE ORIGINATOR DATE IRE ORIGINATOR DATE IRE REV DATE REV REV INDICATOR 8/15/2003 D. T. Dexheimer 8/15/2003 J. Schulz 0 • . .2019 .4881 3.03362-03 2.350 36 9.0843E-02 1.390 Total elemental removal constant= 2.3503 per hour Particulate iodine removal constant= .31145 per hour Total organic removal constant= .00000 per hour \*\*\*\*\*REMOVAL DUE TO WALL DEPOSITION\*\*\*\*\* Elemental removal rate due to wall deposition = 5.1040 per hour Organic removal rate due to wall deposition= .00000 per hour Mean drop diameter= 9.08429E-02 Temperature of air-steam mixture= 85.300 Degree C Pressure of air-steam mixture- 1.7800 Temperature of droplet 1:quid- 85.300 Atm. Degree C Density of air-steam mix!ure- 1.54239E-03 G/CC Viscosity of air-steam m:xture= 1.82127E-04 Poise Density of droplet liquid= .96843 G/CC Viscosity of droplet liquid= 3.34328E-03 Poise Diff. coeff. of elemental 12 in air-steam mixture= 7.29496E-02 sq. cm/sec Diff. coeff. of methyl I? in air-steam mixture= 9.55598E-02 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid= 4.18831E-05 sq. cm/sec Diff. coeff. of methyl I? in droplet liquid= 4.52306E-05 sq. cm/sec Schmidt number for elemental iodine= 1.6187 Schmidt number for methyl iodine= 1.2357 Grashof number= 2.07858E+13 Try mean diameter= 9.09189E-02 Drop parameters for elemental (For mean drop) Diameter Fall Time Reynolds M.T.Coeff G T.V. drop no. Ι CM/SEC CM/SEC CM SEC 36 9.0919E-02 10.29 255.1 10.63 331.4 6959. Sat. Frac. M.T.Coeff L Ί Diameter Sherwood Time Removal CM/SEC /HR CM . 36 9.0919E-02 1.391 .2086 .4991 3.0311E-03 2.403 Total elemental removal constant= 2.4032 per hour Particulate iodine removal constant= .31145 per hour Total organic removal constant= .00000 per hour \*\*\*\*\*RENOVAL DUE TO WALL DEPOSITION\*\*\*\*\* Elemental removal rate due to wall deposition = 5.1040 per hour Organic removal rate due to wall deposition= .00000 per hour

SCE 26-426 REV. 2 [REFERENCE: SO123-XXIV-7.15]

E&TS DEPARTMENT ICCN NO./ CALCULATION SHEET PRELIM. CCN NO. PAGE OF CCN CONVERSION: CCN NÓ. CCN Project or DCP/FCN/ECP Calc No. N-6030-001 Containment Aerosol and Iodine Removal Rates Subject Sheet 210 of 281 REV ORIGINATOR DATE IRE DATE REV ORIGINATOR DATE IRF DATE REV INDICATOR 8/15/2003 D. T. Dexheimer 8/15/2003 J. Schulz 0 Mean drop diameter= 9.09189E-02 Temperature of air-steam :nixture-85.300 Decree C Pressure of air-steam mixture- 1.7800 Temperature of droplet liquid- 85.300 Atm. Degree C Density of air-steam mixture= 1.54239E-03 G/CC Viscosity of air-steam mixture= 1.82127E-04 Poise Density of droplet liquid- .96843 G/CC Viscosity of droplet liquid- 3.34328E-03 Poise Diff. coeff. of elemental I2 in air-steam mixture" 7,29496E-02 sq. cm/sec Diff. coeff. of methyl I2 in air-steam mixture 9.55598E-02 sq. cm/sec Diff. coeff. of elemental I2 in droplet liquid 4.18831E-05 sq. cm/sec Diff. coeff. of methyl I2 in droplet liquid= 4.52306E-05 sq. cm/sec Schmidt number for elemental iodine= 1.6187 Schmidt number for methyl iodine= 1.2357 Grashof number= 2.13430E+13 Try mean diameter= 9.09623E-02 Drop parameters for elemental (For mean drop) Fall Time Reynolds M.T.Coeff G T.V. I Diameter drop no. CM SEC CM/SEC CM/SEC 36 9.0962E-02 10.03 255.4 10.63 331.5 B114. Sherwood Sat. Frac. M.T.Coeff L Ŧ Diameter Time Remova) CM/SEC CM /HR 36 9.0962E-02 1.391 .2031 .4902 3.0296E-03 2.360 Total elemental removal constant= 2.3607 per hour Particulate iodine removal constant= .31420 per hour Total organic removal constant= .00000 per hour \*\*\*\*\*REMOVAL DUE TO WALL DEPOSITION\*\*\*\*\* Elemental removal rate due to wall deposition = 5.1040 per hour Organic removal rate due to wall deposition-.00000 per hour Mean drop diameter= 9.09623E-02 Temperature of air-steam mixture- 85.300 Degree C Pressure of air-steam mixture= 1.7800 Temperature of droplet liquid= 85.300 Atm. Degree C Density of air-steam mixture= 1.54239E-03 G/CC Viscosity of air-steam mixture= 1.82127E-04 Poise Density of droplet liquid= .96843 G/CC Viscosity of droplet liquid= 3.34328E-03 Poise Diff. coeff. of methyl I? in air-steam mixture= 7.29496E-02 sq. cm/sec Diff. coeff. of methyl I? in air-steam mixture= 9.55598E-02 sq. cm/sec Diff. coeff. of elementa? I2 in droplet liquid= 4.18831E-05 sq. cm/sec Diff. coeff. of methyl I? in droplet liquid= 4.52306E-05 sq. cm/sec . Schmidt number for elemental iodine= 1.6187 Schmidt number for methyl iodine- 1.2357 Grashof number= 2.13430E+13 Try mean diameter= 9.10041E-02

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Projec	t or DCP/FCN/I	ECP		ċ	alc No	<u>N-6030-001</u>		CCN CO CCN NO	NVERSI	ON:	·
Subje	ct Containmer	nt Aerosol :	and Iodine Remov	al Rates	<b>_</b>	·····		She	et _2	<u> 1</u> of	
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DATE	1 F
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							
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D	rop parameters ·(For )	for eleme mean drop	ntal }			••					
:	I Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff ( M/SEC	5 T. CM/3	V. drop no SEC	•				
31	5 9.1004E-02	10.38	255.6	10.63	33	1.6 <u>9267</u> .					[
	Diameter : CH	Sherwood	Time S	at. Frac.	. M.T. C	Coeff L Remova M/SEC /HR	<b>al</b>				
3	5 9.1004E-02	1.392	.2100	.5015	3.0	282E-03 2.414					
	**************************************	REMOVAL	RATES*********	•							
T	otal elemental	removal c	onstant= 2.41	47 P <sup>e</sup>	er hour						ļ
Pa	articulate iodi	në rëmova	l constant= .	31420	per h	our ,					ļ
T	otal organic re	moval cor	stant= .00000	per	hour						
*	****REMOVAL DUE	TO WALL	DEPOSITION*****								· ·
E	lemental remova	l rate du	e to wall depos	ition =	5.104	0 per hour					
0:	ganic removal	rate due	to wall deposit	ion= .0	0000	per hour					•
M	an drop diamet	er= 9.1()	041E-02								
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Project or DCP/FCN/ECP       Calc No.       N-6030-001       CCN CONVERSION: CON NON CCN         Subject       Containment Acrosol and lodine Removal Rates       Sheet 212 of 21         REV       ORIGINATOR       DATE       IRE       DATE       REV       ORIGINATOR       DATE       IRE       DATE         0       J.Schulz       9/352003       D.T. Detheimer #1/3001       IRE       DATE       IRE       DATE <t< th=""><th></th><th></th><th>TS DEP</th><th>ARTMENT TION SH</th><th>EET</th><th></th><th>ICCN NO./ PRELIM. CCN N</th><th>10.</th><th></th><th>PAGE</th><th>E</th><th>_OF</th><th></th></t<>			TS DEP	ARTMENT TION SH	EET		ICCN NO./ PRELIM. CCN N	10.		PAGE	E	_OF	
Subject       Containment Across and Lodine Removal Rates       Sheet       212       of       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04       212       04 <th>Projeci</th> <th>t or DCP/FCN/E</th> <th>ECP</th> <th></th> <th>с</th> <th>alc No.</th> <th>N-6030-001</th> <th></th> <th>CCN CO CCN NO</th> <th>NVERS . CCN</th> <th>ION:</th> <th>•</th> <th></th>	Projeci	t or DCP/FCN/E	ECP		с	alc No.	N-6030-001		CCN CO CCN NO	NVERS . CCN	ION:	•	
REV     ORIGINATOR     DATE     IRE     DATE     REV     ORIGINATOR     DATE     IRE     DATE       0     J.Schulz     \$152003     D.T.Dexheimer     \$152003     D.T.Dexheimer     \$152003     D.T.Dexheimer     \$152003       9     J.Schulz     \$10 4 hr Output File ((2-max02.0ut))       Bechtel Standard Computer Program     REMOVE     NE3D5 Version 4.5       [C] 1391     Dorge Schulz     Date 14 Jun 2003     Char Me0.00 Rev No. 0       Order SONSS     Subject I2 Spray Max Temp 2 - 4 hr     Sheet No. 16575-167       Subject I2 Spray Max Temp 2 - 4 hr     Sheet No. 16575-167       MASIOS REMOVE Version 4.0     for the IBM FC/XT/A1       Image: Standard Computer Program calculates the containment spray removal rate constants and a mean drop diameter or drop trajectorites       Cutput in file I2-max02.out was Created on 14 Jun 2003 at 11: 2:57       Bechtel Standard Computer Program     RENOVE, NE305 Version 4.0       Colput in file I2-max02.out was Created on 14 Jun 2003 at 11: 2:57       Bechtel Standard Computer Program     RENOVE, NE305 Version 4.0       Colput in file I2-max02.out was Created on 14 Jun 2003 at 11: 2:57       Bechtel Standard Computer Program       Date 14 Jun 2005 Checked	Subjec	t <u>Containmen</u>	t Aerosol a	and Iodine Remov	al Rates	. <u> </u>		<u>·</u>	She	et _2	12	of	281
0       J. Schulz       \$7157003       D. T. Dexheimer       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003       \$7157003 <t< th=""><th>REV</th><th>ORIGINATOR</th><th>DATE</th><th>IRE</th><th>DATE</th><th>REV</th><th>ORIGINATOR</th><th>DATE</th><th>IR</th><th>E</th><th>DAT</th><th>Έ</th><th>eeee</th></t<>	REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DAT	Έ	eeee
9.2.2.4       2 to 4 hr Output File (12-max02.0ut)         Pechtel Standard Computer Program       RENVE . ME3D5 Version 4.0 Gainstor Jorge Schulz       Date 14 Jun 2003 Checked	0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003								REV
Abstract:         The REMOVE program calculates the containment spray removal rate constants and a mean drop diameter or drop trajectories         Output in file I2-max02.out was created on 14 Jun 2003 at 11: 2:57         Bechtel Standard Computer Program       REMOVE, NE305 Version 4.0 (cl 1991         Calc No. N-6030-00 Rev No. 0         Originator Jorge Schulz       Date 14 Jun 2003 Checked Date	Be (c Or Su	9.2.2.4 2 to chtel Standard ) 1991 iginator Jorge oject SONGS bject I2 Spray	o 4 hr Ou Computer Schulz y Max Ten	tput File (12- ma Program Date 14 p 2 - 4 hr Standard Comp NE305 REMOVE for the IBM	ax02.out) REMOVE Jun 2003	NE305 Calc I Check Job M Sheet	Version 4.0 No. N-6030-00 R edDate D. 16575-167 No. 1	ev No. 0		· ·	· · ·		
Density of droplet liquid= .95798 G/CC Viscosity of droplet liquid= 2.81823E-03 Poise	Bee (c Or: Sul Ten Ten Ten De Vi. Des Vi.	Al Th Sy di Contput in fi chtel Standard ) 1991 iginator Jorge oject SONGS bject I2 Spray mperature of air- mperature of air- scosity of air-st scosity of drople scosity of drople	ile I2-Jua Computer Schulz Max Temmix coplet lli cean mixt -steam mixt -steam init	program calcul val rate consta r drop trajecto x02.out was cre Program Date 14 p 2 - 4 hr nixture= 100.70 ture= 2.2798 quid= 100.70 ure= 1.79680E= kture= 1.78625 cture= 2.61823E-0	ates the nts and a ries ated on 1 REMOVE, Jun 2003 Jun 2005 Jun 20	Contain a mean of l4 Jun : NE305 0 Calc 1 Checkd Job No Sheet egree C se	nment drop 2003 at 11: 2: Version 4.0 No. N-6030-00 R edDate_ D. 16575-167 No. 2	57 ev No. 0	• • •	· ·			
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Project or DCP/FCN/ECP

Calc No. N-6030-001

CCN CONVERSION: CCN NO. CCN

Subject Containment Aerosol and Iodine Removal Rates

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REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	8
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003						REV
				•						
Sc Gr Tr	hmidt number fo ashof number= y mean diameter	or methy] 9.52447E = 8.725	iodine= 1.20 +12 43E-02	39			-			•
Dz	op parameters ( (For n	tor element nean drop	) )							
I	Diameter 1 CM	Fall Time: SEC	Reynolds M. C	T.Coeff G M/SEC	T.V CM/S	V. drop no SEC	•			
35	8.7294E-02	7.276	264.5	9.630	303	1.2 243.3	. •	•		
I	Diameter S CM	Sherwood	Time S	at. Frac.	м.т.( Сі	Coeff L Remov M/SEC /HR	al			
35	8.7294E-02	1.027	.1979	.4018	3.90	060E-03 5.156		•		
**	*********SPRAY	REMOVAL 1	RATES*********	*						
To	tal elemental :	cemoval co	onstant= 5.15	78 pe	r hour					
Pa	rticulate iodir	ne removal	L constant= .	59268	per ho	our				
То	tal organic ren	aoval com	stant= .00000	per	hour					
**	***REMOVAL DUE	TO WALL I	DEPOSITION*****							
El	emental removal	t rate du	e to wall depos	ition =	4.9732	2 per hour				
Or	ganic removal :	cate due f	to wall deposit.	ion0	0000	per hour				
Me Te: De: Vi Di Di Di Sci Sci	an drop diamete mperature of ai essure of air-s mperature of d nsity of air-st scosity of air- st scosity of drople scosity of drople ff. coeff. of m ff. coeff. of m ff. coeff. of m ff. coeff. of m hmidt number for	ar= 8,72 r-steam mixis coplet licit coplet licit coplet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- ble	943E-02 nixture= 100. ture= 2.2798 guid= 100.70 ture= 1.79680E- ture= 1.78625- ture= 1.78625- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.79680E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.2010E- 1.20	70 De Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture= ixture= ixture= 1iquid= 5.5 .5808 39	gree C e C e 6.28 8.25765 5.18200 9625E-0	9893E-02 sq. cm 9E-02 sq. cm/se 3E-05 sq. cm/sec 05 sq. cm/sec	/sec C C	•		
Gr Tr	ashof number- y mean diameter	9.52447E- = 8.817!	+12 53 <b>E-</b> 02							
Dr	op parameters f (For m	for element mean drcp	ntal .							
I	Diameter E CM	Sall Tine SEC	Reynolds M. Ci	<b>F.Coeff</b> G M/SEC	т.\ См/5	J. drop no SEC	•			
35	8.8175E-02	7.524	269.4	9.609	303	3.8 477.0				
I	Diameter S CM	sherwood	Time Sa	at. Frac.	м.т.С СЮ	Coeff L Remov. M/SEC /HR	al			
35	8.8175E-02	1.035	.2006	.4079	3.86	569 <b>E-03</b> 5.234				

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Projec	t or DCP/FCN/E	CP		Ċ	alc No.	N-60	30-001		CCN CO	NVERSIO	DN:		
Subjec	t <u>Containmen</u>	t Aerosol a	nd Iodine Remo	val Rates					She	et	<u>4</u> of	281	
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE	IR	<u> </u>	DATE	ď	
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003								REV	
												Ĩ.	
t. To	*********SPRAY tal elemental p	REMOVAL (	FATES************************************	** 355 pe	r hour								
Pa	rticulate iodin	ne removal	constant=	.59268	per h	our							
To	tal organic rem	noval con:	tant= .0000	0 per	hour								
	***REMOVAL DUE	TO WALL	DEPOSITION****	*									
El	emental removal	l rate du	a to wall depo	sition =	4.973	2 pe	r hour						
Or	ganic removal n	ate due f	o wall deposi	tion= .0	0000	per h	our		•				
Me Te Pr De Vi Di Di Di Sc Gr Tr	Mean drop diameter= 8.81'53E-02 Temperature of air-steam mixture= 100.70 Degree C Pressure of air-steam mixture= 2.2799 Atm. Temperature of droplet liquid= 100.70 Degree C Density of air-steam mixture= 1.79680E-03 G/CC Viscosity of air-steam mixture= 1.78625E-04 Poise Density of droplet liquid= .95798 G/CC Viscosity of droplet liquid= 2.81823E-03 Poise Diff. coeff. of elemental 12 in air-steam mixture= 6.28993E-02 sq. cm/sec Diff. coeff. of elemental 12 in air-steam mixture= 8.25769E-02 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid= 5.18208E-05 sq. cm/sec Diff. coeff. of methyl 12 in droplet liquid= 5.59625E-05 sq. cm/sec Diff. coeff. of methyl 12 in droplet liquid= 5.59625E-05 sq. cm/sec Schmidt number for elemental iodine= 1.5808 Schmidt number for methyl iodine= 1.2039 Grashof number= 1.17514E+13 Try mean diameter= 8.64958E-02												
Dr	op parameters 1 (For m	for element lean drop)	ntal ,										
I	Diameter E CM	Tall Time SEC	Reynolds M	.T.Coeff G CM/SEC	Т. См/:	SEC	drop no	•					
35	8.8496E-02	7.763	271.2	9.602	30-	1.7	707.6				1	- 1	
I	Diameter S CM	herwood	Time :	Sat. Frac.	M.T.( Ci	Coeff L M/SEC	Remov /HR	al					
35	8.8496E-02	1.038	.2055	.4159	3.8	529E-03	5.337				[		
**	********SPRAY	REMOVAL E	ATES********	**							1		
To	tal elemental r	emoval co	onstant= 5.3	378 pe	r hour	•		,			ļ		
Pa	Particulate iodine removal constant= .63567 per hour												
To	Total organic removal constant= .00000 per hour												
**	***REMOVAL DUE	TO WALL I	PEPOSITION****	•									
El	Elemental removal rate due to wall deposition = 4.9732 per hour												
Or	ganic removal r	ate due f	o wall deposit	tion= .0	0000	per h	our						
Me Te: Pr	an drop diamete mperature of ai essure of air-s	r= 8.849 r-steam m team mixt	958E-02 11xture- 100 cure- 2.2798	.70 De Atm.	gree C								

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Projec	t or DCP/FCN/			c	aic No.	N-6030-	001		CCN CO CCN NÓ	NVEF	rsion: N		
Subjec	t Containmer	nt Aerosol a	und Iodine Remov	al Rates	. <u> </u>			·	She	et _	215	of	_ 281
REV	ORIGINATOR	DATE	IRE	DATE	REV	. ORIGINATO	DR D	DATE	IR	E	D	ATE	Ĕ
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003									REV
	·												X.
Te Dee Vi Di Di Di Di Sc Gr Tr Dr I 35 I 35 I 35 I To Pa To ** El Or Me Pr Te Pr De Vi Di Di Sc Gr Tr Dr I 35 I I Sc Gr Tr Dr Dr I Sc Gr Tr Dr Di Sc Gr Tr Dr Di Sc Gr Tr Dr Di Sc Gr Tr Dr Di Sc Gr Tr Dr Di Sc Gr Tr Dr Di Sc Gr Tr Dr Di Sc Gr Tr Dr Di Sc Gr Tr Dr Di Sc Gr Tr Dr Di Sc Gr Tr Dr Di Sc Gr Tr Dr Di Sc Gr Tr Dr Di Sc Gr Tr Dr Di Sc Gr Tr Dr Di Sc Gr Tr Dr Di Sc Gr Tr Dr Di Sc Gr Tr Dr Di Sc Gr Tr Dr Di Sc Gr Tr Dr Di Sc Sc Gr Tr Dr Di Sc Sc Gr Tr Dr Di Sc Sc Gr Tr Dr Di Sc Sc Gr Tr Dr Di Sc Sc Tr Dr Di Sc Sc Tr Dr Di Sc Sc Gr Tr Dr Di Sc Sc Sc Tr Dr Di Sc Sc Tr Dr Di Sc Sc Tr Dr Di Sc Sc Tr Dr Di Sc Sc Tr Di Sc Sc Tr Di Sc Sc Tr Di Sc Sc Tr Di Sc Sc Tr Di Sc Sc Tr Di Sc Sc Tr Di Sc Sc Tr Di Sc Sc Tr Di Sc Sc Tr Di Sc Sc Tr Di Sc Sc Tr Di Sc Sc Sc Sc Tr Di Sc Sc Sc Sc Sc Sc Sc Sc Sc Sc Sc Sc Sc	<pre>mperature of d nsity of air-s scosity of air-s scosity of dcopl scosity of dcopl scosity of dcoff. coeff. of ff. coeff. of ff. coeff. of hmidt number f ashof number- y mean diameter Op parameters (For Diameter CM 8.8627E-02 biameter biamete biamete biamete biamete biamete biamete biamete biamete biamete biamete biamete biamete biamete biamete biamete biamete biamete biamete biamete biamete biamete biamete biamete biamete biamete biamete biamete biame</pre>	roplet li. team mixt -steam mixt et liquid plet liquid plet liquid plet liquid elemental methyl I2 elemental methyl I2 elemental methyl I2 elemental for element sec 8.069 Sherwood 1.039 REMOVAL 1 ne removal construction removal construction to WALL 1 l rate due er= 8.862 ir-steam mixt -steam steam steam -steam -	<pre>quid= 100.70 wre= 1.79680E- sture= 1.78625 " .95798 id= 2.81823E-0 I2 in air-steam m I2 in droplet liq tal iodine= 1 iodine= 1.20 *13 S5E-02 ntal " Reynolds M." 272.0 Time S. .2129 RATES************************************</pre>	Degre 03 G/CC 5-04 Pois G/CC 3 Poise m mixture= liquid= .5808 39 T.Coeff C M/SEC 9.599 at. Frac. .4272 26 per 63567 per ition = .0 70 Dec Atm. Degre D3 G/CC E-04 Pois G/CC 3 Poise m mixture= liquid= 1:0 .5808 39	ee C se 8.2576 5.1820 59625E- 30. M.T.( 3.8 e: hour per h hour 4.973: 00000 9gree C 9625E- 18205 5.18200 9625E- 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205 18205	8893E-02 sq 9E-02 sq. cn 8E-05 sq. cn 5 sq. cm/s 5.1 9: Coeff L R M/SEC 472E-03 5 our 2 per h per hour 9893E-02 sq. cn 9E-02 sq. cn/s	. cm/sec m/sec ec p no. 36.0 emoval /HR .482 our	с		· · · · · · · · · · · · · · · · · · ·			
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Project	or DCP/FCN/	ECP		C	alc No.	N-603	30-001		CCN CO CCN NO	NVERSI	ION:	
Subjec	t Containmer	nt Aerosol a	nd Iodine Remov	al Rates	•				She	et _2	<u>16</u> of	281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE	IR	E	DATE	¥
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003								REV
	•									,		Ň
I	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	: Т. СМ/:	V. c SEC	Irop ло.					
36	8.9018E-02	9.717	274.2	9.590	30	5.2	1150.					
I Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal . CM CM/SEC /HR 26 P. 00107-02 1.042 2542 4854 2.82035-03 4.449												
36	8.9018E-02	1.043	.2542	.4854	3.8	903E-03	4.449					
**	*********spray	REMOVAL	RATES*********	•								
Tot	tal elemental	removal co	onstant= 4.44	90 pe	r hour							
Pat	rticulate iodi	ne removal	l constant= .	56136	per h	our						
To	tal organic re	moval cor.	stant= .00000	per	hour							
***	***REMOVAL DUE	TO WALL	DEPOSITION*****				٠				ł	
EL	emental remova	l rate du	e to wall depos	ition =	4.973	2 per	hour					
Or	ganic removal	rate due i	to wall deposit	ion= .(	0000	per ho	our					
Mei Ter Pro Ter Der Vi: Der Vi: Di Di Di Sci Sci Grz	an drop diamet mperature of a assure of air- mperature of d naity of air- scosity of air associty of drop acosity of drop aff. coeff. of aff. coeff. of aff. coeff. of a midt number f ashof number= y mean diamete	er= 8.900 ir-steam mixts roplet lice team mixts -steam mixts et liquid- plet liquid- elemental methyl I2 elemental methyl I2 cor elemental 2.220733- r= 9.0251	182E-02 mixture= 100. ture= 2.2798 guid= 100.70 Ire= 1.79680E- ture= 1.78625 .95798 Id= 2.61823E-0 I2 in air-steam m I2 in droplet liq tral iodine= 1 100fine= 1.20 -13 19E-02	70 De Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture ixture- liquid- 0.5808 39	gree C e C = 6.21 8.25763 5.18204 9625E-(	9893E-02 9E-02 sq. 8E-05 sq. cm 95 sq. cm	sq. cm/ cm/sec cm/sec /sec	sec :				
Dro	p parameters : (For )	for elemen mean drop)	ntal									
I	Diameter : CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	T.V CM/S	/. d SEC	rop no.					
36	9.0252E-02	10.76	281.2	9.561	305	9.8	2286.					
I	Diameter : CM	Sherwood	Time S	at. Frac.	N.T.C	Coeff L M/SEC	Remova /HR	1				
36	9.0252E-02	1.054	.2737	.5135	3.7	180E-03	4.707					
	**************************************	REMOVAL I	ATES*********	*								
Tot	al elemental	removal co	onstant= 4.70	77 pe	r hour							
Par	ticulate iodi:	ne removal	constant= .	56136	per ho	our						
Tot	al organic re	moval cons	stant= .00000	per	hour							
SCE 26-4	26 REV. 2 IREF	ERENCE: S	0123-XXIV-7.15			<del> </del>				N-60	30-001 Re	v 0.doc

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Projec	t or DCP/FCN/E	CP		c	alc No.	N-6030-001		CCN CO CCN NO	NVERS	ON:	
Subjec	t Containmen	t Aerosol 2	and Iodine Remov	al Rates			· `	She	et _2	1 <u>7</u> of	281
FEV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DATE	ह
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003				<u> </u>			REV
		 									<u> </u>
**	***REMOVAL DUE	TO WALL	DEPOSITION*****								
El	emental removal	l rate du	e to wall depos	ition -	4.973	2 per hour					
Or	ganic removal a	ate due	to wall deposit	ion= .(	10000	per hour					
Me Te Pr De Vi Di Di Di Sc Gr Tr	an drop diameter mperature of air- essure of air- sesure of dir- sesure of dir- scosity of air- nsity of drop fs.coeff. of e ff. coeff. of e ff. coeff. of m ff. coeff. of m hmidt number for hmidt number for ashof number- y mean diameter	r= 9.02 ir-steam mix coplet liv ean mix steam mix st liquid blet liquid blet liquid blet niquid blemental nethyl 12 blemental sor elemental 2.36737E = 9.055	519E-02 mixture= 100.70 ture= 2.2798 quid= 100.70 ure= 1.79680E- xture= 1.78625 95798 id= 2.81823E-0 I2 in air-steam m I2 in droplet liq tal fodine= 1 iodine= 1.20 +13 20E-02	70 De Atm. Degre 03 G/CC E~04 Pois G/CC 3 Poise m mixture ixture- liquid- uid- 5.5 .5808 39	egree C ee C se 6.2( 8.2576) 5.18200 99625E-(	8893E-02 sq. cm 9E-02 sg. cm/se 8E-05 sq. cm/se 5 sq. cm/sec	/sec C				
Dr	op parameters f (For n	for element Nean drop	ntal }								
I	Diameter E CM	SEC	Reynolds M. Cl	T.Coeff G M/SEC	5 T.V CM/5	7. drop no SEC	•				
36	9.0552E-02	9.792	283.0	9.554	31(	3426.					
г	Diameter S CM	sherwood	Time S	at. Frac.	M.T.( Cl	Coeff L Removed N/SEC /HR	al				
36	9.0552E-02	1.057	.2475	.4803	3.76	54E-03 4.402					
**	*********SPRAY	REMOVAL, 1	RATES*********	•					•		
To	tal elemental r	emoval co	onstant= 4.403	33 pe	r hour						
Pa	rticulate iodin	ie removal	l constant= .	57345	per ho	our					
То	tal organic rem	oval cons	stant= .00000	per	hour						
**	***REMOVAL DUE	TO WALL I	DEPOSITION*****								
El	emental removal	. rate du	e to wall depos:	ition =	4.9732	per hour					
Me Te De Vi De Vi Di Di	an drop diamete mperature of ai essure of air-s mperature of dr nsity of air-st scosity of air- nsity of drople scosity of drop ff. coeff. of m	are dus i r= 9.05 r-stean rixt coplet .lic steam mixt steam mixt st liquid tet liquid tet liquid tet niquid tet niquid	520E-02 mixture= 100.7 ture= 2.2798 mid= 100.70 rre= 1.79680E-0 kture= 1.78625 . 95798 ( id= 2.81823E-0 I2 in air-steam mi	70 Fe Atm. Degre 03 G/CC 2-04 Pois 3/CC 3 Poise mixture=	gree C e C e 6.28 8.25765	993E-02 sq. cm/sec	/sec		·		
SCE 26-4	26 REV. 2 (REF	RENCE: S	0123-XXIV-7.15				· · · · · · · · · · · · · · · · · · ·		N-60	30-001 Re	v 0 doc

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Project	t or DCP/FCN/I	ECP	•	ċ	aic No.	<u>N-60</u>	30-001		CCN CO CCN NO	NVERS	SION: I		•
Subjec	t Containmer	nt Aerosol a	nd Iodine Remov	al Rates	·				She	et _2	18	of	281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	IATOR	DATE	IR	3	DA	TE	ĸ
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003					<u> </u>		<u> </u>		REV
┝───┘		1			L								<u> </u>
Di Di Sc Sc Tr	ff. coeff. of ff. coeff. of hmidt number f hmidt number f ashof number= y mean diamete	elemental methyl 12 or elemen or methyl 2.36737E r= 9.076	I2 in droplet in droplet lig tal iodine= 1 iodine= 1.20 013 75E-02	liquid- uid- 5.5 .5808 39	5.1820 59625E-	8E-05 sq 05 sq. c	, cm/se m/sec	c					
. Dr	op parameters (For	for eleme mean drop	ntal ]						·				
I	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff ( M/SEC	5 T. CM/	V. Sec	drop no	•					
36	9.0768E-02	10.93	284.2	9.549	31	1.3	4559.					1	
I	Diameter CM	Sherwood	Time S	at. Frac.	. М.Т. С	Coeff L M/SEC	Remov /HR	al				·	
36	9.0768E-02	1.059	.2750	.5164	3.7	565E-03	4.733						
**	**********SPRAY	REMOVAL	I:ATES*********	*									1
То	tal elemental	removal c	onstant= 4.73	41 pe	er hour								
Pa.	rticulate iodi	ne remova	]. constant= .	57345	per h	our							
To	tal organic re	moval con	stant= .00000	per	hour								
**	***REMOVAL DUE	TO WALL	Deposition*****								•	·	
El	emental remova	il rate du	a to wall depos	ition =	4.973	2 pe	r hour						
Or	ganic removal	rate due	to wall deposit	ion(	00000	per h	our						
Me Te Pr De Vi De Vi De Vi Di Di	an drop diamet mperature of a essure of air- mperature of d nsity of air- scosity of air scosity of dropl scosity of dropl ff. coeff. of	er= 9.07 ir-steam steam mixt leam mixt -steam mi let liquid pplet liqu elemental methyl I2	675E-02 mixture= 100. ture= 2.2798 (µid= 100.70 ure= 1.79680E- xture= 1.78625 " .95798 i.d= 2.81823E-0 I2 in air-steam m	70 De Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture	egree C 9e C 3e 6.2 8.2576	8893E-02 9E-02 sq	sg.cm.	/sec					
Di Di Sc Gr Tr Dr	ff. coeff. of ff. coeff. of thmidt number f hmidt number f ashof number= y mean diamete cop parameters	elemental methyl 12 for elemen for methyl 3.03393E er= 9.086 for eleme	I2 in droplet in droplet lig tal iodine= 1 iodine= 1.20 4:13 60E-02 ntal	liquid- uid= 5.5 .5808 39	5.1820 59625E-	8E-05 sq 05 sq. c	. cm/sec m/sec	2					
r	(For Diameter CM	mean drop Fall Time	) Reynolds M.	T.Coeff G	5 T. CM/	V. (	drop no						
36	9.0866E-02	10.67	284.8	9.547	31	1.5	5693.						
I	Diameter CM	Sherwood	Tine S	at, Frac.	. М.Т.( С	Coeff L M/SEC	Remova /HR	1					

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E&TS DEPARTMENT ICCN NO./ CALCULATION SHEET PRELIM. CON NO. PAGE OF CCN CONVERSION: CCN NO. CCN Project or DCP/FCN/ECP Calc No. N-6030-001 Subject Containment Aerosol and Iodine Removal Rates Sheet \_219 of \_281 DATE DATE REV ORIGINATOR REV ORIGINATOR IRE DATE IRE DATE REV INDICATOR 8/15/2003 D. T. Dexheimer 8/15/2003 J. Schulz ۵ ۰. 36 9.0866E-02 1.060 .2680 ,5078 3.7524E-03 2.327 Total elemental removal constant= 2.3273 per hour Particulate iodine removal constant= .31145 per hour Total organic removal constant= .00000 per hour \*\*\*\*\*REMOVAL DUE TO WALL DEPOSITION\*\*\*\*\* Elemental removal rate due to wall deposition = 4.9732 per hour Organic removal rate due to wall deposition= .00000 per hour Mean drop diameter= 9.08660E-02 Temperature of air-steam mixture= 100.70 Degree C Pressure of air-steam mixture= 2.2798 Temperature of droplet liquid= 100.70 Atm. Degree C Density of air-steam mixture= 1.79680E-03 G/CC Viscosity of air-steam mixture= 1.78625E-04 Poise Density of droplet liquic= .95798 G/CC Viscosity of droplet liquid= 2.81823E-03 Poise Diff. coeff. of elemental 12 in air-steam mixture 6.28893E-02 sq. cm/sec Diff. coeff. of methyl I2 in air-steam mixture= 0.25769E-02 sq. cm/sec Diff. coeff. of elemental I2 in droplet liquid= 5.18208E-05 sq. cm/sec Diff. coeff. of methyl I2 in droplet liquid= 5.59625E-05 sq. cm/sec Schmidt number for elemental iodine= 1.5808 Schmidt number for methyl. iodine= 1.2039 Grashof number= 3.033931:+13 Try mean diameter= 9.09375E-02 Drop parameters for elemental (For mean drop) Diameter Fall Time Reynolds M.T.Coeff G T.V. drop no. Τ CM/SEC CM/SEC CM SEC 36 9.0937E-02 11.00 285.2 9.545 311.7 6824. T Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal CM/SEC CM /HR 36 9.0937E-02 1.060 .2758 .5178 3.7495E-03 2.373 Total elemental removal constant= 2.3730 per hour per hour Particulate iodine removal constant= .31145 Total organic removal constant= .00000 per hour \*\*\*\*\*REMOVAL DUE TO WALL DEPOSITION\*\*\*\*\* Elemental removal rate due to wall deposition = 4.9732 per hour Organic removal rate due to wall deposition .00000 per hour

SCE 26-426 REV. 2 [REFERENCE: SO123-XXIV-7.15]

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CCN CONVERSION: CCN NO. CCN

Subject Containment Aerosol and Iodine Removal Rates

Sheet	220

<u>220</u> of <u>281</u>

0         1 Schulz         #157003         D.T. Dothemer         #157003           Mean drop diameter=         9.03735-02         Degree C         Pressure of Air-Steam mixtures         1.70.00         Degree C           Pressure of Air-Steam mixtures         1.70.00         Degree C         Degree C         Degree C           Pressure of Air-Steam mixtures         1.70.00         Degree C         Degree C         Degree C           Discosity of Air-Steam mixtures         1.70808-03 0/CC         Degree C         Degree C           Viscosity of Air-Steam mixtures         1.80808-03 0/CC         Degree C         Degree C           Viscosity of Air-Steam mixtures         1.80808-03 0/CC         Degree C         Degree C           Viscosity of Air-Steam mixtures         1.80808-03 0/CC         Degree C         Degree C           Diff. Coeff. of Elemental 12 in dropict liquid= 5.180808-02 sq. Cm/sec         Diff. Coeff. of elemental 12 in dropict liquid= 5.180808-03 sq. Cm/sec           Diff. coeff. of elemental 12 in dropict liquid= 5.596258-03 sq. Cm/sec         Diff. Coeff. of elemental 12 in dropict liquid= 5.0000         Cm/sec           Dirp parameters foll Time Reynolds N.T.Coeff G         T.V. drop no.         CM/SEC         CM/SEC           J         Diameter Shervood Time Sat. Frac. M.T.Coeff L Removal         Cm/sec         JAM           S 5	REV	ORIGINATOR	DATE		DATE	KEV	ORIGINATOR	DATE	IRE	UATE	
<pre>Mean drop diameter= 9.09375E-02 Temperature of Air-steam mixture= 100.70 Degree C Temperature of Air-steam mixture= 1.0737 Degree C Temperature of Air-steam mixture= 1.0737 Degree C Temperature of Air-steam mixture= 1.07680E-03 G/C Viscosity of Air-steam mixture= 1.76825E-03 Foise Density of Air-steam mixture= 1.76825E-03 Foise Density of droplet liquid= 2.81238-03 Foise Diff. coeff. of elemental 12 in Air-steam mixture= 0.25765E-02 sq. cm/sec Diff. coeff. of elemental 12 in Air-steam mixture= 0.25765E-03 sq. cm/sec Diff. coeff. of elemental 12 in Air-steam mixture= 0.25765E-03 sq. cm/sec Schwidt number for methyl icdine= 1.2039 Greabof number for methyl icdine= 1.2039 Greabof number for methyl icdine= 1.2039 Greabof number for lemental 160ine= 1.500 (C SEC CH/SEC CH/SEC Diff. coeff. of 285.4 9.545 311.9 7957. 1 Diameter Sherwood Time Sat. Frac. N.T.Coeff L Removal CM/SEC /ANR 36 9.0979E-02 1.061 .2696 .5101 3.7478E-03 2.338 ***********************************</pre>	0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003						M M
<pre>Mean drop diameter= 9.09375E-02 Temperature of Air-steam mixture= 100.70 Degree C Pressure of Air-steam mixture= 1.2788 Atm. Temperature of droplet liquid= 100.70 Degree C Density of air-steam mixture= 1.78625E-04 Folse Density of droplet liquid= .2798 G/CC Viscosity of air-steam fitture= 1.2698 Schmidt number for newernal icoine= 1.5808 Schmidt number for elemental</pre>	ر میں میں م			l							ž
Grashof number= 3.11526E+13 Try mean diameter= 9.10180E-02	Me Te Pr Te Di Di Di Di Scc Gr Tr Dr I 36 1 36 1 36 36 36 4 ** To Pa To Pa To Pr Te Pr Vi Di Di Di Di Di Scc Scc Gr Tr Tr Di Di Di Di Di Di Di Di Di Di Di Di Di	an drop diameter mperature of air- mperature of dir- mperature of dir- mperature of dir- scosity of air- scosity of drople scosity of drople scosity of drople ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a hmidt number fill ashof number- y mean diameter cM 9.0979E-02 biameter CM 9.0979E-02 ********SPRAY tal elemental rticulate iodin tal organic ren- ***REMOVAL DUE emental removal an drop diameter scosity of air- sizesity of drople scosity of drople drople drople drople drople drople drople drople drople drople drople drople drople drople drople drople drople drople drople drople drople drople drople drople drople drople drople drople drople drople drople drople dropl	<pre>[</pre>	375E-02 mixture= 100. ture= 2.2798 quid= 100.70 ure= 1.79680E- xture= 1.79680E- xture= 1.78625 = .95798 id= 2.81823E-00 I2 in air-steam m I2 in droplet liq tal iodine= 1 iodine= 1.20 +13 87E-02 mtal Reynolds M. C 285.4 Time S .2696 RATES************************************	70 De Atm. Degre 03 G/CC E-04 Pois G/CC 3 Foise m mixture ixture= liquid= uid= 5.5 .5808 39 T.Coeff C M/SEC 9.545 at. Frac. .5101 * 77 pe 31420 per ition = ion= .C 70 De Atm. Degre 03 G/CC 3 Poise m mixture= liquid= uid= 5.5 .5808 39	sgree C as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as c as	8893E-02 sq. cm/s 9E-02 sq. cm/s 8E-05 sq. cm/s 05 sq. cm/sec 1.9 7957 Coeff L Remo M/SEC /H 478E-03 2.33 our 2 per hour 2 per hour 9E-02 sq. cm/s 8893E-02 sq. cm/s 8E-05 sq. cm/sec	m/sec ec , ec , val R 8 8			

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Subjec	t Containme	nt Aerosol	and Iodine Remov	al Rates	•			She	et _	<u>221</u> 0	281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	Ē	DATE	¢
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							
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Dr	op parameters (for	for eleme mean drop	ntal			۰.					
I	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff ( M/SEC	см/:	V. drop no SEC	•				
36	9.1018E-02	11.09	285.6	9.544	31:	2.0 9088.					
I	Diameter CM	Sherwood	Time S	at. Frac.	M.T.C	Coeff L Remov M/SEC /HR	al				
36	9.1018E-02	1.061	.2776	.5203	3.7	62E-03 2.384					
**	**************************************	REMOVAL	RATES*********	*			•				
То	tal elemental	removal c	onstant= 2.38	44 pe	er hour						
Pa	rticulate iodi	ne remova	l constant= .	31420	per h	our					
TO	tal organic re	moval con	stant00000	per	hour						
**	***REMOVAL DUE	TO WALL	DEPOSITION*****								
El	emental remova	l rate du	e to wall depos	ition =	4.9732	2 per hour					
Or	ganic removal	rate due	to wall deposit	ion= .0	0000	per hour					1 ·
Me	an drop diamet	er= 9.10	180E-02								
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ubject	Containmen	t Aerosol a	and lodine Remov	val Rates			•	She	et _2	2 <u>2</u> of	281	
FEV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DATE		
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							REV ICATO	
		·						1			<u>§</u>	
Bec (c) Ori Pro Sub	9.2.2.5 4 to chtel Standard 1991 Iginator Jorge oject SONGS oject I2 Spray	Schulz	tput File (i2- m Program Date 14 p 4 - 8 hr	ax03.out) REMOVE Jun 2003	, NE305 Calc I Check Job N Sheet	Version 4.0 No. N-6030-00 R edDate_ o. 16575-167 No1	ev No. O			·		
			Standard Comp NE305 REMOVE for the IBM	Duter Prog Version 4 PC/XT/A	gram 4.0 r				•			
	Ar Tr Sy dj	ostract: ne REMOVE pray reno ameter o	program calcul val rate consta r drop trajecto	lates the ants and a bries	contai a mean (	nment drop						
Bec (C) Ori Pro Sub	Output in fi Intel Standard 1991 ginator Jorge ject SONGS ject I2 Spray	le 12-ma Computer Schulz Max Tem	x03.out was cre Program Date 14 p 4 - 8 hr	REMOVE , Jun 2003	14 Jun NE305 Calc Calc Lock Job N Sheet	2003 at 11: 4: Version 4.0 No. N-6030-00 R edDate_ o. 16575-167 No. 2	49 .ev No. C					
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REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATO	R DATE	IRE	DATE	g
C.	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003						<b>REV</b>
Sc Gr Tr Dr I 355 1 35 1 35 1 35 1 35 1 35 1 7 0 7 0 7 0 7 0 7 0 7 0 7 0 7 0 7 0 7	<pre>chmidt number : cashof number= y mean diameter (For Diameter CM 8.8205E-02 Diameter CM 8.8205E-02 ************************************</pre>	for methyl 8.33401E er 8.82C for eleme mean drop Fall Time SEC 7.003 Sherwood 1.328 ( REMOVAL : removal con E TO WALL : al rate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due due tate due tate due tate due due tate due tate due due tate due due tate due due tate due due tate due due tate due due due due due due due due due du	<pre>iodine= 1.21 iodine= 1.21 i2 iodine= 1.21 i2 iodine= 1.21 id= 02 intal id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id= 02 id=</pre>	45 T.Coeff G M/SEC 10.02 at. Frac. .4279 , 70 pe 59268 per ition = ion= .0 00 De Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture liquid= 1iquid= 2.5934 45	T.V CM/S 311 M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C M.T.C	. drop EC .1 23 oeff L Re /SEC 73E-03 4.	no. 5.8 moval /HR 796 our cm/sec //sec //sec	<u></u>		•
Dr	op parameters (For	for elements near drop	ntal )							
I	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	; T.V CM/S	. drop EC	DO.			
35	8.8629E-02	7.295	260.9	10.01	312	.3 46	2.2			
I	Diameter CM	Sherwood	Time S	at. Frac.	M.T.C CM	oeff L Re /SEC	moval /HR		i	
35	8.8629E-02	1.333	.1791	.4386	3.58	01E-03 4.	915			
										1

SCE 26-426 REV. 2 [REFERENCE: SO123-XXIV-7.15]

## E&TS DEPARTMENT CALCULATION SHEET

ICCN NO./ PRELIM. CCN NO.

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Project or DCP/FCN/ECP

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Calc No. N-6030-001

CCN CONVERSION: CCN NO. CCN

Subject Containment Aerosol and Iodine Removal Rates

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OF

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	8		
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003						₽₹		
		1							1	2		
*** To Pa To El Ox El Ox Me Te Pr Te De Vi Di Di Di Di So So Gr Tr	<pre>************************************</pre>											
Dr	op parameters : (For m Diameter I CM	for eleme: nean drop Fall Time: SEC	ntal ) Reynolds M. C	T.Coeff G M/SEC	5 T. CM/3	V. drop no SEC						
36	8.87995-02	7.523	261.8	10.00	31	2.8 685.6	•	•	:			
I	Diameter S CM	Sherwood	Time S	at. Frac.	M.T. C	Coeff L Remov M/SEC /HF	ral C					
36	8.87992-02	1.335	.1840	.4474	3.5	733E-03 5.014	l					
**	**********\$PRAY	REMOVAL 1	RATES*********	*								
To Pa	tal elemental m rticulate iodir	removal co ne removal	onstant= 5.01 l constant= .	45 pe 63567	er hour per h	our						
To	tal organic rem	noval con	stant= .00000	per	hour		. :					
**	*****REMOVAL DUE TO WALL DEPOSITION*****											
El	emental removal	l rate du	e to wall depos	ition -	5.070	3 per hour						
Or	ganic removal 1	rate due	to wall deposit	ion= .0	0000	per hour						
Me Te Pr	Mean drop diameter= 8.87986E-02 Temperature of air-steam mixture= 95.300 Degree C Pressure of air-steam mixture= 2.0799 Atm.											
SCE 26-4	26 REV. 2 (REFI	ERENCE: 5	0123-XXIV-7.15]					N-6	030-001 Re	v 0.doc		

			ATS DEPA	RTMENT		ICCN NO./ PRELIM. CCN NO. PAGEOF						
Pro	iect	or DCP/FCN/	ECP		С	alc No.	N-6030-001		CCN CO CCN NO	NVERS	ION:	
Sub	- jec	t Containme	nt Aerosol a	nd lodine Remov	al Rates			·	She	et _2	<u>25</u> of	281
R	v	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	Ε	DATE	g
	_	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003				· ·			REV DICAT
	Ter Der Vis Din Din Din Sch Sch Try Dro	mperature of c sity of air-s scosity of air scosity of drop acosity of drop ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of midt number f ashof number= y mean diameter op parameters (For	troplet li team mixt -steam mi et liquid plet liquid plet liquid elemental methyl I2 elemental methyl I2 for elemen for methyl 1.02826E r= 9.011 for eleme mean drop	<pre>quid= 95.300 ure= 1.69468E- kture= 1.79819 = .96178 id= 2.99466E-0 I2 in air-steam m I2 in droplet 1 in droplet 1iq tal iodine= 1 iodine= 1.21 +13 78E-02 ntal )</pre>	Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture= ixture= liquid= aid= 5.2 .5934 45	ee C se € 6.63 8.7366 4.82243 20786E-4	5939E-02 sq. cm 4E-02 sq. cm/se 3E-05 sq. cm/sec 05 sq. cm/sec	/sec c		· · ·		
	I	Diameter CM	Fall Time SEC	Reynolds M. Cl	<b>F.C</b> oeff G M/SEC	; T.V CM/:	J. drop no SEC	•		:		•
	36	9.0118E-02	7.745	269.0	9.972	31	5.8 1361.					
	I	Diameter CM	Sherwood	Time Sa	at. Frac.	M.T.( Ci	Coeff L Remova M/SEC /HR	al				
	36	9.0118E-02	1.350	.1840	.4503	3.5	210E-03 5.047		·			
	***	*********SPRAY	REMOVAL	RATES*********	•		·					
	Tot	al elemental	removal ca ne removal	onstant= 5.04 l constant= .(	33 pe 53567	r hour per ho	our					
	***	**REMOVAL DUE	TO WALL I	DEPOSITION****	per	nour						
	Ele	mental remova	1 rate due	e to wall deposi	ition =	5.0703	per hour					
	Org	anic removal	rate due f	to wall depositi	lon= .0	0000	per hour			r		
Organic removal rate due to wall deposition= .00000 per hour Mean drop diameter= 9.0.178E-02 Temperature of air-steam mixture= 95.300 Degree C Pressure of air-steam mixture= 2.0799 Atm. Temperature of droplet l:quid= 95.300 Degree C Density of air-steam mixture= 1.69468E-03 G/CC Viscosity of air-steam mixture= 1.79819E-04 Poise Density of droplet liquid= .96178 G/CC Viscosity of droplet liquid= .96178 G/CC Viscosity of droplet liquid= 2.98466E-03 Poise Diff. coeff. of elemental I2 in air-steam mixture= 6.65939E-02 sq. cm/sec Diff. coeff. of elemental I2 in air-steam mixture= 6.73664E-02 sq. cm/sec Diff. coeff. of methyl I2 in air-steam mixture= 8.73664E-05 sq. cm/sec Diff. coeff. of nethyl 12 in droplet liquid= 4.82243E-05 sq. cm/sec Diff. coeff. of methyl 12 in droplet liquid= 5.20786E-05 sq. cm/sec Schmidt number for elemental iodine= 1.5934 Schmidt number for methyl iodine= 1.2145 Grashof number= 1.94316E+13 Try mean diameter= 9.07308E-02												
	Dro	p parameters (For )	for eleman nean drop)	ntal								

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oiect	or DCP/FCN/	ECP		C	aic No.	N-6030-001		CCN CONVICEN NO.	ERSION:	•
bject	Containmer	nt Aerosol a	and Iodine Re	moval Rates	•			Sheet	226 <b>o</b>	f 28
	OBICINATOD	DATE		DATE		ORIGINIATOR	DATE	105		
	URIGINATOR L. Sahula	DATE	D T Darhai	041E	KEV	URIGINATUR	DATE			
	J. SCHUIZ	6/15/2005	D. I. Devilen	1101 012005						
I	Diameter CM	Fall Time SEC	Reynolds	M.T.Coeff ( CM/SEC	см/	V. drop no SEC	<u> </u>		<u>_</u>	
36	9.0701E-02	9.295	272.3	9.958	31	8.5 2024	•			
I	Diameter • CM	Sherwood	Time	Sat. Frac.	M.T. C	Coeff L Remov M/SEC /HI	7al R			
36	9.0701E-02	1.357	.2179	.5071	3.4	984E-03 4.06	)			
***	********SPRAY	REMOVAL	RATES******	****						
Tot	al elemental	removal c	onstant- 4	1.0605 pe	e: hour					
Par	ticulate iodi	ne remova	l constant=	,56136	per h	our				
Tot	al organic re	moval con	stant <del>=</del> .00	0000 per	hour					·
***	**REMOVAL DUE	TO WALL	DEPOSITION*	***		ı				
Ele	mental remova	1 rate du	e to wall de	position =	5.070	3 per hour				
010	ania romanal	rate due	to wall done	position (	1000	ner hour				
Pre Tem Den Vis Dif Dif Dif Sch Sch Gra Try	ssure of air- perature of d sity of air-s cosity of air sity of dropl cosity of drop f. coeff. of f. coeff. of f. coeff. of f. coeff. of midt number f midt number f shof number= mean diamete	steam mix roplet li team mix et liquid plet liquid plet liquid elemental methyl I2 elemental methyl I2 or elemental or elemental 1.94316E r- 9.090	ture= 2.07 mid= 95.3 rre= 1.6946 kture= 1.79 96178 id= 2.98466 I2 in air-stea I2 in dropl in droplet tal iodine= 1 +13 15E-02	<pre>/99 Atm. 100 Degre 10819E-03 G/CC 10819E-04 Pois G/CC 105E-03 Poise team mixture= .et liquid= 1iquid= 1.5934 2145</pre>	e C e 6.6 8.7366 4.8224 0786E-	5939E-02 sq. cr 4E-02 sq. cm/se 3E-05 sq. cm/se 05 sq. cm/sec	n/sec ec ec			
Dro	p parameters (For )	for eleman mean drop)	ntal I							
I	Diameter CM	Fall Time SEC	Reynolds	M.T.Coeff C CM/SEC	т. См/	V. drop no SEC				
36	9.0905E-02	10.45	273.4	9.953	31	9.1 2680.				1
I	Diameter CM	Sherwood	Time	Sat. Frac.	M.T. C	Coeff L Remov M/SEC /HI	val R			
36	9.0905E-02	1.360	.2442	.5466	3.4	905E-03 4.37	5			ļ
***	*******SPRAY	REMOVAL I	RATES******	****						
Tot	al elemental	removal co	onstant= 4	.3762 pe	r hour					{
Par	ticulate iodi	ne removal	L constant=	.56136	per h	our				.
Tot	al organic re	moval con	stant= .00	000 per	hour					

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		TS DEFA	ARTMENT TION SH	EET		ICCN NO./ · PRELIM. CCN	NO.		PAGE	0	 
Project	or DCP/FCN/E			C	alc No.	N-6030-001		CCN CO CCN NÓ	NVERS	ON:	
Subjec	t Containmen	t Aerosol a	nd Iodine Remov	al Rates	~			She	et	27 of	
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	I IR	E	DATE	g
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							N REV
							<u> </u>				N.
EL Or Me Te: De Di Di Di Di Di Sci Sci Sci Gr Tr Dr I 366 I I 366 I I Sci Sci Sci Sci Sci Sci Sci Sci Sci Sci	***REMOVAL DUE emental removal ganic removal : an drop diameter mperature of air-si scosity of air-si scosity of air-si scosity of drop1 ff. coeff. of f ff. coeff. of f ff. coeff. of f ff. coeff. of f ff. coeff. of f midt number f hmidt number f thindt number f hmidt number f cff. coeff. of f ganeter f CM 9.0934E-02 Diameter f CM 9.0934E-02 Diameter f CM 9.0934E-02 tal elemental f triculate iodir tal organic removal f and cop diameter scaling f air-st scosity of air-st scosity of air-st scosity of air-st scosity of air-st scosity of air-st ff. coeff. of f	TO WALL : I rate due rate due er= 9.09 ir-stean mix roplet lin team mixti- steam mixti- steam mixti- steam mixti- steam mixti- et liquid et liquid et liquid et liquid plet liquid plet liquid for elemental methyl 12 elemental methyl 12 elemental methyl 12 elemental methyl 12 elemental methyl 12 elemental methyl 12 elemental methyl 12 elemental for elemental sEC 9.491 Sherwood 1.360 REMOVAL I removal const removal const trate due for eremoval const const trate due for elemental mixti colat liquid- obet liquid- obet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid- plet liquid-	DEPOSITION***** e to wall deposit 045E-02 mixture= 95.3 ture= 2.0799 guid= 95.300 ure= 1.69468E- xture= 1.79819 = .96178 id= 2.98466E-0 I2 in air-steam m I2 in droplet lig tal iodine= 1 iodine= 1.21 *13 38E-02 ntal Reynolds M. C 273.5 Time S .2214 RATES************************************	ition = ion = .( Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture= liquid= uid= 5.2 .5934 45 T.Coeff ( M/SEC 9.953 at. Frac. .5130 * 72 Fe 57345 per ition = ion = .( 00 Dec Atm. Degre 03 G/CC 3 Poise m mixture=	5.070 00000 egree C egree C	<ul> <li>per hour</li> <li>per hour</li> <li>per hour</li> <li>per hour</li> <li>per sq. cm/set</li> </ul>	a/sec				

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			RTMENT	EET		ICCN NO./ PRELIM. CCN N	10.		PAGE	≣o	۶
Projec	t or DCP/FCN/E	ECP		c	alc No.	N-6030-001		CCN CO CCN NO	NVERS	ION:	•
Subjec	t Containmen	t Aerosol a	nd Iodine Remov	al Rates	•		I	She	et _2	28 of	281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DATE	۶ ۶
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							] ₽ĭ
								1		Ĺ	<u> </u>
Di Di Sc Gr Tr Dr	ff. coeff. of ff. coeff. of hmidt number for hmidt number for ashof number= y mean diameter y mean diameter (For y Diameter ) CM	elemental methyl I2 or elemen or methyl 2.071485 r= 9.103 for eleme: nean drop Fall Time SEC	I2 in droplet in droplet liq tal iodine= 1 iodine= 1.21 +13 DOE-02 htal Reynolds M.	liquid- uid- 5.2 .5934 45 T.Coeff G M/SEC	4.62243 0786E-0	3E-05 sq. cm/sec 05 sq. cm/sec 7. drop no SEC	с				
36	9.1030E-02	10.67	274.1	9.950	319	).5 3995.					
I	Diameter S CM	Sherwood	Time S	at. Frac.	M.T.( Ch	Coeff L Remova M/SEC /HR	<b>al</b>				
36	9.1030E-02	1.361	.2483	.5528	3.48	57E-03 4.425					
**	**********SPRAY	REMOVAL 1	RATES*********	*							1
To	tal elemental :	cemoval co	onstant= 4.42	52 pe	r hour						
Pa	rticulate iodin	ne removal	constant= .	57345	per ho	our				•	
То	tal organic rem	noval con:	stant= .00000	per	hour						}
**	***REMOVAL DUE	TO WALL I	DEPOSITION*****							•	•
El	emental removal	l rate c.ue	e to wall depos	ition =	5.0703	per hour					<b>]</b> .
Or	ganic removal m	ate due i	o wall deposit:	ion0	0000	per hour					
Me Te Pr De Vi Di Di Di Sc Gr Tr	an drop diamete mperature of air- essure of air- scosity of air- scosity of air- scosity of drops scosity of drops ff. coeff. of a ff. coeff. of a ff. coeff. of a hmidt number for hmidt number for ashof number- y mean diameter	er= 9.103 rr-stean r bteam mixt coplet lic steam mixt steam tal steam steam steam steam steam steam steam steam steam steam steam steam steam 00E-02         aixture       95.30         aure       2.0799         puide       95.300         tre=       1.69468E-0         cture=       1.798199         -       .96178         d=       2.98466E-0         I2 in air-steam mill         I2 in droplet         in droplet         11 dodine=         12 in droplet         13         55E-02	00 Des Atm. Degreg 03 G/CC E-04 Pois G/CC 3 Poise m mixtur? lixture- liquid= uid= 5.2 .5934 45	gree C e C e 6.65 8.73664 4.82243 0786E-0	939E-02 sq. cm. E-02 sq. cm/sec E-05 sq. cm/sec 5 sq. cm/sec	/sec c					
Dr	op parameters 1 (For m	for elemen mean drop)	ital	D (20044 (							
	CM	SEC	Cl	M/SEC	CM/S	EC	•				
36	9.1062E-02	10.37	274.3	9.950	319	.6 4649.					1
I	Diameter S CM	herwood	Time Sa	at. Frac.	M.T.C CM	oeff L Remova /SEC /HR	1				
SCE 26-4	26 REV.2 [REF	RENCE: S	0123-XXIV-7.15]		<u></u>		····-		N-60	30-001 R	l ev 0.dox

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**E&TS DEPARTMENT** 

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containment Aerosol and Lodine Removal Rates Calc No. N-6030-001 Calc NO. N-6030-001 Calc NO. CON Conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conversion of the conv	coject or DCP/FCN/ECPCalc No. N-6030-001CCN NO. CCN biglet Containment Acrosol and Jodine Removal RatesSteel 229 of Steel 229 of <u>a J. Schulz 0157003 D. T. Decheime 0152003</u> DATE <u>a J. Schulz 0157003 D. T. Decheime 0152003</u> <u>b J. Schulz 0157003 D. T. Decheime 0152003</u> <u>a J. Schulz 0157003 D. T. Decheime 0152003</u> <u>b J. Schulz 0157003 D. T. Decheime 0152003</u> <u>a J. Schulz 0157003 D. T. Decheime 0152003</u> <u>b J. Schulz 0157003 D. T. Decheime 0152003</u> <u>a J. Schulz 0157003 D. T. Decheime 0152003</u> <u>b J. Schulz 0157003 D. T. Decheime 0152003</u> <u>a J. Schulz 0157003 D. T. Decheime 0152003</u> <u>b J. Schulz 0157003 D. T. Decheime 0152003</u> <u>a J. Schulz 0157003 D. T. Decheime 0152003</u> <u>a J. Schulz 0157003 D. T. Decheime 0152003</u> <u>a J. Schulz 0157003 D. T. Decheime 0152003</u> <u>b J. Schulz 0157003 D. T. Decheime 0152003</u> <u>a J. Schulz 0157003 D. T. Decheime 0152003</u> <u>b J. Schulz 0157003 D. Decheime 015700</u> <u>a J. Schulz 0157003 D. Decheime 015700</u> <u>b J. Schulz 0157003 D. Decheime 015700</u> <u>b J. Schulz 0157003 D. Decheime 0.0000 per hour</u> <u>b J. Schulz 0157003 D. J. Schulz 05300 Decheime 0.0000 per hour</u> <u>b J. Schulz 0157003 J. J. Schulz 05300 Decheime 0.0000 per hour</u> <u>b J. Schulz 0157003 J. Schulz 05300 Decheime 0.0000 per hour</u> <u>b J. Schulz 10580 J. Schulz 0.0000 per hour</u> <u>b J. J. Schulz 1016 95330 Decheime 0.0000 per hour</u> <u>b J. Schulz 1016000 J. J. J. J. J. J. J. J. J. J. J. J. J. </u>	(	CAL	CULA	TION S	HEET		ICCN N PRELIN	10.1 1. CCN N	10.		PAC	SE	0F	
bject         Containment Acrosol and Iodine Removal Rates         Sheet         229         of         281           20         ORIGNATOR         DATE         IRE         DATE         REV         ORIGNATOR         DATE         IRE         DATE         DATE         IRE <th>bject         Containment Acrosol and Jodine Removal Rates         Sheet         229         of           2V         ORIGINATOR         DATE         IRE         DATE         REV         ORIGINATOR         DATE         IRE         DATE         <tdegrad< td="">         IRE         DATE         IRE</tdegrad<></th> <th>or D</th> <th>DCP/FCN</th> <th>/ECP</th> <th><b>.</b></th> <th>C</th> <th>alc No.</th> <th><u>N-60</u></th> <th>30-001</th> <th></th> <th>CCN C CCN N</th> <th>ONVER O. CC</th> <th>ISION: N</th> <th>: :</th> <th>·</th>	bject         Containment Acrosol and Jodine Removal Rates         Sheet         229         of           2V         ORIGINATOR         DATE         IRE         DATE         REV         ORIGINATOR         DATE         IRE         DATE <tdegrad< td="">         IRE         DATE         IRE</tdegrad<>	or D	DCP/FCN	/ECP	<b>.</b>	C	alc No.	<u>N-60</u>	30-001		CCN C CCN N	ONVER O. CC	ISION: N	: :	·
DV         ORIGINATOR         DATE         IRE         DATE         REV         ORIGINATOR         DATE         IRE         DATE           0         J.Schulz         \$152003         D.T.Denheimer         \$155003         D.T.Denheimer         \$152003         D.T.Denheimer         \$155003         D.T.Denheimer         \$15000         Denheimer	DY         ORIGINATOR         DATE         IRE         DATE         REV         ORIGINATOR         DATE         IRE         DATE           0         J.Schulz         \$152003         D. T. Dexheimer         \$152003         D.         Dexheimer         \$152003         D.         Dexheimer         \$152003         D.         Dexheimer         \$152003         D.         Dexheimer         \$152003         D.         Dexheimer         \$152003         D.         Dexheimer         \$152003         D.         Dexheimer         \$152003         D.         Dexheimer         \$152003         D.         Dexheimer         \$152003         D.         Dexheimer         \$152003         D.         Dexheimer         \$172         Dexheimer         Dexheimer         \$172         Dexheimer         Dexheimer         \$172         Dexheimer         Dexheimer         \$172         Dexheimer         Dexheimer         Dexheimer         \$172         Dexheimer         Dexheimer         \$172         Dexheimer	t _	Containme	ent Aerosol	and Iodine Rer	noval Rates				<u> </u>	Sh	eet _	229	of	281
0         J. Schulz         \$152003         D. T. Dezheimer         \$152003         Dizener         Dezheimer         \$152003         Dizener         Dizener         \$152003         Di	0         J.Schulz         \$152003         D. T. Dexheimer         \$152003           36         9.10622-02         1.361         .2412         .5426         3.4845E-03         2.172           Constant: 2.1722           Particulate iodine removal constant: 2.1722           Particulate iodine removal constant: 3.1145           Particulate iodine removal constant: 3.1145           Particulate iodine removal constant: 3.1145           Particulate iodine removal constant: 3.0000           Per hour           Particulate iodine removal constant: 3.00000           Per hour           Particulate iodine removal constant: 3.0000           Per hour           Persence of air-steam mixture: 9.50300           Persence of air-steam mixture: 9.50300           Particulate iodine mixture	OR	GINATOR	DATE	IRE	DATE	REV	. ORIGIN	IATOR	DATE		RE	D/	ATE	Ĕ
36       9.1062E-02       1.361       .2412       .5426       3.4845E-03       2.172         ************************************	36 9.1062E-02 1.361 .2412 .5426 3.4845E-03 2.172 	J.	J. Schulz	8/15/2003	D. T. Dexhein	ner 8/15/2003					:				<b>REV</b>
36 9.1052E-02 1.361 .2412 .5426 3.4845E-03 2.172 ************************************	36 9.1062E-02 1.361 .2412 .5426 3.4845E-03 2.172					•									
<pre>Riemental removal rate due to wall deposition = 5.0703 per hour Organic removal rate due to wall deposition = .0000 per hour Mean drop diameter 9.1625E-02 Temperature of air-steam mixture 2.0799 Atm. Temperature of droplet liquid 2.0793 Atm. Temperature of droplet liquid 2.0793 Atm. Temperature of droplet liquid 2.0793 Atm. Temperature of droplet liquid 2.0793 C/CC Viscosity of air-steam mixture 1.79918E-04 Poise Density of droplet liquid 2.08466E-03 Poise Diff. coeff. of elemental 12 in air-steam mixture 8.73664E-02 sq. cm/sec Diff. coeff. of methyli Zi in air-steam mixture 8.73664E-02 sq. cm/sec Diff. coeff. of methyli Zi in air-steam mixture 8.73664E-02 sq. cm/sec Diff. coeff. of methyli Zi in droplet liquid 4.02243E-05 sq. cm/sec Diff. coeff. of methyli Zi in droplet liquid 5.20786E-05 sq. cm/sec Schmidt number for nemental 12 in droplet liquid 5.20786E-05 sq. cm/sec Schmidt number for elemental iodine 1.2243 Grashof number = 2.65472H4J3 Try mean drop) I Dismeter Fall Tims Reynolds M.T.Coeff G T.V. drop no. CM SEC CM/SEC CM/SEC 36 9.1095E-02 10.71 274.4 9.949 319.7 5302. I Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal CM SEC //HR 36 9.1055E-02 1.362 .2489 .5537 3.4832E-03 2.216 ************************************</pre>	<pre>Elemental removal rate due to wall deposition = 5.0703 per hour Organic removal rate due to wall deposition = .0000 per hour Mean drop diameter = 9.11625E-02 Temperature of air-steam mixture = 95.300 Degree C Pressure of air-steam mixture = 2.0799 Atm. Temperature of droplet liquid = 55.300 Degree C Density of air-steam mixture = 1.79819E-04 Poise Density of droplet liquid = .9846E-03 Poise Diff. coeff. of elemental 12 in air-steam mixture = 0.73664E-02 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid = .327864E-05 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid = .327864E-05 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid = .327864E-05 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid = .327864E-05 sq. cm/sec Schmidt number for elemental iodime = 1.2534 Schmidt number for elemental IFY mean diameter = 9.10051E-02 Drop parameters for elemental [For mean drop] I Diameter Fall Time Reynolds M.T.Coeff G T.V. drop no. CM SEC CM/SEC CM/SEC 36 9.1095E-02 10.71 274.4 9.949 319.7 5302. I Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal CH 36 9.1095E-02 1.362 .2489 .5537 3.4832E-03 2.216 ************************************</pre>	9.1 tal e rticu tal o	*****SPRA elemental ulate iod organic r EMOVAL DU	Y REMOVAL removal c ine remova emoval con E TO WALL	RATES******* constant= 2 al constant= astant= .00 DEPOSITION**	.5426 **** .1722 pe .31145 000 per	r hour per h hour	our				· ·			
Organic removal rate due to wall deposition       .0000 per hour         Mean drop diameter       9.11625F-02         Temperature of dariesteam mixtures       9.300 Degree C         Pressure of directed liquide       95.300 Degree C         Discoit of air-steam mixtures       1.69468-03 G/CC         Viscosity of directed liquide       95.300 Degree C         Discoit of air-steam mixtures       1.69468-03 G/CC         Viscosity of directed liquide       9.9466E-03 Foice         Diff. coeff. of elemental 12 in sir-steam mixtures       6.59395E-02 sq. cm/sec         Diff. coeff. of elemental 12 in droplet liquide       4.822438-05 sq. cm/sec         Diff. coeff. of elemental 12 in droplet liquide       4.822438-05 sq. cm/sec         Schmidt number for elemental 12 in droplet liquide       5.20766E-02 sq. cm/sec         Diff. coeff. of elemental 12 in droplet liquide       5.20766E-02 sq. cm/sec         Schmidt number for elemental 22 colles       5.517         Schmidt number for elemental       1.5946         (for mean drop)       I       Diameter Fall Time Reynolds M.T.Coeff G T.V. drop no.         CM       Scc       CM/Scc       CM/Scc         36 9.1095E-02 10.71 274.4 9.949 319.7 5302.       I       Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal CM/Scc /HR         36 9.1095E-02 1.362 .2489 .5537 3.4832E-03 2.216	Organic removal rate due to wall deposition .00000 per hour Mean drop diameter 9.1625E-02 Temperature of air-steam mixtures 95.300 Degree C Pressure of air-steam mixtures 1.05966E-03 G/CC Viscosity of air-steam mixtures 1.7591E-04 Poise Density of droplet liquic .96178 G/CC Viscosity of droplet liquic .96178 G/CC Viscosity of droplet liquid .98.300 Degree C Diff. coeff. of elemental 12 in air-steam mixtures 6.65939E-02 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid .82243E-05 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid .82243E-05 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid .82043E-05 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid .82043E-05 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid .82043E-05 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid .82043E-05 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid .82043E-05 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid .82043E-05 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid .82043E-05 sq. cm/sec Diff. coeff. of methyl II in air-steam intures 8.7504E-05 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid .82043E-05 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid .82043E-05 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid .82043E-05 sq. cm/sec Schmidt number for methyl. II in air-steam drops I Diameter Fall Time Reynolds M.T.Coeff G T.V. drop no. CM SEC CM/SEC CM/SEC 36 9.1095E-02 10.71 274.4 9.949 319.7 5302. I Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal CM 36 9.1095E-02 1.362 .2489 .5537 3.4832E-03 2.216 ************************************	ement	tal renov	al rate du	e to wall de	position =	5.070	3 ne	r hour				•		
<pre>Mean drop diameter= 9.1625E-02 Temperature of air=steam mixture= 2.0399 Atm. Temperature of dir=steam mixture= 2.0399 Atm. Temperature of direct liquid= 95.300 Degree C Pressure of dir=steam mixture= 1.69468E-03 G/CC Viscosity of air=steam mixture= 1.78918E-04 Poise Density of droplet liquid= .98168E-03 Poise Diff. coeff. of elemental 12 in air=steam mixture= 6.65339E-02 sq. cm/sec Diff. coeff. of elemental 12 in air=steam mixture= 6.65339E-02 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid= 5.20786E-05 sq. cm/sec Diff. coeff. of elemental iodine= 1.5934 Schmidt number for methy. iodine= 1.2145 Grashof number= 2.64721+13 Try mean diameter= 9.10051E-02 Drop parameters for elemental (For mean drop) I Diameter Fall Time Reynolds M.T.Coeff G T.V. drop no. CM SEC CM/SEC CM/SEC 36 9.1095E-02 10.71 274.4 9.949 319.7 5302. I Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal CM SEC /HR 36 9.1095E-02 1.362 .2489 .5537 3.4832E-03 2.216 ************************************</pre>	<pre>Mean drop diameter 9.10625E-02 Temperature of air-steam mixtures 95.300 Degree C Pressure of dir-steam mixtures 1.69468E-03 G/CC Viscosity of air-steam mixtures 1.79818E-04 Poise Density of air-steam mixtures 1.98468E-03 G/CC Viscosity of droplet liquid- 9.8360 F-03 Foise Diff. coeff. of elemental 12 in air-steam mixture 6.65939E-02 sq. cm/sec Diff. coeff. of elemental 12 in air-steam mixture 8.73664E-02 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid- 4.82243E-05 sq. cm/sec Diff. coeff. of methyl 12 in droplet liquid- 5.20786E-05 sq. cm/sec Schmidt number for methyl 12 in droplet liquid- 5.20786E-05 sq. cm/sec Schmidt number for methyl 12 in droplet liquid- 5.20786E-05 sq. cm/sec Schmidt number for methyl.1001me 1.2145 Grashof number = 5.001951E-02 Drop parameters for elemental (For meen drop) I Diameter Fall Tims Reynolds M.T.Coeff G T.V. drop no. CM SEC CM/SEC CM/SEC 36 9.1055E-02 10.71 274.4 9.949 319.7 5302. I Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal CM CM/SEC /HR 36 9.1055E-02 1.362 .2489 .5537 3.4832E-03 2.216 ************************************</pre>	Tapic	- removal	rate due	to wall deno	sition= .0	0000	Der h	our			•			
I Diameter Fall Time Reynolds M.T.Coeff G T.V. drop no. CM SEC CM/SEC CM/SEC CM/SEC 36 9.1095E-02 10.71 274.4 9.949 319.7 5302. I Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal CM CM/SEC /HR 36 9.1095E-02 1.362 .2489 .5537 3.4832E-03 2.216 ************************************	I Diameter Fall Time Reynolds M.T.Coeff G T.V. drop no. CM SEC CM/SEC CM/SEC CM/SEC 36 9.1095E-02 10.71 274.4 9.949 319.7 5302. I Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal CM CM CM/SEC /HR 36 9.1095E-02 1.362 .2489 .5537 3.4832E-03 2.216 ************************************	an dr pera ssur npera hsity scosi ff. c ff.	rop diame ature of a re of air- ature of a y of air- ity of ai- y of drop ity of drop ity of drop coeff. of coeff. of coeff. of coeff. of coeff. of t number = an diameters	ter= 9.10 air-steam mix droplet 11 steam mix tr-steam mi let liquic oplet liqu elemental methyl 12 elemental methyl 12 for elemen for methyl er= 9.109 for elemen	625E-02 mixture= 9 ture= 2.07 quid= 95.3 ure= 1.6946 xture= 1.79 = .96178 fid= 2.98466 12 in air-stea 12 in droplet in droplet tal iodine= 1 +13 51E-02	5.300 De 99 Atm. 00 Degre 8E-03 G/CC 819E-04 Poise G/CC E-03 Poise team mixture= t liquid= liquid= 5.2 1.5934 .2145	gree C e C e 6.6 8.7366 4.8224 0786E-	5939E-02 4E-02 sq 3E-05 sq 05 sq. c	Sq. cm, . cm/sec . cm/sec	/sec c c					
36       9.1095E-02       10.71       274.4       9.949       319.7       5302.         I       Diameter       Sherwood       Time       Sat. Frac.       M.T.Coeff L       Removal         CM       CM       CM/SEC       /HR         36       9.1095E-02       1.362       .2489       .5537       3.4832E-03       2.216         ************************************	36       9.1095E-02       10.71       274.4       9.949       319.7       5302.         I       Diameter       Sherwood       Time       Sat. Frac.       M.T.Coeff L       Removal         CM       CM       CM/SEC       /HR         36       9.1095E-02       1.362       .2489       .5537       3.4832E-03       2.216         ******SPRAY       REMOVAL RATES********       Total elemental removal constant=       2.2163       per hour         Particulate iodine removal constant=       .31145       per hour         Total organic removal constant=       .00000       per hour         ******REMOVAL DUE TO WALL DEPOSITION******       Elemental removal rate cue to wall deposition =       5.0703       per hour	Di	iameter	Fall Time	Reynolds	M.T.Coeff G	T.	V.	drop no	•		•			
I Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal CM SEC /HR 36 9.1095E-02 1.362 .2489 .5537 3.4832E-03 2.216 *********SPRAY REMOVAL RATES************************************	I Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal CM CM/SEC /HR 36 9.1095E-02 1.362 .2489 .5537 3.4832E-03 2.216 *********SPRAY REMOVAL RATES********* Total elemental removal constant= 2.2163 per hour Particulate iodine removal constant= .31145 per hour Total organic removal constant= .00000 per hour *****REMOVAL DUE TO WALL DEPOSITION***** Elemental removal rate due to wall deposition = 5.0703 per hour	9.1	1095E-02	10.71	274-4	9.949	31	 9.7	5302-			•			
36 9.1095E-02 1.362 .2489 .5537 3.4832E-03 2.216 ************************************	36 9.1095E-02 1.362 .2489 .5537 3.4832E-03 2.216 ************************************	Di	lameter CM	Sherwood	Time	Sat. Frac.	M.T.( Ci	Coeff L M/SEC	Remov. /HR	al					
******SPRAY REMOVAL RATES******** Total elemental removal constant= 2.2163 per hour Particulate iodine removal constant= .31145 per hour Total organic removal constant= .00000 per hour *****REMOVAL DUE TO WALL DEPOSITION***** Elemental removal rate due to wall deposition = 5.0703 per hour	**************************************	9.1	1095E-02	1.362	.2489	.5537	3,4	832E-03	2.216						•
Total elemental removal constant= 2.2163 per hour Particulate iodine removal constant= .31145 per hour Total organic removal constant= .00000 per hour *****REMOVAL DUE TO WALL DEPOSITION***** Elemental removal rate due to wall deposition = 5.0703 per hour	Total elemental removal constant- 2.2163 per hour Particulate iodine removal constant31145 per hour Total organic removal constant00000 per hour *****REMOVAL DUE TO WALL DEPOSITION***** Elemental removal rate due to wall deposition = 5.0703 per hour	****	****SPRA	Y REMOVAL	RATES******	****						:			
Particulate iodine removal constant= .31145 per hour Total organic removal constant= .00000 per hour *****REMOVAL DUE TO WALL DEPOSITION***** Elemental removal rate due to wall deposition = 5.0703 per hour	Particulate iodine removal constant= .31145 per hour Total organic removal constant= .00000 per hour *****REMOVAL DUE TO WALL DEPOSITION***** Elemental removal rate due to wall deposition = 5.0703 per hour	tal e	elemental	removal c	constant- 2	.2163 pe	r hour					< 1.			
Total organic removal constant= .00000 per hour *****REMOVAL DUE TO WALL DEPOSITION***** Elemental removal rate due to wall deposition = 5.0703 per hour	Total organic removal constant= .00000 per hour *****REMOVAL DUE TO WALL DEPOSITION***** Elemental removal rate due to wall deposition = 5.0703 per hour	rticu	ulate iod:	ine remova	1 constant=	.31145	per h	our			٠				
*****REMOVAL DUE TO WALL DEPOSITION***** Elemental removal rate due to wall deposition = 5.0703 per hour	*****REMOVAL DUE TO WALL DEPOSITION***** Elemental removal rate due to wall deposition = 5.0703 per hour	tal o	organic r	emoval con	stant= .00	000 per	hour								
Elemental removal rate due to wall deposition = 5.0703 per hour	Elemental removal rate due to wall deposition = 5.0703 per hour	***RE	emoval du	E TO WALL	DEPOSITION**	***									
		ement	tal remova	al rate ciu	e to wall de	position =	5.070	3 ре	r hour						

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Projec	t or DCP/FCN/E	CP	•	Ċ	aic No.	N-6030-001		CCN CO CCN NO	NVERS	ION:	
Subje	ct Containmen	t Aerosol a	and Iodine Remov	al Rates	•		`	She	et _2	<u>30</u> of	
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	F	DATE	
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							N S S S S S S S S S S S S S S S S S S S
								1			L D D D
Me Te De Vi Di Di Di Sc Sc Sc Sc	an drop diameter mperature of air- mperature of air- mperature of dir- scosity of air- scosity of air- scosity of drople scosity of drople ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a hmidt number for hmidt number for ashof number= y mean diameter op parameters for (For m biameter	er= 9.10 ir-steam mix soplet li- cam mixt steam mixt steam mixt steam mixt steam mixt let liquid blet liquid blet liquid blet liquid blet hiquid blet	951E-02 mixture- 95.30 guid= 95.300 mre= 1.69468E-0 sture= 1.79819 • .96178 id= 2.98466E-0 I2 in air-steam m I2 in droplet 1 in droplet 1 in droplet 1 iodine- 1.21 +13 70E-02 mtal Beynolds	00 De Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise mmixture= liquid= uid= 5.2 .5934 45	gree C e C = 6.65 8.73664 4.82243 0786E-0	5939E-02 sg. cm IE-02 sg. cm/se IE-05 sg. cm/sec	/sec c				
	Diameter F CM	SEC	Reynolds M.: Cl	I.COEII G M/SEC	т.v См/9	SEC	•			-	
36	9.1107E-02	10.46	274.5	9.949	319	5956.					
I	Diameter S CM	herwood	Time Sa	at. Frac.	м.т.С См	coeff L Remova N/SEC /HR	al			•	
36	9.1107E-02	1.362	.2431	.5456	3.48	28E-03 2.184					
**	*********SPRAY	REMOVAL I	RATES**********	ł							
To	tal elemental r	emoval co	onstant- 2.183	38 pe	r hour						
Pa	rticulate iodin	e removal	constant= .3	31420	per ho	rur					
To	tal organic rem	oval cors	stant= .00000	per	nour						
**	***REMOVAL DUE	TO WALL I	DEPOSITION*****								
El	emental removal	rate due	to wall deposi	tion =	5.0703	per hour					
Or Me Te Pr Te De Vi De Vi Di Di Sc Sc Tr	ganic removal r mperature of ai essure of air-s mperature of dr nsity of air-st scosity of air- nsity of drople scosity of drople ff. coeff. of a ff. coeff. of a ff. coeff. of m ff. coeff. of m midt number fo hundt number fo ashof number- y mean diameter	ate due t r= 9.110 r-steam mixt oplet liq eam mixtu steam mixtu steam mixtu t liquid= let liquid= let liquid= lemental. ethyl I2 r elemental. r elemental. r elemental. = 9.1128	<pre>co wall depositi 70E-02 dixture= 95.300 rre= 1.69466E-03 rre= 1.79819E 96178 G d= 2.98466E-03 I2 in air-steam in air-steam mi 12 in droplet liqu al iodine= 1.214 13 7E-02</pre>	on= .00 Atm. Degree 3 G/CC -04 Poise c/CC Poise a mixture= 1 iquid= 4 id= 5.20 5934 5	0000 gree C e C e 5.655 8.73664 4.82243 0786E-0	per hour 939E-02 sq. cm/ E-02 sq. cm/sec E-05 sq. cm/sec 5 sq. cm/sec	'sec 2				

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rev	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DATE	
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							Re L
	op parameters	for eleme	ntal	<u>.</u>	L	·.	<u> </u>	<u> </u>			
I	Diameter 1 CM	Fall Time SEC	Reynolds M. C	T.Coeff ( M/SEC	5 T.V CM/5	V. drop no SEC	•				
36	9.1129E-02	10.80	274.6	9.948	319	9.8 6608.					
I	Diameter : CM	Sherwood	Time S	at. Frac.	M.T.C	Coeff L Remov M/SEC /HR	al				
36	9.1129E-02	1.362	.2509	.5566	3.40	819E-03 2:228	1				
**1	**************************************	REMOVAL	RATES*********	*							
To	tal elemental :	removal c	onstant= 2.22	80 · pe	er hour						
Pa	rticulate iodin	ne removal	l constant= .	31420	per ho	our ,					
Toi	tal organic rea	moval con:	stant= .00000	per	hour						
***	***REMOVAL DUE	TO WALL	DEPOSITION*****								
Ele	emental removal	l rate du	e to wall depos	ition =	5.0703	B per hour					
Org	ganic removal :	rate due	to wall deposit	ion= .0	0000	per hour				·	
Mea	بطبيب فلاستم بداهيه	Arm 0 11'	2075-02								
	an drop diamete	CI 2.11	2076-02								
	an drop diamete	el- 9,11,	2076-02								
	an diop diamete	CI 9,11,	2078-02								
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REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E.	DATE	щ
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							L S S
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			Standard Comp NE305 REMOVE for the IBM	uter Proç Version PC/XT/AT	yram 4.0					·	
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Bec (c) Ori Pro Sub Pre Tem Den Vis Den Vis Dif Dif Dif Sch	aperature of air-st provide air-st provide air-st aperature of air-st provide air-st aperature of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of air-st acosity of acosity of air-st acosity of acosity of acosity acosity of acosity of acosity acosity of acosity of acosity acosity of acosity of acosity acosity of acosity acosity acosity of acosity acosity acosity of acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity acosity	Compute: Schulz Max Teny .r-steam fi team mixto steam mixto steam mixto the liquid let liquid let liquid let hyl I2 lemental ethyl I2 r element	Program Date 14 Date 156799E-1 Date 1.81696 Date 1.816966 Date 1.816966 Date 1.816966 Date 1.81696666666666666666666666666666666666	REMOVE , Jun 2003 Jun 2003 Dun 2003 Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture ixture liquid= uid= 4.6 .6137	- Jun 2 NE305 V Calc N Checke Job Nc Sheet Job Nc Sheet Che C e C e C e 7.18 9.40902 4.30557 4969E-0	078E-02 sq. cm/sec	/sec				

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Projec	t or DCP/FCN	FCP			alc No.	N-60	30-001		CCN CO CCN NO	NVERSI	ON:	•
Subje	ct <u>Containme</u>	nt Aerosol a	nd Iodine Remov	al Rates	•			······································	She	et _2	3 <u>3</u> of	281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE	IRI	Ξ	DATE	ď
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003								REV
												QNI
S G T	chmidt number rashof number= ry mean diamet	for methyl 6.83231E er= 8.969	iodine= 1.23 +12 94E-02	16			•					
D:	cop parameters (For	for eleme mean drop	ntal }									
	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	T.\ CM/S	7. C BEC	lrop nö	•				
3	6 8.9699E-02	6.635	251.9	10.54	32!	5.4	224.2					
:	I Diameter CM	Sherwood	Time S	at. Frac.	м.т.( С	Coeff L 4/SEC	Remova /HR	al				
3	6 8.9699E-02	2.034	.1420	.4714	э.1	583E-03	4.135				-	
<b>*</b>	***************\$PRA`	Y REMOVAL	RATES********	•			•					
Т	otal elemental	removal c	onstant= 4.13	59 pe	r hour							
P	articulate iod	ine remova	l constant= .	59268	per ho	our						
Т	otal organic r	emoval con	stant= .00000	per	hour							
÷	****REMOVAL DU	E TO WALL	DEPOSITION*****								•	
E	lemental remova	al rate du	e to wall depos	ition =	5.1040	) per	hour					
0:	rganic removal	rate due	to wall deposit	ion0	0000	per ho	our				•	
M. P. D. D. D. D. D. D. D. S. S. G. T.	ean drop diame emperature of a ressure of air- separature of de- ensity of air- lacosity of air- lacosity of drop lacosity of drop lif. coeff. of lff. coeff. of lff. coeff. of lff. coeff. of lff. coeff. of chmidt number a chmidt number a chmidt number- cy mean diameter	ter= 8.95 air-steam mix troplet lin steam mixt r-steam mix collet liquid elemental methyl 12 elemental methyl 12 for elemental for elemental 6.83231E er= 9.064	994E-02 nixture= 87.20 ture= 1.8307 quid= 87.200 ure= 1.56799E kture= 1.81696 = .96720 id= 3.26947E-00 I2 in air-steam in air-steam m I2 in droplet 1 in droplet 1iq tal iodine= 1.23 +12 30E-02	00 De Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise a mixture= ixture= liquid= uid= 4.6 .6137 16	gree C e C e 9.40902 4.30557 4969E-(	0078E-02 2E-02 sq. 7E-05 sq. cm	sq.cm, cm/se cm/sec	/sec C				
Dı	rop parameters (For	for elemen mean drcp	ntal									
	I Diameter CM	Fall Time SEC	Reynolds M. Ci	r.Coeff G M/SEC	T.V CM/S	r. c iec	irop no.	•				
3	5 9.0648E-02	6.903	256.9	10.52	328	.4	439.9					
1	I Diameter CM	Sherwood	Time S.	at. Frac.	M.T.C CM	Coeff L I/SEC	Remova /HR	al				
31	5 9.0648E-02	2.051	.1447	.4793	3.12	52E-03	4.204					

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			TS DEP	RTMENT	EET		ICCN N PRELIM	IOJ M. CCN N	10.	<b>15.</b>	PAG	 F	OF	
Proj	ect	or DCP/FCN/	ECP		C	alc No.	N-60	30-001		CCN CO CCN NÓ	NVERS	SION: N		
Subj	jec	t <u>Containmen</u>	t Aerosol a	nd Iodine Remov	al Rates					She	iet _2	234	of	281
REV	71	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE	IR	E	DA	ATE	œ
0		J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003	<u> </u>						T		REV
														ĨN
	*** Toi Pai	**********SPRAY tal elemental rticulate iodi	REMOVAL removal c ne remova	RATES************************************	* 49 pe 59268	er hour per h	our							
	T01	tal organic re	moval cor TO WALL	stant= .00000 DEPOSITION*****	per	hour			•			•		
ł	Ele	emental removal	l rate du	e to wall depos	ition =	5.104	) pe	r hour			•			
	Org	janic removal :	rate due	to wall deposit	ion(	0000	per h	our ·						•
	Ter Pro Ter Der Vis Dir Dir Sch Sch Gra Try	aperature of a essure of air- aperature of d sity of air- scosity of air scosity of dropl- scosity of dropl- ff. coeff. of f ff. coeff. of f ff. coeff. of f ff. coeff. of f midt number f ashof number= y mean diamete:	ir-steam mix: roplet li. team mix: -steam mix: et liquid plet liquid elementa: methyl I? or elementa? or elementa? 8.429802 r≈ 9.097	<pre>mixture= 87.2 ture= 1.8307 quid= 87.200 ure= 1.56799E- xture= 1.81696 = .96720 id= 3.26947E-0 I2 in air-steam m I2 in droplet in droplet liq tal iodine= 1 iodine= 1.23 +12</pre>	00 De Atm. Degre 03 G/CC E-04 Poise G/CC 3 Poise m mixture= liquid= uid= 4.6 .6137 16	egree C ee C ee 7.11 9.4090 4.3055 54969E-4	3078E-02 2E-02 sq 7E-05 sq D5 sq. c	sq.cm .cm/se .cm/se m/sec	/sec c c	·				
ĺ	JIC T	P parameters (For )	mean drop	ntal ) Romolda M	m coadd f	·: •• •	,	drop po						
	*	CM	SEC	Covincities M.	M/SEC	СМ/	SEC		•					
	36	9.0972E-02	7.083	258.6	10.51	32:	9.4	652.8			•			1
	I	Diameter : .CM	Sherwood	Time S	at. Frac.	. M.T.( Cl	Coeff L 4/SEC	Remov /HR	al					
	36	9.0972E-02	2.056	.1474	.4859	3.1	141E-03	4.262						i i
	**1	**************************************	REMOVAL	RATES********	*									
	Tot	al elemental :	removal c	onstant= 4.26	24 pe	er hour								
	Par	rticulate iodi	ne remova	l constant .	63567	per h	our							
	Tot	tal organic re	moval con	stant= .00000	per	hour								
	**1	***REMOVAL DUE	TO WALL	DEPOSITION*****										
	Ele	emental removal	l rate du	e to wall depos	ition =	5.104	) pe	r hour						
ł	Orç	ganic removal :	rate due	to wall deposit	ion= .0	00000	per h	our						
	Mea Ten Pre	n drop diamete mperature of a ssure of air-	ar= 9.09 ir-stean : steam mix	719E-02 mixture= 87.2 ture= 1.8307	00 De Atm.	agree C								

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SCE 26-426 REV.2 [REFERENCE: SO123-XXIV-7.15]

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Subjec	t Containmer	nt Aerosol a	nd Iodine Remov	al Rates	•				She	et _2	35 of	281
E EV	ORIGINATOR		IRE	DATE	REV	ÓRIGIN	ATOR	DATE			DATE	
	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003	-	01(10111		Divite	<u>                                      </u>		Ditte	EV XTOR
<b>`</b>		1			••				1			NDC
Te De Vi Di Di Di Sc Sc Gr Tr Dr	mperature of d nsity of air-s scosity of air scosity of drop. scosity of drop ff. coeff. of a ff. coeff. of a ff. coeff. of a hmidt number f hmidt number f ashof number- y mean diamete op parameters a {For a	roplet li team mixt -steam mi et liquid plet liqu elemental methyl I2 elemental methyl I2 or elemen or methyl 8.42980E r= 9.111 for elemen mean drop	quid= 87.200 ure= 1.56799E- xture= 1.61696 96720 id= 3.26947E-0 I2 in air-stean in air-stean m I2 in droplet in droplet liq tal iodine= 1 iodine= 1.23 +12 75E-02 htal	Degre 03 G/CC E-04 Pois G/CC 03 Poise m mixture ixture= liquid= 1iquid= 0.6137 16	e C e 7.11 9.4090 4.3055 4969E-0	8078E-02 2E-02 sq. 7E-05 sq. cm	sq.cm cm/se cm/se /sec	/sec c c				
I I	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	; т. См/3	V. d SEC	rop no	•				
36	9.1117E-02	7.406	259.3	10.51	32	9.8	863.6					
I	Diameter : CM	Sherwood	Time S	at. Frac.	M.T.( CI	Coeff L M/SEC	Remov /HR	al				
36	9.1117E-02	2.059	.1536	.4996	3.1	091E-03	4.382				•	
**	*********SPRAY	REMOVAL	RATES*********	*								
То	tal elemental :	removal co	onstant= 4.38	25 pe	r hour						•	
Pa	rticulate iodi	ne removal	L constant	63567	per h	our						
.To	tal organic rea	moval cor	stant00000	per	hour							
**	***REMOVAL DUE	TO WALL	DEPOSITION*****						•			
El	emental removal	l rate dro	e to wall depos	ition =	5.104	) per	hour					
Or	ganic removal :	rate due 1	to wall deposit	ion0	0000	per ho	ur					
Ne Te Pr De Vi Di Di Di Sc Gr Tr	an drop diameter mperature of air- mperature of dir- nsity of air-si scosity of air- scosity of air- scosity of drop ff. coeff. of of ff. coeff. of of ff. coeff. of of ff. coeff. of of hmidt number for hmidt number for ashof number= y mean diameter	er 9.11 ir-steam n steam mixt coplet lide -steam mixt -steam mixt et liquict plet liquict plet liquict elemental methyl I2 elemental ir gelemental 1.59302E r= 9.151.5	1/5E-02 mixture= '87.2 ture= 1.8307 guid= 87.200 ire= 1.56799E- ture= 1.81696 96720 id= 3.26947E-0 I2 in air-steam in air-steam m I2 in droplet in droplet lig cal icdine= 1.23 +13 50E-02	00 De Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture ixture- liquid= 4.6 .6137 16	gree C ÷ C ÷ 7.1( 9.4090) 4.3055 <sup>-</sup> 1969E-(	3078E-02 2E-02 sq. 7E-05 sq. 15 sq. cm	sq. cm cm/se cm/se /sec	/sec c				
Dr	op parameters 1 . (For 1	cor elemen mean drop)	ntal )									

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REV	ORIGINATOR	DATE	IRE	DATE	REV	. ORIGIN	IATOR	DATE	IR	Ē	D	ATE	e
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003					· · · · · · · · · · · · · · · · · · ·				REV
		<u> </u>											<sup>2</sup>
I	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff ( M/SEC	5 T. CM/3	V. SEC	drop no	•					
37	9.1515E-02	8.888	261.4	10.50	33	1.0	1061.						
I	Diameter CM	Sherwood	Time S	at. Frac.	M.T. Ci	Coeff L M/SEC	Remova /HR	al					
37	9.1515E-02	2.066	.1828	.5584	3.0	956E-03	3.498				•		
***	*********SPRAY	REMOVAL	RATES*********	*				ſ		•			
Tot	tal elemental	removal c	onstant= 3.49	88 pe	r hour								
Pa	rticulate iodi	ne removal	l constant= .	56136	per h	our				•			
Tot	tal organic re	moval con	stant= .00000	per	hour						• •		•
***	***REMOVAL DUE	TO WALL	DEPOSITION*****								•		
Ele	emental remova	l rate du	e to wall depos	ition =	5.104	0 ре	r hour						,
Orç	ganic removal	rate due	to wall deposit	ion= .0	0000	per h	our						
Mea Ter Pro Ter Der Vis Dif Dif Sch Sch Sch Sch Sch	an drop diamet mperature of a essure of air- mperature of d nsity of air- scosity of air scosity of drop fs. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of fmidt number f ashof number= y mean diamete	er= 9.15 ir-steam miss roplet 1:1 team miss roplet 1:1 et 1:1 elemental methyl 12 or elemental methyl 12 or elemental 1.59302E r= 9.276 for elemental	150E-02 mixture= 87.2 ture= 1.8307 guid= 87.200 ure= 1.56799E- xture= 1.81696 = .96720 id= 3.26947E-0 I2 in air-stea in air-steam m I2 in droplet lig tal icdine= 1.23 +13 D7E-02	00 De Atm, Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture ixture liquid= 1iquid= 4.6 .6137	egree C ee = 7.1 9.4090 4.3055 4969E-	8078E-02 2E-02 sq 7E-05 sq 05 sq. C	sq.cm .cm/se .cm/sec m/sec	/sec c c					
Dro	op parameters (For	nor elemen mean drop	)	m			<b></b>						
I	CM	SEC	Keynolds M. C	M/SEC	CN/2	SEC	arop no	•					
37	9.2761E-02	10.00	268.0	10.47	33	4.8	2109.						
I	Diameter CM	Sherwood	Time S	at. Frac.	м.т.( С	Coeff L M/SEC	Remov. /HR	al					
37	9.2761E-02	2.088	.2002	.5925	3.0	540E-03	3.712						
**1	*********SPRAY	REMOVAL I	RATES*********	*									
Tot	tal elemental	removal c	onstant= 3.71	24 pe	r hour								
Par	rticulate iodi	ne removal	l constant= .	56136	per h	our							
Tot	tal organic re	moval con	stant= .00000	per	hour						•		

ICCN NO./

SCE 26-426 REV. 2 [REFERENCE: SO123-XXIV-7.15]

E&TS DEPARTMENT

	CAL	CULA	<b>FION SH</b>	IEET		ICCN N PRELIN	0./ 1. CCN 1	10.	CCN C		E0	F
ject	or DCP/FCN/I	ECP		· C	alc No.	N-60	30-001		CCN N	0. <b>CCI</b>	۱ <u>.</u>	
bject	Containmer	nt Aerosol a	nd Iodine Remo	val Rates					Sh	eet	2 <u>37</u> of	_2
	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE		RE	DATE	T
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003								<b>₽</b>
	·		;									1 -
Eler Org: Mean Temp Pre: Teng Den: Vis( Den: Vis( Diff Diff Schn Schn Schn Schn	mental remova anic removal n drop diamet perature of a ssure of air- perature of d sity of air-s cosity of air-s cosity of air-s cosity of drop cosity of drop cosity of drop cosity of drop cosity of drop f. coeff. of s f. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff	1 rate du rate due er= 9.27 ir-steam is steam mixt -steam mixt -steam mixt -steam mixt et liquid: plet liquid: plet liquid: plet liquid: liquid: plet liquid: plet liquid: plet liquid: plet liquid: plet liquid: plet liquid: prethyl I2 or elemental methyl I2 or elemental methyl I2 or elemental methyl I2 or elemental 1.69822EE: = 9.25	to wall deposi 607E-02 mixture= 87.3 ture= 1.8307 quid= 87.200 ure= 1.56799E kture= 1.8169 = .96720 id= 3.26947E-1 I2 in air-steam I I2 in droplet in droplet lid tal iodine= 1.23 +13 UF=02	sition = tion= .0 200 De Atm. Degre -03 G/CC 6E-04 Pois G/CC 03 Poise am mixture mixture mixture liquid- quid= 4.6 1.6137 316	5.104( )00000 gree C ee C = 7.18 9.40905 4969E-(	9 pe: per h	sq. cm, . cm/se, . cm/se, a/sec	/sec c				
Droț I	p parameters : (For ) Diameter ) CM	for elemen nean drop Fall Time SEC	ntal ) Reynolds M. (	.T.Coeff G CM/SEC	Ť.V CM/S	EC C	lrop no					
37	9.3050E-02	8,960	269.6	10.46	335	.7	3160.					
I	Diameter : CM	Sherwood	Time S	Bat. Frac.	M.T.C CM	oeff L /SEC	Remova /HR	1				
37	9.30502-02	2.093	.1782	.5531	3.04	45E-03	3.465					ļ
****	**************************************	REMOVAL I	RTES********	**			•			•		1
Tota	l elemental :	cemoval co	onstant= 3.40	561 pe	r hour							
Part	iculate iodi:	ne removal	. constant=	.57345	per ho	ur						
Tota	l organic rea	noval cons	tant00000	) per 1	hour							{
****	*REMOVAL DUE	TO WALL I	DEPOSITION*****	,			•				:	
Elem	ental removal	i rate due	e to wall depos	sition =	5.1040	per	hour					
Orga	nic removal ;	ate due t	o wall deposit	ion= .0	0000	per ho	ur					
Mean Temp Pres Temp Dens Visc Dens Visc	a drop diameter erature of air- soure of air- soure of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source of air- source	er= 9.305 ir-stean mixt coplet lic cam mixt steam mixt steam mixt blet licui blet licui	01E-02 ixture= 87.2 iure= 1.8307 juid= 87.200 ire= 1.56799E- iture= 1.81696 .96720 .d= 3.26947E-0 I2 in air-stea	200 Deg Atm. Degree 03 G/CC SE-04 Poise G/CC 03 Poise m mixtures	gree C e C e 7.18	078 <b>E-0</b> 2	8q. cm/	'sec				

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		TS DEP.	ARTMENT TION SH	EET		ICCN N PRELIN	10./ /. CCN N	10.		PAGE	EOF	;
Proje	ct or DCP/FCN/E	ECP		C	aic No.	N-60	30-001		CCN CO CCN NO	NVERS . CCN	ION:	
Subje	ct Containmen	t Aerosol a	and Iodine Remov	al Rates	•				She	et _2	<u>38</u> of	281
REV	ORIGINATOR	DATE	IRE	DATĘ	REV	ORIGIN	IATOR	DATE	IR	E	DATE	¥
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003								REV
												IN
D D S S G T	iff. coeff. of iff. coeff. of chmidt number f chmidt number f rashof number= ry mean diamete	elemental methyl I2 or elemen or methyl 1.698225 r= 9.327	I2 in droplet in droplet liq tal iodine= 1 iodine= 1.23 +13 19E-02	liquid= uid= 4.6 .6137 16	4.3055 54969E-1	7E-05 sq 05 sq. c	. cm/sec	2				
D	rop parameters (For )	for eleme mean drop	ntal )									
	I Diameter : CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	5 T. CM/3	/. SEC	drop no.	,				
3	7 9.3272E-02	10.83	252.0	10.14	31	3.1	4205.					
	I Diameter : CM	Sherwood	Time S	at. Frac.	M.T.( Ci	Coeff L 4/SEC	Remova /HR	1				
3	7 9.3272E-02	2.034	.2143	.6095	3.0	373E-03	3.819					
+	**************************************	REMOVAL	RATES*********	*								
Т	otal elemental :	removal c	onstant= 3.73	04 pe	r hour						1	
P	artículate iodí	ne remova	l constant= .	57345	per h	our						
Т	otal organic re	moval ccn	stant= .00000	per	hour							
*	****REMOVAL DUE	TO WALL	DEPOSITION*****									
E	lemental removal	l rate c.u	e to wall depos	ition =	5.104	) pe	r hour					
0	rganic removal :	rate due	to wall deposit	ion= .0	0000	per h	our					
M T D D V D D D D D S S G G T	ean drop diamete emperature of air- emperature of di ensity of air- iscosity of air- iscosity of drople iscosity of drople iscosity of drople iscosity of drople iscosity of drople iff. coeff. of a iff. coeff. of a iff. coeff. of a iff. coeff. of a iff. coeff. of a chmidt number for rashof number- ry mean diameter	er= 9.32 ir-stean mix roplet lit team mixt st liquid plet liquid plet liquid elemental methyl 22 elemental nethyl 22 or element 2.17637E r= 9.336	719E-02 mixture= 87.2 ture= 1.8307 quid= 87.200 ure= 1.56799E- xture= 1.81696 id= 3.26947E-0 I2 in air-stea in air-steam m I2 in droplet in droplet lig tal iodine= 1.23 +13 60E-02	00 De Atm, Degre 03 G/CC E-04 Poise G/CC 3 Poise m mixture ixture- liquia- uid= 4.6 .6137 16	egree C ee C = 7.1 9.4090 4.3055 54969E-1	3078E-02 2E-02 sq 7E-05 sq 05 sq. c	sq.cm, cm/sec cm/sec	/sec c				
	rop parameters : (For )	nean drop Rell mine	) Demolds M	T Cooff 7	<u>.</u>	<b>y</b>	drop po					
		SEC	veluoraz W.	M/SEC	CM/3	SEC	LUP NO.	•				
3	/ 9.3366E-02	9.776	2/1.3	10.45	33	b./	5251.					
	I Diameter S CM	Sherwood	Time S	at. Frac.	M.T.C	Coeff L 4/SEC	Remova /HR	al				

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SCE 26-426 REV. 2 [REFERENCE: SO123-XXIV-7.15]

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	E&TS DEPARTMENT CALCULATION SHEET						ICCN NO./ PRELIM. CCN NO.				Ę	_OF	
Projec	t or DCP/FCN/	ECP		C	aic No.	N-60	30-001		CCN CO CCN NÓ	NVERS	SION: N		
Subjea	ct Containme	nt Aerosol	ind lodine Re	moval Rates				<u> </u>	She	et	239	of _	281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE	IR	E	DAT		¥
0	J. Schulz	8/15/2003	D. T. Dexheir	mer 8/15/2003									<b>R</b> M M
		<u></u>						L			<u> </u>	_	ž
37 ** To Pa To E1 Or Me Te Pr Te De	9.3366E-02 ********SPRA tal elemental rticulate iod; tal organic re- ***REMOVAL DUB emental removal an drop diamet mperature of a ressure of air- scosity of air- scosity of air-	2.099 r REMOVAL removal <: ine removal emoval com to WALL al rate due rate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due tate due	.1931 RATES****** onstant= 1 l constant= 00 DEPOSITION** e to wall depo 660E-02 mixture= 6 ture= 1.83 quid= 87.2 ure= 1.5679 xture= 1.81	.5813 	3.03 r hour per ho hour 5.1040 00000 gree C e C	942E-03 pur per h	1.821 r hour our	•			• •		
Vi Di Di Di Sc Gr Tr	scosity of dro ff. coeff. of ff. coeff. of ff. coeff. of hmidt number 1 hmidt number 1 ashof number y mean diamete op parameters	oplet lig: elemental methyl I2 elemental methyl I2 for elemen 2.17637E er= 9.343 for elemen mean drop	<pre>id= 3.26947 I2 in air-s in air-stea I2 in dropl in droplet tal iodine= 1 +13 85E-02 htal</pre>	E-03 Poise team mixture m mixture et liquid= liquid= 4.6 1.6137 2316	= 7.18 9.40902 4.30557 4969E-0	078E-02 E-02 sq E-05 sq 5 sq. c	sq. cm . cm/se . cm/se . cm/sec	/sec c			·		
I	(For Diameter	mean drop Fall Time	Reynolds	M.T.Coeff G	T.V	•	drop no						
	CM	SEC		CM/SEC	CM/S	EC				•		ł	
37 I	9.3439L-02 Diameter	Sherwood	271.7 Time	10.45 Sat. Frac.	336 M.T.C	oeff L	6294. Remov	al					
	CM				СМ	SEC	/HR						
37	9.34396-02	2.100	.1997	.5930	3.03	19E-03	1.858						
To	tal elemental	removal co	unstante 1	8577 56	r hour								
PA	rticulate iodi	ne removal	constant=	.31145	per ho	ur							
To	tal organic re	moval con	stant= .00	000 per l	hour								
**	***REMOVAL DUE	TO WALL	EPOSITION**	***	-								
Ele	emental remova	1 rate due	e to wall de	position =	5.1040	pe	r hour						
Ore	ganic removal	rate due t	o wall depo	sition= .00	0000	per h	our						
í													

		TS DEPA	RTMENT	EET		ICCN NO./ PRELIM. CCN N	10.		PAGE	≣OF	
Projec	t or DCP/FCN/E	ECP	•	C	alc No.	N-6030-001		CCN CO CCN NO	NVERS	SION:	
Subjec	containmen	t Aerosol a	nd Iodine Remov	al Rates	•	······	····· '	She	et _2	40 of	
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRI		DATE	~
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003						1	REV
	· ·										Q
Me Te Pr Te De Vi Di Di Di Sc Gr Tr Tr	an drop diameter mperature of air- mperature of dir- sity of air- scosity of air- scosity of drop ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a thmidt number for ashof number- y mean diameter op parameters f (For m Diameter f	er- 9.34 ir-steam mixt roplet lig team mixt -steam mixt et liquid elemental methyl I2 elemental methyl I2 elemental tethyl I2 cr element 2.23471E4 cr 9.3476 for element mean drop)	3855-02         nixture=       87.20         ture=       1.8307         guid=       87.200         nre=       1.56799E-4         cture=       1.81696         a       .96720         id=       3.26947E-00         I2 in air-steam         in air-steam         I2 in droplet         in droplet         iodine=         13         38E-02         ntal	00 De Atm, Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture ixture- liquid= uid- 4.6 .6137 16	gree C e C e 7.11 9.40902 4.3055 4969E-0	8078E-02 sq. cm. 2E-02 sq. cm/sec 7E-05 sq. cm/sec 5 sq. cm/sec	/sec				
1	CM	SEC	Reynolds M. Cl	M/SEC	CM/S	SEC	•				
37	9.3479E-02	9.859	271.9	10.45	331	7.0 7339.					
I	Diameter S CM	Sherwood	Time Sa	at. Frac.	M.T.C Ch	Coeff L Remova M/SEC /HR	31				
37	9.3479E-02	2.101	.1943	.5837	3.03	06E-03 1.828					. 1
**	*********SPRAY	REMOVAL F	ATES********	•							
То	tal elemental :	cemoval co	onstant- 1.82	35 pe	r hour						
Pa	rticulate iodin	ie removal	constant= .3	31420	per ho	our					
To	tal organic rem	noval coris	tant= .00000	per	hour				•		
**	***REMOVAL DUE	TO WALL D	EPOSITION*****								
El	emental removal	L rate due	to wall deposit	ltion =	5.1040	) per hour					
Or	ganic removal r	ate que t	o wall depositi	.on= .0		per nour					
Mean drop diameter= 9.3:786E-02 Temperature of air-steam mixture= 87.200 Degree C Pressure of air-steam mixture= 1.8307 Atm. Temperature of droplet l:quid= 87.200 Degree C Density of air-steam mixture= 1.81696E-04 Poise Density of air-steam mixture= 1.81696E-04 Poise Density of droplet liquid= .96720 G/CC Viscosity of droplet liquid= .96720 G/CC Viscosity of droplet liquid= 3.26947E-03 Poise Diff. coeff. of elemental I2 in air-steam mixture= 7.16078E-02 sq. cm/sec Diff. coeff. of methyl I2 in air-steam mixture= 9.40902E-02 sq. cm/sec Diff. coeff. of elemental I2 in droplet liquid= 4.30557E-05 sq. cm/sec Diff. coeff. of methyl I2 in droplet liquid= 4.64969E-05 sq. cm/sec Diff. coeff. of methyl I2 in droplet liquid= 4.64969E-05 sq. cm/sec Schmidt number for elemental iodine= 1.6137 Schmidt number for methyl iodine= 1.2316 Grashof number= 2.234713+13 Try mean diameter= 9.35188E-02											

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Project	or DCP/FCN/	ECP		C	aic No.	N-6030-001		CCN CO CCN NÓ	NVERS . CCN	ION:	
Subject	Containme	nt Aerosol	and Iodine Remov	val Rates			<u> </u>	She	et _2	<u>41</u> of	281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	 E	DATE	¥
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							N N N N N N N N N N N N N N N N N N N
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Dro	p parameters (For	for eleme mean drop	ntal )								
I	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff ( M/SEC	GT. CM/	V. drop n SEC	0.				
37	9.3519E-02	10.21	272.1	10.45	33	7.2 8382	•				]
I	Diameter CM	Sherwood	Time S	at. Frac.	. M.T. C	Coeff L Remo M/SEC /H	val R	•		·	
37	9.3519E-02	2.102	.2010	.5955	3.0	293E-03 1.86	5				1
***	********SPRAY	removal	RATES*********	*							
Tot	al elemental	removal c	onstant- 1.86	56 pe	er hour				•		<b>I</b> .
Par	ticulate iodi	.ne remova	l constant= .	31420	per h	our					
Tot	al organic re	moval con	stant00000	) per	hour				•		
***	**REMOVAL DUE	TO WALL	DEPOSITION*****	,							1
Ele	mental remova	l rate du	e to wall depos	ition =	5.104	0 per hour					]
Org	anic removal	rate due	to wall deposit	ion= .(	00000	per hour					
Mea	n drop diamet	er= 9.35	188E-02								
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Projec	t or DCP/FCN/E	ECP		C	alc No.	. <u>N-6030-001</u>		CCN CO CCN NO	NVERS	ION:	
Subjec	t Containmen	t Aerosol a	and Iodine Remov	al Rates	•		<u> </u>	She	et _2	<u>42</u> 0	f <u>281</u>
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DATE	ж ж
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							
	· ·		<u> </u>				<u> </u>				<u> </u>
Be (C Or Pr Su	9.2.2.7 13. chtel Standard ) 1991 iginator Jorge oject SONGS bject I2 Spray	8 to 24 h Compute: Schulz y Max Tem	<b>Output File (i</b> Program Date 14 p 13.8 - 24 hr	2 <b>- max05</b> . REMOVE , Jun 2003	NE305 Calc 1 Checke Job No Sheet	Version 4.0 No. N-6030-00 R dDate_ 0. 16575-167 No. 1	ev No. ()		. •		· · · · · · · · · · · · · · · · · · ·
			Standard Comp	uter Pro:	Jran			-			
		ostract: ne REMOVE	nE305 REMOVE for the IBM	Version PC/XT/A1	contair	ment					
Be (c Or Pr Su	Output in fi chtel Standard ) 1991 iginator Jorge oject SONGS bject I2 Spray	le 12-may Computer Schulz	05.out was created Program 1 Date 14 d	ated on 1 REMOVE , Jun 2003	4 Jun 2 NE305 V Calc N Checke Job No Sheet	2003 at 11: 8: Version 4.0 Io. N-6030-00 R dDate 0. 16575-167 No. 2	42 ev No. 0				
Te: Pr Te De Vi Di Di Di Sc	mperature of ai essure of air-s mperature of dr nsity of air-st scosity of air- sity of drople scosity of drop ff. coeff. of e ff. coeff. of m ff. coeff. of m hmidt number fo	r-stean m team mixtu oplet liq eam mixtu steam mixtu steam mixtu let liquid- let niquid- lement2l ethyl J2 r element	<pre>hixture= 78.30 ure= 1.6155 guid= 78.300 ure= 1.45989E-( ture= 1.83598E .97278</pre>	00 De Atm. Degre 03 G/CC 5-04 Pois G/CC 8 Poise a mixture liduid= 1id= 4.0 6371	gree C e C e .10053 3.76958 7086E-0	196E-02 sq. cm sq. cm/se E-05 sq. cm/sec 5 sq. cm/sec	/sec c c				

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		EATS DEP.	ARTMENT		ICCN N PRELIN	10.1 1. CCN 1	10.		PAGE	E0	F	
Projec	t or DCP/FCN	/ECP		C	alc No.	N-60	30-001		CCN CO CCN NO	NVERS	ION:	•
Subjec	t <u>Containme</u>	ent Aerosol a	and Iodine Remo	oval Rates	•				She	et _2	<u>43</u> of	281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE	IRI		DATE	œ
0	J. Schulz	8/15/2003	D. T. Dexheime	er 8/15/2003								A S
		_ <u></u> ,							<u> </u>			ž
Sc Gr Tr	hmidt number ashof number= y mean diamet	for methyl 5.528263 er= 9.113	iodine= 1.2 +12 96E-02	2509								
Dr	op parameters (For	for elems mean drop	ntal )									1
I	Diameter CM	Fall Tim≥ SEC	Reynolds N	M.T.Coeff G CM/SEC	T.V CH/S	A. SEC	drop no	•				
36	9.1140E-02	6.306	246.0	11.03	339	9.4	213.8					
I	Diameter CM	Sherwood	Time	Sat. Frac.	M.T.C	Coeff L 1/SEC	Remov. /HR	al				
36	9.1140E-02	3.335	.1145	.5160	2.7	214E-03	3.352					
**	**********SPRA	Y REMOVAL	RATES*******	***						•		
Тс	tal elemental	removal c	onstant= 3.3	3524 pe	r hour		•					
Pa	rticulate iod	ine remova	L constant-	.59268	per ho	our		•				
To	tal organic r	emoval ccn	stant= .0000	)0 per	hour							
**	***REMOVAL DU	E TO WALL	DEPOSITION****	• •								
El	emental remova	al rate cu	e to wall depo	osition =	5.1040	) pe:	r hour					
Or	ganic removal	rate due	to wall deposi	Ltion= .0	0000	per h	our				•	
Me Te Pr De Vi Di Di Di Sc Sc Gr	an drop diame mperature of a essure of air mperature of air scosity of air scosity of drop scosity of drop scosity of drop ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of hmidt number a hmidt number a	ter= 9.11 air-stean i -steam mix troplet 1.i. steam mixt -steam nix t-steam nix t-steam nix t-steam nix t-steam nix t-steam nix t-steam nix elemental methyl 32 for eleman for methyl 5.52826E	396E-02 mixture= 78. ture= 1.6155 guid= 78.300 pre= 1.459895 tture= 1.8359 97278 Id= 3.64212E- I2 in air-steam I2 in droplet in droplet li tal iodine= 1.2 +12	.300 De 5 Atm. 0 Degres -03 G/CC 08E-04 Pois G/CC 03 Poise ham mixture mixture liquid 1.6371 2509	gree C e C = 7.68 .1005: 3.76955 7096E-(	31962-02 3 sq 3E-05 sq 05 sq. ca	sq. cm. . cm./se . cm./sec	/sec c	·	•		
Tr Dr	y mean diamete op parameters (For	for element	35E-02									
I	Diameter CM	Fall Time SEC	Reynolds M	I.T.Coeff G CM/SEC	T.V CM/S	7. ( ;EC	drop no	•				
37	9.1369E-02	6.635	247.1	11.03	340	.1	419.1					
I	Diameter CM	Sherwood	Time	Sat. Frac.	M.T.C CN	Coeff L I/SEC	Remov /HR	al				
37	9.13692-02	3.341	.1198	.5309	2.71	.46E-03	3.449					

E&TS DEPARTMENT	
CALCULATION	SHEET

Subject Containment Aerosol and Iodine Removal Rates

ICCN NO./ PRELIM. CCN NO.

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Project or DCP/FCN/ECP

Calc No. <u>N-6030-001</u>

CCN CONVERSION: CCN NÓ. CCN

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REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	f		
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003						T T		
										S. S.		
*** To Pa To Pa To Pa El Or Pa El Or Pr Ta De Vi De Vi Di Di Di Di Scc Scc Scc Scc Scc	**********SPRAY tal elemental : rticulate iodin tal organic ren ***REMOVAL DUE emental removal : an drop diamet mperature of a: essure of air-: mperature of a: scosity of air- f. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a hmidt number ff hmidt number fo ashof number= y mean diameter	REMOVAL removal con ne remova moval con TO WALL 1 rate du rate due er= 9.13 ir-steam mix: roplet 1: roplet 1: et liquid plet liquid plet 1: elemental. methyl 1: elemental: methyl 1: 6.8208413 r= 9.263	RATES************************************	1 194 per 59268 per 100 per 100 pe	er hour per h hour 5.104 00000 egree C eg. C se 7.6 .1005 3.7695 07086E-	our 0 per hour per hour 8196E-02 sq. cm 3 sq. cm/se 8E-05 sq. cm/sec	/sec c c		- <b>1</b>			
Dr	op parameters : (For )	for elema mean drop	ntal )									
I	Diameter : CM	Fall Time SEC	Reynolds M. C	T.Coeff ( M/SEC	T. CM/	V. drop no SEC	•					
37	9.26862-02	6.718	253.8	10.99	34	4.3 829.0	I					
I	Diameter : CM	Sherwood	Time S	at. Frac.	м.т. С	Coeff L Remov M/SEC /HF	al	ı				
37	9.2686E-02	3.379	.1179	.5281	2.6	760E-03 3.431						
**	**************************************	REMOVAL	RATES*********	*								
Total elemental removal constant- 3.4322 per hour												
Particulate iodine removal constant= .63567 per hour												
Total organic removal constant= .00000 per hour												
**	***REMOVAL DUE	to Wali	DEPOSITION*****									
EJ	emental removal	l rate du	e to wall depos	ition =	5.104	0 per hour						
Organic removal rate due to wall deposition= .00000 per hour												
Ne Te Pr	Organic removal rate due: to wall deposition= .00000 per hour Mean drop diameter= 9.3:6863E-02 Temperature of air-stean mixture= 78.300 Degree C Pressure of air-steam mixture= 1.6155 Atm.											

SCE 26-426 REV. 2 [REFERENCE: SO123-XXIV-7.15]

		IEET		ICCN NO	D./ . CCN N	10.		PAGE	E <u>·</u> OI	F		
Projec	t or DCP/FCN/	ECP	•	с	alc No.	N-603	0-001			NVERS	ION:	•
Subjec	t Containme	nt Aerosol a	and Iodine Remo	oval Rates	•			······	She	et _2	4 <u>5</u> of	281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINA	TOR	DATE	IB		DATE	<b>1</b> ~
0	J. Schulz	8/15/2003	D. T. Dexheime	т 8/15/2003					· · ·			₹ No S
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De Vi Di Di Di Di Sc Gr Tr	nsity of air-s scosity of air scosity of drop scosity of drop ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of hmidt number i ashof number- y mean diameter op parameters	steam mixt steam mi let liquid oplet liqu elemental methyl I2 for elemental 6.82084E er= 9.309 for eleme	<pre>ure= 1.459894 sture= 1.8359 • .97278 .d= 3.64212E- I2 in air-stem I2 in droplet in droplet 13 tal iodine= iodine= 1.2 #12 96E-02 ntal</pre>	C-03 G/CC 98E-04 Pois G/CC -03 Poise eam mixture mixture= t liquid= iquid= 4.0 1.6371 2509	;= 7.6 .1005 3.7695 7086E-	8196E-02 3 sg. 8E-05 sg. 05 sq. cm	sg. Cm cm/se cm/sec /sec	/sec c				
п	(For Diameter	mean drop Fall Time	) Reynolds M	(.T.Coeff G	5 T.)	V. d	rop no	•				
37	CM 9.3100E-02	7-034	255.9	10.98	34	5.6	1237.					]
1	Diameter CM	Sherwood	Time	Sat. Frac.	M.T.(	Coeff L M/SEC	Remov /HR	al				
37	9.3100E-02	3.391	.1224	.5407	2.6	641E-03	3.513					ĺ
**	**************************************	REMOVAL	RATES********	* # *								Í
To	tal elemental	removal c	onstant= 3.5	5138 pe	n hour						•	ĺ
Pa	rticulate iodi	ine remova	l constant=	.63567	per ho	our						Ì
То	tal organic re	moval cor	stant≈ .0000	)0 per	hour							
**	***REMOVAL DUE	TO WALL	DEPOSITION****	*								ļ
El	emental remova	il rate du	e to wall depo	sition =	5,104	) per	hour					1
Or	ganic removal	rate due i	to wall deposi	tion0	0000	per ho	ur					
Me Te Pr De Vi Di Di Di Sc Sc Gr	an drop diamet mperature of a essure of air- mperature of d nsity of air-s scosity of air nsity of dropl scosity of dropl scosity of dropl ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of hundt number f ashof number= y mean diamete	er= 9.30 ir-steam mis: broplet 14. team mix: -steam mix: et liquid plet liquid elementa. methyl 12 elementa. methyl 12 ior element ior methy2 1.288972 22 9.343	996E-02 nixture= 78. ture= 1.6155 quid= 78.300 tre= 1.459895 kture= 1.8359 = .97278 Id= 3.64212E- I2 in air-steam I2 in droplet 1 in droplet 1 tal iodine= iodine= 1.2 +13 42E-02	300 De Atm. Degre 2-03 G/CC 18E-04 Pois G/CC 03 Poise am mixture mixture= 1iquid= 4.0 1.6371 2509	gree C e C - 7.61 .1005: 3.76951 7086E-(	3196E-02 3 sq. 3E-05 sq. 35 sq. cm.	sq. cm cm/se cm/se /sec	/sec c . c				
Dr	op parameters (For	for eleman mean drop	ntal )									

**E&TS DEPARTMENT** ICCN NO./ CALCULATION SHEET PRELIM, CCN NO. PAGE OF **CCN CONVERSION:** CCN NÓ. CCN Project or DCP/FCN/ECP Calc No. N-6030-001 Subject Containment Aerosol and Iodine Removal Rates Sheet 246 of 281 ORIGINATOR . DATE IRE DATE REV ORIGINATOR DATE IRE REV DATE REV 8/15/2003 J. Schulz 8/15/2003 D. T. Dexheimer 0 **T.V.** Fall Time Reynolds M.T.Coeff G Ï Diameter drop no. CM SEC CM/SEC CM/SEC 37 9.3484E-02 8,423 257.B 10.97 346.9 1632. Sherwood Time Sat. Frac. M.T.Coeff L Removal I Diameter CM/SEC /HR CM 37 9.3484E-02 3.402 .1453 .5976 2.6532E-03 2.773 .Total elemental removal constant= 2.7736 per hour Particulate iodine removal constant= .56136 per hour Total organic removal constant= .00000 per hour \*\*\*\*\*REMOVAL DUE TO WALL DEPOSITION\*\*\*\*\* Elemental removal rate due to wall deposition = 5.1040 per hour Organic removal rate due to wall deposition= .00000 per hour Mean drop diameter= 9.34842E-02 Temperature of air-steam mixture= 78.300 Degree C Pressure of air-steam mixture= 1.6155 Temperature of droplet liquid= 78.300 Atm. Degree C Density of air-steam mixture= 1.45989E-03 G/CC Viscosity of air-steam mixture= 1.83598E-04 Poise Density of droplet liquid= .97278 G/CC Viscosity of droplet liquid= .3.64212E-03 Poise Diff. coeff. of elementa: I2 in air-steam mixture= 7.68196E-02 sq. cm/sec Diff. coeff. of methyl I? in air-steam mixture .10053 sq. cm/sec Diff. coeff. of elementa: 12 in droplet liquid 3.76958E-05 sq. cm/sec Diff. coeff. of methyl I? in droplet liquid 4.07086E-05 sq. cm/sec sg. cm/sec Schmidt number for elemental iodine= 1.6371 Schmidt number for methyl iodine= 1.2509 Grashof number= 1.2889715+13 Try mean diameter= 9.36256E-02 . Drop parameters for elemental (For mean drop) Diameter Fall Time Reynolds M.T.Coeff G T.V. drop no. I CM SEC CM/SEC CM/SEC 37 9.3626E-02 9.670 258.6 10.97 347.3 2022. I Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal CM/SEC CM /HR .1663 .6430 37 9.3626E-02 3.406 2.64925-03 2.984 Total elemental removal constant= 2.9840 per hour Particulate iodine removal constant-.56136 per hour Total organic removal constant= .00000 per hour

SCE 26-426 REV. 2 [REFERENCE: SO123-XXIV-7.15]

		TS DEPA	RTMENT	EET		ICCN NO	). . CCN N	10.		PAGE	OF	
Projec	t or DCP/FCN/I	ECP	•	ċ	alc No.	<u>N-603</u>	0-001		CCN CO CCN NO	NVERS	ION:	•
Subjec	t Containmer	nt Aerosol a	nd Iodine Remov	val Rates	•				She	et _2	<u>47</u> of	281
RIEV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE	IR	E	DATE	g
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003	<u> </u>							DICAT O
** El Or Me Te Pr Te De Vi Di Di Di Sc Gr Tr Dr I 37 I 37 ** To Pa To ** El Or Me Te Vi Di Di Di Sc Sc Gr Tr Dr Tr De Vi Di Di Sc Sc Gr Tr De Vi Di Di Sc Sc Sc Gr Tr De Vi Di Di Sc Sc Sc Gr Tr De Vi Di Di Sc Sc Sc Sc Sc Gr Tr De Vi Di Di Sc Sc Sc Sc Sc Sc Sc Sc Sc Sc Sc Sc Sc	<pre>***REMOVAL DUE emental removal ganic removal an drop diamet mperature of a essure of air- mperature of d insity of airs scosity of air nsity of dropl scosity of dropl scosity of dro ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of parameters (For Diameter CM 9.3589E-02 Diameter CM 9.3589E-02 Fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. of fi. coeff. coeff. fi. coeff. coef</pre>	TO WALL 1 rate du rate due er= 9.36 ir-steam is steam mix roplet li team mixti- steam mixti-	DEPOSITION***** e to wall deposit 256E-02 mixture= 78.3 ture= 1.6155 quid= 78.300 ure= 1.45989E- xture= 1.83598E- xture= 1.83598E- 12 in air-steam m 12 in droplet liq tal iodine= 1.25 +13 90E-02 ntal Reynolds M. 258.4 Time S .1483 RATES************************************	sition = sion= .( Atm. Degre 03 G/CC De-04 Pois G/CC 03 Poise mixture= liquid= quid= 4.1 .6371 09 T.Coeff ( M/SEC 10.97 Sat. Frac. .6045 * 56 per Sition = sion= .( Atm. Degre 03 G/CC B=-04 Pois G/CC Solution = Sition = .( Atm. Degre 03 G/CC Solution = Solution	5.104 5.104 coooo agree C ae C ae C ae C ae C ar nour per hour per hour per hour bour 5.104 coooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo coo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo cooo co	<pre>     per ho     per ho     per ho     sq.     sq.     sq.     cm     for a sq.     cm     for a sq.     cm     for a sq.     cm     per ho     per     per ho     per ho     sq.     >	hour vur sq. cm/sec rop no 2417. Removi /kR 2.805 hour ur sq. cm/sec	/sec	· ·			

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Subje	ct Containmen	t Aerosol a	nd Iodine Remov	al Rates					She	et _2	<u>48</u> of	
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D D S G T D	iff. coeff. of a chiff. coeff. of a chift number for chift number for cashof number- cy mean diameter cop parameters for (For a	elemental nethyl I2 or elemen or methyl 1.374093 r= 9.367 for elemen mean drop	I2 in droplet in droplet liq tal iodine= 1 iodine= 1.25 +13 47E-02 htal	liquid= uid- 4.0 .6371 09	3.76951 7086E-(	3E-05 sq. c	. CR/Sec	:			·	
	Diameter I CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	5 T.V CM/5	7. Gec	drop no.			•		
3	9.3675E-02	9.867	258.8	10.97	341	7.5	2806.					
	Diameter S CM	Sherwood	Time S	at. Frac.	M.T.( Cl	Coeff L 4/SEC	Remova /HR	1				
3	9.36755-02	3.407	.1695	.6495	2.64	78E-03	3.014			•	· •	
	**************************************	REMOVAL I	RATES********	*								
Т	tal elemental i	removal co	onstant- 3.01	40 pe	r hour							
Р	articulate iodin	ne removal	l constant= .	57345	per ho	our						
T	otal organic rem	noval cons	stant00000	per	hour							
*	*** REMOVAL DUE	TO WALL I	DEPOSITION*****									
E	lemental removal	l rate du	e to wall depos	ition =	5.1040	) pe:	r hour					
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Ma Te Te Di V: Di V:	an drop diameter mperature of air-st ensure of air-st ensity of air-st scosity of air- nsity of drople scosity of drople	er= 9.36 ir-steam mixt coplet lic ceam mixtu steam mixtu steam mix t liquid olet licu	747E-02 mixture= 78.30 ture= 1.6155 puid= 78.300 1re= 1.45989E-0 cture= 1.835981 97278 (1) id= 3.64212E-03	00 Deg Atm. Degre 03 G/CC E-04 Pois 3/CC 3 Poise	igree C Is C Is		•		·			
	ff. coeff. of e ff. coeff. of m ff. coeff. of m ff. coeff. of m thmidt number for thmidt number for cashof number y mean diameter	alemental acthyl 12 acthyl 12 acthyl 12 acthyl 12 ar elemantal ar methyl 1.76098E- c- 9.3681	12 in air-steam mu in air-steam mu I2 in droplet lig in droplet lig cal iodine= 1 1odine= 1.250 13 12E-02	n mixture ixture= Liquid= uid= 4.0 .6371 D9	= 7.68 .10053 3.76958 7086E-0	3196E-02 3 sq 3E-05 sq 35 sq. cr	sq. cm/sec . cm/sec . cm/sec n/sec	Bec				
D	cop parameters f (For m	for elener acan drop)	htal			i	:					
	Diameter H CM	fall Time SEC	Reynolds M.: Cl	F.Coeff G M/SEC	т.V См/9	EC K	irop no.	1				
3'	9.36915-02	9.424	258.8	10.97	347	.5	3195.					
:	Diameter S CM	Sherwool	Time Sa	at. Frac.	M.T.C CN	Coeff L I/SEC	Remova /HR	1		-		

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Subject	Containme	ent Aerosol a	and Iodine Remo	oval Rates					She	et _2	490	f <u>281</u>
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0	J. Schulz	8/15/2003	D. T. Dexheime	r 8/15/2003								REV DICAT
											<u> </u>	<u>z</u>
37 **** Tot. Par Tot. Elea Org. Meau Tem Pre. Tem Den: Vis. Dif: Dif: Schu Schu Schu Schu Schu Schu Schu Schu	9.3681E-02 *******SPRA al elemental ticulate iod al organic r **REMOVAL DU mental removal anic removal anic removal anic removal anic removal anic removal anic removal anic removal cosity of air- perature of a sure of air- perature of a sity of drop cosity of d	3.408 Y REMOVAL : removal con- ine removal emoval con- emoval con- emoval con- emoval con- al rate due ter= 9.35 air-steam mi- steam mi-	.1619 RATES************************************	.6340 .6340 	2.6 2.6 2.6 2.6 2.6 2.6 2.6 2.6	476E-03 our per ho 9196E-02 3 sq. 32 sq. 35 sq. cr 5 sq. cr 5 sq. cr 5 sq. cr	1.471 c hour our sq. cm. cm/sec arop no. 3582. Remova /HR	/sec c				
37	9.3703E-02	3.408	.1680	.6465	2.64	170E-03	1.500					
***	********SPRA1	( REMOVAL F	ATES********	**								
. Tota	al elemental	removal co	onstant= 1.5	002 pe	r hour							
Par	ticulate iodi	ne removal	tante 0000	.31145	per ho	our						
	**REMOVAL DI	TO WALL I	EPOSITION****	* • het	nout						•	
Eler	mental remova	al rate due	to wall depo	sition -	5.1040	) per	hour					
Org	anic removal	rate due t	o wall deposi	tion0	0000	per ho	ųr					

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Project or DCP/FCN/ECP				C	alc No	N-6030-001	N-6030-001		CCN CONVERSION: CCN NO. CCN			
Subject Containment Aerosol and Iodine Remo				al Rates	•	· · · · · · · · · · · · · · · · · · ·	L_		et	250 of	281	
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DATE	g	
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003				T			N N N	
	·						<u> </u>				ž	
Med Ten Pre Ten Der Vis Der Vis Dif Dif Dif Sch Sch Sch Try Dro	<pre>Mean drop diameter= 9.37(34E-02 Temperature of air-steam mixture= 78.300 Degree C Pressure of air-steam mixture= 1.6155 Atm. Temperature of droplet liquid= 78.300 Degree C Density of air-steam mixture= 1.45989E-03 G/CC Viscosity of air-steam mixture= 1.83598E-04 Poise Density of droplet liquid= .97278 G/CC Viscosity of droplet liquid= 3.64212E-03 Poise Diff. coeff. of elemental 12 in air-steam mixture= 7.68196E-02 sq. cm/sec Diff. coeff. of elemental 12 in dir-steam mixture= .10053 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid= 3.76958E-05 sq. cm/sec Diff. coeff. of methyl 12 in droplet liquid= 4.07086E-05 sq. cm/sec Schmidt number for elemental iodine= 1.6371 Schmidt number for methyl iodine= 1.2509 Grashof number= 1.80818E-13 Try mean diameter= 9.36992E-02</pre>											
	СМ	SEC	C	M/SEC	CW/S	SEC					[	
37	9.3699E-02	9.513	258.9	10.97	347	7.5 3971						
I	Diameter S CM	herwood	Time Sa	at. Frac.	M.T.C Cl	Coeff L Removed M/SEC /H:	7 <b>al</b> R					
37	9.3699E-02	3.408	.1634	.6371	2.6	471E-03 1.47	3					
***	*********SPRAY	REMOVAL	RATES**********	*								
Tot	al elemental r	cemoval co	onstant= 1.47	83 pe	er hour						ł	
Particulate iodine removal constant= .31420 per hour												
Tot	al organic rem:	ioval cons	stant= .00000	per	hour							
***	**REMOVAL DUE	TO WALL I	EPOSITION****									
Elemental removal rate due to wall deposition = 5.1040 per hour												
Org	janic removal r	ate due t	:o wall deposit:	ion= .U	0000	per hour						
Mea Tem Pree Den Vis Den Vis Dif Dif Dif Sch Sch Gra	Mean drop diameter= 9.36992E-02 Temperature of air-stean mixture= 78.300 Degree C Pressure of air-stean mixture= 1.6155 Atm. Temperature of droplet liquid= 78.300 Degree C Density of air-steam mixture= 1.45989E-03 G/CC Viscosity of air-steam mixture= 1.83598E-04 Poise Density of droplet liquid= .97278 G/CC Viscosity of droplet liquid= 3.64212E-03 Poise Diff. coeff. of elemental I2 in air-steam mixture= 7.68196E-02 sq. cm/sec Diff. coeff. of elemental I2 in air-steam mixture= .10053 sq. cm/sec Diff. coeff. of elemental I2 in droplet liquid= 3.76958E-05 sq. cm/sec Diff. coeff. of methyl I2 in droplet liquid= 4.07086E-05 sq. cm/sec Diff. coeff. of methyl I2 in droplet liquid= 1.6371 Schmidt number for elemental iodine= 1.6371 Schmidt number for methy.iodine= 1.2509 Grashof number= 1.800181:+13 Try mean diameter= 9.37:58E-02											

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		ICCN NO./ PRELIM. CCN NO.			PAGEOF						
Project or DCP/FCN/ECP Calc No.						N-6030-001	CCN CONVERSION: CCN NO. CCN				
Subjec	t <u>Containmen</u>	t Aerosol a	nd Iodine Remov	al Rates	l Rates			She	et _2	5 <u>1</u> of	281
REV ORIGINATOR DATE IRE DATE REV						ORIGINATOR	IRE		DATE	<u>م</u>	
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							ICATO
											<u>N</u>
Drop parameters for elemental (For mean drop)											
I	Diameter : CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	; T.) CM/:	V. drop no SEC	•				
37	9.3716E-02 9.875 259.0 10.97 347.6 4357.										
I I	Diameter S CM	Sherwood	Time S	at. Frac.	M.T.( Cl	Coeff L Remov M/SEC /HR	al ,		•		
37	9.3716E-02	3.409	.1695	.6495	2.6	466E-03 1.507			•		
***********SPRAY REMOVAL RATES*********											
Total elemental removal constant= 1.5072 per hour											
Particulate iodine removal constant= .31420 per hour											
*****REMOVAL DUE TO WALL DEPOSITION*****											
Elemental removal rate due to wall deposition = 5.1040 per hour											
Organic removal rate due to wall deposition= .00000 per hour											
Me	an drop diamete	er- 9.37	158E-02						•		
								•			
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		TS DEP/	RTMENT	EET		ICCN NO./ PRELIM. CCN I	10.		PAGE	E0F	:
Project	t or DCP/FCN/E	CP	•	C	aic No.	N-6030-001		CCN CO CCN NO	NVERS . CCN	SION: I	•
Subjec	t Containmen	t Aerosol a	and Iodine Remov	al Rates	•		·	She	et _2	52 of	
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRI	Ē	DATE	б
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							<b>P</b>
Be (c Or: Pr Sul	9.2.2.8 24 1 chtel Standard ) 1991 iginator Jorge oject SONGS bject I2 Spray	to 48 hr ( Computer Schulz Max Tem	Dutput File (i2- Program Date 14 p 24 - 48 hr	max06.0 REMOVE , Jun 2003	NE305 Calc 1 Checke Job No Sheet	Version 4.0 No. N-6030-00 R edDate_ D. 16575-167 No1	ev No. 0				
			Standard Comp NE305 REMOVE for the IBM	uter Pro; Version PC/XT/AT	gram 4.0						
	Ab Th Sp di	estract: e REMOVE pray remov ameter o	program calcul val rate consta r drop trajecto	ates the nts and a ries	contair a mean c	ment irop					
Bee (C) Or: Prr Sul Prr Ter Der Vi: Der Vi: Di: Di:	Output in fi chtel Standard ) 1991 iginator Jorge oject SONGS oject I2 Spray mperature of air-st assure of air-st acosity of air-st acosity of air-st scosity of drople scosity of drople f. coeff. of m	le I2-mai Computer Schulz Max Tem r-stean 1 team mixt steam nixt steam nixt steam nixt liquid lemental echvl 12	x06.out was created Program Date 14 0 24 - 48 hr 0 24 hr 0 24 hr 0 24 hr 0 24 hr 0 24 hr 0	ated on 1 REMOVE , Jun 2003 Jun 2003 Jun 2003 Atm. Degre 03 G/CC E-04 Poise G/CC 3 Poise m mixture ixture	A Jun 2 Calc M Checke Job N Sheet Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Checke Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet Sheet She She Sheet Sheet She She Sheet Sheet Sheet She She Sheet Sheet She	2003 at 11:10: Version 4.0 No. N-6030-00 R ad Date 0. 16575-167 No. 2 No. 2 251E-02 sq. cm	43 ev No. 0 				
Di Di Scl	ff. coeff. of m ff. coeff. of m midt number fo	lemental ethyl [2 r eleman	12 in droplet 1 in droplet 1ig tal iodine= 1	liquid- uid= 3.5 .6608	3.25696 1727E-0	SE-05 sg. cm/se 5 sg. cm/sec	c				

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		STS DEP.	ARTMENT TION SH		ICCN N PRELIN	0./ I. CCN N	10.		PAGE	OI	F	
Project o	or DCP/FCN/I			C	aic No.	<u>N-60</u>	<u>30-001</u>		CCN CO CCN NO		ION:	
Subject	Containmen	t Aerosol	and Iodine Remova	al Rates					She	et _2	<u>53</u> of	281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE	IR		DATE	¢
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003					1			N N N
												2
Schm Grás Try s	idt number f hof number- mean diamete	or methyl 4.511925 r= 9.200	iodine= 1.27( +12 90E-02	04								
Drop	parameters (For )	for elema mean drop	ntal )									,
I	Diameter CM	Fall Time SEC	Reynolds M.: Cl	r.Coeff G M/SEC	T.\ CM/S	7. d SEC	irop no.	•		-		
37	9,2009E-02	6.064	239.9	11.44	35(	).4	207.8	ſ		•		
I	Diameter CM	Sherwood	Time Sa	at. Frac.	M.T.( C)	Coeff L M/SEC	Remova /HR	<b>al</b>				
37	9.2009E-02	5.386	9.3317E-02	.5450	2.32	291E-03	2.656					
****	*******SPRAY	REMOVAL	RATES**********	•						•		
Tota	l elemental .	removal co	onstant= 2.65	64 pe	r hour					·		
Part:	iculate iodi:	ne removal	l constant= .	59268	per ho	our						ł
Tota	l organic re	moval con	stant= .00000	per	hour							
****	*REMOVAL DUE	TO WALL	DEPOSITION*****									
Elem	ental remova	l rate du	e to wall deposi	ition =	5.1040	) per	hour			•		
Orgai	nic removal :	rate due i	to wall depositi	Lon= .0	0000	per ho	our					
Mean Tempo Pres: Tempo	drop diamete erature of a sure of air~; erature of d	er= 9.200 ir-steam.u steam mixi roplet lie	090E-02 nixture= 69.20 ture= 1.4459 quid= 69.200	)0 Du Atn. Degru	gree C e C							
Dens: Visco	ity of air-s <sup>.</sup> osity of air-	team mixtu -steam n.ix	ure= 1.37681E-0 kture= 1.850451	03 G/CC 2-04 Pois	e					•		
Dens: Visco	ity of drople osity of drop	et liquid- plet liqui	97804 ( Ld= 4.10621E-03	G/CC B Poise								
Diff Diff	. coeff. of ( . coeff. of )	elemental methyl 12	12 in air-steam in air-steam mi	n mixture  xture=	= 8.09 .10580	251E-02	sq. cm/sec	/sec C				
Diff Diff	. coeff. of ( . coeff. of )	elemental methyl 32	12 in droplet 1 in droplet liqu	liquid= 1id= 3.5	3.25696 1727E~(	5E-05 sq. )5 sq. cm	. cm/sec	2		•		
Schm Schm Grasi	idt number fo idt number fo hof number-	or element or methyl 4.51192E-	tal 1001ne= 1. 10dine= 1.27( +12 395-02	. 6608 )4								
Drop	parameters : (For )	for elener mean drop)	ntal						ı.			
I	Diameter 1 CM	Fall Tine SEC	Reynolds M.J CN	C.Coeff G M/SEC	т.V См/s	7. d	lrop no.	•				
37	9.3059E-02	6.349	245.0	11.41	353	.9	407.1					
I	Diameter : CM	Sherwood	Time Sa	at. Frac.	M.T.C CN	coeff L I/SEC	Remova /HR	a1				
37	9.3059E-02	5.434	9.55202-02	.5537	2.30	28E-03	2.698					

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			TION SH		ICCN NO./ PRELIM. CC	N NO.	<u> </u>	PAGE	E0	=				
Proie	ct or DCP/FCN/	ECP		 C	aic No.		)]		NVERS	ION:	•			
Subje	ct Containmer	at Aerosol a	and Iodine Remov	al Rates	•			She	et 2	54 of	281			
	ORIGINATOR	DATE			PEV			1 15						
	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003					<u></u>	DAIL	N COR			
<u> </u>											NDICK			
T P T	***********SPRAY otal elemental articulate iodi: otal organic re: ****REMOVAL DUE	REMOVAL removal c ne remova moval con TO WALL	RATES************************************	* 85 pe 59268 per	er hour per h hour	· . Dur								
E	Elemental removal rate due to wall deposition = 5.1040 per hour													
Organic removal rate due to wall deposition - 0.0000 per hour														
Organic removal rate due to wall deposition= .0000 per hour Mean drop diameter= 9.30589E-02 Temperature of air-steam mixture= 69.200 Degree C Pressure of air-steam mixture= 1.4459 Atm. Temperature of droplet liquid= 69.200 Degree C Density of air-steam mixture= 1.37681E-03 G/CC Viscosity of air-steam mixture= 1.85045E-04 Poise Density of droplet liquid= .97804 G/CC Viscosity of droplet liquid= 4.10621E-03 Poise Diff. coeff. of elemental 12 in air-steam mixture= 8.09251E-02 sq. cm/sec Diff. coeff. of elemental 12 in air-steam mixture= 1.0580 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid= 3.25696E-05 sq. cm/sec Diff. coeff. of methyl 12 in droplet liquid= 3.51727E-05 sq. cm/sec Schmidt number for elemental iodine= 1.2704 Grashof number= 5.56686E+12 Try mean diameter= 9.34011E-02 Drop parameters for elemental (For mean drcp)														
· :	Diameter 1 CM	Fall Time SEC	Reynolds M.: Cl	F.Coeff ( 1/SEC	T.V CM/S	'. drop	no.							
3	9.3401E-02	6.473	246.7	11.40	355	.0 · 604	.2							
	C Diameter : CM	Sherwooci	Time Sa	at. Frac.	м.т.( Ср	Coeff L Rem N/SEC /	oval HR							
3	9.3401E-02	5.450	9.6672E-02	.5579	2.29	944E-03 2.7	18							
f *	**************************************	REMOVAL I	RATES**********	r										
Т	otal elemental i	cemoval co	onstant= 2.718	86 pe	r hour									
Pa	articulate iodin	ne removal	L constant= .	53567	per ho	our								
T	tal organic rem	noval cons	stant= .00000	per	hour									
*	*****REMOVAL DUE TO WALL DEPOSITION*****													
ε	Elemental removal rate due to wall deposition = 5.1040 per hour													
Organic removal rate due to wall deposition= .00000 per hour														
N( T) P:	ean drop diamete emperature of air-s	er- 9.340 ir-steam r steam mixt	011E-02 nixture= 69.20 cure= 1.4459	)O De Atm.	gree C									

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Projec	t or DCP/FCN/E	ECP	•	C	alc No.	N-6030	-001		NVERS	ION:				
Subjec	containmen	it Aerosol a	und Iodine Remov	al Rates	• 			She	et _2	<u>55</u> of				
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINAT	OR DATE	IR	E	DATE	Ĕ			
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							N N N N N N N N N N N N N N N N N N N			
		<u> </u>		L						1	N			
De Vi De Vi Di Di Di Sc Sc Gr Tr	<pre>Temperature of droplet liquid= 69.200 Degree C Density of air-steam mixture= 1.37681E-03 G/CC Viscosity of air-steam mixture= 1.85045E-04 Poise Density of droplet liquid= .97804 G/CC Viscosity of droplet liquid= 4.10621E-03 Poise Diff. coeff. of elemental I2 in air-steam mixture= 8.09251E-02 sq. cm/sec Diff. coeff. of elemental I2 in air-steam mixture= .10580 sq. cm/sec Diff. coeff. of elemental I2 in droplet liquid= 3.25696E-05 sq. cm/sec Diff. coeff. of elemental I2 in droplet liquid= 3.51727E-05 sq. cm/sec Schmidt number for elemental iodine= 1.6608 Schmidt number for methyl iodine= 1.2704 Grashof number= 5.56686E+12 Try mean diameter= 9.35667E-02 Drop parameters for elemental (For mean drop) I Diameter Fall Time Reynolds M.T.Coeff G T.V. drop no. CM SEC CN/SEC CM/SEC</pre>													
	I Diameter Fall Time Reynolds M.T.Coeff G T.V. drop no. CM SEC CN/SEC CM/SEC													
37	9.3567E-02	6.815	247.5	11.40	35	5.5	799.3			I				
I	Diameter .: CM	Sherwood	Time S	at. Frac.	M.T.( Ci	Coeff L I M/SEC	Removal /HR							
37	9.3567E-02	5.457	.1014	.5728	2.2	903E-03 2	2.791							
**	**********SPRAY	REMOVAL	RATES*********	*										
To	tal elemental :	removal c	onstant= 2.79	13 pe	r: hour									
Pa	rticulate iodin	ne removal	l constant= .	63567	per h	our								
. To	tal organic rea	moval con:	stant= .00000	per	hour									
	***REMOVAL DUE	TO WALL	DEPOSITION*****											
El	emental removal	l rate due	e to wall depos	ition =	5.104	0 per 1	nour							
Or	ganic removal :	rate due f	to wall deposit	ion⇒ .0	0000	per hou	r							
Detended removal rate due to wall deposition = 0:000 per hour Mean drop diameter= 9.35667E-02 Temperature of air-steam mixture= 69.200 Degree C Pressure of air-steam mixture= 1.4459 Atm. Temperature of droplet liquid= 69.200 Degres C Density of air-steam mixture= 1.37681E-03 G/CC Viscosity of air-steam mixture= 1.85045E-04 Poise Density of droplet liquid= 4.10621E-03 Poise Diff. coeff. of elemental. I2 in air-steam mixture= 8.09251E-02 sq. cm/sec Diff. coeff. of methyl I2 in air-steam mixture= .10580 sq. cm/sec Diff. coeff. of elemental. I2 in droplet liquid= 3.25696E-05 sq. cm/sec Diff. coeff. of elemental iodine= 1.6608 Schmidt number for elemental iodine= 1.2704 Grashof number= 9.39347E-02 Drop parameters for elemental (For mean droo)														
	(For 1	mean drop	)											

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E&TS DEPARTMENT	IEET		ICCN NO./ PRELIM. CCN I	NO.		PAGE_	OF	:					
Project or DCP/FCN/ECP	·· C	alc No.	N-6030-001		CCN CO CCN NÓ	NVERSIC	PN:						
Subject Containment Aerosol and Iodine Remo	val Rates			· ·	She	et _256	j of	281					
REV ORIGINATOR DATE IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DATE	¥					
0 J. Schulz 8/15/2003 D. T. Dexheimer	8/15/2003							REV					
								QNI					
I Diameter Fall Time Reynolds M CM SEC	.T.Coeff G CM/SEC	5 T. CM/	V. drop no SEC	?•									
38 9.3955E-02 8.146 249.4	11.39	35	6.8 983.3	ł									
I Diameter Sherwood Time CM	Sat. Frac.	M.T.( Ci	Coeff L Remov M/SEC /HP	al									
38 9.3955E-02 5.475 .1202 .6266 2.2809E-03 2.181													
**************************************	**			•									
Total elemental removal constant= 2.1	810 pe	er hour											
Particulate iodine removal constant=	.56136	per h	our				Í						
Total organic removal constant0000	0 per	hour											
*****REMOVAL DUE TO WALL DEPOSITION****	*												
Elemental removal rate due to wall depo	sition =	5.104	D per hour				1						
Organic removal rate due to wall deposi	tion= .0	0000	per hour										
Elemental removal rate due to wall deposition = 5.1040 per hour Organic removal rate due to wall deposition = .00000 per hour Mean drop diameter = 9.35547E-02 Temperature of air-steam mixture = 69.200 Degree C Pressure of air-steam mixture = 1.4459 Atm. Temperature of droplet liquid = 69.200 Degree C Density of air-steam mixture = 1.37601E-03 G/CC Viscosity of air-steam mixture = 1.35045E-04 Poise Density of droplet liquid = 4.10621E-03 Poise Diff. coeff. of elemental. 12 in air-steam mixture = 0.09251E-02 sq. cm/sec Diff. coeff. of elemental. 12 in droplet liquid = 3.25696E-05 sq. cm/sec Diff. coeff. of methyl 12 in droplet liquid = 3.51727E-05 sq. cm/sec Diff. coeff. of methyl 12 in droplet liquid = 3.51727E-05 sq. cm/sec Schmidt number for elemental I Diameter Fall Time Reynolds M.T.Coeff C T.V. drop no. CM SEC CM/SEC 38 9.5232E-02 9.334 255.7 11.36 360.9 1955.													
I Diameter Sherwood lime CM	Sat. Fiac.	M.T.C	M/SEC /HP	al.		•							
38 9.5232E-02 5.534 .1341	.6629	2.2	503E-03 2.307				ĺ						
**************************************	** .												
Total elemental removal constant- 2.3	075 pe	r hour		-			{						
Particulate iodine removal constant=	.56136	per h	our										
Total organic removal constant= .0000	) per	hour											

		ULA	RTMENT	EET		ICCN NO./ PRELIM. CC	NO.		PAGE	E01		
Proiec	t or DCP/FCN/E	ECP		ċ	alc No.	N-6030-00			NVERS	ION:		
Subjec	t <u>Containmen</u>	t Aerosol a	nd Iodine Remov	al Rates	•			She	et _2	<u>57</u> of	281	
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	ε	DATE	g	
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003		······					A Star	
										<u> </u>	ž	
** E1	***REMOVAL DUE emental removal	TO WALL l rate du	DEPOSITION***** > to wall depos	ition =	5.104	) per hou	r					
Or	ganic removal i	rate due	to wall deposit	ion0	00000	per hour						
Me Te Pr De Vi Di Di Di Sc Sc Gr Tr Dr	Organic removal rate due to wall deposition .0000 per hourMean drop diameter 9.52322E-02Temperature of air-steam mixture 69.200 Degree CPressure of air-steam mixture 1.4459 Atm.Temperature of droplet liquid 69.200 Degree CDensity of air-steam mixture 1.37681E-03 G/CCViscosity of droplet liquid .97804 G/CCViscosity of droplet liquid 4.10621E-03 PoiseDiff. coeff. of elemental 12 in air-steam mixture 8.09251E-02 sq. cm/secDiff. coeff. of elemental 12 in droplet liquid - 3.25696E-05 sq. cm/secDiff. coeff. of methyl 12 in droplet liquid 3.51727E-05 sq. cm/secSchmidt number for methyl iodine 1.26608Schmidt number for methyl iodine 1.2704Grashof number = 9.55312E-02Drop parameters for elemental (for mean drop)I Diameter Fall Time Reynolds M.T.Coeff G T.V. drop no. CM SEC CM/SEC38 9.5531E-02 8.212 257.2 11.35 361.9 2931.											
38 I	9.5531E-02 Diameter S	8.212 Sherwood	257.2 Time S	11.35 at. Frac.	36: M.T.(	Coeff L Rem	l. oval					
38	CM 9.5531E-02	5.547	.1172	.6208	2-24	132E-03 2.1	61					
	*********SPRAY	REMOVAL	RATES********	*								
To	tal elemental :	removal c	onstant= 2.16	11 pe	er hour							
Pa	rticulate iodir	ne removal	l constant= .	57345	per h	our						
То	tal organic rem	noval con	stant= .00000	per	hour							
**	***REMOVAL DUE	TO WALL	DEPOSITION*****									
El	emental removal	L rate du	e to wall depos.	ition =	5.104	) per hou	r					
Or	ganic removal i	rate due '	to wall deposit	ion= .0	00000	per hour						
N0 Te Pr Te De Vi De Vi Di Di	an drop diameter mperature of air- mperature of dir- msity of air- scosity of air- nsity of drople scosity of drop ff. coeff. of m	er= 9.55 ir-steam mik coplet lin team mixt et liquid blet liquid blet liquid blet liquid blet liquid	312E-02 mixture= 69.20 ture= 1.4459 guid= 69.200 ure= 1.37681E-0 kture= 1.850450 = .97804 id= 4.10621E-00 I2 in air-steam m	00 De Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture ixture	egree C ee C ee 8.09 .10580	)251E-02 sq. ) sq. cm/	cm/sec sec					

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			RTMENT	FFT		ICCN I PRELI	NO./ M. CCN N	10.		PAGE	OF	·			
Projec				<b>، ع</b> عد ۲	sta No	N-6	030-001		CCN CO CCN NÓ	NVERSIO	DN:				
Subje	ct <u>Containmen</u>	nt Aerosol :	and Iodine Remov	al Rates					She	et _25	<u>3</u> of	281			
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGI	NATOR	DATE	IR	E I	DATE				
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003								REV			
		1										R.			
D: D: So So Gi Ti	iff. coeff. of lff. coeff. of chmidt number f chmidt number f rashof number= cy mean diameter cop parameters	elementa). methyl IX for elemen for methyl. 1.1214703 for element	I2 in droplet in droplet lig tal iodine= 1 iodine= 1.27 +13 77E-02 ntal	liquid= uid= 3.5 .6608 04	3.2569 1727E-	6E-05 sc 05 sq. c	q. cm/sec cm/sec	2							
	(For	mean drop	)												
:	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff C M/SEC	т. См/	V. SEC	drop no.	•		•					
30	38 9.5758E-02 9.486 258.4 11.34 362.6 3901. I Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal														
	I Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal CM CM/SEC /HR 38 9.57588-02 5.558 .1348 .6652 2.2379E-03 2.315														
38	38 9.5758E-02 5.558 .1348 .6652 2.2379E-03 2.315														
**	**************************************	REMOVAL	RATES*********	*											
Т	stal elemental	removal c	onstant= 2.31	55 pe	r hour										
PI	articulate iodi	ne remova	l constant= .	57345	per h	our									
Т	otal organic re	moval con	stant= .00000	per	hour										
	****REMOVAL DUE	TO WALL	Deposition*****												
E	lemental remova	l rate du	e to wall depos	ition =	5.104	D pe	er hour								
01	ganic removal	rate due	to wall deposit	ion0	0000	per 1	nour								
Me Te	an drop diamet	er= 9.57 1r-steam	577E-02 mixture= 69.2	00 De	gree C										
PI	mperature of d	steam mix roplet li	ture= 1.4459 quid= 69.200	Atm. Degre	e C					•					
De Vi	scosity of air-s. scosity of air	team mixt -steam mix	ure= 1.37681E- xture= 1.85045	U3 G/CC E-04 Pois	e					•					
De Vi	ensity of dropl scosity of dro	et liquid plet liqu	= .97804 id= 4.10621E-0	G/CC 3 Poise											
Di Di	ff. coeff. of ff. coeff. of	elemental methyl 12	I2 in air-stea in air-steam m	m mixture ixture=	= 8.0 .1058	9251E-02 D sc	2 sq. cm, q. cm/see	/sec C							
Di	ff. coeff. of ff. coeff. of	elemental methyl 12	I2 in droplet in droplet lig	liquid= uid= 3.5	3.2569 1727E-	6E-05 sc 05 sq. c	g. cm/sec	2							
Sc Sc GI TI	hmidt number f hmidt number f ashof number= y mean diamete	or eleman or methyl 1.43723E r= 9.585	tal iodine= 1 iodine= 1.27 +13 39E-02	.6608 04			,								
Di	op parameters {For	for elene mean drop	ntal >												
. 1	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	т. См/	V. SEC	drop no	•							
38	9.5854E-02	8.969	258.8	11.34	36	2.9	4872.								
I I	Diameter CM	Sherwood	Time S	at. Frac.	M.T.C	Coeff L M/SEC	Remova /HR	al							
SCE 26-	426 REV. 2 (REF	ERENCE: S	0123-XXIV-7.15]			<u> </u>			···	N-603	0-001 Re	v 0.doc			

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		STS DEPA	RTMENT	HEET		ICCN N PRELIM		NO.		PAGE	:o	F
Project	or DCP/FCN/	ECP	•	C	alc No.	N-60	30-001		CCN CO CCN NO	NVERS	ION:	
Subject	Containmer	nt Aerosol a	nd Iodine Rem	oval Rates	•				She	et _2	<u>59</u> of	281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE	IR	E	DATE	В
0	J. Schulz	8/15/2003	D. T. Dexheime	er 8/15/2003								] & Š
		,			L				<u> </u>		<u> </u>	Ž
<pre>38 9.5854E-02 5.562 .1272 .6470 2.2357E-03 1.126 ************************************</pre>												
I	Diameter : CM	Fall Time SEC	Reynolds	M.T.Coeff ( CM/SEC	: Т. СМ/	V. · · ·	irop no	•				
38	9.5929E-02	9.335	259.2	11.34	36	3.2	5841.					
I	Diameter : CM	Sherwood	Time	Sat. Frac.	M.T. C	Coeff L M/SEC	Remov /HF	ral L				
38	9.5929E-02	5.566	.1322	.6592	2.2	339E-03	1.147	,				
***	********SPRAY	REMOVAL	RATES*******	***								1
Tota	al elemental :	removal c	onstant= 1.	1473 pe	r hour							
Particulate iodine removal constant= .31145 · per hour												
Total organic removal constant= .00000 per hour												
***	**REMOVAL DUE	TO WALL	DEPOSITION***	**								
Elemental removal rate due to wall deposition = 5.1040 per hour												
Orga	anic removal :	rate dus :	to wall depos	ition≕`.0	0000	per ho	our					

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			ICCN NO	D./ I. CCN N	10.		PAG	E	0F	;			
Projec	t or DCP/FCN/E	CP		C	alc No.	N-603	80-001		CCN CO CCN NO	NVER	SION: N	•	
Subje	ct Containmen	t Aerosol a	and Iodine Remov	al Rates				<u> </u>	She	et _	260	of	281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE	IR	E	DA	TE	œ
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003									REV ICATO
													QN
Ma Te De Vi Di Di Di Di Soc Soc Soc Soc Soc Soc Soc Soc Soc Soc	an drop diameter imperature of air- imperature of air- iscosity of air- scosity of air- scosity of air- scosity of drop ff. coeff. of e ff. dt number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for ashof number for	er- 9.59 ir-steam mix roplet li team mixt steam mixt steam mixt steam mixt steam mixt steam mixt lemental methyl 12 or elemen ar methyl 12 or elemen ar methyl 12 or elemen for elemen sec 9.046 sherwood 5.567 REMOVAL 1 semoval cons to wall cons to wall cons to wall on ste due ste due trate due trate due	290E-02 mixture= 69.2 ture= 1.4459 quid= 69.200 ure= 1.37681E- kture= 1.85045 = .97804 id= 4.10621E-0 12 in air-steam m 12 in droplet 11q tal iodine= 1 iodine= 1.27 +13 01E-02 mtal Reynolds M. C 259.4 Time S .1280 RATES************************************	100 De Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture ixture= liquid= uid= 3.5 .6608 04 T.Coeff G M/SEC 11.34 at. Frac. .6491 + 96 pe 31420 per ition = ion= .0 00 De	agree C ee C = 8.01 .10584 2.2569 1727E-4 361 M.T.C CM/1 361 2.21 er hour per ho hour 5.1040 00000 gree C	9251E-02 9 sq. 6E-05 sq. 05 sq. cm 9. 9. 9. 9. 9. 9. 9. 9. 9. 9.	sq. cm cm/se cm/sec cm/sec lrop no 6810. Remov /HR 1.130	/Bec c					
Organic removal rate due to wall deposition= .00000 per hour Mean drop diameter= 9.53701E-02 Temperature of air-steam mixture= 69.200 Degree C Pressure of air-steam mixture= 1.4459 Atm. Temperature of droplet liquid= 69.200 Degree C Density of air-steam mixture= 1.37681E-03 G/CC Viscosity of air-steam mixture= 1.85045E-04 Poise Density of droplet liquid= .97804 G/CC Viscosity of droplet liquid= 4.10621E-03 Poise Diff. coeff. of elemental I2 in air-steam mixture= 8.09251E-02 sq. cm/sec Diff. coeff. of elemental I2 in droplet liquid= 3.25696E-05 sq. cm/sec Diff. coeff. of methyl I2 in droplet liquid= 3.51727E-05 sq. cm/sec Schmidt number for elemental idine= 1.6608 Schmidt number = 1.47576E+13 Try mean diameter= 9.60117E-02													

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		ATS DEP	ARTMENT	EET		ICCN NO./ PRELIM. CCN I	NO		PAGE	0	 F
Project o	or DCP/FCN/	ECP	<b></b>	 c	alc No.	N-6030-001	<u> </u>		NVERSI	ON:	
Subject	Containmer	nt Aerosol a	and Iodine Remov	al Rates		· · · · · · · · · · · · · · · · · · ·	·	She	et _26	i of	281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DATE	g
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							<b>B</b> RA
				[	L		l			<u></u>	2
Drop	parameters {For	for eleme mean drop	ntal :								
I.	Diameter CM	Fall Time SEC	Reynolds M. Ci	T.Coeff ( M/SEC	G T. CM/3	V. drop no SEC	•				
38	9.6012E-02	9.415	259.6	11.34	36	3.4 7779.					
I	Diameter CM	Sherwood	Time S	at. Frac.	. M.T.( C	Coeff L Remov M/SEC /HR	al	,			1
38	9.6012E-02	5.569	.1331	.6615	2.2	320E-03 1.151			•		
	*******SPRAY	REMOVAL	RATES*********	*							
Tota	l elemental	removal c	onstant= 1.15	13 pe	er hour				•		
Part	iculate iodi	ne remova	L constant= .	31420	per h	our			•		
Tota	l organic re	moval con	stant00000	per	t.our						
****	*RENOVAL DUE	TO WALL	DEPOSITION*****								
Elem	ental removal	l rate du	e to wall depos	ition =	5.104	0 per hour					
Orga	nic removal	rate due l	to wall deposit:	ion= .0	0000	per hour					ļ
Mean	drop diamet	er= 9.60	117E-02								
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Project	or DCP/FCN/E	CP		c	alc No.	N-6030-001		CCN CO CCN NO	NVERS	ION:				
Subject	Containmen	t Aerosol a	and Iodine Remov	al Rates	•			She	et _2	<u>62</u> of	281			
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DATE	œ			
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							LCATO LCATO			
											<u>n</u>			
Bec (C) Ori Pro Sub	9.2.2.9 48 1 thtel Standard 1991 ginator Jorge ject SONGS ject 12 Spray	to <b>96 hr (</b> Computer Schulz Max Tem	Dutput File (i2- Program Date 14 9 48 - 96 hr	<i>max07.0</i> REMOVE Jun 2003	u() NE305 Calc I Checke Job No Sheet	Version 4.0 No. N-6030-00 R d Date 5. 16575-167 No. 1	ev No. C							
	Standard Computer Program NE305 REMOVE Version 4.0 for the IBM PC/XT/AT													
	AL Th Sp di	estract: e REMOVE pray remc ameter c	program calcul val rate consta r drop trajecto	ates the nts and a ries	contain mean d	ument irop								
Bec (c) Ori Pro Sub	Output in fi htel Standard 1991 ginator Jorge ject SONGS ject I2 Spray	le 12-m2: Computer Schulz Max Tern	x07.out was crea Program Date 14 Date 14 p 48 - 96 hr	ated on J REMOVE , Jun 2003	A Jun 2 NE305 1 Calc 1 Checke Job No Sheet	2003 at 11:12: Version 4.0 No. N-6030-00 P ed Date Date No. 2	48 .ev No. (							
Tem Pre Tem Den Vis Den Vis Dif Dif Dif	perature of ai ssure of air-s perature of dr sity of air-st cosity of drople cosity of drople cosity of drop f. coeff. of e f. coeff. of m f. coeff. of m midt number fo	r-steam i team mix oplet lid eam mix steam mix t liquid it liquid lemental ethyl I2 lemental ethyl I2 r elemen	mixture= 59.00 ture= 1.3023 guid= 59.000 ure= 1.30967E- kture= 1.857511 = .98339 id= 4.75969E-01 I2 in air-steam mi I2 in droplet 1 in droplet 1 in droplet 1 in droplet 1 in dire= 1	00 De Atm. Degre 03 G/CC E-04 Poi: G/CC 3 Poise m mixture ixture 1iquid= 1iquid= 2.9 .6858	egree C ee C :e 8,41 .10990 2.72609 94397E-0	1306E-02 sg. cm ) sq. cm/se )E-05 sg. cm/se )5 sq. cm/sec	l/sec c c							
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		SULA	RTMENT		ICCN NO	D./ . CCN N	10.		PAGE	0	F		
Projec	t or DCP/FCN/	ECP		C	alc No.	N-603	80-001		CCN CO CCN NO	NVERS	ION:		
Subje	ct Containmer	nt Aerosol a	nd Iodine Remov	al Rates					She	et	<u>63</u> of		
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE	· IRI		DATE	e e	
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003			•					LE LO	
	· ·												
Sc Gr Tr	chmidt number f cashof number= cy mean diamete	or methyl 3.68496E r= 9.215	iodine= 1.29 +12 41E-02	06	·								
Dz	op parameters (For	for eleme mean drop	ntal )										
1	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	; T. CM/:	v. d SEC	lrop no	•			•		
37	9.2154E-02	5.893	232.9	11.78	35	3.5	205.8		1	•			
נ	Diameter CM	Sherwood	Time S	at. Frac.	M.T.( Cl	Coeff L 4/SEC	Remova /HR	a1		•			
37	9.2154E-02	8.654	7.5662E-02	.5552	1.9	464E-03	2.074						
	********** SPRAY	REMOVAL	RATES*********	*							•		
***********SPRAY REMOVAL RATES************************************													
Total elemental removal constant= 2.0745 per hour Particulate iodine removal constant= .59268 per hour													
Тс	tal organic re	moval con	stant= .00000	per	hour								
**	***REMOVAL DUE	TO WALL	DEPOSITION*****						•				
EI	emental remova	l rate du	e to wall depos:	ition =	5.096	3 per	hour						
Or	ganic removal	rate due	to wall deposit:	ion= .0	0000	per ho	ur					1	
Me Te	an drop diamet mperature of a	er= 9.21 ir-steam	541E-02 mixture= 59.00	00 De	gree C								
Pr Te	essure of air- mperature of d	steam mix roplet li	ture= 1.3023 quid= 59.000	Atm. Degre	e C				•				
De Vi	nsity of air-s scosity of air	team mixt -steam mi	ure= 1.30967E-0 xture= 1.857510	D3 G/CC E-04 Pois	e.								
De Vi	nsity of drople scosity of drop	et liguid plet liga	= .98339 ( id= 4.75969E-0	3/CC } Poise						•			
Di Di	ff. coeff. of a ff. coeff. of a	elemental methyl I2	I2 in air-stear in air-steam m	n mixtur⊕ Lxture=	≈ 8.42 .1099	1306E-02 ) sq.	sq. cm. cm/sec	/sec c					
Di Di	ff. coeff. of a ff. coeff. of a	elemental methyl 12	12 in droplet 1 in droplet light	liquid= aid= 2.9	2.7260 4397E-0	9E-05 sq. 05 sq. cπ	cm/sec	C			•		
Sc Sc	hmidt number fe	or elemen or methyl	tal iodine= 1. iodine= 1.290	.6858 06									
Gr Tr	ashof number <del>.</del> y mean diamete.	3.68496E r= 9.312	+12 01E-02										
Dr	op parameters : (For )	for elemen mean drop	ntal )				·						
I	Diameter CM	Fall Time SEC	Reynolds M.1 Cl	C.Coeff G 4/SEC	т. См/1	7. d	rop no	•		•			
37	9.3120E-02	6.191	237.5	11.75	36	L.8	405.3						
I	Diameter : CM	Sherwood	Time Sa	st. Frac.	м.т.¢ С1	Coeff L M/SEC	Remova /HR	al					
37	9.3120E-02	8.725	7.7853E-02	.5645	1.92	262E-03	2.109						

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E&TS DEPARTMENT CALCULA'TION SHEET

ICCN NO./ PRELIM. CCN NO.

PAGE\_\_\_

Project or	DCP/FCN/ECP	Calc No.	N-6030-001
Subject	Containment Aerosol and Iodine Removal Rates	• •	

CCN CONVERSION: CCN NO. CCN

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OF

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	¥		
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003						<b>S</b> <b>M</b>		
										E E		
<pre>************************************</pre>												
. I	Diameter I CM	Fall Time SEC	Reynolds M. C	T.Coeff ( M/SEC	T. CH/	V. drop no SEC	· ·					
37	9.3434E-02	6.300	239.0	11.74	36	2.8 601.8	3					
I	Diameter S CM	Sherwood.	Time S	at. Frac.	M.T. C	Coeff L Remov M/SEC /HI	7al R					
37	9.3434E-02	8.748	7.8690E-02	.5679	1.9	197E-03 2.12	2					
**	**********\$Pray	REMOVAL	RATES*********	*								
То	tal elemental :	cemoval c	onstant= 2.12	18 p.	er hour							
Pa	rticulate iodin	ne removal	l constant= .	63567	per h	our						
То	tal organic rem	aoval cons	stant= .00000	per	hour							
**	***REMOVAL DUE	TO WALL	DEPOSITION*****									
El	emental removal	L rate du	e to wall depos	ition =	5.096	3 per hour						
Or	ganic removal 1	cate due	to wall deposit	ion(	00000	per hour						
Me Te Pr	an drop diamete mperature of ai essure of air-s	er- 9.34 ir-stean n steam mix	340E-02 mixture≖ 59.0 ture≃ 1.3023	00 · De Atm.	egree C							

SCE 26-426 REV. 2 [REFERENCE: SO123-XXIV-7.15]

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**E&TS DEPARTMENT** ICCN NO./ CALCULATION SHEET PRELIM. CCN NO. PAGE OF **CCN CONVERSION:** CCN NO. CCN Project or DCP/FCN/ECP Calc No. . N-6030-001 Sheet Subject Containment Aerosol and Iodine Removal Rates 265 of 281 ORIGINATOR REV ORIGINATOR DATE IRE DATE REV DATE IRF DATE REV INDICATOR J. Schulz 8/15/2003 D. T. Dexheimer 8/15/2003 0 Temperature of droplet liquid= 59.000 Deg: Density of air-steam mixture= 1.30967E-03 G/CC Degree C Viscosity of air-steam mixture= 1.85751E-04 Poise Density of droplet liquid: .98339 G/CC Viscosity of droplet liqu:d= 4.75969E-03 Poise Diff. coeff. of elemental I2 in air-steam mixture= 8.41306E-02 sg. cm/sec Diff. coeff. of methyl 12 in air-steam mixture .10990 sq. cm/sec Diff. coeff. of elemental 12 in droplet liquid= 2.72609E-05 sq. cm/sec Diff. coeff. of methyl 12 in droplet liquid= 2.94397E-05 sq. cm/sec Schmidt number for elemental iodine= 1.6858 Schmidt number for methyl iodine= 1.2906 Grashof number= 4.54656E+12 Try mean diameter= 9.35877E-02 Drop parameters for elemental (For mean drop) Diameter Fall Time Reynolds M.T.Coeff G T.V. drop no. CM/SEC CM SEC CM/SEC 37 9.35888-02 6.649 239.7 11.74 363.3 796.3 Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal I CM/SEC /HR CM 37 9.3588E-02 8.760 8.2773E-02 .5827 1.9166E-03 2.177 Total elemental removal constant= 2.1770 per hour Particulate iodine removal constant= .63567 per hour .00000 per hour Total organic removal constant= \*\*\*\*\*REMOVAL DUE TO WALL DEPOSITION\*\*\*\*\* Elemental removal rate due to wall deposition = 5.0963 per hour Organic removal rate due to wall deposition= .00000 per hour Mean drop diameter= 9.35877E-02 Temperature of air-steam mixture= 59.000 Degree C Pressure of air-steam mixture= 1.3023 Temperature of droplet 1.quid= 59.000 Atm. Degree C Density of air-steam mixture= 1.30967E-03 G/CC .Viscosity of air-steam mixture= 1.85751E-04 Poise Density of droplet liquid .98339 G/CC Viscosity of droplet liquid = 4.75969E-03 Poise Diff. coeff. of elemental I2 in air-steam mixture= 8.41306E-02 sq. cm/sec Diff. coeff. of methyl I2 in air-steam mixture= .10990 sq. cm/sec Diff. coeff. of elemental I2 in droplet liquid= 2.72609E-05 sq. cm/sec Diff. coeff. of methyl I2 in droplet liquid= 2.94397E-05 sq. cm/sec Schmidt number for elemental iodine= 1.6858 Schmidt number for methyl iodine= 1.2906 Grashof number= 8.59187E+12 Try mean diameter= 9.39515E-02 Drop parameters for elemental (For mean drop)

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**E&TS DEPARTMENT** ICCN NO./ **CALCULATION SHEET** PRELIM. CCN NO. PAGE OF **CCN CONVERSION:** CCN NO. CCN Project or DCP/FCN/ECP Calc No. N-6030-001 Containment Aerosol and Iodine Removal Rates Subject Sheet 266 of 281 REV ORIGINATOR DATE IRE DATE REV ORIGINATOR DATE IRE DATE REV INDICATOR 8/15/2003 D. T. Dexheimer 8/15/2003 J. Schulz 0 Ĩ Diameter Fall Time Reynolds M.T.Coeff G T.V. drop no. SEC CM/SEC CM/SEC ĈМ 38 9.3952E-02 241.5 980.4 7.938 11.73 364.5 Sat. Frac. M.T.Coeff L Removal Diameter Sherwood Time Ť CM/SEC · CM /HR 38 9.39522-02 8.787 9.8067E-02 .6330 1.9092E-03 1.689 Total elemental removal constant= 1.6891 per hour Particulate iodine removal constant= .56136 per hour Total organic removal constant= .00000 per hour \*\*\*\*\*REMOVAL DUE TO WALL DEPOSITION\*\*\*\*\* Elemental removal rate dre to wall deposition = 5.0963 per hour Organic removal rate due to wall deposition= .00000 per hour Mean drop diameter 9.35515E-02 Temperature of air-steam mixture= 59.000 Degree C Pressure of air-steam mixture= 1.3023 Temperature of droplet liquid= 59.000 Atm. Degrea C Density of air-steam mixture= 1.30967E-03 G/CC Viscosity of air-steam mixture= 1.85751E-04 Poise Density of droplet liquid= .98339 G/CC Viscosity of droplet liquid= 4.75959E-03 Poise Diff. coeff. of elemental I2 in air-steam mixture= 8.41306E-02 sq. cm/sec Diff. coeff. of methyl II: in air-steam mixture= .10990 sq. cm/sec Diff. coeff. of elemental. I2 in droplet liquid= 2.72609E-05 sq. cm/sec Diff. coeff. of methyl IS in droplet liquid= 2.94397E-05 sq. cm/sec Schmidt number for elemental iodins= 1.6858 Schmidt number for methyl iodine= 1.2906 Grashof number= 8.468251:+12 Try mean diameter= 9.52286E-02 Drop parameters for elemental (For mean drop) Diameter Fall Time Reynolds M.T.Coeff G T.V. drop no. 1 CM/SEC CM/SEC CM SEC 38 9.5229E-02 9.109 247.6 11.69 368.8 1950. Ĩ Diameter Sherwood Time Sat. Frac. M.T.Coeff L Removal CM CM/SEC /HR 38 9.5229E-02 8.881 .1095 .6672 1.8836E-03 1.780 Total elemental removal constant= 1,7805 ' per hour Particulate iodine removal constant-.55865 per hour Total organic removal constant= .00000 per hour

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E&TS DEPARTMENT       ICCN NO./         CALCULATION SHEET       PRELIM. CCN NO.         Project or DCP/FCN/ECP       Calc No.         N-6030-001       CCN CONVERSION:         CCN NO.       CCN													
					1			CCN CC	NVERS	ION:			
Projec	t or DCP/FCN/E	ECP	·	Ċ	alc No.	N-6030-0	01	CCN NO	). CCN		•		
Subjec	t Containmen	t Aerosol a	nd Iodine Remov	al Rates	•			She	et _2	<u>67</u> of	281		
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATO	R DAT	E IR	E	DATE	щ		
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							25		
										<u> </u>	Ē		
** El Or Me Te De Vi De Vi Di Di Di Sc Gr Tr Dr I	***REMOVAL DUE emental removal ganic removal re- mperature of air- mperature of air- mperature of dinsity of air- scosity of air- scosity of air- ff. coeff. of air- ff. coeff. of a ff. t number for ashof number- y mean diameter (For r Diameter i CM	TO WALL I I rate due rate due er= 9.52 ir-steam in toplet li team mixt -steam	DEPOSITION***** to wall deposit: 286E-02 mixture= 59.0 ture= 1.3023 guid= 59.000 ure= 1.30967E xture= 1.85751 = .98339 id= 4.75969E-00 T2 in dir-steam m T2 in droplet lig tal iodine= 1 iodine= 1.29 +12 96E-02 mtal Reynolds M.°	ition - ion .C Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise m mixture ixture- liquid= uid= 2.9 .6858 06 T.Coeff G M/SEC	5.096 00000 00000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 000	per hour per hour 1306E-02 sq. 3 sq. cm 2E-05 sq. cm 5 sq. cm/se 7. drop	cm/sec h/sec h/sec c c						
38 I	9.5530E-02 Diameter S	8.002 Sherwood	249.1 Time S	11.69 at. Frac.	369 M.T.C	0.8 29 Coeff L Re	23. moval						
	CM	8 903	9 5616F-02	. 6271	CN 1 8-	1/SEC	/HR 673						
36	9.000UE-V2	0.303		• ¥2 f 3	1.0	,,02-03 ¥,	010				}		
** To Pa	***********SPRAY tal elemental p rticulate iodir tal organic rem	REMOVAL I cemoval co ne removal	CATES************************************	* 36 pe 57345 Der	er hour per ho hour	bur			·				
++	***	TO WATT. I	TEPOSTETON*****	•									
				ltion	E 00/7								
Ord	emental removal ganic removal r	ate due t	e to wall deposition wall deposition	ion= .0	5.0963 0000	per hour	υr						
Me. Ter Ter De: Vi De: Vi De:	an drop diameter mperature of air- mperature of di nsity of air-st scosity of air- nsity of drople scosity of drople ff. coeff. of m	er= 9.552 ir-steam mixt oplet lic ceam mixtu- steam mixtu- steam mixtu- st liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid- blet liquid-	296E-02 mixture= 59.00 cure= 1.3023 yuid= 59.000 ore= 1.30967E-0 (ture= 1.857511) 98339 ( d= 4.75969E-03 I2 in air-steam mi	00 De Atm. Degre D3 G/CC E-04 Pois G/CC 3 Poise m mixture ixture-	gree C e C e 8.41 .10990	306E-02 sq. 9 sq. cn	cm/sec N/sec						

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Project	or DCP/FCN/I	ECP		C	alc No.	N-60	30-001		CCN CO CCN NÓ	NVERS	ON:	
Subjec	t Containmer	nt Aerosol a	nd Iodine Remov	al Rates	. <u></u>				She	et _2	58 of	281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGIN	ATOR	DATE	IRI		DATE	ĸ
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003								A S S S S S S S S S S S S S S S S S S S
						. <u> </u>	·					ž
Di Di Scl Scl Gra Tr	ff. coeff. of ff. coeff. of mmidt number f hmidt number f ashof number= y mean diamete	elemental methyl II: or elemen or methyl 9.15923H r= 9.575	I2 in droplet in droplet liq tal icdine= 1 icdine= 1.29 +12 76E-02	liquid <del>=</del> uid= 2.9 .6858 06	2.72609 4397E-0	)E-05 sq. 15 sq. cf	. cm/sec n/sec	c				
	(For	mean drop	)									ļ .
ľ	Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	T.V. . CM/S	r. «	irop no	•				
<sup>.</sup> 38	9.5758E-02	9.299	250.2	11.68	370	.5	3890.					
I	Diameter CM	Sherwood	Time S	at. Frac.	M.T.C Cł	Coeff L N/SEC	Remov: /HR	al				
38	9.5758E-02	8.919	.1106	.6705	1.87	32E-03	1.789					
**	********SPRAY	REMOVAL	RATES*********	*								•
Tot	tal elemental	removal co	onstant= 1.78	94 pe	r hour							
Pa	rticulate iodi	ne removal	l constant= .	57345	per ho	our					:	
Tot	tal organic re	moval con	stant= .00000	per	hour					•		
<b>**</b>	***REMOVAL DUE	TO WALL	DEPOSITION*****									
Ele	emental remova	l rate di	e to wall depos	ition =	5.0963	per per	r hour					
Org	ganic removal .	rate due :	to wall deposit	ion= .0	0000	per ho	our					
Mea Ter Pre Ter Der Vis Der	an drop diamet mperature of a assure of air- mperature of d isity of air- sity of air- sity of air- sity of air	er- 9.57 ir-steam mixt steam mixt roplet lic team mixt steam mix et liquid	576E-02 mixture= 59.0 cure= 1.3023 guid= 59.000 ire= 1.30967E- cture= 1.85751 98339	00 De Atm. Degre 03 G/CC E-04 Pois G/CC	gree C e C e							
Vi Dii Dii Dii Sch Gra Try	scosity of dro ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a build number for unidt number for ashof number= y mean diamete	plet ligu: elemental methyl I2 elemental methyl I2 or element or methyl 1.17381E r= 9.585	<pre>La= 4.75969E-0 I2 in air-steam in air-steam m I2 in droplet liq cal iodine= 1 iodine= 1.29 -13 L2E-02</pre>	3 Poise m mixture= ixture= liquid= uid= 2.9 .6858 06	- 8.41 .10990 2.72609 4397E-0	306E-02 5 sq. E-05 sq. 5 sq. Cl	sq. cm cm/sec cm/sec	/sec 2				
Dro	p parameters : (For )	for elemen mean drcp)	htal									
I	Diameter : CM	Fall Time SEC	Reynolds M. C	<b>I.C</b> oeff G M/SEC	T.V Cm/s	EC C	lrop no	•		: : .		
38	9.5851E-02	8.743	250.6	11.68	370	.9	4858.					
I	Diameter CM	Sherwood	Time S.	at. Frac.	M.T.C CM	oeff L /SEC	Remova /HR	31				

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Projec	or DCP/FCN/	ECP		- — C:	aic No.	N-603(	)-001		CCN CO CCN NO	NVERS CCN	ION:		
Subjec	t <u>Containme</u>	nt Aerosol	and Iodine Remo	val Rates	•			`	She	et _2	<u>69</u> of	281	
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINA	TOR	DATE	IRI		DATE	<u> </u>	
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003									
<pre>38 9.5851E-02 8.926 .1038 .6517 1.8713E-03 .8695 ************************************</pre>													
Dr	op parameters (For	for elem: mean drop	ntal )										
, I	Diameter CM	Fall Time SEC	Reynolds M	.T.Coeff G CM/SEC	; 3. CN/:	V. dr SEC	rop no.						
38	9.5926E-02	9.116	251.0	11.68	37:	1.1	5824.						
I	Diameter CM	Sherwood	Time	Sat. Frac.	M.T.( Ci	Coeff L M/SEC	Remova /HR	1					
38	9.5926E-02	8.932	.1080	.6637	1.8	599E-03	.8855						
**	**************************************	REMOVAL	RATES********	**									
To Pa To	tal elemental rticulate iodi tal organic re	removal c ine remova emoval con	onstant= .88 l constant= stant= .0000	558 pe .31145 0 per *	r hour per ho hour	our							
51	Planantal removal rate due to wall denotition r 5 0963 per bour												
Or	ganic removal	rate due	to wall deposi	tion .(	0000	per per	ir				:		

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			RTMENT	EET		ICCN NO./ PRELIM. CCN N	10.	· · · · · ·	PAGE	0	=		
Proiec	roject or DCP/FCN/ECP Calc No. N-6030-001 CCN NO. CCN ubject Containment Aerosol and Iodine Removal Rates Sheet 270 of281												
Subjec	t <u>Containmen</u>	t Aerosol a	nd Iodine Remov	al Rates		110050-001	· '	She	et _2	70 of	281		
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DATE	~		
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							ICATO ICATO		
											2		
Me Te Pr De Vi Di Di Di Sc Gr Tr Tr I 38	an drop diameter mperature of air- mperature of di nsity of air- scosity of air- scosity of drop ff. coeff. of e ff. coeff. of e ff. coeff. of e ff. coeff. of e hmidt number fo hmidt number fo ashof number y mean diameter op parameters f (For m Diameter I CM 9.5968E-02 Diameter S	er= 9.59 ir-steam mix coplet li team mixt -steam mi to st liquid plet liquid plet liquid plet liquid plet liquid pethyl 12 por elemental methyl 12 por elemental 1.20528E c= 9.5966 for elemen sEC 6.818 Sherwood	264E-02 nixture= 59.0 ture= 1.3023 guid= 59.000 are= 1.30967E- kture= 1.85751 = .98339 id= 4.75969E-0 I2 in air-steam m I2 in droplet lig tal iodine= 1.29 +13 BlE-02 htal Reynolds M. Cl 251.2 Time S.	00 De Atm. Degre 03 G/CC 5-04 Poise mixture ixture= liquid= 2.9 .6858 06 T.Coeff G M/SEC 11.68 at. Frac.	egree C ee C := 8.41 .10990 2.72609 4397E-( 4397E-( CM/S .37) M.T.(	L306E-02 sq. cm ) sq. cm/se )E-05 sq. cm/sec )5 sq. cm/sec ). drop no SEC L.2 6792. Coeff L Remov	/sec c	•		· ·			
	CM	0 075	1044	6536	Ct 1 81	4/SEC /HR							
38	3.3300L-UZ	REMOVAL I	.1044 RATES*********	*	1.0								
То	tal elemental 1	cemoval co	onstant872	13 ре	r hour	. •							
Pa	rticulate iodir	ne removal	l constant= .	31420	per ho	our		•			ļ		
То	tal organic rem	noval cors	stant00000	per	hour					:			
· **	***REMOVAL DUE	TO WALL I	DEPOSITION*****	(	E 000	)			•				
El	emental removal a	ate due 1	e to wall deposit:	ion= .0	0000	per hour							
Me Te Pr Te De Vi Di Di Di C SC Gr Tr	Mean drop diameter= 9.55681E-02 Temperature of air-steam mixture= 59.000 Degree C Pressure of air-steam mixture= 1.3023 Atm. Temperature of droplet liquid= 59.000 Degree C Density of air-steam mixture= 1.30967E-03 G/CC Viscosity of air-steam mixture= 1.85751E-04 Poise Density of droplet liquid= .98339 G/CC Viscosity of droplet liquid= 4.75969E-03 Poise Diff. coeff. of elemental I2 in air-steam mixture= 8.41306E-02 sq. cm/sec Diff. coeff. of methyl I2 in air-steam mixture= .10990 sq. cm/sec Diff. coeff. of methyl I2 in droplet liquid= 2.72609E-05 sq. cm/sec Diff. coeff. of methyl I2 in droplet liquid= 2.94397E-05 sq. cm/sec Schmidt number for elemental iodine= 1.6858 Schmidt number for methyl iodine= 1.2906 Grashof number= 1.20528E+13 Try mean diameter= 9.60097E-02												
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Proi	ect	or DCP/FCN/	ECP			C	alc No	N-6030	-001		CCN CO CCN NO	NVERS	ION:	
Sub	ject	Containme	nt Aerosol a	and Iodine Re	mov	al Rates	•			······ '	She	et _2	7 <u>1</u> of	
RE	<u>v T</u>	ORIGINATOR	DATE	IRE	<u> </u>	DATE	REV	ORIGINAT	OR	DATE	IR	E	DATE	Ψ
0		J. Schulz	8/15/2003	D. T. Dexhe	imer	8/15/2003								DICATO
ļ			1											ž
	Dro	p parameters (For	for eleme mean drop	ntal :				•						
	I	Diameter CM	Fall Time SEC	Reynolds	м. С	T.Coeff ( M/SEC	см/	V. dro SEC	op no.					
	38	9.6010E-02	9.194	251.4		11.67	37	1.4 .	7757.					]
	I	Diameter CM	Sherwood	Time	S	at. Frac.	N.T. C	Coeff L 1 M/SEC	Remova /HR	1				
	38	9.60105-02	8.938	.1088		.6658	1.8	682E-03	.8883					ł
	***	********SPRAY	REMOVAL	RATES*****	****	*								ĺ
	Tot	al elemental	removal c	onstant-	.888	38 pe	r hour						•	
	Par	ticulate iodi	ine remova	1 constant=	•	31420	per h	our	1					ŧ
	Tot	al organic re	emoval con	stant= .0	0000	per	hour							
ł	***	**REMOVAL DUE	E TO WALL	DEPOSITION*	****								•	ľ
1	Ele	mental remova	al rate du	e to wall d	epos.	11100 =	5.095	3 per 1	nour					
	org	anic removal	rate que	CO WALL DEP	051 C.	100= .0	1000	per nou	E.					
	меа	n drop diamet	ter= 9.00	0976-02										
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L SCE 2	6.4	A REV 2 IREE	ERENCE: S	0123-XXIV-7.	151							N-60	30-001 84	V 0 dag

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Djeci	t or DCP/FCN/E	ECP		C	alc No.	N-6030-001		CCN CON CCN NÓ.	VERS CCN	ION:	
bjec	t Containmen	t Aerosol a	and Iodine Remov	al Rates			•	Shee	t _2	72 of	_2
EV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE		DATE	T
>	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003			•				] ≩
Be (C Or Pr Su	9.2.2.10 96 chtel Standard ) 1991 iginator Jorge oject SONGS bject 12 Spray	to 720 hr Computer Schulz y Max Ten	<b>Output File (i2</b> Program Date 14 p 96 - 720 hr	- max08. REMOVE Jun 2003	(VUI) NE305 Calc 1 Check Job N Sheet	Version 4.0 No. N-6030-00 R edDate D. 16575-167 No1	ev No. 0	<b>-</b>			
			Standard Comp NE305 REMOVE • for the IBM	uter Prog Version PC/XT/AT	()ran 4.0						
	At Tr Sg di	ostract: ne REMOVIS pray remus ameter ()	program calcul val rate consta r drop trajecto	ates the nts and ( ries	contail a mean d	nment . drop					
						•			•		
Bec (C) Or: Pro Sult Ter Pro Ter Den Vi:	Output in fi chtel Standard ) 1991 iginator Jorge oject SONGS bject I2 Spray apperature of ai essure of air-s aperature of dr nsity of air-st scosity of air-st	Le 12-mai Computer Schulz Max Tem Max Tem Tetam mixti coplet lin eam mixti steam mixti	208.out was created Program Date 14 of Date 14 of 0 96 - 720 hr dixture= 44.10 cure= 1.1549 puid= 44.100 hre= 1.24766E-4 cure= 1.847180	ated on 1 REMOVE , Jun 2003 	14 Jun : NE305 1 Calc I Check Job N Sheet egree C ee C	2003 at 11:14: Version 4.0 No. N-6030-00 R ed Date D. 16575-167 No. 2	54 av No. 0	-			
Den Vis Din Din Din Din Sch	nsity of drople scosity of drop ff. coeff. of e ff. coeff. of m ff. coeff. of m tf. coeff. of m hundt number fo	et liquid blet liquid elemental methyl I2 elemental methyl I2 pr element	.99013 d- 6.08709E-0 I2 in air-steam in air-steam m I2 in droplet in droplet liq al iodine= 1	G/CC 3 Poise m mixture ixture= liquid= uid= 2.1 .7177	= 8.61 .11253 2.03600 19872E-0	8995-02 sq. cm sq. cm/sec )E-05 sq. cm/sec 15 sq. cm/sec	/sec c				
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# E&TS DEPARTMENT CALCULATION SHEET

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Project or	DCP/FCN/ECP	Calc No.	N-6030-001	CCN CONVE CCN NÓ. C	rsion: Cn	:
Subject	Containment Aerosol a 1d Iodine Removal Rates	•	· ·	Sheet	273	of

REV	ORIGINATOR	DATE	IRE	DATE	REV	. ORIGINATOR	DATE	IRE	DATE	ĸ
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003						<b>CAI</b>
										Ĩ
Sc Gr Tr Dr	chmidt number fo ashof number- y mean diameter op parameters i (For p Diameter 1	or methyl 2.93485E - 9.209 for eleme mean drop fall Time	iodine= 1.31 -12 54E-02 htal Reynolds M.	56 T.Coeff G		drop no	-	· ·		
-	CM	SEC	a 200 D	M/SEC	CN/S	SEC	•			
37	9.2096E-02	5.723	228.3	12.03	367	207.2		• .		
I	Diameter S CM	Sherwood	Time S.	at. Frac.	M.T.C CM	Coeff L Remova M/SEC /HR	al			
37	9.2096E-02	24.74	5.4946E-02	.5664	1.45	46E-03 1.012	•			
**	**************************************	REMOVAL I	RATES*********	•						
То	tal elemental 1	cemoval co	onstant= 1.01	22 pe	r hour			•		
Pa	rticulate iodir	ie removal	constant.	5926B	per ho	pur				
Тс	tal organic rem	noval cors	stant= .00000	per 3	hour				i	
**	***REMOVAL DUE	TO WALL I	EPOSITION*****					•		
El	emental removal	rate due	e to wall depose	ition =	4.9038	per hour				
Or	ganic removal r	ate due t	o wall deposition	ion= .C	0000	per hour				
Me Te Pr De Vi De Vi Di Di Sc	an drop diamete mperature of ai essure of air-s mperature of dr nsity of air-st scosity of air- nsity of drople scosity of drop ff. coeff. of m ff. coeff. of m ff. coeff. of m hmidt number fo	r= 9.209 r-steam mixtoplet Lico eam mixto steam mixto steam mixto t liquid- blet liquid- blet liquid- lemental ethyl I2 c element r methyl	964E-02 ixture= 44.10 iure= 1.1549 yuid= 44.100 are= 1.24766E-( iture= 1.84718) .99013 ( .99013 ( .99013 ( .12 in air-steam mid .12 in droplet 1 in droplet 1iq .1 iodine= 1.315	00 De: Atm. Degre: 03 G/CC E-04 Pois: G/CC 3 Poise a mixture= liquid= : 1id= 2.11 .7177 56	gree C e C = 8.61 .11253 2.03600 9872E-0	899E-02 sq. cm sq. cm/sec E-05 sq. cm/sec 5 sq. cm/sec	/sec 2	•		
SC Gr Tr	nmidt number id ashof number= y mean diameter	2.93485E+ = 9.3071	10dine= 1.31: 12 9E-02	56						
Dr	op parameters f (For m	or elegen ean drcp)	tal						ļ	
I	Diameter F CM	all Tin.e SEC	Reynolds M.1 CN	C.Coeff G M/SEC	T.V Cm/s	. drop no. EC				
37	9.3072E-02	6.028	232.8	12.01	370	.4 406.3			1	ļ
I	Diameter S CM	herwood	Time Sa	at. Frac.	M.T.C CM	oeff L Remova /SEC /HR	al			
37	9.3072E-02	24.95	5.6669E-02	.5747	1.43	94E-03 1.027				

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**E&TS DEPARTMENT** ICCN NO./ **CALCULATION SHEET** PRELIM. CCN NO. PAGE OF CCN CONVERSION: CCN NO. CCN Project or DCP/FCN/ECP Calc No. N-6030-001 Subject Containment Aerosol and Iodine Removal Rates Sheet 274 of 281 REV ORIGINATOR DATE IRE DATE REV ORIGINATOR DATE IRE DATE ട് REV MDICATO 8/15/2003 D. T. Dexheimer 8/15/2003 J. Schulz 0 Total elemental removal constant= 1.0270 per hour Particulate iodine removal constant= .59268 per hour Total organic removal constant .00000 per hour \*\*\*\*\*REMOVAL DUE TO WALL DEPOSITION\*\*\*\*\* Elemental removal rate due to wall deposition = 4.9038 per hour Organic removal rate due to wall deposition= .00000 per hour Mean drop diameter= 9.30719E-02 Temperature of air-steam mixture= 44.100 Degree C Pressure of air-steam misture= 1.1549 Temperature of droplet liquid= 44.100 Atm. Degree C Density of air-steam mixture= 1.24766E-03 G/CC Viscosity of air-steam m.xture= 1.84718E-04 Poise Density of droplet liquid= .99013 G/CC Viscosity of droplet liquid= 6.08709E-03 Poise Diff. coeff. of elemental I2 in air-steam mixture= 8.61899E-02 sq. cm/sec Diff. coeff. of methyl I? in air-steam mixture= .11253 sq. cm/sec Diff. coeff. of elemental I2 in droplet liquid= 2.03600E-05 sq. cm/sec Diff. coeff. of methyl 12 in droplet liquid= 2.19872E-05 sq. cm/sec Schmidt number for elemental iodine= 1.7177 Schmidt number for methyl iodine= 1.3156 Grashof number= 3.62106E+12 Try mean diameter= 9.33906E-02 Drop parameters for elemental (For mean drop) I Diameter Fall Tire Reynolds M.T.Coeff G T.V. drop no. CM SEC CM/SEC CM/SEC 37 9.3391E-02 6.119 234.3 12.00 371.5 603.7 I Diameter Sherwood Sat. Frac. M.T.Coeff L Time Removal CM CM/SEC /HR 37 9.3391E-02 25.01 5.7138E-02 .5770 1.4344E-03 1.031 Total elemental removal constant= 1.0310 per hour Particulate iodine removal constant- .63567 per hour Total organic removal constant= .00000 per hour \*\*\*\*\*REMOVAL DUE TO WALL DEPOSITION\*\*\*\*\* Elemental removal rate due to wall deposition = 4.9038 per hour Organic removal rate due to wall deposition= .00000 per hour Mean drop diameter= 9.33906E-02 Temperature of air-steam mixture= 44.100 Degree C Pressure of air-steam mixture= 1.1549 Atm.

SCE 26-426 REV. 2 [REFERENCE: SO123-XXIV-7.15]

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Subjec	containmer	nt Aerosol :	ind Iodine Remov	al Rates			· · · · · · · · · · · · · · · · · · ·	She	et _2	7 <u>5</u> of	281
FEV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DATE	۲ ۲
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003	Ì						ICATO CATO
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Te De Vi De Vi Di Di Di Sc Sc Gr Tr Dr J 37 I 37	<pre>mperature of d nsity of air-s scosity of air nsity of dropl scosity of drop ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of hmidt number f ashof number f ashof number f wean diameter op parameters (For Diameter CM 9.3546E-02 Diameter CM 9.3546E-02 ********SPRAY tal elemental</pre>	<pre>iroplet li team mixt -steam mi et liquic plet liqui elemental methyl 12 elemental methyl 12 or methyl 12</pre>	<pre>quid= 44.100 ure= 1.24766E- xture= 1.84718 = .99013 id= 6.08709E-0 12 in air-steam m 12 in droplet 1 in droplet 1iq tal iodine= 1 iodine= 1.31 +12 59E-02 ntal ) Reynolds M. Cl 235.1 Time S 6.0250E-02 RATES************************************</pre>	Degre 03 G/CC E-04 Pois G/CC 3 Poise n mixture= liquid= uid= 2.1 .7177 56 T.Coeff C M/SEC 11.99 at. Frac. .5906 *	ee C 30 2.1125: 2.0360 13872E-1 37: M.T.1 CH/3 37: 1.4: er hour	1899E-02 sq. c 3 sq. cm/s 0E-05 sq. cm/s 05 sq. cm/sec V. drop r SEC 2.0 799. Coeff L Remo M/SEC /F 321E-03 1.05	m/sec ec ec 3 vval R 5	•	•		
Pa	rticulate iodi	ne removi	l constant	63567	per h	our					
То	tal organic re	moval con	stant= .00000	per	hour						
E1	emental remova	l rate du	e to wall depos	ition =	4,903	B per hour	•		•	•	
Or	ganic removal	rate due	to wall deposit	ion= .0	10000	per hour			•		
Me Te Pr Te De Vi Di Di Di Sc Gr Tr	an drop diamet mperature of a essure of air- mperature of d nsity of air- scosity of air scosity of drop scosity of drop ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of ff. coeff. of ashof number f ashof number- y mean diamete	er= 9.35 ir-steam mix roplet li team mix -steam mi et liquid plet liqu elemental methyl I2 elemental methyl I2 or elemen or methyl 6.84291E r= 9.387	459E-02 mixture= 44.11 ture= 1.1549 quid= 44.100 ure= 1.24766E-1 xture= 1.847180 id= 6.08709E-01 12 in air-steam mi 12 in droplet 1 in droplet 1iq tal iodine= 1 iodine= 1.315 +12 82E-02	00 De Atm. Degre 03 G/CC E-04 Pois S/CC 3 Poise mixture= liquid= uid= 2.1 .7177 56	:gree C :e C := 8.6 .1125 2.0360 .9872E-1	1899E-02 sq. C 3 sq. cm/s 0E-05 sq. cm/sec	त्रा/sec ec ec		• •		
Dr	op parameters (For s	for eleme mean drop	ntal )								

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OF

Project or DCP/FCN/ECP

Calc No. N-6030-001

CCN CONVERSION: CCN NO. CCN

Subject Containment Aerosol and Iodine Removal Rates

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REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	g
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003						₽ž
										<u> </u>
 I	Diameter H CM	Fall Time SEC	Reynolds M.	T.Coeff G M/SEC	T. CM/:	V. drop no SEC	•	L <u></u>		
38	9.3878E-02	7.721	236.6	11.9B	37	3.2 985.6				
I	Diameter S • CM	Sherwood	Time S	at. Frac.	M.T.C	Coeff L Remov M/SEC /HR	al			
38	9.3878E-02	25.12	7.1347E-02	.6346	1.4	270E-03 .8098				
**1	*********SPRAY	REMOVAL	RATES*********	•						
To	tal elemental r	cemoval c	onstant809	87 pe	r hour					Í
Par	cticulate iodir	ne removal	l constant= .	56136	per h	our				
Tot	tal organic rem	noval con:	stant= .00000	per	Lour					
***	***REMOVAL DUE	TO WALL	DEPOSITION****			•				
Ele	emental removal	l rate du	e to wall depos	ition =	4.903	B per hour				
Org	ganic removal r	rate due 1	to wall deposit	ion= .0	(1000	per hour			•	
Ter Pro Ter Der Vis Dir Dir Dir Sch Gra Try	merature of air- ssure of air- mperature of dr sity of air- strosity of drople scosity of drople f. coeff. of e f. coeff. of e ff. coeff. of e ff. coeff. of m midt number for shof number= y mean diameter	steam mixt coplet lid ceam mixt steam mixt steam mixt steam mix st liquic blet liquic elemental methyl I2 clemental methyl I2 for elemental 6.842918 = 9.517	Aixture= 44.10 ture= 1.1549 quid= 44.100 tre= 1.24766E- kture= 1.84718 = .99013 ( id= 6.08709E-01 I2 in air-steam in air-steam m I2 in droplet 1 in droplet light cal iodine= 1.315 +12 70E-02	00 De Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise n mixture ixture liquid- uid- 2.1 .7177 56	gree C e C ** 8.6 .1125 2.03600 9872E-0	1899E-02 sq. cm 3 sq. cm/se DE-05 sq. cm/sec 55 sq. cm/sec	/sec c			
Dro	p parameters 1 (For m	for element mean drop)	ntal							
ľ	Diameter F CM	Fall Time SEC	Reynolds M.: Cl	C.Coeff G 4/SEC	т. См/:	J. drop no SEC	•	:		
38	9.5177E-02	8.957	242.7	11.95	37'	7.6 1961.		i		•
. <sup>I</sup>	Diameter S CM	Sherwood	Time Sa	at. Frac.	M.T.( Ci	Coeff L Remov M/SEC /HR	al			
38	9.5177E-02	25.39	8.0523E~02	.6670	1.4	075E-03 .8512				
**1	********SPRAY	REMOVAL I	ATES**********	ł				:		
Tot	al elemental r	removal co	onstant= .8512	28 pe	r hour					
Par	ticulate iodin	ne removal	l constant .!	56136	per ho	our				
Tot	al organic rep	noval cons	stant= .00000	per	hour					
SCE 26-4	26 REV. 2 (REFE	ERENCE: S	0123-XXIV-7.15]	,	<u>.                                    </u>	<u> </u>		N-60	30-001 Re	v 0.doc

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Subjec	t Containmer	it Aerosol	and Iodine Remov	al Rates				She	et _2	<u>77</u> of	281
FEV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DATE	¢,
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							REV KCATO
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** El Or Me Te Pr Te De Vi Di Di Di Sc Gr Tr Dr I 38 I 38	***REMOVAL DUE emental remova ganic removal an drop diamet mperature of air- mperature of air- mperature of dir- scosity of air- scosity of air- scosity of air- scosity of air- scosity of drop fs. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. of a ff. coeff. coeff. of a ff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff. coeff.	TO WALL I rate due er= 9.5: ir-steam mix: roplet 1: team mix: -steam mix: -steam mix: et liquid plet liquid plet liquid plet mental: methyl I? elemental: methyl I? for element r= 9.550 for element mean drop Fall Time SEC 7.779 Sherwood 25.46 REMOVAL 1	DEPOSITION***** e to wall depos to wall deposit 770E-02 mixture= 1.1549 guid= 44.10 ure= 1.24766E xture= 1.84718 = .99013 id= 6.08709E-0 I2 in air-steam m I2 in droplet liq tal iodine= 1 in droplet liq tal iodine= 1.31 *12 62E-02 mtal Reynolds M. Cl 244.3 Time S. 6.9453E-02 RATES**********	ition - ion= .( Atm. Degree 03 G/CC 5-04 Pois G/CC 3 Poise m mixture- liquid= uid= 2.1 .7177 56 T.Coeff ( M/SEC 11.94 at. Frac. .6283	4.903 20000 2gree C 2 C 2 C 2 C 2 C 2 C 2 C 2 C 2	8 per hour per hour 1899E-02 sq. cr 3 sq. cn/se 05 sq. cm/sec 05 sq. sq. sq. sq. sq. sq. sq. sq. sq. sq.	a/sec ec ec	<u>.</u>		J	2
To	tal elemental p	removal c	onstant801	92 p	r hour						
Pa	rticulate iodi	ne removal	L constant= .	57345	per h	our					
10 <sup>1</sup>	AT OLYANIC TEL	TO WALL	DEPOSTTION****	ber	NUUT						
El	emental removal	L rate do	to wall denoe	ition =	4,903	B per bour					
Or	ranic removal	rate due f	to wall deposit	lon= .0	00000	per hour					
Me Ter Pr Der Vis Der Vis Di Di	an drop diameter mperature of air- essure of air- mperature of dir- sity of air- scosity of air- sity of drople acosity of drop ff. coeff. of a	er= 9.550 ir-steam mixt roplet lic team mixt ceam mixt st liquid blet liquid blet liquid blet liquid blet liquid	062E-02 aixture= 44.10 cure= 1.1549 guid= 44.100 ure= 1.24766E-0 (ture= 1.847181 99013 ( id= 6.08709E-0 I2 in air-steam m	00 D: Atm. Degre 03 G/CC E-04 Pois G/CC 3 Poise a mixture ixture-	egree C ee C ee 8.6: .1125:	1899E-02 sq. cm 3 sq. cm/se	1/sec c				
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Subje	ct <u>Containme</u>	nt Aerosol :	and Iodine Remov	al Rates				She	et 2	78 <b>of</b>	281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE			DATE	
	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003					• •••••••		lev Cator
		1								-	
D: D: S: G: T: D:	Diff. coeff. of elemental I2 in droplet liquid= 2.03600E-05 sq. cm/sec Diff. coeff. of methyl I2 in droplet liquid= 2.19872E-05 sq. cm/sec Schmidt number for elemental iodine= 1.7177 Schmidt number for methyl iodine= 1.3156 Grashof number= 7.29478E+12 Try mean diameter= 9.57295E-02 Drop parameters for elemental (For mean drop.)										
	I Diameter CM	Fall Time SEC	Reynolds M. C	T.Coeff G M/SEC	T. CM/	V. drop SEC	no.				
31	3 9.5730E-02 I Diameter CM	9.099 Sherwood	245.4 Time S	11.93 at. Frac.	37: M.T.(	9.5 391 Coeff L Rem M/SEC /	oval HR				
38	9.5730E-02	25.51	8,0863E-02	.6683	1.3	994E-03 <b>*</b> 85	29				
*	**************************************	REMOVAL	RATES*********	*						•	
Т	otal elemental	removal c	onstant= .852	96 pe	r hour					i	
Pa	articulate iodi	ne remova	l constant= .	57345	per h	our		•			
T	otal organic re	moval con	stant⊨ .00000	per	hour						
h +-	***REMOVAL DUE	TO WALL	DEPOSITION*****								
E	lemental remova	l rate du	e to wall depos	ition -	4.903	8 per hou	r				
01	rganic removal	rate due	to wall deposit	ion= .(	0000	per hour					
Me Te Pr Te De Di Di Di Di Sc Sc Sc Sc	Mean drop diameter= 9.57295E-02 Temperature of air-steam mixture= 44.100 Degree C Pressure of air-steam mixture= 1.1549 Atm. Temperature of droplet liquid= 44.100 Degree C Density of air-steam mixture= 1.24766E-03 G/CC Viscosity of air-steam mixture= 1.84718E-04 Poixe Density of droplet liquid= 6.08709E-03 Poixe Diff. coeff. of elemental I2 in air-steam mixture= 8.61899E-02 sq. cm/sec Diff. coeff. of methyl I2 in air-steam mixture= .11253 sq. cm/sec Diff. coeff. of elemental I2 in droplet liquid= 2.03600E-05 sq. cm/sec Diff. coeff. of methyl I2 in droplet liquid= 2.19872E-05 sq. cm/sec Schmidt number for elemental iodine= 1.7177 Schmidt number for methyl iodine= 1.3156 Grashof number= 9.348712+12 Try mean diameter= 9.58341E-02										
D	op parameters (For	for eleman mean drop Fall Time	ntal ) Revnolds M.	r.Coeff G	·	V. drop	NO.				
[ '	CM	SEC	Cl	M/SEC	CM/	SEC					
38	9.5834E-02	8.502	245.9	11.93	37	9.8 488	7.				
	Diameter CM	Sherwood	Time S.	at. Frac.	M.T.( Ci	Coeff L Rem M/SEC /	oval KR				
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F:EV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATO	R DATE	IRI	5	DATE	<u>ج</u>
0	0 J. Schulz 8/15/2003 D. T. Dexheimer 8/15/2003										
<pre>38 9.5834E-02 25.53 7.5386E-02 .6499 1.3979E-03 .4147 ***********************************</pre>											
I	Diameter CM	Fall Tine SEC	Reynolds M. C	.T.Coeff G CM/SEC	5 T. CM/	v. drop SEC	o no.				
38	9.5911E-02	8.881	246.2	11.93	38	0.1 58	159.				
I	Diameter CM	Sherwood	Time S	Sat. Frac.	M.T. Ci	Coeff L Re M/SEC	moval /HR				
38	9.5911E-02	25.55	7.8624E-02	.6610	1.3	967E-03 .4	218				
**************************************											
Total elemental removal constant= .42180 per hour										ļ	
Particulate iodine removal constant= .31145 per hour											
Total organic removal constant= .00000 per hour											
**	***REMOVAL DUE	TO WALL I	DEPOSITION****	1							
El	emental remova	l rate du	e to wall depos	sition =	4.903	9 per ho	ur				
Or	ganic removal	rate due f	to wall deposit	ion= .0	0000	per hour					

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Subjec	t Containmen	t Aerosol :	and Iodine Remov	al Rates	<u> </u>		<u>.</u>	She	et _28	30 <b>of</b>	281
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE		DATE	
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003							EV CATOF
								1			<sup>1</sup> Q
Me Te De Di Di Di Di Di Sc Sc Gr Tr Dr 38 38 ** To Pa To Pa To Pa To Pa To Pa To Pa To Di Di Di Di Sc Sc Sc Sc Sc Sc Sc Sc Sc Sc Sc Sc Sc	an drop diameter mperature of air- sessure of air- sessure of air- sessity of air- sessity of drople sessity of drople sessity of drople sessity of drople sessity of drople sessity of drople ff. coeff. of m ff. coeff. of m chmidt number for ashof number= y mean diameter op parameters f (For m Diameter F CM 9.5956E-02 Diameter S CM 9.5956E-02 ********SPRAY tal elemental r rticulate iodin tal organic rem ***REMOVAL DUE emental removal r an drop diameter mperature of air- st coeff. of m ff. coeff. of m ff. coeff. of m ff. coeff. of m ff. coeff. of m hmidt number fo hmidt number fo hmidt number fo ashof number= y mean diameter	er= 9.55 ir-steam mix ream mix: ream mix: ream mix: ream mix: ream mix: ream mix: ream mix: ream mix: relemental methyl I2: lemental methyl I2: relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental relemental rele	113E-02 mixture= 44.1 ture= 1.1549 guid= 44.100 ure= 1.24766E xture= 1.84718 = .99013 Id= 6.08709E-0 I2 in air-steam m I2 in droplet liq tal iodine= 1 iodine= 1.31 +12 57E-02 mtal Reynolds M.: 246.5 Time S. 7.5842E-02 RATES************************************	00 De Atm. Degree 03 G/CC E-04 Pois G/CC 3 Poise m mixture= liquid= uid= 2.1 .7177 56 f.Coeff G M/SEC 11.93 at. Frac. .6515 * 77 pe 31420 per ltion = .00 De Atm. Degre 03 G/CC 3 Poise m mixture= Liquid= 2.1 .7177 56	<pre>sgiree C %</pre>	1899E-02 sq. cm/sec         3 sq. cm/sec         3 sq. cm/sec         05 sq. cm/sec         05 sq. cm/sec         0.3 6832.         Coeff L Remov.         0.4/SEC /HR         061E-03 .4157         our         9         per hour         per hour         sq. cm/sec         .899E-02 sq. cm/sec         .899E-02 sq. cm/sec         .899E-05 sq. cm/sec	/sec				

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Subje	Subject Containment Aerosol and Iodine Removal Rates									<u>81</u> of	
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IR	E	DATE	ં સ્ટ
0	J. Schulz	8/15/2003	D. T. Dexheimer	8/15/2003				<b> </b>			REV
Drop parameters for elemental											
(For mean drop)											
	I Diameter CM	Fall Time SEC	Reynolds M. Ci	r.Coeff ( M/SEC	5 T. CM/:	V. drop no SEC	•				
31	9.5998E-02	8.957	246.7	11.93	38(	0.4 7803.					[
	I Diameter CM	Sherwood	Time S	at. Frac.	. M.T.C Cl	Coeff L Remov A/SEC /HR	al				
31	9.5998E-02	25.56	7.9155E-02	.6628	1.3	955E-03 .4229					
+	**********\$PRAY	REMOVAL I	ATES*********	•							
T	otal elemental	removal co	nstant= .422	95 pe	er hour					•	
Pi	articulate iodi	ne removal	constant= .	31420	per ho	our .					
Т	otal organic re	moval cons	tant= .00000	per	hour						
- +·	****REMOVAL DUE	TO WALL I	EPOSITION*****								
E	lemental remova	l rate due	to wall deposi	tion -	4.9038	9 per hour					
01	rganic removal	rate due 1	o wall depositi	ion= .0	0000	per hour					
Me	ean drop diamet	er= 9.599	82E-02								
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Enclosure 2 Response to Request for Additional Information Dated October 7, 2005

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### **RAI 1:**

Confirm that the 1993 through 2002 site meteorological data provided in the SCE letter to the staff dated October 6, 2004, are the same data used to generate the ACRON96 control room  $\chi/Q$  values presented in the application. (RAI Category Code 2.a)

#### **RESPONSE:**

The meteorological data contained in the SCE letter to the staff dated October 6, 2004 was the data used to generate the ARCON96 control room  $\chi/Q$  values presented in the application dated December 27, 2004. However, the ARCON96 control room  $\chi/Q$  values presented in the original application have been revised to correct an error in the 1999 data file (to be discussed in the response to RAI 2). The corrected ARCON96 control room  $\chi/Q$  values have been provided to the staff in an October 27, 2005 Supplement to the application. Enclosed with this RAI response is an electronic copy of the 1993 through 2002 site meteorological data used to generate the ARCON96 control room  $\chi/Q$  values presented in the October 27, 2005 Supplement to the application.

### **RAI 2:**

A review of the 1993 through 2002 onsite meteorological database revealed that the average lower and upper level wind speeds in 1999 were approximately 1.8 times higher than the lower and upper level wind speeds averaged over the remaining 9-year period (1993 through 1998 and 2000 through 2002). Explain this phenomenon (e.g., verify that the 1999 electronic data file has been properly formatted and unit conversions have been performed correctly) and its impact on the resulting ARCON96 dispersion analyses. (RAI Category Code 2.a)

#### **RESPONSE:**

It has been determined that the 1999 meteorological data used to generate the ARCON96 control room  $\chi/Q$  values presented in the application dated December 27, 2004 was erroneous. The corrected ARCON96 control room  $\chi/Q$  values have been provided to the staff in an October 27, 2005 Supplement to the application. The October 27, 2005 Supplement to the application updated the control room doses to reflect modeling of the corrected ARCON96 control room  $\chi/Q$  values.

## RAI 3:

Provide a site plan showing the locations of all potential accident release pathways and control room intakes and unfiltered inleakage pathways. If possible, the drawing should be approximately to scale and indicate true north. (RAI Category Code 4.b)

## **RESPONSE:**

Section 4.4.2 of the AST application identifies the various accident release pathways and control room ventilation outside air intake locations. The attached Figure 1 is a draft revision to UFSAR Figure 6.4-3 that shows the plant layout, including the location of potential radiological release points with respect to the control room ventilation outside air intakes. The figure is scaled and shows plant north, which is 57 degrees west of "true north".

The release point locations are:

- Main plant vent (Figure 1 location 1)
- Containment shell diffusion
- Containment equipment hatch (Figure 1 location 8)
- Main Steam Safety Valves (Figure 1 location 9)
- Atmospheric Dump Valves (Figure 1 location 10)
- Steam Line Break Outside Containment (Figure 1 location 11)
- Auxiliary Feedwater Turbine steam discharge (Figure 1 location 12)
- Refueling Water Storage Tank Area (Figure 1 location 13)
- Fuel Handling Building (Figure 1 location 14)

The three control room ventilation outside air intake locations are:

- Control room normal air intake (Figure 1 location 6)
- Control room Unit 2 emergency air intake (Figure 1 location 7)
- Control room Unit 3 emergency air intake (Figure 1 location 7)

Based on the plant coordinates the locations of the three control room ventilation intakes are as follows:

Air Intake Location	From Unit 2 Cer	2 Containment iterline	From Unit 3 Containment Centerline			
Normal	147 ft West	144.50 ft South	147 ft West	286.50 ft North		
Unit 2 Emergency	147 ft West	131.83 ft . South	147 ft West	299.17 ft North		
Unit 3 Emergency	147 ft West	299.17 ft South	147 ft West	131.83 ft North		

As discussed in Section 4.3.2.1 of the application, the AST dose analyses conservatively assume that unfiltered inleakage into the control room envelope (CRE) is from the radioactive plumes released from the facility as they pass west of the CRE.



Figure 1 — Radiological Release Point and Control Room Air Intake Locations (Draft UFSAR Figure 6.4-3)

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#### **RAI 4:**

Unfiltered leakage into the control room was modeled using control room air intake  $\chi/Q$  values. Confirm (using the results of tracer gas testing if possible) that there are no potential unfiltered inleakage pathways (during both normal and emergency modes) that could result in  $\chi/Q$  values that are higher than the control room intake  $\chi/Q$  values. (RAI Category Code 2.a)

## **RESPONSE:**

As discussed in Section 4.3.2.1 of the AST application, only the west side of the control room envelope (CRE) is exposed to the radioactive plumes released from the facility.

The most likely source of unfiltered inleakage is the ductwork that leaves the Control Room Cabinet Areas to the fan rooms at the 50' level, outside of the Control Room Envelope. The adjacent areas and structures to the north, south, and east of the CRE, and the adjacent areas and structures above and below the CRE, do not contain activity release points. These adjacent areas and locations can only become contaminated with air introduced via intake or infiltration of radioactive material contained in the radioactive plumes released from the facility, which are then recirculated and diluted throughout these regions. Consequently, the resultant activity concentrations in the adjacent areas and structures will be less contaminated than any radioactive plume. For this reason, the AST dose analyses conservatively assume that all intake and infiltration (i.e., inleakage) into the CRE is from the radioactive plumes released from the facility as they pass west of the CRE.

The control room normal air intake is located near the northwest corner of the CRE, and the control room emergency air intakes are located near the northwest and southwest corners of the CRE. As discussed in Sections 4.3.2.1 and 4.4.5 of the AST application, the maximum atmospheric dispersion factor for any activity release location to any of the three outside air intakes is modeled in the evaluation of contaminated air intake and unfiltered inleakage.

## RAI 5:

Explain the basis for using the same source-receptor horizontal distances for containment equipment hatch releases assuming flow both around and over (through) the containment building. (RAI Category Code 2.a)

#### **RESPONSE:**

As discussed in Section 4.4.4.4 of the AST application, the containment equipment hatch release is assumed to be from its mid-height at elevation 38 feet above grade. Per Section 4.4.4.1 of the AST application, the control room emergency air intakes are no higher than elevation 43 feet. Per Section 4.4.4.4 of the AST application, the containment building is between the containment equipment hatch release point and the control room air intakes. The containment building rises to an elevation 161 feet.

Atmospheric dispersion was evaluated for flow paths both around the containment and over the containment. The flow path lengths are to be calculated using the "taut string length" method allowed by Regulatory Guide 1.194 Section 3.4. The containment equipment hatch to receptor distance around the containment is shorter than the containment equipment hatch to receptor distance over the containment. As discussed in Section 4.4.4.4 and reported in Table 4.4-4 of the AST application, for each release point and control room receptor combination, the ARCON96 analysis modeled the conservatively shorter "taut string length" distance associated with the path around the containment.

The following questions concern the atmospheric dispersion modeling for the main steamline safety valve (MSSV) and atmospheric dump valve (ADV) release pathways:

a. Provide a diagram showing the relative locations of the main steam isolation valves (NSIVs), MSSV stacks, ADV stacks, and control room air intakes. If possible, the diagram should be approximately to scale. Show on the diagram the locations modeled as the MSSV release points. (RAI Category Code 4.b)

## **RESPONSE:**

The response to RAI # 3 shows a scaled drawing with the relative locations of the MSSV and ADV release locations, and the control room air intakes. Provided as Attachment A to this Enclosure are Drawings 40483 and 41983 which show the Units 2 and 3 MSIV, MSSVs and ADV locations relative to the containment centerlines. As shown in these drawings, the MSIVs are numbered 2HV8204, 2HV8205, 3HV8204 and 3HV8205. Nine MSSVs are arranged around each MSIV. The fifty-inch ADV stack associated with each main steam line is located between the containment outer wall and the steam line's MSIV and MSSVs. These drawings, in conjunction with the control room air intake coordinates provided in the response to RAI 3 and Figure 1 can be used to determine the relative distances from the release points to the intakes.

The following questions concern the atmospheric dispersion modeling for the main steamline safety valve (MSSV) and atmospheric dump valve (ADV) release pathways:

b. Explain the methodology and assumptions used to calculate the minimum MSSV stack exit velocity. (RAI Category Code 2.b)

# **RESPONSE:**

Section 6.0 of Regulatory Guide 1.194 states that, in lieu of mechanistically addressing the amount of buoyant plume rise:

"...the ground level  $\chi/Q$  value calculated with ARCON96 (on the basis of the physical height of the release point) may be reduced by a factor of 5. This reduction may be taken only if (1) the release point is uncapped and vertically oriented and (2) the time-dependent vertical velocity exceeds the 95th-percentile wind speed (at the release point height) by a factor of 5."

The SONGS MSSVs are uncapped and vertically oriented. Thus, to take credit for plume rise, the flow velocities at the stack exit must be determined. Per Section 4.4.4.5 of the AST application, the minimum flow velocity at the exit of the MSSV stack is determined by calculating the minimum volumetric flowrate at the exit and dividing by the internal cross-sectional area of the MSSV stack. The minimum volumetric flow rate at the exit is equal to the product of the minimum mass flowrate through an MSSV and the specific volume of the steam at the exit.

The minimum mass flowrate through an MSSV is set equal to the flow capacity for the lowest set pressure MSSV.

The specific volume of steam is determined for the saturated steam pressure in the MSSV stack. The saturated steam pressure in the MSSV stack is equal to the maximum backpressure on the MSSVs during blowdown minus the pressure drop through the MSSV stack. The pressure drop through the MSSV stack is calculated from the following equation:

$$\Delta P = 0.00000028 \frac{KW^2 \overline{V}}{Y^2 d^4}$$

where:

K is the total resistance coefficient from the MSSV outlet to the stack exit

W is the mass flowrate in lbm/hr

 $\overline{V}$  is the specific volume of steam in ft<sup>3</sup>/lb

Y is the net expansion factor for compressible flow

d is the inside diameter of the stack in inches

In evaluating the preceding equation, the following conservative assumptions are made:

- 1. All MSSVs lift at the lowest set pressure of all the valves.
- 2. The pressure in the MSSV stack is equal to the maximum backpressure.

- 3. No credit is taken for head loss due to elevation changes or pipe friction.
- 4. No credit is taken for expansion of the steam through the stack.

As discussed in Section 4.4.4.5 of the AST application, the minimum MSSV stack exit velocity of 72 meters/second was calculated using the preceding equation and assumptions.

The following questions concern the atmospheric dispersion modeling for the main steamline safety valve (MSSV) and atmospheric dump valve (ADV) release pathways:

c. Confirm that a stuck-open MSSV concurrent with other design basis accidents is excluded from the licensing basis for the MSSVs. (RAI Category Code 2.a)

## **RESPONSE:**

UFSAR Section 10.3 addresses the design and licensing basis of the main steam supply system, inclucing the main steam safety valves. The SONGS 2 and 3 licensing basis, as reflected in the UFSAR, does not require that a stuck-open MSSV be considered concurrent with other design basis accidents.

The inadvertent opening of a safety valve is a transient that is considered in UFSAR Chapter 15. However, this transient is not modeled concurrent with other design basis accidents.

The following questions concern the atmospheric dispersion modeling for the main steamline safety valve (MSSV) and atmospheric dump valve (ADV) release pathways:

d. Table 4.4-11 of Enclosure 2 to the application presents χ/Q values for ADV releases with plume rise credit. Please identify the release scenarios where these χ/Q values have been used and describe the methodology and assumptions used to determine that the ADV stack exit vertical flow velocity for these release scenarios exceeds 5 times the 95<sup>th</sup> percentile upper level wind speed of 6.8 miles per second. (RAI Category Code 2.b)

# **RESPONSE:**

Clarification: Per the October 27, 2005 supplement to the application, the 95<sup>th</sup> percentile upper level wind speed has been revised from 6.8 miles per second to 6.4 miles per second.

The events addressed in the AST application do not use the  $\chi/Q$  values for ADV releases with plume rise credit.

Although no event has yet been identified where credit for plume rise is necessary, the application presents  $\chi/Q$  values for ADV releases with plume rise credit to allow for their future use.

Per Section 4.4.4.6 cf the AST application, the accident analyses assume that an ADV is operated manually; therefore, the flow velocity at the ADV stack exit will decrease over time, as the steam generator blows down. Thus, in order to credit plume rise in an ADV release dose analysis, the time period for which the ADV stack exit vertical flow velocity exceeds five times the 95th percentile upper level wind speed of 6.4 m/s (i.e., exceeds 5 x 6.4 m/s = 32 m/s) would need to be determined and the plume rise adjustment factor applied, on an event-specific and time-interval specific basis.

As of this date, a calculation of the ADV stack exit velocity for the purpose of crediting plume rise has not been performed. If it were to be performed, the time-dependent flow velocity at the exit of the ADV stack would be determined using a methodology similar to that described in the response to RAI # 6b, based on the time-dependent ADV mass release rate and steam specific volume.

The following questions concern the atmospheric dispersion modeling for the main steamline safety valve (MSSV) and atmospheric dump valve (ADV) release pathways:

e. Provide ε copy of the output files for the bounding ARCON96 MSSV and ADV runs. (RAI Category Code 2.b)

# **RESPONSE:**

Per Section 4.4.4.5 of the AST application, the results of the ARCON96 analysis show that the Unit 2 MSSVs centered at MSIV 8204 to Unit 2 emergency air intake release path has the more conservative atmospheric dispersion (i.e., the maximum atmospheric dispersion factor). This ARCON96 run is identified by file name ms4-u2u2 (.rsf, .log and .cfd). Electronic copies of these files are enclosed with this response.

Per Section 4.4.4.6 cf the AST application, the results of the ARCON96 analysis show that the Unit 2 ADV 607 to Unit 2 emergency air intake release path has the more conservative atmospheric dispersion (i.e., the maximum atmospheric dispersion factor). This ARCON96 run is identified by file name ad7-u2u2 (.rsf, .log and .cfd). Electronic copies of these files are enclosed with this response.

Time Interval	ADV (no plume rise credit)	MSSV (no plume rise credit)	MSSV (with plume rise credit)
Computer run:	N-4010-003 R2 Section 9.7.4 ad7-u2u2.rsf ad7-u2u2.log ad7-u2u2.cfd	N-4010-003 R2 Section 9.6.1 ms4-u2u2.rsf ms4-u2u2.log ms4-u2u2.cfd	Previous values divided by a factor of five (5)
0 to 2 hrs	3.70E-03	6.08E-03	1.22E-03
2 to 8 hrs	1.99E-03	3.76E-03	7.52E-04
8 to 24 hrs	6.95E-04	1.24E-03	2.48E-04
1 to 4 days	7.04E-04	1.43E-03	2.86E-04
4 to 30 days	6.34E-04	1.30E-03	2.60E-04

# Excerpts from TABLE 4.4-11: 95<sup>th</sup> Percentile Control Room x/Qs (sec/m<sup>3</sup>)

### RAI 7:

In order to understand the atmospheric dispersion modeling for the steam line break outside containment (SLB-OC) release pathways, provide a diagram showing the relative locations of the main steam line isolation valve, the main steam isolation valve/main feedwater isolation valve (MFIV) enclosure structures, the walkway between the turbine building east wall and the MSIV/MFIV enclosure structures, and control room air intakes. If possible, the diagram should be approximately to scale. Also show on the diagram the location of the blowout panels on the roof and walls of the MSIV/MFIV enclosure, as well as the location modeled as the SLB-OC release location. (RAI Category Code 4.b)

### **RESPONSE:**

The response to RAI # 3 shows a scaled drawing with the relative locations of the steam line break outside containment release location, and the control room air intakes. The response to RAI # 6.a shows a scaled drawing with the relative location of the main steam isolation valve within the MSIV/MFIV enclosure structure.

Provided in Attachment B of this Enclosure is Drawing 10328 Sheet 1 which shows the walkway between the Unit 2 turbine building east wall and the Unit 2 MSIV/MFIV enclosure structures (Unit 3 is similarly designed).

Also provided in Attachment B of this Enclosure are Drawings 23090, 23075 and 23069. Drawing 23090 presents the design of the various MSIV/MFIV enclosure walls and Drawing 23075 presents the design of the MSIV/MFIV enclosure roof. The blow out panels in these walls and the roof are presented in Drawing 23069.

These drawings and figures, in conjunction with the control room air intake coordinates provided in the response to RAI # 3 can be used to determine the relative distance from the SLB-OC release point to the intakes.

## RAI 8:

In order to understand the atmospheric dispersion modeling for the fuel handling building (FHB) release pathways, provide a diagram showing the relative locations of all the FHB spent fuel cask hatches and the control room air intakes. (RAI Category Code 4.b)

## **RESPONSE:**

Provided as Attachment C of this Enclosure is drawing 10201, Sheet 1, Revision 7. The portion of this drawing showing the floor plan at elevation 63'-6" shows the fuel cask hatch openings. The larger cask hatch over the south end of the U2 railroad access bay (north end of U3 bay) is assumed to be the point of release from the fuel handling building. This hatch is closer to the control room air intake locations than other potential release locations, such as the smaller cask hatch over the opposite ends of the respective railroad bays.

The response to RAI # 3 shows a scaled drawing with the relative locations of the FHB spent fuel cask hatch release location and the control room air intakes. Drawing 10201, Sheet 1, Revision 7, in conjunction with the control room air intake coordinates provided in the response to RAI 3, can be used to determine the relative distances from the release point to the intakes.

## **RAI 9:**

In Section 4.5.1.3.5 in Enclosure 2 of the application, the total combined fission product removal rates in the containment by combining the individual removal rates from natural deposition and spray were provided. This is incorrect in that the various removal mechanisms would be acting simultaneously in an accident (i.e., the particulates being removed by spray would also include particulates being removed by deposition because the two different processes can not be separated). NUREG/CR-6189, "A Simplified Method for Aerosol Flemoval by Natural Processes in Reactor Containment," and NUREG/CR-5966, "A Simplified Model for Aerosol Removal by Containment Spray," assume individual removal process independent of each removal mechanism (natural deposition and spray). Discuss why the total combined fission product removal rate in the containment is determined by combining the individual removal rates from natural deposition and spray, or revise your analysis accordingly to properly account for both processes occurring at the same time. (RAI Category Code 2.b)

## **RESPONSE:**

As discussed in Section 4.5.1.3.5 of the AST application, the Bechtel LocaDose code is used to calculate the activity as a function of time in the containment sprayed and unsprayed regions. The governing equation used is similar to the governing equation used by the RADTRAD code (Equation 1 in NUREG/CR-6604 Section 2). The only difference is that the spray removal coefficient and the natural deposition removal coefficient are combined into an effective removal coefficient for each region. This is consistent with SRP 6.5.2 Section III.4.b. In the containment sprayed region, spray and deposition removal rates are combined. In the containment unsprayed region, only deposition removal rates are modeled.

As discussed in Section 4.5.1.3.3 of the AST application, aerosol spray removal is modeled using the Powers tenth percentile spray removal model described in NUREG/CR-5966. In the Powers model, aerosol removal by sprays is derived based on how a single falling droplet would scavenge particles. The extent to which sprays will decontaminate an aerosol-laden atmosphere depends on the number of spray droplets falling through the atmosphere and the distance they fall. As discussed in Section 4.5.1.3.5 of the AST application, spray removal of aerosols is only modeled during the first 4 hours of the LOCA event.

As discussed in Section 4.5.1.3.1 of the AST application, aerosol natural deposition removal is modeled using the Powers tenth percentile deposition model described in NUREG/CR-6189. In the Powers model, by the end of the in-vessel release phase, the natural deposition process is primarily due to the removal of heavier particulates from the containment atmosphere due to the effects of gravitational settling. Therefore, it is appropriate to take the credit of gravitational deposition during and following the post-LOCA spray operation. As shown in Table 4.5-7 of the AST application, deposition removal of aerosols is only modeled during the first 22.2 hours of the LOCA event.

Of note, a comparison of Tables 4.5-6 and 4.5-7 of the AST application shows that the aerosol natural deposition rates are approximately two orders of magnitude smaller than

the aerosol spray removal rates during the majority of the time between 1 minute to 4 hours, when containment spray is modeled. As such combining the spray and deposition aerosol removal rates has little impact on the results.

Spray removal of the elemental iodine is only modeled during the first four hours of the LOCA event. During this time period the elemental iodine activity removed by containment spray and deposition mechanism is limited by the elemental iodine decontamination factor (DF). The elemental iodine DF is reached within 2 hours. Further removal by deposition or spray after the DF is reached is not credited.

#### **RAI 10:**

In Tables 4.5-8, 4.4-9, and 4.5.10, in Enclosure 2 of the application, an iodine flashing fraction of 10 percent was assumed. Section 5.5 of Appendix A to Regulatory Guide (RG) 1.183 states that the amount of iodine that becomes airborne should be assumed to be 10 percent of the total iodine activity (i.e., iodine in particulate, elemental, and organic forms) in the leaked fluid. In NUREG-1465, "Accident Source Terms for Light-Water Nuclear Powe" Plant," the staff stated that iodine entering the containment is at least 95 percent cesium iodine with the remaining 5 percent as elemental iodine. Once the iodine enters the containment sump in aqueous environment which becomes the emergency core cooling system leakage source, cesium iodine in particulate form will readily dissolve in sump water and it enters ionic iodine form. Clarify whether you have included all forms of iodine in your 10 percent iodine flashing parameter. (RAI Category Code 2.b)

#### **RESPONSE:**

All forms of iodine have been included in the 10 percent iodine flashing parameter. The post-LOCA ESF leakage dose analysis models the iodine in the containment sump liquid source term as 97 percent elemental and 3 percent organic. A flashing fraction of 10 percent is applied to both iodine species.

#### RAI 11:

In Section 4.5.2.2 and Table 4.5-8 in Enclosure 2 of the application, the maximum engineered safety feature (ESF) recirculation loop leakage rate of 7E-3 cubic feet per minute (cfm) for the accident duration of 20 minutes to 30 days was stated. Further it was stated that this leakage value represents two times the sum of the simultaneous maximum expected leakage from ESF systems consistent with guidance provided in RG 1.183. Discuss if this leakage value (one-half of 7E-3 cfm) is specified in the current SONGS Technical Specifications (TSs). If it is not specified in the SONG TSs, provide the bases and references for this leakage value and discuss how this leakage would be tested to meet this leakage limit. (RAI Category Code 2.a)

#### **RESPONSE:**

Technical Specification Section 5.5.2.8 requires establishment of a "Primary Coolant Sources Outside Cortainment Program" to provide controls to minimize leakage from those portions of systems outside containment that could contain highly radioactive fluids during a serious transient or accident to levels as low as practicable. SONGS Units 2&3 Procedure SO23-XVII-8 describes the establishment, implementation and maintenance of the Program. Per the procedure, leakage from the High Pressure Safety Injection, Low Pressure Safety Injection, and Containment Spray Systems is limited to 5,950 cm<sup>3</sup>/hour. This value is one-half of the 7E-3 cfm modeled in the post-LOCA ESF Leakage dose analysis described in Section 4.5.2.2 and Table 4.5-8 of the application.

### RAI 12:

In Section 4.5.1.3.2 in Enclosure 2 of the application, the resultant elemental iodine natural deposition rate in the containment was provided using the methodology provided in Standard Review Flan (SRP) Section 6.5.2. The methodology provided in SRP Section 6.5.2 is only applicable for use in conjunction with the containment spray operation and is not applicable for natural deposition processes. Discuss why the use of SRP 6.5.2 methodology is applicable to the elemental iodine natural deposition rate in the containment, or revise your analysis accordingly. (RAI Category Code 2.b)

#### **RESPONSE:**

As discussed in Section 4.5.1.3 of the AST application, elemental iodine natural deposition is calculated using the elemental iodine natural deposition methodology provided in Section III.4.c.(1) of Standard Review Plan (SRP) Section 6.5.2. Consistent with the SRP, elemental iodine removal by natural deposition is only credited concurrent with containment spray system operation.

Elemental iodine removal by natural deposition is only credited until the elemental iodine decontamination factor value is reached. The elemental iodine DF value is reached approximately 2 hours after the onset of the LOCA.

As discussed in Sections 4.5.1.3.4 and 4.5.1.3.5 of the AST application, credit for spray removal is assumed for four hours after the onset of the LOCA (i.e., continuing for a period of time beyond which elemental iocline removal by natural deposition is no longer credited).

Therefore, the elemental iodine natural deposition modeled in the dose analysis is consistent with the SRP 6.5.2 methodology.

## RAI 13:

In Tables 4.5-4, 4.5-5, and 4.5-6 in Enclosure 2 of the application, the elemental and aerosol iodine removal rates by the containment spray were provided. Provide your detailed calculations in determining (1) elemental and aerosol iodine removal rates by the containment spray, and (2) elemental iodine removal cutoff times after reaching decontamination factor (DF) as specified in SRP Section 6.5.2, Revision 2. In your response, show the rnajor parameters used and their references. The DF is defined as the maximum iodine concentration in the containment atmosphere divided by the concentration of iodine in the containment atmosphere at some time after decontamination. (RAI Category Code 2.a)

## **RESPONSE:**

Attachment B of Enclosure 1 of this letter provides a copy of Calculation N-6030-001 which calculates the elemental iodine and aerosol containment spray removal rates and the elemental iodine decontamination factors (DF) used in the dose calculation.

The elemental iodine DF is calculated by the Bechtel LocaDose code that has been used for the AST dose analysis. Activity sprayed or plated out is collected into a specially designated computer code node called the "sump node". At the end of every time-step, a check is made to determine if the elemental iodine DF level has been reached. The DF level is calculated as the ratio of total elemental iodine activity in the containment airborne regions plus sump node, divided by the elemental iodine activity present in the sump node. Once the elemental iodine DF level is reached, re-suspension from the sump to the containment airborne regions is initiated to keep the DF at the equilibrium level.

The LocaDose code modeling is more conservative than merely stopping spray or deposition removal at a DF defined as the maximum iodine concentration in the containment atmosphere divided by the concentration of iodine in the containment atmosphere at some time after decontamination. In the LocaDose code model, following the initial achievement of the DF the airborne activity is depleted by both decay and leakage to the environment, while the sump activity is depleted by only decay. The net effect is a more rapid reduction in the airborne activity relative to the sump activity. To maintain the DF, the LocaDose code resuspends sump activity into the containment air region. This increases the airborne activity available for subsequent leakage to the environment.

## RAI 14:

In Tables 4.5-3, and 4.5-7 in Enclosure 2 of the application, the containment natural deposition rates of aerosols using NUREG/CR-6189 were provided. Provide the calculations used to determine the containment natural deposition rates. (RAI Category Code 2.b)

# **RESPONSE:**

Attachment B of Enclosure 1 of this letter provides a copy of Calculation N-6030-001 which calculates the containment natural deposition removal rates used in the dose calculation.

#### RAI 15:

In Table 4.5-9, "Loss-of-Coolant Accident Refueling Water Storage Tank (RWST) Release Analysis Parameters," of Enclosure 2 of the application, it is assumed that the RWST inflow rates from the ESF pump mini-flow isolation valve and RWST discharge check valve are 1.5 and 5 gallons per minute (gpm), respectively. Provide the bases and references for these leak rate assumptions. (RAI Category Code 2.a)

#### **RESPONSE:**

As discussed in Sect on 4.5.3.2.1 of the AST application, the Safety Injection System (SIS) and Containment Spray System (CSS) pumps minimum flow return paths to the RWST are isolated following a Recirculation Actuation Signal (RAS) by two sets of 4inch mini-flow isolation valves. Valves 1204-HV-9306 and 1204-HV-9307 are in series in one flow path, and valves 1204-HV-9347 and 1204-HV-9348 are in series in a second flow path. The maximum allowable leakage rate for each of the valves is 0.75 gpm per the leakage acceptance criteria specified in SONGS Units 2&3 Document No. 90055, "Selection of Valves and Determination of Inservice Testing". Consequently, for either path with its two valves in series, the maximum allowable path leakage rate is assumed to be 0.75 gpm. For the scenario of a LOCA without an assumed DG failure, the total leakage rate past the valves in the two parallel flow paths is 1.5 gpm.

As discussed in Section 4.5.3.2.2 of the AST application, following a RAS, each of the two RWSTs is isolated from the ESF recirculation loop by an RWST discharge check valve (1204-MU-001 or 1204-MU-002). The maximum allowable leakage through both check valves combined is 5 gpm per the leakage acceptance criteria specified in SONGS Units 2&3 Document No. 90055, "Selection of Valves and Determination of Inservice Testing".

# NOTE: no RAI #16 was provided

# RAI 17:

In Section 4.5.3.2.3 in Enclosure 2 of the application, it is stated that an iodine partition coefficient of 200 was used for the RWST water. Discuss if this coefficient applies to all forms of iodine (particulate and elemental) and provide the RWST water pH values as a function of time. (RAI Category Code 2.a)

# **RESPONSE:**

Please refer to RAI 3 response provided in Enclosure 1 of this letter.

### RAI 18:

Section 15.7.3.4.2.2, "Structural Evaluation of Fuel Assembly," and Table 15.7.5 of the SONGS updated final safety analysis report (UFSAR) stated that the design basis assumption for the number of failed fuel rods due to the postulated fuel-handling accident (FHA) is 60. In Table 4.6-1 of Enclosure 2 of the application, it is assumed there are 16 failed fuel rods for the FHA inside the containment. Explain the discrepancies. (RAI Category Code 2.a)

## **RESPONSE:**

There is no discrepancy between the SONGS UFSAR and the AST application.

UFSAR Sections 15.7.3.4 and 15.10.7.3.4 address a postulated fuel handling accident inside the fuel handling building (FHA-FHB). Per the UFSAR, the design basis FHA-FHB fails 60 fuel rods. As discussed in Section 4.7 of the AST application, the failure of 60 fuel rods is also modeled in the AST FHA-FHB analysis.

UFSAR Sections 15.7.3.9 and 15.10.7.3.9 address a postulated fuel handling accident inside the containment building (FHA-IC). Per the UFSAR, the design basis FHA-IC fails 16 fuel rods in the dropped fuel bundle and 210 fuel rods in the impacted fuel bundles. As discussed in Section 4.6 of the AST application, the failure of 16 fuel rods in the dropped fuel bundle and 210 fuel rods in the impacted fuel bundles is also modeled in the AST FHA-IC analysis.

#### RAI 19:

For the postulated FHA, provide noble gases and iodine activity inventory in the fuel rod gaps that are available for release to the water surrounding the failed fuel assemblies (1) during normal operation, and (2) prior to fuel movement after a 75-hour decay period. Also provide the amount of noble gases and iodine activities released (in curies) to the environment following the postulated FHA. (RAI Category Code 2.b)

#### **RESPONSE:**

Clarification – As discussed in Section 4.1.1 of the AST application, the fuel handling accident dose analyses model 72 hours of radioactive decay prior to an event, which is the minimum decay time required by SONGS Units 2 and 3 Licensee Controlled Specification (LCS) 3.9.101 prior to movement of irradiated fuel in the reactor vessel.

Table 4.1-3 of the AST application lists the average fuel rod noble gases and iodine isotope activity inventory at shutdown, prior to any post-shutdown decay (i.e., during normal operation). The noble gases and iodine activity inventory in the fuel rod gaps that are available for release to the water surrounding the failed fuel assemblies are calculated by scaling the Table 4.1-3 activity inventory by the radial peaking factor and the core iodine and noble gas fission product fractions in fuel rod gaps specified in Tables 4.6-1 and 4.7-1 of the AST application. Table 19-1 of this document performs this scaling operation.

Table 4.1-4 of the AST application lists the average fuel rod noble gases and iodine isotope activity inventory at 72 hours post-shutdown. The noble gases and iodine activity inventory in the fuel rod gaps that are available for release to the water surrounding the failed fuel assemblies are calculated by scaling the Table 4.1-4 activity inventory by the radial peaking factor and the core iodine and noble gas fission product fractions in fuel rod gaps specified in Tables 4.6-1 and 4.7-1 of the AST application. Table 19-2 of this dccument performs this scaling operation.

Section 4.6 of the AST application describes the AST fuel handling accident inside containment (FHA-IC) analysis. Use of the parameters presented in Table 4.6-1 of the application yields the containment airborne activity inventory specified in Table 19-3. As discussed in Sectior 4.6 of the AST application, this activity (less any activity removed by radioactive decay) is released to the environment over a two-hour time interval.

Section 4.7 of the AST application describes the AST fuel handling accident inside the fuel handling building (FHA-FHB) analysis. Use of the parameters presented in Table 4.7-1 of the AST application yields the FHB airborne activity inventory specified in Table 19-3. As discussed in Section 4.7 of the AST application, this activity (less any activity removed by 'adioactive decay) is released to the environment over a two-hour time interval.

ISOTOPE	AVERAGE	RADIAL	GAP	AVERAGE
	FUEL ROD	PEAKING	FRACTION	FUEL ROD GAP
	INVENTORY	FACTOR		INVENTORY
	AT SHUTDOWN			AT SHUTDOWN
	(CURIES)			(CURIES)
	[A]	[B]	[C]	$[=A \times B \times C]$
XE-131M	2.38E+01	1.75	0.05	2.08E+00
XE-133M	1.18E+02	1.75	0.05	1.03E+01
XE-133	3.78E+03	1.75	0.05	3.31E+02
XE-135M	7.94E+02	1.75	0.05	6.95E+01
XE-135	1.38E+03	1.75	0.05	1.21E+02
XE-137	3.52E+03	1.75	0.05	3.08E+02
XE-138	3.50E+03	1.75	0.05	3.06E+02
KR-83M	2.79E+02	1.75	0.05	2.44E+01
KR-85M	6.11E+02	1.75	0.05	5.35E+01
KR-85	2.13E+01	1.75	0.10	3.73E+00
KR-87	1.25E+03	1.75	0.05	1.09E+02
KR-88	1.76E+03	1.75	0.05	1.54E+02
KR-89	2.25E+03	1.75	0.05	1.97E+02
I-129	7.09E-05	1.75	0.05	6.20E-06
I-130	4.88E+01	1.75	0.05	4.27E+00
I-131	1.83E+03	1.75	0.08	2.56E+02
I-132	2.67E+03	1.75	0.05	2.34E+02
I-133	3.87E+03	1.75	0.05	3.39E+02
I-134	4.41E+03	1.75	0.05	3.86E+02
I-135	3.65E+03	1.75	0.05	3.19E+02
I-136	1.80E+03	1.75	0.05	1.58E+02
I-137	1.85E+03	1.75	0.05	1.62E+02
I-138	9.25E+02	1.75	0.05	8.09E+01

# Table 19-1: Average Fuel Rod Gap Inventory at Shutdown

[A] per Table 4.1-3 of the AST application[B] per Section 4.1.3 of the AST application[C] per Tables 4.1-6 and 4.1-7 of the AST application

ISOTOPE	AVERAGE	RADIAL	GAP	AVERAGE
	FUEL ROD	PEAKING	FRACTION	FUEL ROD GAP
	INVENTORY	FACTOR		INVENTORY
	AT 72 HOURS			AT 72 HOURS
	POST-SHUTDOWN	4		POST-SHUTDOWN
	(CURIES)	· · · ·		(CURIES)
	[A]	[B]	[C]	$[=A \times B \times C]$
I-129	7.09E-05	1.75	0.05	6.20E-06
I-130	8.62E-01	1.75	0.05	7.54E-02
I-131	1.41E+03	1.75	0.08	1.97E+02
I-132	8.76E-07	1.75	0.05	7.67E-08
I-133	3.56E+02	1.75	0.05	3.12E+01
I-134	7.57E-22	1.75	0.05	6.62E-23
I-135	1.92E+00	1.75	0.05	1.68E-01
KR-83m	4.01E-10	1.75	0.05	3.51E-11
KR-85m	8.89E-03	1.75	0.05	7.78E-04
KR-85	2.13E+01	1.75	0.10	3.73E+00
KR-87	1.13E-14	1.75	0.05	9.89E-16
KR-88	4.66E-05	1.75	0.05	4.08E-06
XE-131m	2.00E+01	1.75	0.05	1.75E+00
XE-133m	4.57E+01	1.75	0.05	4.00E+00
XE-133	2.54E+03	1.75	0.05	2.22E+02
XE-135	5.74E+00	1.75	0.05	5.02E-01

Table 19-2: Average Fuel Rod Gap Inventory at 72 Hours Post-Shutdown

[A] per Table 4.1-4 cf the AST application

[B] per Section 4.1.3 of the AST application[C] per Tables 4.1-6 and 4.1-7 of the AST application

ISOTOPE	INITIAL	INITIAL
	CONTAINMENT	FHB
	AIRBORNE ACTIVITY	AIRBORNE ACTIVITY
	AVAILABLE FOR	AVAILABLE FOR
	RELEASE TO	RELEASE TO
	ENVIRONMENT	ENVIRONMENT
	(CURIES)	(CURIES)
I-129	7.01E-06	1.86E-06
I-130	8.53E-02	2.26E-02
I-131	2.24E+02	5.93E+01
I-132	8.66E-08	2.30E-08
I-133	3.52E+01	9.33E+00
I-134	7.49E-23	1.99E-23
I-135	1.90E-01	5.05E-02
Kr-83m	7.93E-09	2.11E-09
Kr-85m	1.76E-01	4.67E-02
Kr-85	8.42E+02	2.24E+02
Kr-87	2.24E-13	5.94E-14
Kr-88	9.22E-04	2.45E-04
Xe-131m	3.95E+02	1.05E+02
Xe-133m	9.03E+02	2.40E+02
Xe-133	5.03E+04	1.34E+04
Xe-135	1.14E+02	3.01E+01

Table 19-3: Init al FHA Airborne Activity Available for Release to Environment

## RAI 20:

The main steamline break (MSLB) in the SONGS UFSAR Section 15.1.3 assumed that the steam generators would have the maximum 1 gpm primary-to-secondary leakage specified in SONG TSs and this entire leakage is occurring in the faulted steam generator. Instead, it is stated that only 0.5 gpm in Table 4.8-1 in Enclosure 2 of the application for the MSLB. Explain the discrepancy. (RAI Category Code 2.a)

## **RESPONSE:**

SONGS Units 2 and 3 Technical Specification LCO 3.4.13 limits primary to secondary leakage to 720 gallons/day (i.e., 0.5 gallons/minute [gpm]) through any one steam generator, and 1 gpm total leakage through all (i.e., both) steam generators.

The AST MSLB analysis is evaluated using the 0.5 gpm limit for primary to secondary leakage rate into any one steam generator.

SCE submitted PCN-564 for NRC review and approval on November 30, 2005. PCN-564 is a request to revise LCO 3.4.13 to eliminate reference to the 1 gpm total leakage rate through all steam generators criterion, and to reduce the limit for primary to secondary leakage rate into any single steam generator to 150 gallons/day (i.e., approximately 0.1 gallons/minute).

### RAI 21:

In Table 4.8-1 in Enc osure 2 of the application, an iodine flashing factor of 20 during the steam generator uncovery is assumed. Provide the basis for this assumption and how this value is used in the MSLB radiological consequence analysis. (RAI Category Code 2.a)

#### **RESPONSE:**

As discussed in Section 4.8.2 of the AST application, during periods where the steam generator tubes are uncovered, a portion of the primary-to-secondary leakage flashes to vapor based on the thermodynamic conditions in the reactor coolant and the secondary coolant. The flashing fraction is calculated using the following expression:

$$FF = \frac{h_{f_1} - h_{f_2}}{h_{g_2} - h_{f_2}}$$

Where:

FF is the flashing fraction

 $h_{f_1}$  is the enthalpy of the liquid at primary coolant conditions (btu/lbm)

 $h_{f_2}$  is the enthalpy of the liquid at secondary system conditions (btu/lbm)

 $h_{g_2}$  is the enthalpy of steam at secondary system conditions (btu/lbm)

The thermodynamic conditions are evaluated at 60 second intervals for each steam generator. In the main steam line break analysis a maximum flashing fraction in either steam generator of 14.41% occurs at the start of the event. Conservatively, the pre-trip SLB-OC AST dose analysis models a bounding flashing fraction of 20% during periods of steam generator tube uncovery.

As discussed in Section 4.8.2 of the AST application, during periods of full tube coverage the primary-to-secondary leakage is directed to the water space of the steam generators. During the period of tube uncovery, the flashed portion of the primary to secondary leakage (20% of the leakage) is directed to the steam space of the steam generator, and the remainder (80% of the leakage) is directed to the water space of the steam steam generator.

## RAI 22:

In Table 4.8-1 in Enclosure 2 of the application, 10 percent of the fuel rods in the core were assumed to fail following the postulated MSLB. The design basis for the failed fuel rods in SONGS UFSAR Section 15.1.3.1.1.4 is that "fuel clad barrier is evaluated on the basis that all fuel rods which experience a [departure from nucleate boiling ratio (DNBR)] less than 1.31 are assumed to experience cladding perforation." The UFSAR further stated that, "the radiological consequence analysis is conservatively based on the assumption that all fuel pins with a DNBR value below the DNBR limit fail." Explain how it was determined that 10 percent of the fuel rods in the core would fail following the postulated MSLB. (RAI Category Code 2.a)

### **RESPONSE:**

Fuel failure estimates for the steam line break event are prepared as part of each core reload safety analysis campaign. The fuel failure estimates are established on the basis that all fuel rods which experience a departure from nucleate boiling ratio (DNBR) less than 1.31 are assumed to experience clacking perforation. The transient evaluations for Unit 2 Cycle 12 and Unit 3 Cycle 12 operation determined that no more than 7 percent fuel failure would occur. As noted in Section 4.8.1 of the AST application, the pre-trip steam line break outside containment AST dose analysis conservatively assumes 10 percent fuel failure to bound future operating cycle fuel failure predictions.

## RAI 23:

For the MSLB accident, please provide the following:

a. Concentrations of dose equivalent iodine 131 for each iodine isotope for pre-existing and accident initiated iodine spikes. (RAI Category Code 2.b)

## **RESPONSE:**

Ten percent fuel damage is postulated for the MSLB AST dose analysis. As stated in Section 4.8.1 of the AST application, consistent with RG 1.183 Appendix E Section 2, because more than minimal fuel damage is postulated, the pre-trip SLB-OC AST activity release model does not address primary coolant iodine spiking.

If more than minimal fuel damage had not been postulated for the MSLB event, then the MSLB would have been evaluated using the pre-existing and accident initiated iodine spike characteristics described in Section 4.1.2 of the AST application.

Table 4.1-5 of the AST application provides concentrations for each iodine isotope for the pre-existing iodine spike. The corresponding dose equivalent iodine-131 concentrations for each iodine isotope for the pre-existing iodine spike are provided in the following table:

Isotope	Primary Side Pre-Accident Iodine Spike Concentration (microCi/gm DE I-131)
I-131	4.95E+01
I-132	8.04E-02
I-133	9.68E+00
I-134	5.49E-03
I-135	7.61E-01
Total	60

An accident initiated iodine spike results in time-dependent primary side iodine concentrations. As such, it is not possible to provide concentrations of dose equivalent iodine-131 for each iodine isotope for an accident initiated iodine spike.

## RAI 23:

For the MSLB accident, please provide the following:

b. Curie contents of each iodine isotope in the primary coolant and secondary coolant at 1.0 micro curie per gram and 60 micro curie per gram. (RAI Category Code 2.b)

## **RESPONSE:**

As stated in the response to RAI 23.a, because more than minimal fuel damage is postulated, the pre-trip SLB-OC AST activity release model does not address primary coolant iodine spiking. If more than minimal fuel damage had not been postulated for the MSLB event, then the MSLB would have been evaluated using the pre-existing and accident initiated iodine spike characteristics described in Section 4.1.2 of the AST application.

As stated in Section 4.1.2 of the AST application, Table 4.1-5 summarizes the primary side equilibrium (no iodine spike) activity concentration profile determined for the Technical Specification LCO 3.4.16 condition of 1.0  $\mu$ Ci/gram Iodine-131 dose equivalency. Table 4.1-5 of the AST application also summarizes the primary side pre-existing iodine spike activity concentration profile determined for the Technical Specification LCO 3.4.16 condition of 60  $\mu$ Ci/gram Iodine-131 dose equivalency.

Per Table 4.8-1 of the AST application, the RCS dilution mass modeled in the MSLB event is approximately 2.015E+08 grams. The curie content of each iodine isotope in the primary coolant at 1.0 or 60  $\mu$ Ci/gram lodine-131 dose equivalency is the product of this dilution mass and the Table 4.1-5 primary side iodine isotope activity concentration.

As stated in Section 4.1.2 of the AST application, Table 4.1-5 also summarizes the secondary side water iodine activity concentration profile determined for the Technical Specification LCO 3.7.19 condition of 0.1  $\mu$ Ci/gram lodine-131 dose equivalency (please note that there is no requirement to evaluate secondary side water iodine activity concentration profiles at 1.0 or 60  $\mu$ Ci/gram lodine-131 dose equivalency).

Per Table 4.8-1 of the AST application, the secondary dilution water mass modeled in the MSLB event is approximately 1.59E+05 lbm. The curie content of each iodine isotope in the secondary coolant at 0.1 microcurie per gram is the product of this dilution mass and the Table 4.1-5 secondary side water iodine isotope activity concentration.

## RAI 23:

For the MSLB accident, please provide the following:

c. Iodine production rates for accident initiated iodine spikes. (RAI Category Code 2.b)

## **RESPONSE:**

As stated in the response to RAI 23.a, because more than minimal fuel damage is postulated, the pre-trip SLB-OC AST activity release model does not address primary coolant iodine spiking. If more than minimal fuel damage had not been postulated for the MSLB event, then the MSLB would have been evaluated using the pre-existing and accident initiated iodine spike characteristics described in Section 4.1.2 of the AST application.

Section 4.1.2 of the AST application addresses accident initiated iodine spiking. Table 4.1-6 of the AST application summarizes the concurrent iodine spike release rate in terms of escape rate coefficients that are to be modeled with the AST reactor core iodine inventory and an assumed 0.62 percent failed fuel.

When an escape rate coefficient of  $1.3E-08 \text{ sec}^{-1}$  is modeled with the AST reactor core iodine inventory and 0.62 percent fuel failure, the resultant equilibrium primary coolant iodine activity concentration is  $1.0 \mu \text{Ci/gram DE I-131}$ .

An accident initiated spiking factor of 335 can be modeled with an escape rate coefficient of 4.4E-06 sec<sup>-1</sup>, an AST reactor core iodine inventory, and 0.62 percent fuel failure.

An accident initiated spiking factor of 500 can be modeled with an escape rate coefficient of 6.5E-06 sec<sup>-1</sup>, an AST reactor core iodine inventory, and 0.62 percent fuel failure.

## RAI 24:

List any deviations or exceptions taken in your radiological consequence analyses performed for the design-basis loss-of-coclant accident, FHAs inside and outside containment, and the MSLB accident from RG 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors." (RAI Category Code 2.a)

#### **RESPONSE:**

No deviations or exceptions from RG 1.183 were taken in the radiological consequence analyses performed for the design-basis loss-of-coolant accident, FHAs inside and outside containment, and the MSLB accident. Sections 4.5 through 4.8 of the application provide explicit statements as to how the analyses comply with the applicable portions of RG 1.183 guidance.

Attachment A

Drawing Nos. 40483 and 41983

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Attachment B

Drawing Numbers 10328, Sheet 1; and

Drawing Numbers 23090, 23075 and 23069








Attachment C

Drawing Number 10201, Sheet 1, Revision 7

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Site File Copy 10201

Enclosure 3

Complete Replacement of PCN-555,

"Alternative Source Term"

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# LICENSEE'S EVALUATION

# PCN 555

# **Alternative Source Term**

1.0 INTRODUCTION

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- 2.0 PROPOSED CHANGE
- 3.0 BACKGROUND
- 4.0 TECHNICAL ANALYSIS
- 5.0 REGULATORY SAFETY ANALYSIS
  - 5.1 No Significant Hazards Consideration
  - 5.2 Applicable Regulatory Requirements/Criteria
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ATTACHMENTS

A. Acronyms

B. List of Regulatory Commitments

# 1.0 INTRODUCTION

This letter is a request to amend Operating Licenses NPF-10 and NPF-15 for San Onofre Nuclear Generating Station (SONGS) Units 2 and 3, respectively.

This license amendment request will revise the accident source term used in the design basis radiological consequences analyses to an Alternative Source Term (AST) in accordance with the requirements of 10 CFR 50.67.

This license amendment request will also expand the allowed use of fuel failure estimates by Departure from Nucleate Boiling (DNB) statistical convolution methodology from only the reactor coolant pump sheared shaft event to the UFSAR Chapter 15 non-LOCA events that assume a loss of flow (i.e., a loss of AC power) and that fail fuel.

#### 2.0 PROPOSED CHANGE

This license amendment is requested in accordance with the requirements of 10 CFR 50.67, which addresses the use of an AST at operating reactors, and relevant guidance of Regulatory Guide 1.183 (Reference 1). This license amendment request represents full-scope implementation of the AST described in Regulatory Guide 1.183.

Full-scope implementation of an AST requires re-analysis of Updated Final Safety Analysis Fleport (UFSAR) Chapter 15 accident analyses, including the Loss-of-Coolant Accident (LOCA) and Fuel Handling Accident (FHA) at a minimum. Southern California Edison (SCE) has re-analyzed the LOCA, FHA inside containment (FHA-IC), and FHA in the Fuel Handling Building (FHA-FHB). In addition, to ensure that the most limiting accident in terms of dose consequences has been included, SCE has re-analyzed the pre-trip Steam Line Break Outside Containment (SLB-OC) accident as well.

This license amendment request will also expand the allowed use of fuel failure estimates by DNB statistical convolution methodology from only the reactor coolant pump sheared shaft event to the UFSAR Chapter 15 non-LOCA events that assume a loss of flow (i.e., a loss of AC power) and that fail fuel.

Implementation of this license amendment will require changes to the SONGS UFSAR Chapter 15 control room and offsite radiological consequence analyses for these four Design Basis Accidents (DBAs). Following approval of this license amendment request, SCE will provide the revised UFSAR sections to the NRC as part of its normal UFSAR update required by 10 CFR 50.71(e).

In summary, the requested license amendment will revise the accident source term used in the design basis radiological consequences analyses to an Alternative Source Term in accordance with the requirements of 10 CFR 50.67, and allow fuel failure estimates for UFSAR Chapter 15 non-LOCA events that assume a loss of flow (i.e., a loss of AC power) and that fail fuel, to be based on the DNB statistical convolution methodology.

# 3.0 BACKGROUND

#### Generic Letter 2003-01

On June 12, 2003, the NRC issued Generic Letter (GL) 2003-01, "Control Room Habitability" (Reference 2) GL 2003-01 discussed the results of Control Room Envelope (CRE) inleakage testing at several plants. These test results indicate that current testing methods (positive pressure testing) do not give a good indication of CRE inleakage. GL 2003-01 requested that licensees confirm that the most limiting unfiltered inleakage into the CRE is no more than the value assumed in the design basis radiological analyses. SCE performed CRE inleakage testing in May, 2004 and transmitted the results of this testing to the NRC by letter dated September 17, 2004 (Reference 3).

As stated in SCE's August 5, 2003 letter (Reference 4) responding to GL 2003-01, the current value of assumed unfiltered inleakage into the CRE in the design basis radiological analyses is 0 cfm, plus an additional assumed 10 cfm for ingress and egress. As described in SCE's letter dated September 17, 2004, testing has shown that actual CRE inleakage exceeds that assumed in the current design basis radiological analyses. Since testing was completed, SONGS Units 2 and 3 have continued to operate based on operability assessments that rely on AST methodology. Approval of this proposed change will make the AST the SONGS Units 2 and 3 CRE to full qualification.

As described abcve, this license amendment request represents full-scope implementation of the AST as described in Regulatory Guide 1.183. The LOCA, FHA-IC, FHA-FHB, and pre-trip SLB-OC analyses have been updated and show results within the acceptance criteria defined in 10CFR50.67 with an assumed CRE unfiltered boundary inleakage of 990 cfm plus 10 cfm assumed unfiltered inleakage due to CRE ingress and egress. Following approval of this license amendment request, future revisions to UFSAR Chapter 15 design basis accident control room and offsite radiological consequence analyses will be performed using AST methodology. In addition, following approval of this license amendment request, fuel failure estimates for UFSAR Chapter 15 non-LOCA events that assume a loss of flow (i.e., a loss of AC power) and that fail fuel may be based on the DNB statistical convolution methodology.

There are no physical changes to plant equipment or operation of the plant as a result of this proposed change. There are no changes to the Technical Specifications (TSs) as a result of this proposed change.

#### Impact to the Site

The following clarifications are provided to address source term implementation considerations of RG 1.183 that are not explicitly stated elsewhere in this proposed change:

#### 1. Impact on Equipment Environmental Qualification

Regulatory Guide 1.183 Regulatory Position 1.3.5 states that equipment Environmental Qualification (EQ) analyses that have assumptions or inputs affected by a proposed plant modification associated with the AST implementation should be updated to address these impacts. Regulatory Position 1.3.5 of RG 1.183 also states that the NRC staff is assessing the effect of increased cesium releases on EQ doses to determine whether licensee action is warranted, and that until such time as this generic issue (GSI-187) is resolved, licensees may use either the AST or the Technical Information Document (TID) 14844 assumptions for performing the required EQ analyses. The GSI has since been closed with the determination that a generic action was not warranted. Consistent with the RG 1.183 guidance and the GSI closure determination, since no plant modifications are required to address AST implementation, the existing equipment gualification analyses, which are based upon the TID-14844 source term, are considered acceptable. Future EQ analyses may use either the AST or TID-14844 source term.

#### 2. Control Room Habitability

NUREG-0737 (Reference 5), Task III.D.3.4, "Control-Room Habitability Requirements," requires that the control room (CR) operators be adequately protected against the effects of accidental release of radioactive gases, and that the nuclear power plant can be safely operated cr shut down under design basis accident conditions (as required by 10 CFR 50, Appendix A, General Design Criterion 19). With approval of the Alternative Source Term methodology, the dose acceptance criterion for CR operators will become the 5 rem Total Effective Dose Equivalent (TEDE) dose criterion of 10 CFR 50.67.

As documented in Section 4, the CR operator post-accident dose for each of the evaluated events is less than 5 rem TEDE. Compliance with this dose acceptance criterion ensures that the CR operators are adequately protected against the effects of accidental release of radioactive gases, and that the nuclear power plant can be safely operated or shut down under design basis accident conditions.

#### 3. Emergency Response Facility Habitability

The Emergency Response Facilities (ERFs) consist of the Technical Support Center (TSC), the Operations Support Center (OSC), and the Emergency Operations Facility (EOF).

NUREG-0737, Task II.B.2, "Design Review of Plant Shielding and Environmental Qualification of Equipment for Spaces/Systems Which May Be Used in Postaccident Operations", provides dose criteria for CR and TSC occupants. This document states that the dose to individuals in the CR or TSC should not be in excess of 5 rem whole body, or its equivalent to any part of the body for the duration of the accident. The document also states the CR and TSC dose criteria should be based on the control room occupancy factors contained in Standard Review Plan 6.4.

The TSC is located within the control room envelope, in rooms that overlook the Units 2 and 3 control room operating areas. TSC occupants receive the same inhalation and immersion doses calculated for CR occupants. SCE has determined that although a given gamma shine dose to a TSC occupant may be higher or lower than the dose to a CR occupant, the net effect from all post-accident gamma shine sources is that the TSC shine dose is no more than the CR shine dose. Since the CR dose criterion of 5 rem TEDE is met using an AST methodology, the TSC dose criterion of 5 rem would also be met.

The OSC is located in the Auxiliary Building. This facility does not have isolation or filtration capabilities. Consistent with current emergency planning requirements, post-accident radiation dose rate surveys of the OSC would be performed by Health Physics personnel, and protective actions would be taken if necessary.

The EOF is located at the SONGS Mesa Facility across Interstate 5 from San Onofre Units 2 and 3. The EOF is protected by charcoal and HEPA filtration systems. Because of the distance from the various possible release points and the available filtration systems, any doses seen in the EOF would be bounded by those seen in the control room or TSC.

#### 4. Impact on Emergency Planning Radiological Assessment Methodology

Implementation of an AST will impact several aspects of Emergency Planning Radiological Dose Assessment Methodology. The behavior of radioactive iodine released under post-accident conditions, which is defined by the accident source term, is an input to emergency planning dose assessment calculations. Following approval of this license amendment request, the manual dose calculation methodology as described in Emergency Planning Implementation Procedures (EPIPs) and other Emergency Planning guidance documents will be revised to reflect AST methodology.

Raddose V dose assessment software will be evaluated by June 30, 2005, to determine what specific changes may be warranted in order to maintain consistency with the manual dose assessment calculation methodology.

#### 5. Post Accident Sampling Capability

Post Accident Sampling System (PASS) licensing requirements were deleted from the SONGS Units 2 & 3 Technical Specifications per Unit 2 License Amendment 178 and Unit 3 License Amendment 169 (Reference 6). Currently, the diluted depressurized grab sample portion of the PASS is retained for severe accident management only. Application of AST methodology has determined that, if required for severe accident management, an individual can draw a PASS sample approximately 17 hours following the onset of a loss of coolant accident without exceeding the NUREG-0737 dose criteria for whole body and extremity exposures.

Application of AST methodology has also determined that an individual performing reactor coolant sample collection and analysis at the Normal Sampling Station (NSS) for boron, hydrogen, gas activity, and liquid activity at 3 hours following a non-LOCA event, and with up to 5% fuel clad failures, will not exceed the 5 rem whole body dose limit. This determination is consistent with the current licensing basis source term dose evaluation for this same exposure mechanism.

As described in the Safety Evaluation Report for License Amendments 178 and 169 for San Onofre Units 2 and 3, SCE is committed to maintain the capability for classifying fuel damage events at the Alert level threshold of 300  $\mu$ Ci/gram dose equivalent iodine-131. The value of 300  $\mu$ Ci/gram DE I-131 is unaffected by use of an AST. Therefore, the capability for classifying fuel damage events at the Alert level threshold is unchanged.

#### 6. Accident Monitoring Instrumentation

A review of Accident Monitoring setpoint calculations was performed. This review determined that no setpoint changes will be required to implement the AST. Some setpoint calculations were unaffected. The remaining calculations were determined to be conservative relative to calculations that would be based on an AST, because the mix of isotopes predicted by the AST calculations is bounded by the mix of isotopes expected under the current licensing basis. Following approval of this license amendment request, future revisions to Accident Monitoring setpoint calculations will reflect the AST source term.

#### 7. Other Design Eases Not Affected

This proposed change has been determined to have no affect on postaccident access, environmental reports, facility siting, or leakage control.

# 4.0 TECHNICAL ANALYSIS

To address the issue of measured CRE inleakage rate exceeding the currently assumed CRE inleakage rate, a series of new radiological dose analyses have been originated using the AST methodology of Regulatory Guide (RG) 1.183 to document the acceptability of an assured increase in SONGS Units 2 and 3 CRE unfiltered inleakage rate to a value of 1,000 cfm (including ingress and egress related inleakage). This Section summarizes the analyses supporting the SONGS Units 2 and 3 license amendment request.

As recommended by RG 1.183, a complete LOCA dose analysis has been performed. Additionally, dose analyses have been performed to assess the radiological consequences of FHAs in both the containment and fuel handling buildings, and the radiological consequences of a pre-trip SLB-OC. The FHAs and SLB-OC have been re-analyzed since the current licensing basis analyses for these events challenge the offsite close acceptance criteria. In addition, the pre-trip SLB-OC had not been previously evaluated for control room dose consequences.

With the exception of the Increased Main Steam Flow with single failure (IMSF-SF) event, all other design basis accidents that are currently evaluated in the SONGS Units 2 and 3 UFSAR Chapter 15 have control room and offsite dose consequences that are less severe than those of the LOCA, FHA, and pre-trip SLB-OC accidents. The IMSF-SF Exclusion Area Boundary (EAB) whole body gamma dose is slightly greater than for the pre-trip SLB-OC. The IMSF-SF EAB thyroid inhalation dose is significantly less than for the pre-trip SLB-OC. For this reason, the IMSF-SF has not been re-evaluated as part of this license amendment request.

Following approval of this license amendment request, future revisions to UFSAR Chapter 15 design basis accident control room and offsite radiological consequence analyses will be evaluated using AST methodology whenever a need arises for them to be updated.

Section 4.1 summarizes the core and fuel rod fission product inventories that were recalculated using the guidance in AST RG 1.183 as clarified in RG 1.195 (Reference 7). Section 4.1 also presents the recalculated activity profiles associated with operation at the primary and secondary activity concentration limits, with and without iodine spiking, as specified in Technical Specification Limiting Conditions For Operation (LCOs) 3.4.16 and 3.7.19. Section 4.2 summarizes the model used in evaluating offsite dose consequences at the EAB and at the outer boundary of the low population zone (LPZ). This model is generic to the dose analyses evaluating offsite dose consequences.

Section 4.3 summarizes the model used in evaluating control room dose consequences. This model is generic to the dose analyses evaluating control room dose consequences.

Adoption of the AST methodology guidance has imposed the need to recalculate atmospheric dispersion between various post-accident release points and the control room outside air ventilation intakes. The atmospheric dispersion analysis uses the ARCON96 computer code and guidance provided in RG 1.194 (Reference 8). Section 4.4 summarizes the ARCON96 analyses.

Section 4.5 summarizes the model used in evaluating the radiological consequences of a loss of coolant accident.

Section 4.6 summarizes the model used in evaluating the radiological consequences of a fuel handling accident inside the containment building.

Section 4.7 summarizes the model used in evaluating the radiological consequences of a fuel handling accident inside the fuel handling building.

Section 4.8 summarizes the model used in evaluating the radiological consequences of a pre-trip steam line break outside containment.

# Section 4.1 ACTIVITY INVENTORIES AND TECHNICAL SPECIFICATION ACTIVITY PROFILES

The SONGS Units 2 and 3 core and fuel rod fission product inventories have been recalculated using the guidance in AST RG 1.183 as clarified in RG 1.195. Activity profiles have also been recalculated for operation at the primary and secondary activity concentration limits, with and without iodine spiking.

# Section 4.1.1 Core and Average Fuel Rod Activity Inventories

Table 4.1-1 summarizes the parameters modeled in the evaluation of the reactor core activity inventory. The core inventory of fission products is based on the maximum full-power operation of the core with, as a minimum, currently licensed values for fuel enrichment, fuel burnup, and an assumed core power equal to the current licensed rated thermal power times the emergency core cooling system (ECCS) evaluation uncertainty. These parameters were examined parametrically to maximize the fission product inventory. The period of irradiation is of sufficient duration to allow the activity of dose significant radionuclides to reach equilibrium or to reach maximum values. The core inventory was developed using the SAS2H and ORIGEN-S modules of the NRC-sponsored SCALE code package, which is an appropriate isotope generation and depletion computer code.

PARAMETER	MODELED VALUE
Maximum Core Average Burnup	40.0 GWD/T
Maximum Core Average Enrichment	4.8 w/o U-235
Maximum Core Uranium Loading	95.5 MTU
Core Rated Thermal Power	3,438 MW-t
Core Thermal Power Uncertainty	0.58% actual, 2.0% modeled
Analyzed Core Thermal Power	3,507 MW-t
Minimum Number of Fuel Rods per Core	51,132 rods/core

TABLE 4.1-1: ACTIVITY INVENTORY MODEL PARAMETERS

The ORIGEN-S code was executed for the various combinations of core average burnups (0, 10, 20, 30 and 40 GWD/T) and enrichments (3.8 and 4.8 w/o U-235). Each ORIGEN-S code run evaluated the activity inventory in a single fuel assembly. In any code run, the maximum curie value of an isotope represents the sum of the ORIGEN-S code output identified as "Light Elements", "Fission Products", and "Actinides". For each isotope, the maximum curie value from the ORIGEN-S code runs was chosen to represent the inventory of that isotope in the composite fuel assembly. Activity inventories were originated for 540 isotopes of the elements listed in RG 1.183 Table 5. The maximum full core accident source term was determined by multiplying the composite maximum fuel assembly activity inventory by 217 fuel assemblies per core. Table 4.1-2 summarizes the full core accident source term. The original 540 isotopes were reduced to the Table 4.1-2 listing of 166 isotopes that are included in the Bechtel LocaDose code isotope library. Per the guidance of RG 1.183 Regulatory Position 4.1.1, the isotope libraries contain all radionuclides, including progeny from the decay of parent radionuclides, that are significant with regard to dose consequences and the released radioactivity. The 166 isotopes include all but one of the isotopes listed in the RADTRAD code isotope library as identified in NUREG/CR-6/304 (Reference 9) Table 1.4.3.3-2. The missing isotope is Niobium-97m, which is a short-lived daughter of Zirconium-97, and which does not have a dose conversion factor in Federal Guidance Report 11 (Reference 10). Niobium-97m decays to Niobium-97. The Bechtel LocaDose code isotope library conservat vely assumes that Zirconium-97 decays directly to Niobium-97.

Consistent with the guidance of RG 1.183 Regulatory Position 3.1, for events that do not involve the entire core, Table 4.1-3 summarizes the average fission product inventory of each damaged fuel rod as determined by dividing the Table 4.1-2 total core inventory by the minimum number of fuel rods in the core.

Per RG 1.183 Regulatory Positions 3.2 and 3.4, the only elements to be considered in design basis analyses for non-LOCA events, including fuel handling accidents, are xenon, krypton, iodine, bromine, cesium, and rubidium.

ISOTOPE	CORE	ISOTOPE	CORE	ISOTOPE	CORE	ISOTOPE	CORE
	INVENTORY		INVENTORY		INVENTORY		INVENTORY
	[curies]		[curies]		[curies]		[curies]
XE-131M	1.22E+06	TE-127M	1.44E+06	CO-58	2.21E+05	CM-243	2.26E+03
XE-133M	6.05E+05	TE-127	8.48E+06i	CO-60	4.60E+05	CM-244	3.91E+05
XE-133	1.93E+03	TE-129M	5.95E+06	LA-140	1.90E+08	CM-245	3.06E+01
XE-135M	4.06E+07	TE-129	2.91E+07	LA-141	1.67E+08	CM-246	8.05E+00
XE-135	7.05E+07	TE-131M	1.92E+07	LA-142	1.66E+08	CM-247	4.34E-05
XE-137	1.80E+03	TE-131	7.90E+07	LA-143	1.63E+08	CM-248	1.97E-04
XE-138	1.79E+03	TE-132	1.34E+08	ZR-93	1.56E+02	AM-241	1.57E+04
KR-83M	1.43E+07	TE-133M	9.20E+07	ZR-95	1.78E+08	AM-242M	1.06E+03
KR-85M	3.12E+07	TE-133	1.11E+08	ZR-97	1.69E+08	AM-242	9.20E+06
KR-85	1.09E+03	TE-134	1.92E+08	ND-144	0.00E+00	AM-243	2.93E+03
KR-87	6.38E+07	SB-124	8.79E+04	ND-147	6.55E+07	CE-141	1.67E+08
KR-88	8.98E+07	SB-125	1.03E+06	EU-152	9.37E+02	CE-142	3.19E-03
KR-89	1.15E+08	SB-126M	5.13E+04	EU-154	7.68E+05	CE-143	1.64E+08
I-129	3.62E+00	SB-126	4.37E+04	EU-155	3.12E+05	CE-144	1.29E+08
I-130	2.50E+06	SB-127	8.57E+06	EU-156	2.65E+07	PU-236	5.34E+01
I-131	9.37E+07	SB-129	3.06E+07	NB-93M	2.16E+02	PU-237	7.05E+02
I-132	1.36E+08	SE-79	7.86E+00	NB-95M	2.05E+06	PU-238	3.56E+05
I-133	1.98E+08	BA-136M	6.36E+05	NB-95	1.79E+08	PU-239	3.60E+04
I-134	2.26E+08	BA-137M	1.19E+07	NB-97	1.70E+08	PU-240	5.16E+04
I-135	1.87E+08	BA-139	1.82E+08	PM-147	1.87E+07	PU-241	1.53E+07
I-136	9.20E+07	BA-140	1.81E+03	PM-148M	3.30E+06	PU-242	2.50E+02
I-137	9.46E+07	BA-141	1.66E+03	PM-148	1.84E+07	PU-243	4.95E+07
I-138	4.73E+07	SR-89	1.24E+03	PM-149	5.97E+07	PU-244	0.00E+00
BR-82	3.43E+05	SR-90	9.48E+05	PM-151	1.95E+07	NP-236	1.24E-03
BR-83	1.42E+C7	SR-91	1.53E+03	PR-143	1.58E+08	NP-237	4.04E+01
BR-84	2.73E+C7	SR-92	1.55E+03	PR-144M	1.81E+06	NP-238	4.67E+07
BR-85	3.12E+C7	SR-93	1.68E+08	PR-144	1.30E+08	NP-239	2.03E+09
BR-87	5.10E+C7	SR-94	1.63E+08	SM-147	1.97E-04	GD-152	0.00E+00
BR-88	5.10E+C7	SR-95	1.46E+08	SM-148	0.00E+00	U-232	0.00E+00
CS-134M	4.56E+C6	RU-103	1.55E+08	SM-149	0.00E+00	U-234	0.00E+00
CS-134	1.87E+07	RU-105	1.12E+08	SM-151	5.14E+04	U-236	0.00E+00
CS-135	5.97E+01	RU-106	6.08E+07	SM-153	5.01E+07	U-237	0.00E+00
CS-136	5.58E+()6	RH-103M	1.55E+08	Y-89M	1.33E+05	U-238	0.00E+00
CS-137	1.25E+()7	RH-105	1.02E+08	Y-90M	5.82E+02	PA-233	0.00E+00
CS-138	1.90E+()8	RH-106	6.73E+07	Y90	9.94E+06	TH-228	0.00E+00
CS-139	1.79E+()8	PD-107	1.32E+01	Y-91M	8.85E+07	TH-230	0.00E+00
RB-86	1.90E+()5	PD-109	4.06E+07	Y91	1.51E+08	TH-232	0.00E+00
RB-87	2.54E-C3	MO-99	1.80E+08	Y92	1.56E+08	TH-234	0.00E+00
RB-88	9.20E+()7	TC-99M	1.59E+08	Y93	1.13E+08	U-233	0.00E+00
RB-89	1.22E+()8	TC-99	1.55E+03	Y94	1.75E+08	TH-229	0.00E+00
RB-90	1.14E+08	TC-101	1.59E+08	Y95	1.77E+08	-	-
TE-125M	2.23E+05	CO-57	0.00E+00	CM-242	5.08E+06	-	-

# TABLE 4.1-2: REACTOR CORE ISOTOPE INVENTORY AT SHUTDOWN

ISOTOPE	AVG. ROD	ISOTOPE	AVG. ROD	ISOTOPE	AVG. ROD	ISOTOPE	AVG. ROD
jj	INVENTORY		INVENTORY		INVENTORY		INVENTORY
	[curies]		[curies]		[curies]		[curies]
XE-131M	2.38E+01	TE-127M	2.81E+01	CO-58	4.33E+00	CM-243	4.41E-02
XE-133M	1.18E+02	TE-127	1.66E+02	CO-60	9.00E+00	CM-244	7.64E+00
XE-133	3.78E+03	TE-129M	1.16E+02	LA-140	3.72E+03	CM-245	5.98E-04
XE-135M	7.94E+02	TE-129	5.69E+02	LA-141	3.26E+03	CM-246	1.57E-04
XE-135	1.38E+03	TE-131M	3.76E+02	LA-142	3.24E+03	CM-247	8.49E-10
XE-137	3.52E+03	TE-131	1.54E+03	LA-143	3.19E+03	CM-248	3.85E-09
XE-138	3.50E+03	TE-132	2.62E+03	ZR-93	3.04E-03	AM-241	3.06E-01
KR-83M	2.79E+02	TE-133M	1.80E+03	ZR-95	3.48E+03	AM-242M	2.07E-02
KR-85M	6.11E+02	TE-133	2.17E+03	ZR-97	3.31E+03	AM-242	1.80E+02
KR-85	2.13E+01	TE-134	3.76E+03	ND-144	0.00E+00	AM-243	5.73E-02
KR-87	1.25E+03	SB-124	1.72E+00	ND-147	1.28E+03	CE-141	3.26E+03
KR-88	1.76E+()3	SB-125	2.01E+01	EU-152	1.83E-02	CE-142	6.24E-08
KR-89	2.25E+()3	SB-126M	1.00E+00	EU-154	1.50E+01	CE-143	3.21E+03
I-129	7.09E-C/5	SB-126	8.55E-01	EU-155	6.11E+00	<u>CE-144</u>	2.52E+03
I-130	4.88E+()1	SB-127	1.68E+02	EU-156	5.18E+02	PU-236	1.04E-03
I-131	1.83E+03	SB-129	5.98E+02	NB-93M	4.23E-03	PU-237	1.38E-02
I-132	2.67E+03	SE-79	1.54E-04	NB-95M	4.02E+01	PU-238	6.96E+00
I-133	3.87E+()3	BA-136M	1.24E+01	NB-95	3.50E+03	PU-239	7.04E-01
I-134	4.41E+03	BA-137M	2.32E+02	NB-97	3.32E+03	PU-240	1.01E+00
I-135	3.65E+03	BA-139	3.56E+03	PM-147	3.65E+02	PU-241	2.98E+02
I-136	1.80E+()3	BA-140	3.54E+03	PM-148M	6.45E+01	PU-242	4.88E-03
I-137	1.85E+()3	BA-141	3.24E+03	PM-148	3.60E+02	PU-243	9.68E+02
I-138	9.25E+()2	SR-89	2.42E+03	PM-149	1.17E+03	PU-244	0.00E+00
BR-82	6.71E+00	SR-90	1.85E+02	PM-151	3.81E+02	NP-236	2.42E-08
BR-83	2.78E+()2	SR-91	2.98E+03	PR-143	3.10E+03	NP-237	7.89E-04
<u>BR-84</u>	5.35E+()2	SR-92	3.03E+03	PR-144M	3.54E+01	NP-238	9.12E+02
BR-85	6.11E+()2	SR-93	3.28E+03	PR-144	2.53E+03	NP-239	3.97E+04
BR-87	9.97E+()2	SR-94	3.19E+03	SM-147	3.85E-09	GD-152	0.00E+00
BR-88	9.97E+()2	SR-95	2.86E+03	SM-148	0.00E+00	<u>U-232</u>	0.00E+00
CS-134M	8.91E+()1	RU-103	3.04E+03	SM-149	0.00E+00	U-234	_0.00E+00
CS-134	3.67E+()2	RU-105	2.19E+03	SM-151	1.01E+00	U-236	0.00E+00
CS-135	1.17E-C3	RU-106	1.19E+03	SM-153	9.80E+02	<u>U-237</u>	0.00E+00
CS-136	1.09E+()2	RH-103M	3.03E+03	Y-89M	2.61E+00	U-238	0.00E+00
CS-137	2.44E+()2	RH-105	2.00E+03	Y-90M	1.14E-02	PA-233	_0.00E+00
CS-138	3.71E+()3	RH-106	1.32E+03	Y90	1.94E+02	<u>TH-228</u>	0.00E+00
CS-139	3.50E+()3	PD-107	2.58E-04	Y-91M	1.73E+03	TH-230	0.00E+00
RB-86	3.72E+()0	PD-109	7.94E+02	Y91	2.95E+03	<u>TH-232</u>	0.00E+00
RB-87	4.97E-C8	MO-99	3.52E+03	Y92	3.06E+03	TH-234	0.00E+00
RB-88	1.80E+()3	TC-99M	3.10E+03	_Y93	2.22E+03	U-233	0.00E+00
RB-89	2.38E+()3	TC-99	3.03E-02	Y94	3.42E+03	TH-229	0.00E+00
RB-90	2.24E+()3	TC-101	3.11E+03	Y95	3.47E+03		-
TE-125M	4.37E+()0	CO-57	0.00E+00	CM-242	9.93E+01	-	-

TABLE 4.1-3: AVERAGE FUEL ROD ISOTOPE INVENTORY AT SHUTDOWN

Consistent with RG 1.183 Appendix B Section 3.1, the fuel handling accident dose analyses model 72 hours of radioactive decay prior to an event, which is the minimum decay time required by SONGS Units 2 and 3 Licensee Controlled Specification (LCS) 3.9.101 prior to movement of irradiated fuel in the reactor vessel (Note: some licensees refer to the LCS as their Technical Requirements Manual). Table 4.1-4 summarizes the average fuel rod isotope inventory for use in the fuel handling accident AST dose analyses. Table 4.1-4 determines the fission product inventory of an average fuel rod by decaying the Table 4.1-3 average rod inventory for 72 hours.

Per RG 1.183 Regulatory Positions 3.2 and 3.4, the only elements considered in design basis analyses for fuel handling accidents are xenon, krypton, iodine, bromine, cesium, and rubidium. The limited number of elements listed in Table 4.1-4 is consistent with RG 1.183 Appendix B Section 3, which indicates that particulate radionuclides are retained by the water in the fuel storage pool or refueling water.

ISOTOPE	AVERAGE FUEL ROD INVENTORY 72 HOURS AFTER SHUTDOWN [curies]
BR-82	1.64E+00
BR-83	2.39E-07
I-129	7.09E-05
I-130	8.62E-01
I-131	1.41E+03
I-132	8.76E-07
I-133	3.56E+02
I-134	7.57E-22
I-135	1.92E+00
KR-83m	4.01Ē-10
KR-85m	8.89E-03
KR-85	2.13E+01
KR-87	1.13E-14
KR-88	4.66E-05
XE-131m	2.00E+01
XE-133m	4.57E+01
XE-133	2.54E+03
XE-135	5.74E+00

# TABLE 4.1-4: AVERAGE FUEL ROD ISOTOPE INVENTORYAT 72 HOURS POST-SHUTDOWN

#### Section 4.1.2 Primary and Secondary Coolant Activity Profiles

Several of the AST dose analyses model primary and secondary activity profiles, with and without iodine spiking, associated with operation at the concentration limits specified in Technical Specification Limiting Conditions For Operation (LCOs) 3.4.16 and 3.7.19. These activity profiles have been recalculated for use in AST dose analyses to address changes in the maximum core activity profile specified in Section 4.1.1.

Table 4.1-5 summarizes the primary side equilibrium (no iodine spike) activity concentration profile determined for the conditions of 1.0  $\mu$ Ci/gram lodine-131 dose equivalency and 100/Ē  $\mu$ Ci/gram average activity concentration for other non-iodine isotopes, including tritium. These activity limits are consistent with LCO 3.4.16, "Reactor Coolant System Specific Activity". The primary side iodine activity concentration profile is based on the Technical Specification Section 1.1 definition for DOSE EQUIVALENT I-131 (DE I-131), using ICRP-30 thyroid inhalation dose conversion factors. The primary side non-iodine activity concentration profile is based on the Technical Specification Section 1.1 definition for  $\bar{E} - AVERAGE$  DISINTEGRATION ENERGY, using total gamma and average beta disintegration energies provided in NUREG/CR-1413 (Reference 11).

<u></u>			······	·····
Isotope	Primary Side	Primary Side	Secondary Side	Secondary Side
	Equilibrium	Pre-Accident	Water	Steam
	(No Spiking)	Iodine Spike	Concentration	Concentration
	Concentration	Concentration		
	[microCi/gm]	[microCi/gm]	[microCi/gm]	[microCi/gm]
I-131	8.24E-01	4.95E+01	8.33E-02	8.33E-04
I-132	2.28E-01	1.37E+01	1.55E-02	1.55E-04
I-133	9.54E-01	5.72E+01	9.19E-02	9.19E-04
I-134	9.15E-02	5.49E+00	4.04E-03	4.04E-05
I-135	4.31E-01	2:.59E+01	3.73E-02	3.73E-04
H-3	1.80E+00	-	3.62E-02	3.62E-02
Br-84	3.81E-02	-	2.85E-05	2.85E-07
Kr-85m	1.84E+00	-	0.00E+00	6.52E-05
Kr-85	6.41E+00	-	0.00E+00	2.27E-04
Kr-87	1.08E+00	-	0.00E+00	3.82E-05
Kr-88	3.36E+00	-	0.00E+00	1.19E-04
Rb-88	3.40E+00	-	1.81E-03	3.63E-06
Sr-89	9.16E-03	-	3.38E-05	6.76E-08
Sr-90	5.93E-04	-	2.19E-06	4.38E-09
Y-90	1.53E-03	-	5.51E-06	1.10E-08
Sr-91	5.29E-03	-	1.65E-05	3.30E-08
Y-91m	3.25E-03	-	3.85E-06	7.69E-09
Y-91	4.09E-02	-	1.51E-04	3.02E-07
Zr-95	1.10E-02	-	4.05E-05	8.09E-08
Mo-99	2.13E+00	-	7.69E-03	1.54E-05
Ru-103	1.45E-02	•	5.39E-05	1.08E-07
Ru-106	3.79E-03	-	1.41E-05	2.82E-08
Te-129	4.41E-02	-	6.48E-05	1.30E-07
Xe-131m	4.74E+00	-	0.00E+00	1.67E-04
Te-132	6.53E-01	-	2.37E-03	4.73E-06
Xe-133	3.27E+02	•	0.00E+00	1.16E-02
Cs-134	2.78E+00		1.04E-02	2.07E-05
Xe-135m	8.11E-01		0.00E+00	2.87E-05
Xe-135	1.41E+01	-	0.00E+00	4.99E-04
<u>Cs-136</u>	8.28E-01		3.07E-03	6.14E-06
<u>Cs-137</u>	1.87E+00	-	6.96E-03	1.39E-05
Xe-138	5.58E-01	-	0.00E+00	1.97E-05
Ba-140	1.19E-02	-	4.38E-05	8.76E-08
La-140	1.20E-02	-	4.25E-05	8.50E-08
Pr-143	9.87E-03	-	3.63E-05	7.26E-08
Ce-144	8.01E-03	-	2.96E-05	5.92E-08
Cr-51	3.36E-03	-	1.24E-05	2.48E-08
Mn-54	1.60E-03	-	5.92E-06	1.18E-08
Co-60	3.54E-03	-	1.31E-05	2.62E-08
Fe-59	1.76E-03	-	6.50E-06	1.30E-08
Co-58	2.82E-02	-	1.04E-04	2.08E-07

# TABLE 4.1-5: ACTIVITY CONCENTRATIONS AT TECH. SPEC. LIMITS

Table 4.1-5 summarizes the primary side iodine activity concentration profile determined for the conditions of 60  $\mu$ Ci/gram DE I-131 at full power operations (i.e., a pre-accident iodine spike). This activity limit is permitted by LCO 3.4.16. The primary side pre-accident iodine spike activity concentration profile is a factor of 60 greater than the Table 4.1-5 profile for the normal operation conditions of 1.0  $\mu$ Ci/gram DE I-131.

Table 4.1-5 summarizes the secondary side water iodine activity concentration profile determined for the condition of 0.1 µCi/gram lodine-131 dose equivalency. This activity limit is consistent with LCO 3.7.19, "Secondary Specific Activity". The secondary side iodine activity concentration profile is based on the Technical Specification Section 1.1 definition for DOSE EQUIVALENT I-131, using ICRP-30 thyroid inhalation dose conversion factors. Table 4.1-5 also summarizes the secondary side water non-iodine activity concentration profile. No Technical Specification limit exists for the secondary side water non-iodine activity concentration profile. The secondary side water non-iodine activity concentration profile was determined using a steady-state activity balance. Primary side activity at LCO 3.4.16 concentrations was introduced into the steam generator liquid at the Technical Specification LCO 3.4.13, "Reactor Coolant System Operational Leakage", total maximum primary-to-secondary leakage rate of 1.0 gallon/minute. Secondary side water activity was removed via partitioning into the secondary steam, demineralization by the full-flow condensate polisher demineralizer and the blowdown demineralizer, secondary side leakage, and radioactive decay. The concentration of noble gases in the secondary side water is negligible since all noble gas activity is assumed to be released to the steam generator gas space. This is modeled as a steam generator liquid to steam noble gas partition coefficient (i.e., liquid concentration divided by gas concentration) of 0.0.

Table 4.1-5 summarizes the secondary side steam activity concentration profile. No Technical Specification limit exists for the secondary side steam activity concentration profile. The secondary side steam iodine and particulate activity concentrations were determined by considering partitioning and moisture carryover from the secondary side water activity concentration profile. The secondary side steam noble gas activity concentrations were determined using a steady-state act vity balance and the assumption of a steam generator liquid to steam noble gas partition coefficient of 0.0. Primary side activity at LCO 3.4.16 concentrations was introduced into the steam generator water at the LCO 3.4.13 total maximum primary-to-secondary leakage rate of 1.0 gallon/minute. Secondary side steam noble gas activity was removed at the total main steam flow rate.

In addition to the condition of a pre-accident iodine spike, AST dose analyses may model an accident induced (i.e., coincident or concurrent) iodine spike. Per RG 1.183 Appendices E and F, the concurrent iodine spike assumes that the iodine release rate from the fuel rods to the primary coolant increases to a value

of 335 or 500 times greater than the release rate corresponding to the iodine concentration at the equilibrium value of 1.0  $\mu$ Ci/gram DE I-131 specified in the Technical Specifications. The calculation of the concurrent iodine spike release rate conservatively assumed maximum letdown flow, maximum allowable identified and unidentified primary coolant leak rates, maximum allowable primary-to-secondary leak rate, maximum reactor coolant pump seal controlled bleed-off flow rate, 100 percent removal of all iodine from the letdown stream by the purification ion exchanger, and minimum reactor coolant system mass. Table 4.1-6 summarizes the concurrent iodine spike release rate in terms of escape rate coefficients that are to be modeled with the AST reactor core iodine inventory and an assumed 0.62 percent failed fuel. As an example, when the iodine spike release rate for the equilibrium case of 1.3E-08 sec<sup>-1</sup> is modeled with the AST reactor core iodine inventory and 0.62 percent fuel failure, the resultant equilibrium primary coolant iodine activity concentration is 1.0  $\mu$ Ci/gram DE I-131.

Condition	lodine Escape Rate Coefficient [1/second]	Iodine Escape Rate Coefficient [1/hour]
Equilibrium (no spike)	1.3E-08	4.7E-05
Spiking Factor of 335500	6.5E-06	2.4E-02
Spiking Factor of 500335	4.4E-06	1.6E-02

TABLE 4.1-6:	<b>CONCURRENT IODINE SPIKE ESCAPE RATE COEFFICIENTS</b>

#### Section 4.1.3 Radial Peaking Factor

Consistent with the guidance of RG 1.183 Regulatory Position 3.1, to account for differences in power level across the core, Radial Peaking Factors (RPFs) are applied to the Section 4.1.1 Tables 4.1-3 and 4.1-4 average fuel rod isotope inventory in determining the activity inventory of the damaged fuel rods when only a portion of the core is damaged.

Per RG 1.183 Regulatory Position 3.1, the RPFs should be values from the facility's Core Operating Limits Report (COLR) or Technical Specifications. SONGS Units 2 and 3 do not report RPFs in the facility's COLR or in the SONGS Technical Specifications. SONGS Units 2 and 3 calculate RPFs in unit and cycle specific reload physics analyses.

A review of the recent SONGS Units 2 and 3 Cycle 11 and 12 reload physics analyses identified RPFs with values no greater than 1.67 at 100 percent power. For conservatism the non-LOCA AST dose calculations addressed in this AST license amendment request model an RPF of 1.75 for all damaged fuel rods. For the DBA LOCA, all fuel assemblies are damaged and the core average inventory (without peaking factor) is used.

#### Section 4.1.4 Fuel Damage in Non-LOCA Design Basis Accidents

Per RG 1.183 Regulatory Position 3.6, the amount of fuel damage caused by non-LOCA design basis events should be analyzed to determine the fraction of the fuel that reaches or exceeds the initiation temperature of fuel melt and the fraction of fuel elements for which the fuel clad is breached.

Consistent with the NRC approved SONGS Units 2 & 3 reload analysis methodology documented in Section 3.4.2.1 of SCE-9801-P-A, "Reload Analysis Methodology for the San Onofre Nuclear Generating Station Units 2 and 3," fuel failure for the control element assembly (i.e., rod) ejection event is currently based on enthalpy deposition methodology. Per SCE-9801-P-A, fuel failure for the reactor coolant pump sheared shaft event is currently based on the Departure from Nucleate Boiling (DNE) statistical convolution methodology, and fuel failure for the remaining non-LOCA events that fail fuel are currently based on the DNB deterministic methodology.

Following approval of this license amendment request, in addition to the reactor coolant pump sheared shaft event, fuel failure estimates for UFSAR Chapter 15 non-LOCA events that assume a loss of flow (i.e., a loss of AC power) and that fail fuel (currently steam system piping failures and increased main steam flow with single failure) may be based on the DNB statistical convolution methodology.

The DNB statistical convolution technique is described in NRC approved Combustion Engineering document CENPD-183-A "C-E Methods for Loss of Flow Analysis" (Reference 18). The DNB statistical convolution technique estimates the amount of fuel failure by the probability density function with the DNB distribution. The DNB deterministic technique ignores the DNB distribution and uses a single value, the Departure from Nucleate Boiling Ratio (DNBR) Specified Acceptable Fuel Design Limit (SAFDL), as the fuel failure criterion.

The DNB statistical convolution technique is widely used to determine fuel failure for events at Combustion Engineering designed reactors. The SONGS Units 2 & 3 current licensing basis uses the DNB statistical convolution technique for predicting fuel failure for the reactor coolant pump sheared shaft evaluation. In addition, the Palo Verde Nuclear Generating Station uses the DNB statistical convolution technique for the calculation of fuel failures for transients that result in fuel failure.

# Section 4.2 OFI-SITE DOSE MODEL

Regulatory Guide 1.183 Regulatory Position 4.1 provides guidance to be used in determining the TEDE for persons located at or beyond the boundary of the exclusion area, including the outer boundary of the LPZ. This Section addresses the applicability of this guidance to the SONGS Units 2 and 3 AST dose analyses as it relates to the offsite dose exposure parameters.

The characteristics of the offsite dose exposure parameters as modeled in the AST dose analyses are summarized in Tables 4.2-1 and 4.2-2 for the EAB and LPZ dose receptors, respectively.

EXCLUSION AREA BOUNDARY PARAMETER	MODELED VALUE
EAB dose acceptance criterion, Rem TEDE	Varies by event
EAB dose exposure duration, hours	2-hour window
Committed effective dose equivalent (CEDE) dose conversion factors	Per Federal Guidance Report (FGR)-11
Effective dose equivalent (EDE) dose conversion factors	Per FGR-12
EAB breathing rate, event duration, m <sup>3</sup> /second	3.5E-04
EAB atmospheric dispersion factor, event duration, seconds/m <sup>3</sup>	2.72E-04

#### TABLE 4.2-1: EAB DOSE EXPOSURE PARAMETERS

LOV/ POPULATION ZONE PARAMETER	MODELED VALUE
LPZ dose acceptance criterion, Rem TEDE	Varies by event
LPZ dose exposure duration, hours	Event Duration
Committed effective dose equivalent (CEDE) dose conversion factors	Per FGR-11
Effective dose equivalent (EDE) dose conversion factors	Per FGR-12
LPZ breathing rates, m <sup>3</sup> /second	
0 to 8 hours	3.5E-04
8 to 24 hours	1.8E-04
1 day to end of event	2.3E-04
LPZ atmospheric dispersion factors, seconds/m <sup>3</sup>	
0 to 8 hours	7.72E-06
8 to 24 hours	4.74E-06
1 to 4 days	3.67E-06
4 days to end of event	2.67E-06

#### TABLE 4.2-2: LPZ DOSE EXPOSURE PARAMETERS

Consistent with FIG 1.183 Regulatory Position 4.1.1, the offsite dose calculations determine TEDE, which is the sum of the committed effective dose equivalent (CEDE) from inhalation and the deep dose equivalent (DDE) from external exposure. Consistent with RG 1.183 Regulatory Position 4.1.4, the EDE from external exposure is used in lieu of DDE in determining the contribution of external dose to the TEDE. The calculation of the CEDE and EDE components of the TEDE consider all radionuclides identified in Section 4.1 of this license

amendment request, including progeny from the decay of parent radionuclides, that are significant with regard to dose consequences and the released radioactivity.

Consistent with RG 1.183 Regulatory Position 4.1.2, the AST analyses model CEDE dose conversion factors taken from the column headed "effective" in Table 2.1 of Federal Guidance Report (FGR) 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion".

Consistent with RG 1.183 Regulatory Position 4.1.3, for the first 8 hours, the breathing rate of persons at the outer boundary of the LPZ is assumed to be 3.5E-4 cubic meters per second. From 8 to 24 hours following the accident, the breathing rate is assumed to be 1.8E-4 cubic meters per second. After that and until the end of the accident, the rate is assumed to be 2.3E-4 cubic meters per second. The breathing rate for persons at the EAB is assumed to be 3.5E-4 cubic meters per second for the event duration.

Consistent with RG 1.183 Regulatory Position 4.1.4, the AST analyses model EDE dose conversion factors taken from the column headed "effective" in Table III.1 of Fecleral Guidance Report (FGR) 12, "External Exposure to Radionuclides in Air, Water, and Soil" (Reference 12).

Consistent with RG 1.183 Regulatory Positions 4.1.5, 4.1.6 and 4.4, the radiological criteria for the EAB and for the outer boundary of the LPZ are in 10 CFR 50.67. These criteria are stated for evaluating reactor accidents of exceedingly low probability of occurrence and low risk of public exposure to radiation, e.g., a large-break LOCA. For events with a higher probability of occurrence, postulated EAB and LPZ doses should not exceed the criteria tabulated in RG 1.183 Table 6.

Consistent with RG 1.183 Regulatory Position 4.1.5, 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 dose criteria. The Bechtel LocaDose code used in the AST dose analyses determines the maximum two-hour TEDE at the EAB by calculating the postulated dose for a series of small time increments and performing a "sliding" sum over the increments for successive two-hour periods. The time increments appropriately reflect the progression of the accident to capture the peak dose interval between the start of the event and the end of radioactivity release.

The AST dose analyses for exposure to individuals at the EAB and LPZ consider immersion of the individual in the radioactive plume released from the facility. Consistent with IRG 1.183 Regulatory Position 5.3, the atmospheric dispersion values for the EAB and the LPZ that were approved by the NRC staff during initial facility licensing are used in performing the AST radiological analyses. These atmospheric dispersion factors for the EAB and LPZ are the five percentile

values listed in SONGS Units 2 and 3 UFSAR Appendix 15B Table 15B-4. Consistent with RG 1.183 Regulatory Position 4.1.7, no correction is made for depletion of the effluent plume by deposition on the ground.

Radioactive material contained in a plant structure is assumed to be a negligible radiation shine source to the offsite dose receptors relative to the dose associated with immersion in the radioactive plume (i.e., environmental cloud) released from the facility. To evaluate the conservatism present in this modeling when using an alternative source term, the post-LOCA reactor containment building shine doses at the EAB and at the outer boundary of the LPZ were compared to the post-LOCA offsite immersion/inhalation doses. As shown in Table 4.2-3, the EAB and LPZ doses due to containment shine are at least three orders of magnitude (a factor of 1,000) smaller than the EAB and LPZ doses due to immersion in the radioactive plume released from the containment.

POST-LOCA CONTAINMENT LEAKAGE RADIATION SOURCE	AST TEDE DOSE (REM)
Maximum 2-hour EAB dose due to immersion and inhalation	<u>3.651E+00</u> 3.547E+00
Maximum 2-hour EAB dose due to Containment Building shine	<u>1.206E-03</u> <del>1.204E-03</del>
Event duration LPZ dose due to immersion and inhalation	<u>2.377E-01</u> 2.309E-01
Event duration LPZ dose due to Containment Building shine	<u>1.799E-09</u> <del>1.810E-09</del>

#### TABLE 4.2-3: SIGNIFICANCE OF PLANT STRUCTURE SHINE DOSE

# Section 4.3 CONTROL ROOM DOSE MODEL

SONGS Units 2 and 3 share a combined control room. RG 1.183 Regulatory Position 4.2 prov des guidance to be used in determining the TEDE for persons located in the control room. Section 4.3.1 addresses the applicability of this guidance to the SONGS Units 2 and 3 AST dose analyses as it relates to the control room dose exposure parameters. Section 4.3.2 addresses the applicability of the RG 1.183 guidance as it relates to the control room response to radiation sources that may cause exposure to control room personnel.

#### Section 4.3.1 Control Room Dose Exposure Parameters

The characteristics of the control room dose exposure parameters as modeled in the AST dose analyses are summarized in Table 4.3-1.

CONTROL ROOM PARAMETER	MODELED VALUE
CR dose acceptance criterion, Rem TEDE	5
Committed effective dose equivalent (CEDE) dose conversion factors	Per FGR-11
Effective dose equivalent (EDE) dose conversion factors	Per FGR-12
CR occupancy factors, percent of time present in CR	
0 to 1 day	100
1 to 4 days	60
4 to 30 days	40
CR breathing rate, event duration, m <sup>3</sup> /second	3.5E-04

TABLE 4.3-1: CONTROL ROOM DOSE EXPOSURE PARAMETE
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Consistent with RG 1.183 Regulatory Position 4.2.2, the radioactive material releases and radiation levels modeled in the control room dose analyses are determined using the same source term, transport, and release assumptions used for determining the EAB and LPZ TEDE values. These parameters are detailed in the later sections of this license amendment request that describe the various accident scenarios. These parameters do not result in non-conservative results for the control room.

Consistent with RG 1.183 Regulatory Position 4.2.7, the control room doses are calculated using the dose conversion factors identified in RG 1.183 Regulatory Position 4.1 for use in offsite dose analyses. The control room dose calculations determine the TEDE, which is the sum of the CEDE from inhalation and the DDE from external exposure. Consistent with RG 1.183 Regulatory Position 4.1.4, the EDE from external exposure is used in lieu of DDE in determining the contribution of external dose to the TEDE. The calculation of the CEDE and EDE components of the TEDE consider all radionuclides identified in Section 4.1 of this license amendment request, including progeny from the decay of parent radionuclides, that are significant with regard to dose consequences and the released radioactivity.

Consistent with RG 1.183 Regulatory Position 4.1.2, the AST analyses model CEDE dose conversion factors taken from the column headed "effective" in Table 2.1 of Federal Guidance Report 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion".

Consistent with RG 1.183 Regulatory Position 4.1.4, the AST analyses model EDE dose conversion factors taken from the column headed "effective" in Table III.1 of Federal Guidance Report 12, "External Exposure to Radionuclides in Air, Water, and Soil."

Consistent with RG 1.183 Regulatory Position 4.2.7, the DDE from photons (i.e., the EDE) is corrected for the difference between finite cloud geometry in the control room and the semi-infinite cloud assumption used in calculating the dose conversion factors. The Bechtel LocaDose code used in this analysis employs the following RG 1.183 Equation 1 to correct the semi-infinite cloud dose, DDE<sub>\*</sub>, to a finite cloud dose, DDE<sub>finite</sub>, where the control room is modeled as a hemisphere that has a volume, V, in cubic feet, equivalent to that of the control room:

 $DDE_{finite} = (DDE_{\infty} \times V^{0.338}) / 1173$ 

Consistent with RG 1.183 Regulatory Position 4.4, as an AST dose analysis acceptance criterion the postulated control room dose is evaluated to ensure that that it does not exceed the 5 Rem TEDE criterion established in 10 CFR 50.67.

Consistent with RG 1.183 Regulatory Position 4.2.6, the control room dose receptor for the AST analyses is the hypothetical maximum exposed individual who is present in the control room for 100% of the time during the first 24 hours after an event, 60% of the time between 1 and 4 days, and 40% of the time from 4 days to 30 days. These occupancy factors are not modeled in the ARCON96 atmospheric dispersion factors discussed in Section 4.4 of this license amendment request.

Consistent with FIG 1.183 Regulatory Position 4.2.6, for the duration of any event, the breathing rate of the hypothetical maximum exposed individual who is present in the control room is assumed to be 3.5E-04 cubic meters per second.

Consistent with FiG 1.183 Regulatory Position 4.2.5, credit is not taken for the control room personnel use of personal protective equipment (e.g., protective beta radiation resistant clothing, eye protection, or self-contained breathing apparatus [SCBA]) or prophylactic drugs (i.e., potassium iodide [KI] pills).

#### Section 4.3.2 Control Room Response to Radiation Sources

Consistent with RG 1.183 Regulatory Position 4.2.3, the models used to transport radioactive material into and through the control room, and the shielding models used to determine radiation dose rates from external sources, are structured to provide suitably conservative estimates of the exposure to control room personnel. The control room response to these radiation sources is discussed in this section.

Consistent with RG 1.183 Regulatory Position 4.2.1, the AST dose analyses consider the following sources of radiation that may cause exposure to control room personnel:

- Contamination of the control room atmosphere by the intake or infiltration of radioactive material contained in the radioactive plume released from the facility,
- Contamination of the control room atmosphere by the intake or infiltration 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,
- Radiation shine from radioactive material in the reactor containment building,
- Radiation shine from radioactive material in systems and components inside or external to the control room envelope.

The characteristics of the control room as modeled in the AST dose analyses are summarized in Table 4.3-2.

CONTROL ROOM PARAMETER	NOMINAL VALUE	MODELED VALUE
CR net free volume, cubic feet	266,920	266,920
CR unfiltered outside air inleakage, event duration		
ingress and egress, cfm	not applicable	10
Boundary and system inleakage, cfm	132	990
total unfiltered inleakage, cfm	not applicable	1,000
CR Normal mode of operation		
unfiltered outside air makeup, cfm	5820	6402
filtered outside air makeup, cfm	0	0
filtered CR air recirculation, cfm	0	0
Control Room Emergency Air Cleanup System (CREACUS) initiation time		
Safety Injection Actuation Signal (SIAS) induced Control Room Isolation Signal (CRIS), seconds	< 10	о
High CR Heating, Ventilation, and Air-Conditioning (HVAC) intake radiation induced CRIS, seconds	120.0	180
CREACUS Emergency mode of operation, one train operation		
filtered outside air makeup, cfm	2,050	2,200
filtered CR air recirculation, cfm	33,505	29,934
CREACUS Emergency mode of operation, two train operation		
filtered outside air makeup, cfm	4,100	4,400
filtered CR air recirculation, cfm	67,010	_ 59,869
CREACUS Emergency mode of operation, Emergency Ventilation Supply (EVS) filter efficiencies		
Elemental iodine, percent removal	> 90	0
organic iodide, percent removal	> 90	0
Particulate iodine and aerosols, percent removal	> 99.95	0
CREACUS Emergency mode of operation, Emergency Air Conditioner (EAC) filter efficiencies		
elemental iodine, percent removal	> 99	95
organic iodide, percent removal	> 99	95
Particulate iodine and aerosols, percent removal	> 99.95	99

#### TABLE 4.3-2: CONTROL ROOM MODEL PARAMETERS

# Section 4.3.2.1 Control Room Intake and Infiltration of Contaminated Air

Only the west side of the control room envelope is exposed to the radioactive plumes released from the facility. The adjacent areas and structures to the north, south, and east of the CRE, and the adjacent areas and structures above and below the CRE, do not contain activity release points. These adjacent areas and locations can only become contaminated with air introduced via intake or infiltration of radioactive material contained in the radioactive plumes released from the facility. Consequently, the resultant activity concentrations in the adjacent areas and structures will be less contaminated than any radioactive plume. For this reason, the AST dose analyses conservatively assume that all

intake and infiltration (i.e., inleakage) into the CRE is from the radioactive plumes released from the facility as they pass west of the control room envelope.

The control room Normal Mode Heating, Ventilation, and Air Conditioning (HVAC) outside air intake is located near the northwest corner of the control room envelope, and the control room emergency air cleanup system (CREACUS) Emergency Mode HVAC outside air intakes are located near the northwest and southwest corners of the control room envelope. Per the ARCON96 atmospheric dispersion analysis detailed in Section 4.4, the maximum atmospheric dispersion factor for any activity release location to any of these three outside air intakes is modeled in the evaluation of contaminated air intake and infiltration (i.e., inleakage).

# Section 4.3.2.1.1 Control Room Isolation Signal

Consistent with IRG 1.183 Regulatory Position 4.2.4, the AST analyses credit engineered safety features (ESF) that mitigate airborne radioactive material within the control room, such as control room isolation actuated by ESF signals and radiation monitors.

The control room Normal Mode HVAC systems can be shifted to CREACUS Emergency Mode, which is an operational mode in which the control room is isolated and pressurized to protect operational personnel from radiation exposure. The CREACUS Emergency mode of operation can be actuated either automatically following a Control Room Isolation Signal (CRIS) or manually. The CRIS may be generated automatically by a Safety Injection Actuation Signal (SIAS) or by the detection of high radioactivity concentrations in the control room outside air inflow.

A SIAS-induced CRIS is credited in the evaluation of the LOCA. A SIAS-induced CRIS is capable of initiating CREACUS Emergency mode of operation within 10 seconds. The SIAS is generated in response to high containment pressure within seconds of the onset of the LOCA event. Since the gap release activity is not released into the containment until 30 seconds after the onset of the LOCA event, and since a SIAS induced CRIS is capable of initiating CREACUS Emergency mode of operation in less than 30 seconds, the AST LOCA model credits CREACUS Emergency mode of operation initiation at time zero (i.e., prior to the arrival of any contaminated air reaching the control room outside air intakes) due to a SIAS-induced CRIS.

Per LCS 3.3.100, Table 3.3.100-2, a high radiation induced CRIS is to be generated and the normal HVAC outside air dampers are to be closed, within 120.0 seconds. The non-LOCA and FHA dose analyses conservatively assume that a high-radiation-induced CRIS initiates the CREACUS Emergency mode of operation at 180 seconds.

# Section 4.3.2.1.2 Control Room Unfiltered Inleakage

The AST dose analyses model the introduction of an assumed 1,000 cfm of unfiltered outside air into the CRE beginning at time zero and continuing for the event duration. This inleakage rate includes 10 cfm as a reasonable estimate for ingress and egress, and an assumed 990 cfm for inleakage via other paths. The 10 cfm estimate for ingress and egress inleakage is consistent with guidance provided in RG 1.197 (Reference 13) Regulatory Position 2.5.

The CRE inleakage testing to verify actual inleakage was conducted from May 18, 2004 to May 25, 2004. As described in SCE's letter to the NRC dated September 17, 2004, CRE inleakage testing has shown the actual inleakage via other paths, including uncertainty, is less than 990 cfm.

# Section 4.3.2.1.3 Control Room HVAC Flow Rates and Filtration

During the control room Normal Mode of HVAC operation, there is no filtered outside air makeup flow nor is there filtered control room air recirculation flow.

During the control room Normal Mode of HVAC operation, the AST dose analyses model an outside air makeup flow rate that is conservatively greater than the nominal outside air makeup flow rate. The outside air introduced into the control room during the normal mode of operation is unfiltered. The total unfiltered inleakage rate of 1,000 cfm is added to this Normal Mode of operation unfiltered outside air makeup flow rate.

Consistent with FIG 1.183 Regulatory Position 4.2.4, the AST dose analyses credit ESFs that mitigate airborne radioactive material within the control room. Such features include control room pressurization, and intake and recirculation filtration.

The CREACUS Emergency mode of operation is facilitated by two 100% redundant subsystems. As shown in Figure 4.3-1, for each CREACUS Emergency mode of operation flow path, the control room outside makeup air passes through intake filters of an emergency ventilation supply (EVS) unit and then through recirculation filters of an emergency air conditioner (EAC) unit prior to being discharged into the control room envelope.

#### FIGURE 4.3-1: CREACUS EMERGENCY MODE OF OPERATION FLOW PATH (SINGLE TRAIN)



During the CREACUS Emergency mode of operation, the AST dose analyses model an outside air makeup flow rate that is conservatively greater than the nominal outside air makeup flow rate. The outside air introduced into the control room is filtered. Consistent with the current SONGS Units 2 and 3 licensing basis, filtration credit is not taken for outside air iodine and particulate removal by the EVS unit filters. Filtration credit is only taken for outside air makeup iodine and particulate removal by the EAC unit filters. The total unfiltered inleakage rate of 1,000 cfm is added to this CREACUS Emergency mode of operation flow rate.

During the CREACUS Emergency mode of operation, the AST dose analyses model a control room recirculation flow rate that is conservatively smaller than the nominal recirculation flow rate. This flow rate is calculated by subtracting the maximum outside air inflow rate entering the EAC unit from the minimum total flow rate (i.e., outside air inflow rate plus control room recirculation air flow rate) through the EAC unit.

Consistent with the current SONGS Units 2 and 3 licensing basis, filtration credit is taken for iodine and particulate removal by the EAC filters. The EAC charcoal filters are credited with the removal of 95 percent of the elemental iodine and organic iodide in the HVAC air flow. The EAC HEPA filters are credited with the removal of 99 percent of the particulate iodine and other aerosols in the HVAC air flow.

In the AST dose analyses the potential exists for one or two trains of HVAC to function during the CREACUS Emergency mode of operation. The SONGS Units 2 and 3 current licensing basis models Operator action at eight hours to secure one of the two trains of CREACUS that are modeled as being in operation at the onset of an event. To evaluate the conservatism present in this modeling when using an AST source term, the post-LOCA containment leakage path was evaluated for three scenarios: (1) one CREACUS train operating throughout the event, (2) two CREACUS trains operating throughout the event, and (3) two CREACUS trains operating for the first eight hours, and a single CREACUS train operating for the remainder of the event. As shown in Table 4.3-3, the first scenario with its operation of a single CREACUS train throughout the event results in the largest control room dose. For this reason, the AST dose analyses conservatively assume the failure of one CREACUS train and model single CREACUS train operation throughout an event.

	LOCA CONTAINMENT LEAKAGE TEDE DOSE (REM)
Single CREACUS train operation throughout the event	<u>9.482E-01</u> 9.112E-01
Two CREACUS train operation throughout the event	7.574E-017.303E-01
Two CREACUS train operation for 8 hours, one CREACUS train operation thereafter	<u>7.939E-01</u> 7.650E-01

#### TABLE 4.3-3: CONTROL ROOM CREACUS MODEL OPTIONS

#### Section 4.3.2.2 Environmental Cloud Gamma Radiation Shine Model

Consistent with F.G 1.183 Regulatory Position 4.2.1, the AST dose analyses consider exposure to control room personnel due to radiation shine from the external radioactive plume (i.e., environmental or outside cloud shine). The following discussion elaborates on the modeling described in SONGS Units 2 and 3 UFSAR Appendix 15.10B.

Activity releases to the environment from sources such as post-LOCA containment building leakage will result in the formation of a radioactive cloud. Radioactivity concentrations in the radioactive cloud surrounding the control room are the product of the building leak rate and the control room atmospheric dispersion factor.

For conservatism it is assumed that this cloud surrounds the control room, entering adjacent areas that are not part of the control room envelope. Gamma radiation from this cloud can penetrate the control room ceiling and walls resulting in a whole body gamma dose to control room personnel. The cloud is modeled as a cylinder with a 4000 foot radius and a 4000 foot height. The radius and height values ensure that dose contributions from the outer portions of the cloud are considered. The radioactivity present in the outside cloud is assumed to be uniformly distributed in the cylindrical source.

The environmental cloud radiation shine dose is the maximum dose calculated at one of several dose receptors modeled within the control room board area.

Shielding modeled between the control room dose receptors and the outside cloud include the concrete containment structures that lie within the 4000 foot radius cloud, the concrete safety equipment building wall adjacent to the control building, the control room concrete walls, floor and ceiling, the auxiliary/radwaste building outer concrete walls, floors and roof, several of the internal control room fire partition walls, and the air spaces between these walls, floor and ceilings.

# Section 4.3.2.3 Control Room Filter Gamma Radiation Shine Model

Consistent with FIG 1.183 Regulatory Position 4.2.1, the AST dose analyses consider exposure to control room personnel due to radiation shine from radioactive material in the CREACUS filters inside the CRE (i.e., control room filter shine). The following discussion elaborates on the modeling described in SONGS Units 2 and 3 UFSAR Appendix 15B, Section 15B.5.

The activity released to the environment during an event and dispersed to the CREACUS outside air intake is assumed to accumulate onto the CREACUS filters for the duration of an activity release. For those events in which the release terminates prior to 30 days (e.g., fuel handling accident), the activity

accumulated on the charcoal filter is allowed to decay for the remainder of the 30-day event duration to facilitate determination of a 30-day control room dose.

As previously shown in Figure 4.3-1, for each CREACUS Emergency mode of operation flow path, the control room outside makeup air passes through intake filters of an EVS intake unit and then through recirculation filters of an EAC unit prior to being discharged into the CRE. Per Section 4.3.2.1, the AST dose analyses conservatively assume the failure of one CREACUS train and model single CREACUS train operation throughout an event.

In determining the filter shine dose, the charcoal and HEPA filters of the EVS intake units are assumed to be 100 percent efficient at removing iodine and particulates from the incoming air, thereby maximizing the shine dose from the EVS intake unit filters. In reality, iodine and particulates that are not trapped on the intake filters (such as the activity present in the 1,000 cfm of unfiltered air inleakage) will eventually be trapped on the charcoal and HEPA filters of the downstream EAC recirculation unit. The EAC recirculation units are located in the vicinity of the EVS intake units, with an EAC recirculation unit filter direct shine to control room pathway geometry that is similar to that of the EVS intake unit filters. Consequently, the results of the EVS intake unit filter shine dose calculation address the EAC recirculation unit filter shine.

To address the potential shine from unfiltered inleakage that is eventually trapped on the EAC recirculation unit filters, the filter shine model includes an additional 1,000 cfm of contaminated outside air inflow to the CREACUS air intake flow rate. The CREACUS filter shine dose is the maximum dose calculated at one of several dose receptors modeled within the control room board area.

Shielding modeled between the control room dose receptors and the CREACUS filter units include the control room fire partition walls and the air spaces between these walls.

# Section 4.3.2.4 Containment Building Gamma Radiation Shine Model

Consistent with RG 1.183 Regulatory Position 4.2.1, the AST dose analyses consider exposure to control room personnel due to radiation shine from radioactive material in the reactor containment building (i.e., direct containment shine). The following discussion elaborates on the modeling described in SONGS Units 2 and 3 UFSAR Appendix 15.10B.

The containment is modeled by an equivalent volume cylindrical source having a diameter of 150 feet and a height of 129.25 feet. The radioactivity in the containment is modeled as being uniformly distributed in the cylindrical source.
The containment radiation shine dose is the maximum dose calculated at one of several dose receptors modeled within the control room board area.

Shielding modeled between the control room dose receptors and the containment air includes the 1/4-inch steel containment liner, the 4-foot concrete containment wall and the 3-foot 9-inch concrete containment dome. No credit is taken for shielding afforded by the internal containment concrete structure. The penetration building lies between the containment and the control building. Modeled shielding includes the 2-foot penetration building concrete wall and the adjacent 2-foot 6-inch control building concrete wall, a 2-inch fire partition wall that separates the control room from the cable riser gallery adjacent to the penetration building, and the air spaces between these walls.

#### Section 4.3.2.5 Post-LOCA Piping Gamma Radiation Shine Model

Consistent with FIG 1.183 Regulatory Position 4.2.1, the AST dose analyses consider exposure to control room personnel due to radiation shine from radioactive material in recirculation loop piping outside the CRE (i.e., piping shine). The following discussion elaborates on the modeling described in SONGS Units 2 and 3 UFSAR Appendix 15B, Section 15B.5.

This piping is modeled as a series of finite length shielded cylinders filled with post-LOCA containment sump recirculation liquid radiation source. The piping shine model considers those pipes in the Auxiliary Building Penetration Area that are outside the containment penetration area shield walls at plant elevation 30-foot (i.e., at the same plant elevation as the control room). The dose contributions from other pipes that are either behind the shield walls or below the 30-foot concrete floor are much less than the dose contributions from the modeled pipes.

The piping shine dose is the maximum dose calculated at one of several dose receptors modeled within the control room board area.

Shielding modeled between the control room dose receptors and the piping includes Auxiliary Building walls and floor slabs, the concrete wall separating the control room from the cable riser gallery, the steel door in the concrete wall separating the cable riser gallery from the Penetration Area, and the air spaces between these walls, floor and ceilings.

# Section 4.4 ARCON96 ATMOSPHERIC DISPERSION ANALYSIS

UFSAR Section 2.3.4.2 and UFSAR Appendix 15B.5 discuss the Current Licensing Basis (CLB) methodology used in evaluating atmospheric dispersion between the post-accident containment building release point and the control room outside air ventilation intakes. The CLB applies the atmospheric dispersion factors for the release from the containment to the control room HVAC intakes for all potential release points. The CLB methodology for evaluating this atmospheric dispersion utilizes the Murphy-Campe diffuse source point receptor model.

Per RG 1.183 Regulatory Position 5.3, atmospheric dispersion values for the control room that were approved by the staff during initial facility licensing or in subsequent licensing proceedings (i.e., the CLB) may be used in performing the AST radiological analyses.

The limiting condition for Control Room Habitability (CRH) is the event configuration that results in the maximum consequences to the control room operators. Per FG 1.196 (Reference 14) Regulatory Position 2.3.2, determining the limiting condition for CRH requires consideration of the location of the activity release points for the various accidents relative to the control room intakes.

Although RG 1.183 allows continued use of the CLB atmospheric dispersion values, to comply with the guidance of RG 1.196 it is necessary to calculate atmospheric dispersion values between the various post-accident release points and the control room outside air ventilation intakes. The new atmospheric dispersion analysis uses the ARCON96 computer program and guidance provided in RG 1.194. This section summarizes the ARCON96 analysis.

# Section 4.4.1 ARCON96 Background Information

The ARCON96 computer program was developed for the U.S. Nuclear Regulatory Commission Office of Nuclear Reactor Regulation by Pacific Northwest National Laboratory (PNNL) for potential use in control room habitability assessments. This code is documented in NUREG/CR-6331 Revision 1 (Reference 15), which includes a user's guide, a programmer's guide, and a description of the technical basis for the code. The ARCON96 code uses hourly meteorological data and recently developed methods for estimating dispersion in the vicinity of buildings to calculate relative concentrations at control room intakes that would be exceeded no more than 5 percent of the time. RG 1.194 provides guidance on the use of the ARCON96 computer program for determining atmospheric relative concentrations to be used in design basis evaluations of control room radiological habitability.

Bechtel Power Corporation (BPC) originated the ARCON96 calculations under contract to Southern California Edison. The ARCON96 code was obtained by

BPC, and is maintained as Bechtel Standard Computer Program (SCP) number EV138. Bechtel SCPs are those computer programs that have been developed, validated, documented and controlled in accordance with Bechtel Engineering Department procedures so that they may be used without detailed description and validation in  $\alpha$  calculation package.

### Section 4.4.2 Summary of Evaluated Release Point to Intake Combinations

The ARCON96 computer program with the guidance of RG 1.194 has been used to determine the atmospheric dispersion factors for a combination of nine activity release point locations and three control room ventilation outside air intake locations. The release point locations are:

- Main plant vent
- Containment shell diffusion
- Containment equipment hatch
- Main Stearn Safety Valves (MSSV)
- Atmospheric Dump Valves (ADV)
- Steam Line Break Outside Containment (SLB-OC)
- Auxiliary Feedwater (AFW) Turbine steam discharge
- Refueling Water Storage Tank (RWST) Vent
- Fuel Handling Building

The three control room ventilation outside air intake locations are:

- Control room normal air intake
- Control room Unit 2 emergency air intake
- Control room Unit 3 emergency air intake

Each of the 27 release-to-intake combinations has been investigated. Release locations from both of SONGS Units 2 and 3 are considered.

# Section 4.4.3 Meteorological Data Input

The ARCON96 atmospheric dispersion analysis uses actual site hourly meteorological data spanning ten full years from 1993 through 2002. Full year meteorology is used to eliminate bias due to seasonal fluctuations. RG 1.194 Regulatory Position 3.1 states that 5 years of hourly observations are considered to be representative of long-term trends at most sites. The use of ten years of meteorological data satisfies this recommendation, while enhancing the statistical basis for the calculated control room atmospheric dispersion factors due to the expanded meteorological data set.

The input meteorological data identify invalid data by coding such data as either "999" or "9999". In each year, more than 99 percent of the lower level wind speed data are valid. Overall, about 99.8 percent of the lower level wind speed data are valid. Except for year 1994, more than 95 percent of each year's upper level wind speed data are valid. Overall, about 96.5 percent of the upper level wind speed data are valid. Therefore, the meteorological input is representative. The meteorological tower's lower wind instrument is at elevation 10 meters. The meteorological tower's upper wind instrument is at elevation 40 meters. The meteorological data was converted to the ARCON96 format presented in NUREG/CR-6331 Section 4.4.2 and RG 1.194 Appendix A, Table A-1.

Consistent with RG 1.194 Regulatory Position 3.1, wind direction is expressed as the direction from which the wind is blowing (i.e., the upwind direction from the center of the site) referenced from true north. A north wind (wind from the north) is entered as 360 degrees, and a south wind is entered as 180 degrees.

Consistent with RG 1.194 Regulatory Position 3.1, atmospheric stability is entered as a number from 1 through 7. A stability class of 1 represents extremely unstable conditions, and a stability class of 7 represents extremely stable conditions. Atmospheric stability classes are determined from the  $\Delta T$  given in the meteorological data.

# Section 4.4.4 Non-Meteorological Data Input

RG 1.194 Appendix A Table A-2 discusses input parameters for ARCON96. Per Table 4.4-1, the ARCON96 analysis complies with the regulatory guidance presented in Table A-2.

The following subsections summarize the ARCON96 non-meteorological data input for each of the release point and receptor location combinations.

Parameter	Acceptable Input	Comments
Lower Measurement Height, meters	Use the actual instrumentation height when known. Otherwise, assume 10 meters.	Used actual measurement height, which is 10 meters above bluff grade. The bluff grade is above the plant grade.
Upper Measurement Height, meters	Use the actual instrumentation height when known. Otherwise, use the height of the containment or the stack height, as appropriate. If wind speed measurements are available at more than two elevations, the instrumentation at the height closest to the release height should be used.	Used actual measurement height of 40 meters above the bluff grade.

 Table 4.4-1: ARCON96 Input Parameters for Design Basis Assessments

Parameter	Acceptable Input	Comments
Wind Speed Units	Use the wind speed units that correspond to the units of the wind speeds in the meteorological data file.	The raw meteorological data expresses wind speeds in miles per hour. However, these data are pre-processed to convert the wind speeds to meters per second in the resulting meteorological input files. The ARCON96 input files (*.RSF) are set for wind speeds in units of meters per second. Thus, the units used for wind speeds in the analysis are applied consistently.
Release Height, meters	Use the actual release heights whenever available. Plume rise from buoyancy and mechanical jet effects may be considered in establishing the release height if the analyst can demonstrate with reasonable assurance that the vertical velocity of the release will be maintained during the course of the accident. If actual release height is not available, set release height equal to intake height.	As clarified below, actual release heights above plant grade are used. For the containment diffuse area source, the release is assumed to be from the containment mid-height of 80.5 feet above grade (i.e., Elevation 110.5'). This elevation allows for unimpeded flow above the Auxiliary Building roof. Because the control room intakes are on the Auxiliary Building wall opposite the Unit 2 and Unit 3 containments, the release cloud can only flow to the intakes by first passing over the Auxiliary Building roof. This assumption is consistent with the NRC recommendation to set the release height for a diffuse area source at the vertical center of the projected plane of the above-grade cross-sectional area perpendicular to the line of sight from the building center to the control room intake (Regulatory Guide 1.194, section 3.2.4.5). (There is also a pathway between the containment and the intakes via grated openings into the Turbine Building and then into the corrugated metal-sided passageway west of the Auxiliary Building. This pathway is longer and more tortuous than the pathway over the Auxiliary Building roof; therefore, it is not

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Parameter	Acceptable Input	Comments
		Steam from a steam line break outside containment (SLB-OC) is assumed to be released via the blowout panels mounted on the roof of the respective Main Steam Isolation Valve (MSIV)/Main Feedwater Isolation Valve (MFIV) enclosure directly above the main steam line. The x/Qs for an MSSV release credit plume rise due to jet effects in accordance with section 6.0 of BG 1.194
Building Area, meters <sup>2</sup>	Use the actual building vertical cross- sect onal area perpendicular to the wind direction. Use default of 2000 m <sup>2</sup> if the area is not readily available. Do not enter zero. Use 0.01 m <sup>2</sup> if a zero entry is desired. Note: This building area is for the building(s) that has the largest impact on the building wake within the wind direction winclow. This is usually, but need not always be, the reactor containment. With regard to the diffuse area source option, the building area entered here may be different from that used to establish the diffuse source.	The cross-sectional area of the containment is used for all release points except for the Fuel Handling Building (FHB). For the FHB <u>release</u> , the FHB east cross-section area and one half of the containment cross-section area <u>areis</u> used. Only one half of the containment is conservatively considered since it is partially offset from the release to intake axis. All other intervening buildings, such as the auxiliary building, are conservatively ignored.
Vertical Velocity, meters/seconds	Note: the vent release model should not be used for DBA accident calculations. For stack release calculations only, use the actual vertical velocity if the licensee can demonstrate with reasonable assurance that the value will be maintained during the course of the accident (e.g., addressed by technical specifications), otherwise, enter zero. If the vertical velocity is set to zero, ARCON96 will reduce the stack height by 6 times the stack radius for all wind spe∋ds. If this reduction is not desired, the stack radius should also be set to zero.	The vent release model is not used for DBA accident calculations. For all vent stack releases, the vertical velocity is set to zero.

Parameter	Acceptable Input	Comments
Stack Flow, meters <sup>3</sup> /s Stack Radius,	Use actual flow if it can be demonstrated with reasonable assurance that the value will be maintained during the course of the accident (e.g., addressed by technical specifications). Otherwise, enter zero. The flow is used in both elevated and ground-level release modes to establish a maximum $\chi/Q$ value. This value is sign ficant only if the flow is large and the distance from the release point to the receptor is small. Use the actual stack internal radius when	Stack flow is set to zero in all cases. Stack radius is set to zero in all cases.
meters	both the stack radius and vertical velocity are available. If the stack flow is zero, the radius should be set to zero.	
Distance to Receptor, meters	Use the actual straight line horizontal distance between the release point and the control room intake. For ground-level releases, it may be appropriate to consider flow around an intervening building if the building is sufficiently tall that it is unrealistic to expect flow from the release point to go over the building. Note: If the distance to receptor is less than about 10 meters, ARCON96 should not be used to assess relative concentrations.	The actual straight line horizontal distance between the release point and the control room intake is used in all cases other than the Containment Equipment Hatch release. Except for the Containment Equipment Hatch release, flow around intervening buildings is not considered. The Equipment Hatches are on the opposite side of the Containment structure from the Control Room Intakes and are located at ground level. The top of the Containment is 161 feet above plant grade and the top of equipment hatch is 17.5 feet above plant grade; therefore, it is unrealistic to expect flow from the Equipment Hatch to go over the Containment building. The Equipment Hatch to receptor distances are measured as the shortest path around the Containment ("taut string length"), as allowed by section 3.4 of RG 1.194. No source-receptor distance is less than 10 meters.
Intake Height, meters	Use the actual intake height. If the intake height is not available for ground level releases, assume the intake height is equal to the release height. For elevated releases, assume the height of the tallest site building.	The actual heights at the centerline of the control room intakes are used.
Elevation Difference, meters	Use zero unless it is known that the release heights are reported relative to different grades or reference datum.	The release and receptor heights are reported with respect to the same grade datum.

Parameter	Acceptable Input	Comments
Direction to Source, degrees	Use the direction FROM the intake back TO the release point. (Wind d rections are reported as the direction from which the wind is blowing. Thus, if the direction from the intake to the release point is north, a north wind will carry the plume from the release point to the intake.)	SONGS' met. meteorological data is are given relative to true north. SONGS' site arrangement drawings do have a "Plant North" designation that is 57 degrees west of "true north;" consequently, <u>source-to-receptor</u> directions entered into the ARCON96 code are corrected to model true north as the point of reference.
	shown on site arrangement drawings that is different from "true north." The direction entered must have the same point of reference as the wind directions reported in the meteorological data.	For the scenario of an equipment hatch release, the $\chi/Q$ is calculated assuming flow both around and over (through) the containment building, and the higher of the $\chi/Q$ values is used.
	For ground level releases, if the plume is assumed to flow around a building rather than over it, the direction may need to be modified to account for the reclirected flow. In this case, the $\chi/Q$ should be calculated assuming flow around and flow over (through) the building and the higher of the two $\chi/Q$ s should be used.	
Surface Roughness Length, meters	Use a value of 0.2 in lieu of the default value of 0.1 for most sites. (Reasonable values range from 0.1 for sites with low surface vegetation to 0.5 for forest covered sites.)	Used value of 0.2. SONGS is a seaside site with low surface vegetation.
Wind Direction Window, degrees Code Default	Use the default window of 90 degrees (45 degrees on either side of line of sight from the source to the receptor).	Used 90 degrees.
Minimum Wind Speed, meters/second Code Default	Use the default wind speed of 0.5 m/s (regardless of the wind speed units entered earlier), unless there is some indication that the anemometer threshold is greater than 0.6 m/s.	Used the default wind speed of 0.5 m/s. The minimum SONGS site meteorological tower wind speed reported is 0.3 mph, or 0.13 m/s. Thus, the anemometer threshold is less than 0.6 m/s.
Averaging Sector Width Constant Code Default	Although the default value is 4, a value of 4.3 is preferred. (A future revision to ARC DN96 will change the default to 4.3)	Used 4.3.
Initial Diffusion Coefficients, meters	These values will normally be set to zero. If the diffuse source option is being used, see Regulatory Position 2.2.4.	For containment releases, a diffuse source is modeled in accordance with Regulatory Guide 1.194, section 3.2.4.4. For the steam line break outside containment, the releases from the MSIV/MFIV enclosure are modeled as an area source in accordance with

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Parameter	Acceptable Input	Comments
Hours in Averages	Use the default values.	Used the default values.
<u>Code Default</u> Minimum Number of Hours	Use the default values.	Used the default values.
Code Default	·	

# Section 4.4.4.1 Control Room HVAC Intakes

Three control room HVAC intake locations are modeled in the ARCON96 analysis:

- Control room normal air intake
- Control room Unit 2 emergency air intake
- Control room Unit 3 emergency air intake

The center of the control room normal air intake is at plant elevation 35.50 feet (10.82 meters). The center of each control room emergency air intake is at plant elevation 43.00 feet (13.11 meters).

# Section 4.4.4.2 Main Plant Vent Release

Atmospheric dispersion between the main plant vent and the control room HVAC intakes is modeled as a point source using the ARCON96 ground level release option.

The plant vent release height is at plant elevation 206 feet (62.79 meters).

For the plant vent release, only the cross-sectional area of the containment is used to determine the building wake area. All other intervening buildings, such as the auxiliary building, are conservatively ignored. The building wake area of 2123.33 square meters is the projected area of the containment cylindrical lower portion and the containment upper dome portion.

Table 4.4-2 presents the separation distances and wind directions that characterize the releases from the two plant vent activity release point locations to the three control room HVAC intake locations.

Release Point	Control Room Receptor	Separation Distance (meters)	Wind Direction (degrees, North = 0)
U2 Plant Vent	Normal Air Intake	62.83	348
U2 Plant Vent	U2 emergency air intake	60.18	351
U2 Plant Vent	U3 emergency air intake	101.6	329
U3 Plant Vent	Normal Air Intake	98.15	96
U3 Plant Vent	U2 emergency air intake	101.6	97
U3 Plant Vent	U3 emergency air intake	60.18	75

TABLE 4.4-2: PLANT VENT TO CONTROL ROOM MODELING

The results of the ARCON96 analysis show that the Unit 2 plant vent to Unit 2 emergency air intake release path has the more conservative atmospheric dispersion (i.e., the maximum atmospheric dispersion factor). The resultant 95th percentile control room atmospheric dispersion factors for this release path are presented in Section 4.4.5.

# Section 4.4.4.3 Containment Shell Release

Atmospheric dispersion between the containment shell (surface) and the control room HVAC intakes is modeled as an area (diffuse) source using the ARCON96 ground level release option.

Consistent with RG 1.194 Sections 3.2.4.4 and 3.2.4.5, the height and width of the area source (i.e., the containment shell surface) are taken as the maximum vertical and horizontal dimensions of the above-grade building cross-sectional area perpendicular to the line of sight from the building center to the control room intake. The initial horizontal diffusion coefficient ( $\sigma_{y,0}$ ) is determined to be 8.06 meters, based on the 158.66 foct containment diameter. The initial vertical diffusion coefficient ( $\sigma_{z,0}$ ) is determined to be 8.18 meters, based on the 161.00 foot containment above-grade height.

The containment shell diffuse release is assumed to be from its mid-height of 80.5 feet (24.54 meters) above grade. This elevation allows for unimpeded flow above the Auxiliary Building roof. Because the control room intakes are on the Auxiliary Building wall opposite the U2 and U3 containments, the release cloud will flow to the intakes by first passing over the Auxiliary Building roof. This assumption is consistent with the RG 1.194 Section 3.2.4.5 recommendation to set the release height for a diffuse area source at the vertical center of the projected plane of the above-grade cross-sectional area perpendicular to the line of sight from the building center to the control room intake.

For the containment shell release, only the cross-sectional area of the containment is used to determine the building wake area. All other intervening buildings, such as the auxiliary building, are conservatively ignored. The building wake area of 2123.33 square meters is the projected area of the containment cylindrical lower portion and the containment upper dome portion.

Table 4.4-3 presents the separation distances and wind directions that characterize the releases from the two containment shell release point locations to the three control room HVAC intake locations:

Release Point	Control Room Receptor	Separation Distance (meters)	Wind Direction (degrees, North = 0)
U2 Containment	Normal Air Intake	38.6	348
U2 Containment	U2 emergency air intake	36	351
U2 Containment	U3 emergency air intake	77.4	329
U3 Containment	Normal Air Intake	74	96
U3 Containment	U2 emergency air intake	77.4	97
U3 Containment	U3 emergency air intake	36	75

TABLE 4.4-3: CONTAINMENT TO CONTROL ROOM MODELING

The results of the ARCON96 analysis show that the Unit 2 containment shell to Unit 2 emergency air intake release path has the more conservative atmospheric dispersion (i.e., the maximum atmospheric dispersion factor). The resultant 95th percentile contro room atmospheric dispersion factors for this release path are presented in Section 4.4.5.

### Section 4.4.4.4 Containment Equipment Hatch Release

Atmospheric dispersion between the containment equipment hatch and the control room HVAC intakes is modeled as an area (diffuse) source using the ARCON96 ground level release option.

The Containment Equipment Hatch is a large circular opening through the containment wall. The equipment hatch meets the conditions for a diffuse source as set forth in RG 1.194 Section 3.2.4.8: (1) the release from the hatch will be essentially equally dispersed over the entire opening, and (2) assumptions of mixing, dilution and transport within Containment necessary to meet condition 1 are supported by the interior containment arrangement. Consistent with RG 1.194 Section 3.2.4.4, the initial horizontal and vertical diffusion coefficients ( $\sigma_{y,0}$  and  $\sigma_{z,0}$ ) are each determined to be 0.97 meters, based on the clear 19-foot diameter of the hatch opening.

The Unit 2 and 3 Containment Equipment Hatches are on the opposite side of their respective Containment structures from the control room air intakes. The containment equipment hatch diffuse release is assumed to be from its mid-height at plant elevation 38.00 feet (11.58 meters). The top of the Containment is 161 feet above grade; therefore, it is unrealistic to expect flow from the Equipment Hatch to go over the Containment building. The Equipment Hatches to receptor distances are measured as the shortest path around the Containment ("taut string length"), as allowed by RG 1.194 Section 3.4. To determine the taut string length, a tangent is drawn from each intake to the side

of the containment closest to the equipment hatch. That distance is added to the length of the arc around the containment from the tangent line intersection to the centerline of the hatch.

As requested by RG 1.194 Appendix A Table A-2, since the plume is assumed to flow around the containment building rather than over it, the atmospheric dispersion value is calculated assuming flow both around and over (through) the building, and the higher of the atmospheric dispersion values is used.

For the containment equipment hatch release, only the cross-sectional area of the containment is used to determine the building wake area. All other intervening buildings, such as the auxiliary building, are conservatively ignored. The building wake area of 2123.33 square meters is the projected area of the containment cylindrical lower portion and the containment upper dome portion.

Table 4.4-4 presents the separation distances and wind directions that characterize the releases from the two containment equipment hatch release point locations to the three control room HVAC intake locations:

#### TABLE 4.4-4: CONTAINMENT EQUIPMENT HATCH TO CONTROL ROOM MODELING

Release Point	Control Room Receptor	Separation Distance (meters)	Wind Direction Over / Around Containment (degrees, North = 0)
U2 Ctmt Equip. Hatch	Normal Air Intake	98.1	353 / 11
U2 Ctmt Equip. Hatch	U2 emergency air intake	96.8	355 / 15
U2 Ctmt Equip. Hatch	U3 emergency air intake	126.9	336 / 343
U3 Ctmt Equip. Hatch	Normal Air Intake	124	89 / 82
U3 Ctmt Equip. Hatch	U2 emergency air intake	126.9	90 / 83
U3 Ctmt Equip. Hatch	U3 emergency air intake	96.8	71/51

The results of the ARCON96 analysis show that the Unit 2 equipment hatch to Unit 2 emergency air intake release path modeling flow over (through) the containment building has the more conservative atmospheric dispersion (i.e., the maximum atmospheric dispersion factor) during the 8 to 24 hour time period. For all other time periods, the results of the ARCON96 analysis show that the Unit 2 equipment hatch to Unit 2 emergency air intake release path modeling flow around the containment building has the more conservative atmospheric dispersion. The atmospheric dispersion factors for this release are a conservative composite of these two flow paths. The resultant 95th percentile control room atmospheric dispersion factors are presented in Section 4.4.5.

# Section 4.4.4.5 Main Steam Safety Valve (MSSV) Stack Release

Atmospheric dispersion between the MSSV stack and the control room HVAC intakes is modeled as a point source using the ARCON96 ground level release

option. Consistent with RG 1.194 Section 6.0 (and as justified in the following text), a reduction factor of 5 is applied to the ARCON96 results to allow credit for buoyant plume rise in determining the control room atmospheric dispersion factors associated with the energetic release from MSSVs.

Each reactor has two sets of nine MSSV stacks arrayed around a Main Steam Isolation Valve (MSIV). As an average location, the center of the MSIV (X and Y dimensions only) is modeled as the MSSV release location. MSIV 8205 is located north of the Unit 2 containment centerline (south for Unit 3). MSIV 8204 is located south of the Unit 2 containment centerline (north for Unit 3).

The MSSV release height is at plant elevation 73.42 feet (22.38 meters).

For the MSSV release, only the cross-sectional area of the containment is used to determine the building wake area. All other intervening buildings, such as the auxiliary building, are conservatively ignored. The building wake area of 2123.33 square meters is the projected area of the containment cylindrical lower portion and the containment upper dome portion.

Table 4.4-5 presents the separation distances and wind directions that characterize the releases from the MSSV release point locations (i.e., Unit 2 MSSVs centered at MSIVs 8204 and 8205, and Unit 3 MSSVs centered at MSIVs 8204 and 8205) to the three control room HVAC intake locations:

Release Point	Control Room Receptor	Separation Distance (meters)	Wind Direction (degrees, North = 0)
U2 MSSV 8204	Normal Air Intake	35.71	339
U2 MSSV 8204	U2 emergency air intake	32.65	343
U2 MSSV 8204	U3 emergency air intake	78.96	318
U2 MSSV 8205	Normal Air Intake	60.17	322
U2 MSSV 8205	U2 emergency air intake	56.54	323
U2 MSSV 8205	U3 emergency air intake	105.87	314
U3 MSSV 8204	Normal Air Intake	75.25	107
U3 MSSV 8204	U2 emergency air intake	78.96	108
U3 MSSV 8204	U3 emergency air intake	32.65	83
U3 MSSV 8205	Normal Air Intake	102.08	112
U3 MSSV 8205	U2 emergency air intake	105.87	112
U3 MSSV 8205	U3 emergency air intake	56.54	103

TABLE 4.4-5: MSSV TO CONTROL ROOM MODELING

The results of the ARCON96 analysis show that the Unit 2 MSSVs centered at MSIV 8204 to Unit 2 emergency air intake release path has the more conservative atmospheric dispersion (i.e., the maximum atmospheric dispersion factor).

RG 1.194 allows credit for buoyant plume rise in determining the Control Room atmospheric dispersion factors associated with an energetic release from main

steam safety valves. RG 1.194 Section 6.0 states that in lieu of mechanistically addressing the amount of buoyant plume rise:

"...the ground level  $\chi/Q$  value calculated with ARCON96 (on the basis of the physical height of the release point) may be reduced by a factor of 5. This reduction may be taken only if (1) the release point is uncapped and vertically criented and (2) the time-dependent vertical velocity exceeds the 95th-percentile wind speed (at the release point height) by a factor of 5."

The MSSVs are uncapped and vertically oriented, thereby satisfying the first criterion required for plume rise credit per RG 1.194, Section 6.0.

Since the MSSV stack exit is at plant elevation 73.4 ft and grade is at plant elevation 30 ft, the height of the stack exit above grade is 43.4 ft, or 13.2 meters. This is reasonably close to the height of the lower meteorological tower wind measurement instrumentation at 10 meters; therefore, the MSSV stack exit velocity is compared with the 95th percentile 10-m wind speed of 5.55.8 m/s.

For purposes of calculating the minimum flow velocity at the exit of the MSSV stack, the following conservative assumptions are made:

- 1. All MSSVs lift at the lowest set pressure of all the valves.
- 2. The pressure in the MSSV stack is equal to the maximum backpressure.
- 3. No credit is taken for head loss due to elevation changes or pipe friction.
- 4. No credit is taken for expansion of the steam through the stack.

The calculated minimum MSSV stack exit velocity is 72 meters/second. This exit velocity exceeds five times the 95th percentile wind speed (i.e., exceeds 5 x  $\frac{5.5}{5.5}$  m/s =  $\frac{29 \cdot 27 \cdot 5}{27 \cdot 5}$  m/s); thereby satisfying the second criterion required for plume rise credit per RGi 1.194 Section 6.0.

Since both criteria are satisfied, the ground level atmospheric dispersion factors calculated with ARCON96 (on the basis of the physical height of the release point) for MSSV releases are reduced by a factor of 5. The resultant 95th percentile control room atmospheric dispersion factors for the MSSV release path with credit for plume rise are presented in Section 4.4.5.

# Section 4.4.4.6 Atmospheric Dump Valve (ADV) Stack Release

Atmospheric dispersion between the ADV and the control room HVAC intakes is modeled as a point source using the ARCON96 ground level release option. Per RG 1.194 Section 6.0 (and as justified in the following text), a reduction factor of 5 may be applied to the ARCON96 results to allow credit for buoyant plume rise in determining the Control Room atmospheric dispersion factors associated with the energetic release from atmospheric dump valves. Each reactor has two ADV stacks. ADV 606 is located north of the Unit 2 containment centerline (south for Unit 3). ADV 607 is located south of the Unit 2 containment centerline (north for Unit 3).

The ADV release height is at plant elevation 113.92 feet (34.72 meters).

For the ADV release, only the cross-sectional area of the containment is used to determine the building wake area. All other intervening buildings, such as the auxiliary building, are conservatively ignored. The building wake area of 2123.33 square meters is the projected area of the containment cylindrical lower portion and the containment upper dome portion.

Table 4.4-6 presents the separation distances and wind directions that characterize the releases from the ADV release point locations (i.e., Unit 2 ADVs 606 and 607, and Unit 3 ADVs 606 and 607) to the three control room HVAC intake locations:

Release Point	Control Room Receptor	Separation Distance (meters)	Wind Direction (degrees, North = 0)
U2 ADV 606	Normal Air Intake	57.45	325
U2 ADV 606	U2 emergency air intake	53.88	326
U2 ADV 606	U3 emergency air intake	102.76	315
U2 ADV 607	Normal Air Intake	37.69	343
U2 ADV 607	U2 emergency air intake	34.84	348
U2 ADV 607	U3 emergency air intake	79.66	321
U3 ADV 606	Normal Air Intake	98.98	111
U3 ADV 606	U2 emergency air intake	102.76	111
U3 ADV 606	U3 emergency air intake	53.88	100
U3 ADV 607	Normal Air Intake	75.99	104
U3 ADV 607	U2 emergency air intake	79.66	105
U3 ADV 607	U3 emergency air intake	34.84	78

TABLE 4.4-6: ADV TO CONTROL ROOM MODELING

The results of the ARCON96 analysis show that the Unit 2 ADV 607 to Unit 2 emergency air intake release path has the more conservative atmospheric dispersion (i.e., the maximum atmospheric dispersion factor).

RG 1.194 allows credit for buoyant plume rise in determining the Control Room atmospheric dispersion factors associated with an energetic release from atmospheric dump valves. RG 1.194 Section 6.0 states that in lieu of mechanistically addressing the amount of buoyant plume rise:

"...the ground level  $\chi/Q$  value calculated with ARCON96 (on the basis of the physical height of the release point) may be reduced by a factor of 5. This reduction may be taken only if (1) the release point is uncapped and vertically criented and (2) the time-dependent vertical velocity exceeds the 95th-percentile wind speed (at the release point height) by a factor of 5."

The ADVs are uncapped and vertically oriented, thereby satisfying the first criterion requirec for plume rise credit per RG 1.194 Section 6.0.

Since the ADV stack exit is at plant elevation 113.92 ft and grade is at plant elevation 30 ft, the height of the stack exit above grade is 83.92 ft, or 25.6 meters. Since the ADV stack exit is closer in height to the upper meteorological tower wind measurement instrumentation at 40 meters than to the lower meteorological tower wind measurement instrumentation at 10 meters, the ADV stack exit velocity is compared with the 95th percentile 40-m wind speed of  $6.4 \pm 8$ -m/s.

The accident analyses assume that an ADV is operated manually; therefore, the flow velocity at the ADV stack exit will decrease over time, as the steam generator blows down. Thus, in order to credit plume rise in an ADV release dose analysis, the period for which the ADV stack exit vertical flow velocity exceeds five times the 95th percentile upper level wind speed of 6.8-6.4 m/s (i.e., exceeds 5 x 6.8-6.4 m/s = 34-32 m/s) would need to be determined.

Since the second criterion is not necessarily satisfied for the duration of a dose analysis, the ground level atmospheric dispersion factors calculated with ARCON96 (on the basis of the physical height of the release point) for ADV releases may or may not be reduced by a factor of 5 for the duration of a dose analysis. The resultant 95th percentile control room atmospheric dispersion factors for the ADV release path with and without credit for plume rise are presented in Section 4.4.5. The use of the lower values crediting plume rise will be evaluated on an event-specific basis.

# Section 4.4.4.7 Steam Line Break Outside Containment (SLB-OC) Release

Atmospheric dispersion between the steam line break outside containment and the control room HVAC intakes is modeled as an area (diffuse) source using the ARCON96 ground level release option.

The SLB-OC is postulated to occur outboard of the main steam line restraint/anchor downstream of the main steam isolation valve. Thus, the location of the postulated break is in the walkway between the east wall of the Turbine Building and the Main Steam Isolation Valve/Main Feedwater Isolation Valve (MSIV/MFIV) enclosure structures. The enclosure structures are open to the walkway, which is then open to the atmosphere above. Several blowout panels are present on the roofs of the enclosure structures. There are also blowout panels on the walls of the MSIV/MFIV enclosure. The blowout panels open during a large SLB-OC to protect the enclosure structures from overpressurizing. Thus, depending on the size of the steam line break, there are multiple pathways for steam blowdown. Steam from an SLB-OC is assumed to be released via the blowout panels mounted on the roof of the respective MSIV/MFIV enclosure directly above the main steam line. For a small SLB-OC, the pressure may not exceed the relief setting of the blowout panels; in such an instance, steam will escape via the enclosure opening to the walkway between the enclosure and the Turbine Building. For a large SLB-OC, steam may also escape via the roof blowout panel above the main feedwater line and via the enclosure wall-mounted blowout panels. Nevertheless, the assumption that the release is solely via the roof blowout panels is conservative, because it results in a smaller flow area, which means a smaller initial horizontal diffusion coefficient, than if all the potential vent paths were considered.

The SLB-OC release via the roof blowout panels meets the conditions for a diffuse source in RG 1.194 Section 3.2.4.7, which states that the application of the diffuse area source model to determine atmospheric dispersion factors for multiple (i.e., 3 or more) roof vents is:

"...appropriate for configurations in which (1) the vents are in close arrangement, (2) no individual vent is significantly closer to the control room intake than the center of the area source, (3) the release rate from each vent is approximately the same, and (4) no credit is taken for plume rise."

Condition 1 is satisfied since the 3 roof-mounted blowout panels directly above each main steam line are in close proximity with each other (spaced from 2.0 to 3.5 feet apart). Condition 2 is satisfied since no individual blowout panel is significantly closer to the control room intake than the center of the area source. Although there are other vent paths (i.e., through the enclosure opening adjacent to the walkway, the roof-mounted blowout panels over the main feedwater lines, and the wall-mounted blowout panels), it is conservative for purposes of determining control room atmospheric dispersion factors to minimize the initial dispersion area by accounting only for the area source presented by the blowout panels above the main steam lines. Condition 3 is satisfied since the steam is assumed to rise evenly through the three adjacent blowout panels. Condition 4 is satisfied since no credit is taken for plume rise. Therefore, the SLB-OC release meets the conditions for a diffuse source per Regulatory Guide 1.194, Section 3.2.4.7.

The area width is measured across the area formed by the three blowout panels mounted on the roof of the MSIV enclosure perpendicular to the line of sight from the MSIVs to the respective control room intake. Table 4.4-7 presents the initial horizontal diffusion coefficients ( $\sigma_{y,0}$ ) that characterize the releases from the SLB-OC release point locations. Consistent with RG 1.194 Section 3.2.4.7, because the blowout panel openings are in a horizontal configuration on the MSIV enclosure roof, there is no initial vertical dispersion coefficient (i.e.,  $\sigma_{z,0}$  is zero).

The distance between the SLB-OC release point and the control room intakes is measured from the closest point on the perimeter of the roof blowout panels above the MSIVs, as allowed by Section 3.2.4.7 of RG 1.194.

The SLB-OC release height via the MSIV/MFIV enclosure roof blowout panels is at plant elevation 63.50 feet (19.35 meters).

For the SLB-OC release, only the cross-sectional area of the containment is used to determine the building wake area. All other intervening buildings, such as the auxiliary building, are conservatively ignored. The building wake area of 2123.33 square rneters is the projected area of the containment cylindrical lower portion and the containment upper dome portion.

Table 4.4-7 presents the separation distances, wind directions and initial horizontal diffusion coefficients ( $\sigma_{y,0}$ ) that characterize the releases from the SLB-OC release point locations (i.e., Unit 2 North and South MSIV/MFIV enclosure roof blowout panels, and Unit 3 North and South MSIV/MFIV enclosure roof blowout panels) to the three control room HVAC intake locations:

Release Point	Control Room Receptor	Separation Distance (meters)	Wind Direction (degrees, North = 0)	σ <sub>y,0</sub> [σ <sub>z,0</sub> = 0] (meters)
U2 N Panels	Normal Air Intake	58.5	322	0.96
U2 N Panels	LI2 emergency air intake	54.9	323	0.96
U2 N Panels	LI3 emergency air intake	104.2	314	0.99
U2 S Panels	Normal Air Intake	32.3	339	0.56
U2 S Panels	LI2 emergency air intake	29.3	343	0.54
U2 S Panels	U3 emergency air intake	76.9	318	0.7
U3 N Panels	Normal Air Intake	100.4	112	0.99
U3 N Panels	LI2 emergency air intake	104.2	112	0.99
U3 N Panels	LI3 emergency air intake	54.9	103	0.96
U3 S Panels	Normal Air Intake	73.2	107	1.42
U3 S Panels	LI2 emergency air intake	76.9	108	1.44
U3 S Panels	LI3 emergency air intake	29.3	83	1.12

TABLE 4.4-7: SLB-OC TO CONTROL ROOM MODELING

The results of the ARCON96 analysis show that the Unit 2 South MSIV/MFIV enclosure structure (housing Unit 2 MSIV 8204) roof blowout panels to Unit 2 emergency air intake release path have the more conservative atmospheric dispersion (i.e., the maximum atmospheric dispersion factor). The resultant 95th percentile control room atmospheric dispersion factors for this release path are presented in Section 4.4.5.

# Section 4.4.4.8 Auxiliary Feedwater (AFW) Turbine Stack Release

Atmospheric dispersion between the AFW turbine stack and the control room HVAC intakes is modeled as a point source using the ARCON96 vent release option.

The AFW turbine stack is located near the south wall of the Unit 2 refueling water storage and conclensate storage tank farm (north wall for Unit 3).

The AFW turbine stack release height is at plant elevation 59 feet (17.98 meters).

For the AFW turbine stack release, only the cross-sectional area of the containment is used to determine the building wake area. All other intervening buildings, such as the auxiliary building, are conservatively ignored. The building wake area of 2123.33 square meters is the projected area of the containment cylindrical lower portion and the containment upper dome portion.

Table 4.4-8 presents the separation distances and wind directions that characterize the releases from the two AFW turbine stack activity release point locations to the three control room HVAC intake locations:

Release Point	Control Room Receptor	Separation Distance (meters)	Wind Direction (degrees, North = 0)
U2 AFW Turbine Stack	Normal Air Intake	86.89	332
U2 AFW Turbine Stack	U2 emergency air intake	83.53	333
U2 AFW Turbine Stack	U3 emergency air intake	130.22	322
U3 AFW Turbine Stack	Normal Air Intake	126.57	104
U3 AFW Turbine Stack	U2 emergency air intake	130.22	104
U3 AFW Turbine Stack	U3 emergency air intake	83.53	93

TABLE 4.4-8: AFW TURBINE STACK TO CONTROL ROOM MODELING

The results of the ARCON96 analysis show that the Unit 2 AFW turbine stack to Unit 2 emergency air intake release path has the more conservative atmospheric dispersion (i.e., the maximum atmospheric dispersion factor). The resultant 95th percentile control room atmospheric dispersion factors for this release path are presented in Section 4.4.5.

# Section 4.4.4.9 Refueling Water Storage Tank (RWST) Vent Release

Atmospheric dispersion between the RWST vent and the control room HVAC intakes is modeled as a point source using the ARCON96 vent release option.

There are two RVST tanks for each unit (T005 and T006). The two tanks are located in the Units 2 and 3 refueling water storage and condensate storage tank farms, which are mirror images of each other. Unit 2 RWST T005 is located northeast of the Unit 2 containment centerline (southeast for Unit 3). Unit 2

RWST T006 is located northwest of the containment centerline (southwest for Unit 3).

The RWST release location is assumed to be the center of the roof vent on each RWST. These vents are offset from the center of the tank roofs. The Unit 2 RWST T005 and T006 vent release height is at plant elevation 71.57 feet (21.81 meters). The Unit 3 RWST T005 and T006 vent release height is at plant elevation 71.73 feet (21.86 meters).

For the RWST vent release, only the cross-sectional area of the containment is used to determine the building wake area. All other intervening buildings, such as the auxiliary building, are conservatively ignored. The building wake area of 2123.33 square meters is the projected area of the containment cylindrical lower portion and the containment upper dome portion.

Table 4.4-9 presents the separation distances and wind directions that characterize the releases from the four RWST vent activity release point locations (i.e., Unit 2 RWSTs T005 and T006, and Unit 3 RWSTs T005 and T006) to the three control room HVAC intake locations:

Release Point	Control Room Receptor	Separation Distance (meters)	Wind Direction (degrees, North = 0)
U2 RWST T005	Normal Air Intake	106.66	330
U2 RWST T005	U2 emergency air intake	103.23	331
U2 RWST T005	U3 emergency air intake	150.24	322
U2 RWST T006	Normal Air Intake	103.79	327
U2 RWST T006	U2 emergency air intake	100.26	327
U2 RWST T006	U3 emergency air intake	148.21	319
<b>U3 RWST T005</b>	Normal Air Intake	146.59	104
<b>U3 RWST T005</b>	U2 emergency air intake	150.24	104
<b>U3 RWST T005</b>	U3 emergency air intake	103.23	95
<b>U3 RWST T006</b>	Normal Air Intake	144.51	106
<b>U3 RWST T006</b>	U2 emergency air intake	148.21	107
U3 RWST T006	U3 emergency air intake	100.26	99

TABLE 4.4-9: RWST TO CONTROL ROOM MODELING

The results of the ARCON96 analysis show that the Unit 2 RWST T006 vent to Unit 2 emergency air intake release path has the more conservative atmospheric dispersion (i.e., the maximum atmospheric dispersion factor) for the 0 to 2 hour time period. For time periods after 2 hours, the results of the ARCON96 analysis show that the Unit 2 RWST T005 vent to Unit 2 emergency air intake release path has the more conservative atmospheric dispersion. The atmospheric dispersion factors for this release are a conservative composite of these two flow paths. The resultant 95th percentile control room atmospheric dispersion factors for these release paths are presented in Section 4.4.5.

# Section 4.4.4.10 Fuel Handling Building (FHB) Release

Atmospheric dispersion between the fuel handling building and the control room HVAC intakes is modeled as a point source using the ARCON96 vent release option.

The Units 2 and 3 FHBs are each located to the east of the Units 2 and 3 containment buildings. The FHB release location is assumed to be the spent fuel cask hatch over the south end of the Unit 2 railroad access bay (north end of Unit 3 bay). This hatch is larger and closer to the control room air intake locations than the smaller cask hatch over the opposite ends of the respective railroad bays. The centerline of the spent fuel cask is south and east of the Unit 2 containment centerline (north and east of the Unit 3 containment centerline).

The FHB spent fuel cask hatch release height is at plant elevation 63.50 feet (19.35 meters).

For the FHB release, the fuel handling building east cross-section area and one half of the containment cross-section area is used. Only one half of the containment is conservatively considered since it is partially offset from the release to intake axis. All other intervening buildings, such as the auxiliary building, are conservatively ignored. The building wake area for the FHB release is 2076.78 square meters.

Table 4.4-10 presents the separation distances and wind directions that characterize the releases from the two FHB activity release point locations to the three control room HVAC intake locations:

Release Point	Control Room Receptor	Separation Distance (meters)	Wind Direction (degrees, North = 0)
U2 FHB	Normal Air Intake	91.82	20
U2 FHB	U2 emergency air intake	91.06	23
U2 FHB	U3 emergency air intake	112	356
U3 FHB	Normal Air Intake	109.73	68
U3 FHB	U2 emergency air intake	112	70
U3 FHB	U3 emergency air intake	91.06	43

TABLE 4.4-10: FHB TO CONTROL ROOM MODELING

The results of the ARCON96 analysis show that the Unit 2 FHB to Unit 2 emergency air intake release path has the more conservative atmospheric dispersion (i.e., the maximum atmospheric dispersion factor). The resultant 95th percentile control room atmospheric dispersion factors for this release path are presented in Section 4.4.5.

### Section 4.4.5 ARCON96 Results – 95th Percentile Control Room Atmospheric Dispersion Factors

For each of the release locations, the maximum atmospheric dispersion factor from either unit to any of the three control room air intakes is determined. The resultant 95th percentile control room atmospheric dispersion factors are presented in Table 4.4-11.

As discussed in Section 4.4.4.5, the control room atmospheric dispersion factor results for the MSSV stack release include credit for plume rise. MSSV plume rise credit may be modeled for any accident with an MSSV release.

The control room atmospheric dispersion factor results for the ADV stack release are presented with and without credit for plume rise. The determination of whether ADV plume rise credit can be taken must be determined on an accidentspecific basis.

Control room occupancy factors are not included in the 95th percentile atmospheric dispersion factors reported in Table 4.4-11. Control room occupancy factors are modeled as separate input parameters to the dose analyses.

Time Interval	Main Flant Vent	Containment Shell	Equipment Hatch	ADV (no plume rise credit)	ADV (with plume rise credit)
0 to 2 hrs	<del>1.14E-03</del> 1.15E-03	<del>9.94E-04</del> <u>1.01E-3</u>	<del>7.99E-04</del> 8.01E-04	3.70E-03	7.40E-04
2 to 8 hrs	<del>6.11E-04</del> 6.23E-04	<del>6.32E-04</del> <u>6.41E-04</u>	<del>6.30E-04</del> 6.35E-04	<del>1,97E-03</del> <u>1,99E-03</u>	<del>3.94E-04</del> <u>3.98E-04</u>
8 to 24 hrs	2.10E-04 2.14E-04	1.77E-04	<del>1.77E-04</del> <u>1.78E-04</u>	<del>6.86E-04</del> <u>6.95E-04</u>	<del>1.37E-04</del> <u>1.39E-04</u>
1 to 4 days	2.20E-04 2.22E-04	<del>2.34E-04</del> 2.36E-04	2.23E-04	<del>6.97E-04</del> <u>7.04E-04</u>	<del>1.39E-04</del> <u>1.41E-04</u>
4 to 30 days	<del>1.98E-04</del> 2.02E-04	2.18E-04 2.20E-04	2.03E-04	<del>6.33E-04</del> <u>6.34E-04</u>	1.27E-04

TABLE 4.4-11: 95<sup>th</sup> Percentile Control Room χ/Qs (sec/m<sup>3</sup>) [without CR Occupancy Factors]

Time Interval	MSSV (with plume rise credit)	SLB-OC	AFW Turbine Exhaust	RWST	Fuel Handling Building
0 to 2 hrs	1.21E-03 1.22E-03	7.74E-03 7.78E-03	8.55E-04 8.60E-04	<del>5.65E-04</del> 5.67E-04	<del>9.45E-04</del> 9.48E-04
2 to 8 hrs	7.48E-04 7.52E-04	4 <del>.79E-03</del> 4.81E-03	3.60E-04 3.70E-04	2.17E-04 2.25E-04	7.48E-04 7.61E-04
8 to 24 hrs	2.50E-04 2.48E-04	1.62E-03	1.56E-04	8.67E-05 8.84E-05	<del>1.93E-04</del> 1.92E-04
1 to 4 days	2.86E-04	1.83E-03	<del>1.60E-04</del> <u>1.61E-04</u>	8.88E-05 8.97E-05	2.64E-04 2.65E-04
4 to 30 days	2.60E-04	1.68E-03	1.30E-04	<del>7.33E-05</del> <u>7.37E-05</u>	2.43E-04

# Section 4.5 LOSS OF COOLANT ACCIDENT ANALYSIS

Regulatory Guide 1.183 Appendix A provides assumptions for use in evaluating the radiological consequences of a LOCA. These assumptions supplement the guidance provided in the main body of RG 1.183.

The SONGS Units 2 and 3 LOCA is characterized by the following activity release paths:

- Containment leakage
- Engineered Safety Feature (ESF) recirculation loop leakage
- Refueling Water Storage Tank (RWST) release
- Post Accident Sampling System (PASS) leakage

The SONGS Units 2 and 3 LOCA is also characterized by the following gamma radiation shine dose contributors which are discussed in Section 4.3:

- Environmental cloud gamma radiation shine
- Control room filter gamma radiation shine
- Containment building gamma radiation shine
- Post-LOCA piping gamma radiation shine

The characteristics of the LOCA model are summarized in Table 4.5-1.

This Section presents the assumptions, design input, methodology employed in evaluating, and the radiological consequences of each of the SONGS Units 2 and 3 LOCA dose contributors.

LOCA PARAMETER	MODELED VALUE
Dose acceptance criteria, Rem TEDE	
Control Room	5
EAB	25
LPZ	25
Containment leakage parameters	per Table 4.5-2
ESF system leakage parameters	per Table 4.5-8
RWST release parameters	per Table 4.5-9
PASS leakage parameters	per Table 4.5-10
Offsite dose evaluation model	per Section 4.2
Control Room dose evaluation model	per Section 4.3

#### TABLE 4.5-1: LOCA DOSE ANALYSIS PARAMETERS

#### Section 4.5.1 Containment Leakage

Regulatory Guide 1.183 Appendix A provides assumptions for use in evaluating the radiological consequences of the containment leakage pathway for a LOCA.

These assumptions supplement the guidance provided in the main body of RG 1.183.

This Section presents the assumptions, design input, and methodology employed in evaluating the radiological consequences of the SONGS Units 2 and 3 LOCA containment leakage path. The characteristics of the LOCA containment leakage model are summarized in Table 4.5-2.

The control room and offsite doses associated with containment leakage are summarized in Section 4.5.7.

LOCA CONTAINMENT LEAKAGE PARAMETER	MODELED VALUE
LOCA source term	
Reactor core isotope inventory at shutdown, curies	per Section 4.1
Timing of core activity release into containment	
Gap release phase	0.5 to 30 minutes
Early in-vessel phase	0.5 to 1.8 hours
Core inventory fract on released into containment, gap release phase	
Noble gases (Xe, Kr)	0.05
Halogens (I, Br)	0.05
Alkali Metals (Cs, Rb)	0.05
Other Elements	0.00
Core inventory fraction released into containment, early in-vessel phase	
Noble gases (Xe, Kr)	0.95
Halogens (I, Br)	0.35
Alkali metals (Cs, Rb)	0.25
Tellurium metals (Te, Sb, Se)	0.05
Barium, Strontium (Ba, Sr)	0.02
Noble metals (Ru Rh, Pd, Mo, Tc, Co)	0.0025
Cerium group (Ce, Pu, Np)	0.0005
Lanthanides (La, Zr, Nd, Eu, Nb, Pm, Pr, Sm, Y, Cm, Am)	0.0002
Chemical form of lodine released into containment, percent of iodine	
Cesium iodide (C3I) (particulate iodine)	95.00
Elemental iodine	4.85
Organic iodide	0.15
Containment net free volume, cubic feet	
Total	2.284E+06
Sprayed volume	1.907E+06
Unsprayed volume	3.770E+05
Containment mechanical air mixing	
Number of operating emergency cooling unit (ECU) trains	1
Number of operating emergency cooling units	2 ECUs per train
Emergency cooling unit flow rate, ft <sup>3</sup> /minute per ECU	31,000
Number of operating dome air circulator unit (DACU) trains	1
Number of operating dome air circulator units	2-1_DACUs per train
Dome air circulator unit flow rate, ft <sup>3</sup> /minute per DACU (not credited)	<u>0</u> 37,000

# TABLE 4.5-2: LOCA CONTAINMENT LEAKAGE ANALYSIS PARAMETERS

1

LOCA CONTAINMENT LEAKAGE PARAMETER	MODELED VALUE
Natural deposition (plateout) removal of airborne radionuclides	Per Section 4.5.1.3
Containment spray removal of airborne radionuclides	Per Section 4.5.1.3
Containment leakage rate, ft <sup>3</sup> /minute	
0 to 1 day, Total leakage	1.6
0 to 1 day, Sprayed volume leakage	1.34
0 to 1 day, Unsprayed volume leakage	0.26
1 to 30 days, Total leakage	0.8
1 to 30 days, Sprayed volume leakage	0.67
1 to 30 days, Unsprayed volume leakage	0.13
Atmospheric Dispersion Factors for the Containment Leakage release via the Containment Shell to Control Room, seconds/m <sup>3</sup>	per Section 4.4

### Section 4.5.1.1 Containment Leakage Source Term

Regulatory Guide 1.183 Appendix A Section 1 states that acceptable assumptions regarding core inventory and the release of radionuclides from the fuel are provided in RG 1.183 Regulatory Position 3.

Consistent with FiG 1.183 Regulatory Position 3.4 and its Table 5, the core isotopes released into the containment are grouped into chemically similar groups. The elements of each group are as listed in Table 4.5-2 Consistent with RG 1.183 Regulatory Position 3.2, the core inventory release fractions, by radionuclide groups, for the gap release and early in-vessel phases for DBA LOCAs are as listed in Table 4.5-2.

Consistent with FiG 1.183 Regulatory Position 3.2, the core inventory release fractions are applied to the equilibrium reactor core isotope inventory at shutdown as described in Section 4.1.

Consistent with F.G 1.183 Regulatory Position 3.3 and its Table 4, the onset and duration of the sequential gap release and early in-vessel release phases for the LOCA are as specified in Table 4.5-2. The gap release phase begins at 30 seconds and the early in-vessel release phase begins at 30 minutes. Although the gap release duration is to be 30 minutes, it is conservatively assumed to end at 30 minutes so that there is no overlap with the start of the early in-vessel release phase (i.e., the gap release phase is modeled with a duration of 29 minutes and 30 seconds). The activity released from the core during each release phase is modeled as increasing in a linear fashion over the duration of the phase.

Consistent with F.G 1.183 Appendix A Section 2, an evaluation of post-LOCA containment sump pH has considered the effect of acids and bases created during the LOCA event (e.g., radiolysis products). As discussed in Section 4.5.1.3.4, the containment sump pH is at a value of 7 or greater at the start of the LOCA when iodine evolution from the containment sump is a concern, and for

worst case cond tions the containment sump pH is not lower than approximately 6.9 at the end of 30 days. Consistent with RG 1.183 Appendix A Section 2, since the containment sump pH is controlled at a value of 7 or greater during the release of radioiodine to the containment, the chemical form of radioiodine released to the containment is assumed to be 95 percent cesium iodide (CsI), 4.85 percent elemental iodine, and 0.15 percent organic iodide.

Consistent with Regulatory Guide 1.183 Appendix A Section 2, with the exception of elemental and organic icdine and noble gases, fission products are assumed to be in particulate form (i.e., subject to particulate spray and deposition removal as well as by HEPA filtration).

# Section 4.5.1.2 Containment Leakage Activity Release Model

Consistent with RG 1.183 Appendix A Section 3.1, the radioactivity released from the fuel is assumed to mix instantaneously and homogeneously throughout the free air volume cf the primary containment. The activity release is terminated at the end of the early in-vessel phase.

Consistent with RG 1.183 Appendix A Section 3.2, reduction in containment airborne radioactivity by natural deposition within the containment is credited. As discussed in Section 4.5.1.3, the removal of iodines and aerosols by natural processes is calculated using the models presented in Standard Review Plan (SRP) Section 6.5.2 and NUREG/CR-6189, "A Simplified Model of Aerosol Removal by Natural Processes in Reactor Containments" (Reference 16).

Consistent with RG 1.183 Appendix A Section 3.3, reduction in containment airborne radioactivity by the containment spray system is credited. As discussed in Section 4.5.1.3, removal of iodines and aerosols by containment sprays are calculated using the models presented in SRP Section 6.5.2 and NUREG/CR-5966 "A Simplified Model of Aerosol Removal by Containment Sprays" (Reference 17).

Consistent with RG 1.183 Appendix A Section 3.3, the containment building atmosphere is not considered a single, well-mixed volume because the containment sprays cover less than 90% of the containment net free air volume. The total primary containment net free air volume of 2,284,000 cubic feet consists of a sprayed volume of 1,907,000 cubic feet (83.5 percent) and an unsprayed volume of 377,000 cubic feet (16.5 percent).

Consistent with RG 1.183 Appendix A Section 3.7, the containment is assumed to leak at the peak pressure technical specification leak rate of 0.1 percent of the containment air weight per day for the first 24 hours of the LOCA event. Consistent with RG 1.183 Appendix A Section 3.7, after the first 24 hours, the containment leak rate is halved to 0.05 percent of the containment air weight per day.

The containment leakage is assumed to originate from the containment sprayed and unsprayed regions in flow rates that are proportional to the total volume of each region. A well-mixed containment is necessary to justify this modeling. The Containment Emergency Cooling Units (ECUs or air coolers) and the Containment Dome Air Circulator Units (DACUs) provide the necessary air mixing action. Evue to an assumed failure, only one of the two Containment ECU trains and one of the two Containment DACU trains are modeled as being operational. The containment ECUs and DACUs are assumed to start operation one minute after the start of the LOCA. Assuming that the air mixing removal of containment unsprayed region activity can be approximated by an exponential relationship, 99 percent of the containment air in the containment unsprayed region will be replaced with air from the sprayed region within 13-28 minutes, ensuring well-mixing of the containment air with more than 8-approximately 4 change-outs of the containment unsprayed region activity prior to the cessation of activity releases at the conclusion of the early in-vessel phase.

The containment mini-purge represents a potential containment airborne activity release path to the environment. Per TS LCO 3.6.3 Surveillance Requirement 3.6.3.2, the 8-inch mini-purge valves are closed except when the valves are open for pressure control, As-Low-As-Reasonably Achievable (ALARA), or air quality considerations for personnel entry, or for surveillances that require the valves to be open. Consistent with the guidance of RG 1.183 Appendix A Section 3.8, because the containment is not routinely purged with the mini-purge system, activity releases through the containment 8-inch mini-purge valves are not analyzed.

The containment purging system represents another potential containment airborne activity release path to the environment. Per TS LCO 3.6.3 Surveillance Requirement 3.6.3.1, the 42-inch purge valves are sealed closed. Consistent with the guidance of RG 1.183 Appendix A Section 7, since the installed containment purging system is not credited in any design basis analysis, activity releases through the containment 42-inch purge valves are not evaluated.

The activity released from the containment is transported by atmospheric dispersion to the control room HVAC intake and to the offsite EAB and LPZ dose receptors. Section 4.4 and its Table 4.4-11 present the San Onofre site-specific 95th percentile meteorology atmospheric dispersion factors used for the containment shell to control room release pathway. No credit is taken for radioactive decay of the isotopes during this atmospheric dispersion transit to the control room or offsite dose locations. Consistent with RG 1.183 Regulatory Positions 4.1.7 and 4.2.2, no correction is made for depletion of the effluent plume by deposition on the ground.

#### Section 4.5.1.3 Containment Aerosol and Elemental Iodine Removal

Consistent with FIG 1.183 Appendix A Sections 3.2 and 3.3, reductions in containment airborne radioactivity by natural deposition within the containment and by the containment spray system are credited. This section discusses the modeling employed in determining the aerosol and iodine natural deposition and spray removal rates in the containment sprayed and unsprayed regions.

Section 4.5.1.3.1 addresses the natural deposition of aerosols, including particulate iodine (i.e., cesium iodide). Section 4.5.1.3.2 addresses the natural deposition of elemental iodine. Natural deposition is not considered for the removal of organic iodide and noble gases.

Section 4.5.1.3.3 addresses the spray removal of aerosols, including particulate iodine. Section 4.5.1.3.4 addresses the spray removal of elemental iodine. Spray removal is not considered for the removal of organic iodide and noble gases.

Section 4.5.1.3.5 presents the combined time-dependent natural deposition plus spray removal rates in the containment sprayed and unsprayed regions for elemental iodine, halogens and other particulates.

#### Section 4.5.1.3.1 Containment Natural Deposition of Aerosols

Consistent with RG 1.183 Appendix A Section 3.2, reduction in containment airborne aerosol radioactivity by natural deposition is credited in the SONGS Units 2 and 3 AST dose analyses. The SONGS natural deposition analysis uses a simplified natural deposition model for aerosols developed by Powers et.al. in NUREG/CR-6189 for the different types of reactors and various operating power levels using a Monte Carlo uncertainty analysis. The results of these analyses for PWR design basis accidents are summarized in correlations provided in NUREG/CR-6189 Table 36. Per RG 1.183 Appendix A Section 3.2, the NUREG/CR-6189 model is incorporated into the RADTRAD analysis code of NUREG/CR-6604.

The aerosol natural deposition removal rates for the gap release and the early in-vessel release phases for the different time periods are conservatively calculated using the Powers model with 10th percentile natural deposition correlations (i.e., minimum deposition) and the analysis models the core rated thermal power of 3438 MWt specified in Section 4.1.1. These deposition rates are weighted by each chemical group release rate reflecting the core release fractions and release phase durations specified in Table 4.5-2, as required by NUREG/CR-6604 Section 2.2.2.1.2. The resultant aerosol natural deposition rates for halogeris, alkali metals, and other particulates are shown in Table 4.5-3.

TIME PERIOD (hours)	HALOGENS 10th PERCENTILE NATURAL DEPOSITION IREMOVAL RATE (1/hour)	ALKALI METALS 10th PERCENTILE NATURAL DEPOSITION REMOVAL RATE (1/hour)	OTHER PARTICULATES 10th PERCENTILE NATURAL DEPOSITION REMOVAL RATE (1/hour)
0 to 0.5	2.94E-02	2.94E-02	N/A
0.5 to 1.8	3.95E-02	4.17E-02	3.12E-02
1.8 to 3.8	8.93E-02	8.93E-02	8.93E-02
3.8 to 13.8	1.16E-01	1.16E-01	1.16E-01
13.8 to 22.2	8.60E-02	8.60E-02	8.60E-02
22.2 to 720	0.00E+00	0.00E+00	0.00E+00

TABLE 4.5-3: AEROSOL	NATURAL	DEPOSITION	<b>REMOVAL R</b>	ATES
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#### Section 4.5.1.3.2 Containment Natural Deposition of Elemental Iodine

Consistent with FiG 1.183 Appendix A Section 3.2, reduction in containment airborne elemental iodine radioactivity by natural deposition is credited in the SONGS Units 2 and 3 AST dose analyses. The SONGS natural deposition analysis uses a model provided in NUREG-0800 SRP Section 6.5.2.

Removal of elemental iodine by wall deposition is estimated using the methodology of SRP 6.5.2 Section III.4.c.(1). Input to this methodology includes a mass transfer coefficient, the wetted surface area inside containment, and the containment building net free volume.

The mass transfer coefficient is modeled with a value of 0.137 cm/sec, consistent with the value of 4.9 m/hr recommended by SRP 6.5.2 Section III.4.c.(1).

As discussed in NUREG/CR-0009 Section 5.1.2, the natural deposition model for elemental iodine assumes that the bulk gas in the containment atmosphere is well-mixed by natural convection, by steam flows, and by spray operations. Therefore, all surfaces within the containment are available for elemental iodine aerosol deposition. The wetted surface area modeled for natural deposition is the surface area of 601,519 square feet that is used for the passive heat sinks in the containment pressure/temperature response analyses for LOCA and Main Steam Line Break (MSLB).

The total primary containment net free air volume of 2,284,000 cubic feet is the sum of the containment sprayed and unsprayed volumes.

Based on these parameters, the resultant elemental iodine natural deposition rate is 4.26 inverse hours.

# Section 4.5.1.3.3 Containment Spray Removal of Aerosols

Consistent with RG 1.183 Appendix A Section 3.3, reduction in containment airborne aerosol radioactivity by the Containment Spray System (CSS) is credited in the SONGS Units 2 and 3 AST dose analyses. The SONGS spray removal analysis uses a simplified spray removal model for aerosols that was developed by Powers et.al. in NUREG/CR-5966 using a Monte Carlo uncertainty analysis. Per RG 1.183 Appendix A Section 3.3, the NUREG/CR-5966 model is incorporated into the RADTRAD analysis code of NUREG/CR-6604.

The aerosol spray removal model input parameters are the CSS spray water flux, the fall height of the spray droplets, and the aerosol mass fraction, which is defined as the aerosol mass in the atmosphere at a given time divided by the total aerosol mass released into the compartment atmosphere until this time.

The CSS has two phases of operation, an injection phase and a recirculation phase. During the injection phase the CSS draws water from the refueling water storage tank until this tank source is exhausted. Following the injection phase, the CSS enters the recirculation phase where water is drawn from the containment sump and recirculated through the CSS. The minimum flow rate per spray header is 1,606 gpm during the injection phase and 1,991 gpm during the recirculation phase. The SONGS spray removal analysis conservatively models the lower injection phase flow rate, rounded down to 1,600 gpm per spray header, throughout the CSS operation. The lower flow rate and resultant spray flux minimizes the activity removal by the sprays and maximizes the airborne radionuclide concentrations. For further conservatism, the SONGS spray removal analysis assumes that only one of the two CSS headers is in operation.

The Powers model is valid for spray water fluxes ranging from 0.001 to 0.25 cm<sup>3</sup> H<sub>2</sub>0/ cm<sup>2</sup>-s. The total spray flux for the SONGS Units 2 and 3 spray system has been determined to fall within this applicability range. The spray flux is 0.00615 cm<sup>3</sup> H<sub>2</sub>0/ cm<sup>2</sup>-s based on a minimum spray system flow rate for one spray header of 1,600 gpm, and the circular floor coverage area for the containment inner diameter of 150 feet.

The Powers model is valid for fall heights ranging from 500 to 5,000 cm. The range of fall heights for the SONGS Units 2 and 3 spray system has been determined to fall within this applicability range. The SONGS Units 2 and 3 containment spray system is designed with multiple spray rings at varying heights within the containment. The fall height of the spray droplets from the various rings to the operating floor ranges from a minimum of 2,433 cm to a maximum of 3,611 cm.

Per NUREG/CR-5966 page 99, the value of the aerosol removal coefficient at an aerosol mass fraction of 0.9 is indicative of the initial rate of decontamination when aerosol is first exposed to the action of a spray.

Unique aerosol spray removal rates were calculated for each spray ring in each of the two CSS spray headers. The calculations address the fact that each spray ring is located at a different height with its own unique spray flux due to different coverage areas and number of spray nozzles per spray ring. The aerosol spray removal rates were conservatively calculated for an aerosol mass fraction of 0.9 using the Powers model with 10th percentile spray removal correlations (i.e., minimum deposition). The aerosol spray removal rates for each ring in a spray header were then summed together, and the lowest header value of 4.73 inverse hours for an aerosol mass fraction of 0.9 was determined.

The aerosol spray removal rate will vary from the value of 4.73 inverse hours as a function of the aerosol mass fraction. The Powers model was originally developed for a puff release of aerosol into a system. In those cases where there is a continuous release, such as the AST LOCA with its gap and early in-vessel releases, the injected aerosols will continually renew the aerosol size distribution. For this reason, the aerosol mass fraction has been modeled with a constant value of one until the release stops at 1.8 hours. The SONGS spray removal analysis: applies the Powers model equations to determine the elapsed time since the end of the in-vessel phase to reach a given aerosol mass fraction, and the aerosol spray removal rate corresponding to that aerosol mass fraction.

The Bechtel LocaDose code is used in the AST dose analyses. The LocaDose code treats the aerosol spray removal rates as constants for any given time period. Therefore, to model the time dependency, average aerosol spray removal rates have been calculated for specified LocaDose code time periods. The resultant average aerosol spray removal rates are shown in Table 4.5-4.

TIME PERIOD (hours)	AEROSOL 10th PERCENTILE SPRAY REMOVAL RATE (1/hour)
0 to 1.8	5.15
1.8 to 2	3.79
2 to 3.8	1.32
3.8 to 4	0.79
4 to 8	0.62
8 to 13.8	0.52
13.8 to 24	0.50
24 to 48	0.50
48 to 96	0.50
96 to 720	0.50

ABLE 4.5-4:	AEROSOL SPRAY	<b>REMOVAL RATES</b>
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#### Section 4.5.1.3.4 Containment Spray Removal of Elemental Iodine

Consistent with RG 1.183 Appendix A Section 3.3, reduction in containment airborne elemental iodine radioactivity by the CSS is credited in the SONGS Units 2 and 3 AST dose analyses. The SONGS spray removal analysis uses a model provided in NUREG-0800 SRP Section 6.5.2, "Containment Spray as a Fission Product Cleanup System" that is based on NUREG/CR-0009, "Technological Elases for Models of Spray Washout of Airborne Contaminants in Containment Vessels".

Elemental iodine removal rates by sprays are calculated using the Bechtel REMOVE code, which incorporates the models of SRP 6.5.2 and NUREG/CR-0009. The removal rates are calculated as a function of time. Spray removal rates are calculated for each spray header and each ring individually, and then added together to determine an overall elemental iodine spray removal rate.

Input to the Bechtel REMOVE code includes the CSS characteristics as described in Section 4.5.1.3.3. As in the aerosol spray removal analysis, the SONGS elemental iodine spray removal analysis conservatively assumes that only one of the two containment spray system headers is in operation, and it is operating at 1,600 gpm throughout the CSS injection and recirculation phases.

A spectrum of drop sizes produced by the containment spray system nozzle is used in the REMOVE code model to determine a spray removal rate constant. The SONGS containment spray system is designed with SPRACO 1713A nozzles. The drop size distribution for this nozzle is built into the Bechtel REMOVE code.

The elemental icdine spray removal rates are dependent on the temperature of the air-steam mixture in the containment. A parametric study was performed to determine the appropriate temperatures to model that will result in conservative removal rate estimates. The study temperatures ranged from the minimum containment air lemperature of 89.9 degrees Fahrenheit (32.2 C) to the maximum containment air temperature of 267.4 degrees Fahrenheit (130.8 C). as determined in the containment pressure/temperature response analysis for the LOCA. The elemental iodine removal rate was found to increase with temperature until about 100 C, and then decrease with further increasing temperature. Within the studied temperature range, the maximum removal rate is 5.314 inverse hours, and the minimum removal rate is 4.569 inverse hours, for a ratio of 1.2 between these extremes. Since the removal rates determined in the spray removal calculation are dependent on a post-LOCA environment that may be revised due to changes in the reactor system or steam generator characteristics, the resultant removal rates calculated with the Bechtel REMOVE code for modeling in the AST containment leakage dose analysis have been conservatively reduced by a factor of 1.2.

The elemental iodine spray removal rates are calculated as a function of time for two phases, the CSS injection phase and the CSS recirculation phase. Input to the Bechtel REMOVE code includes the partition coefficient of iodine between the water and air.

The CSS injection phase begins with initiation of spray and lasts from a minimum of approximately 20 minutes (with two CSS trains in operation) to a maximum of approximately 40 minutes (with one CSS train in operation). During the injection phase, borated vater from the RWST is used in the spray system. Consistent with NUREG/CR-0009 page 61, a partition coefficient (i.e., liquid concentration divided by gas concentration) of 200 for boric acid solutions is modeled.

The CSS recirculation phase begins at the end of the CSS injection phase. During the recirculation phase the spray system draws water from the containment sump. The partition coefficients of iodine between the water and air during the recirculation phase are calculated with the Bechtel ICONC code, using the methodology developed by L.P. Parsly in ORNL-TM-2412 Part IV. Key input parameters for this methodology include the containment sump water temperature and pH, the volumes of the gaseous and liquid phases, the initial iodine inventory in the containment sump water, and the elemental iodine equilibrium constants K1 and K3.

The partition coefficient increases with increasing containment sump water temperature. The containment sump water temperature varies with time during the CSS recirculation phase. Therefore, for each time interval of interest, the minimum contairment sump water temperature for that time interval has been conservatively modeled.

The partition coefficient increases with increasing containment sump pH. Therefore, the minimum containment sump pH level of 7 has been conservatively modeled. SONGS Units 2 and 3 TS LCO 3.5.5 provides for periodic surveillances of the ECCS Trisodium Phosphate (TSP) Dodecahydrate to ensure compliance with the Standard Review Plan 6.5.2 requirement of a pH of at least seven by the onset of recirculation after a LOCA. The required amount of TSP has been calculated based upon the extreme cases of water volume and pH possible in the containment sump. Combustion Engineering Owners Group (CEOG) Task 1178 evaluated the effect of non-traditional acid formers on postaccident containment sump pH for CEOG plants, including SONGS. The evaluation showed that for worst-case conditions, the inclusion of additional acid formers resulted in a slightly lower containment sump pH (approximately 6.9) at the end of 30 days. The evaluation concluded that this pH will continue to ensure that radioiodines remain in the sump solution and are not re-evolved to the containment atmosphere.

The volume of the gaseous phase is the containment free air volume of 2.284E+06 ft<sup>3</sup>. The volume of the liquid phase is 46,647 ft<sup>3</sup>, representing the minimum containment emergency sump volume available at the start of the

post-LOCA CSS and Safety Injection System (SIS) recirculation mode of operation. The minimum sump volume is appropriate for this calculation since larger liquid volumes will retain more iodine thus increasing the partition coefficient.

The initial iodine inventory in the containment sump water is 2.03 moles, based on the elemental iodine available for release during the gap and the early invessel phases.

The elemental iodine equilibrium constants K1 and K3 are obtained from Tables 1 and 2 of ORNL-TM-2412 Part IV.

Unique elemental iodine spray removal rates were calculated for each spray ring in each of the two CSS spray headers. The calculations address the fact that each spray ring is located at a different height with its own unique spray flux due to different coverage areas and number of spray nozzles per spray ring. The elemental iodine spray removal rates for each ring in a spray header were then summed together, and the lowest header value at each time interval was determined.

The resultant elemental iodine spray removal rates and decontamination factors are presented in Table 4.5-5. The tabulated removal rates include the previously discussed reduction factor of 1.2.

Per Standard Review Plan 6.5.2 Section III.4.c.(1), the elemental spray removal rate is limited to a maximum value of 20 inverse hours. The elemental iodine spray removal analysis predicts CSS recirculation phase elemental iodine removal rates in excess of 20 inverse hours during the first 4 hours of the LOCA. Table 4.5-5 reflects this SRP 6.5.2 limitation.

TIME PERIOD (hours)	ELEMENTAL IODINE SPRAY REMOVAL RATE (1/hour)	ELEMENTAL IODINE DECON. FACTOR (unitless)	
Prior to start of CSS injection phase	0.00	N/A	
Duration of CSS injection phase	1.02	110	
Start of CSS recirculation phase to 2 hours	20.00	170	
2 to 4	20.00	160	
4 to 8	18.86	140	
8 to 13.8	16.01	110	
13.8 tc 24	12.99	84	
24 to 48	10.09	64	
48 to 96	7.83	48	
96 to 720	3.78	25	

#### TABLE 4.5-5: ELEMENTAL IODINE SPRAY REMOVAL RATES

### Section 4.5.1.3.5 Combined Natural Deposition Plus Containment Spray Removal Rates

The preceding sections present the natural deposition and containment spray removal rates. In this section the individual removal rates are combined into total containment removal rates for use in Bechtel LocaDose code dose assessment calculations. Individual removal rates as a function of time for four groups are determined: elemental iodines, particulate iodines including other halogens, alkali metals, and all other particulates.

The total removal rate is calculated by combining the individual removal rates from the following sources:

- 1. The aerosol natural deposition rates per Section 4.5.1.3.1
- 2. The elemental iodine natural deposition rate per Section 4.5.1.3.2
- 3. The aerosol spray removal rates per Section 4.5.1.3.3
- 4. The elemental iodine spray removal rates per Section 4.5.1.3.4

Removal rates are determined for the sprayed and the unsprayed containment regions. In the sprayed containment region the total removal rate consists of a combination of natural deposition and spray removal. In the unsprayed containment region the total removal rate consists only of the natural deposition rates. The resultant total containment removal rates are shown in Tables 4.5-6 and 4.5-7.

Aerosol natural deposition removal is assumed to begin coincident with the start of the gap release phase at 30 seconds.

CSS injection phase aerosol and elemental iodine removal are assumed to begin with the onset of full flow containment spray, which is conservatively modeled as beginning one minute after the start of the LOCA.

The CSS recirculation phase is entered when the ESF recirculation system begins operation. The ESF recirculation system circulates containment sump liquid via the High Pressure Safety Injection (HPSI), Low Pressure Safety Injection (LPSI), and CSS pumps following a Recirculation Actuation Signal (RAS). This analysis assumes only one train of CSS is in operation, and that the onset of CSS recirculation mode of operation is thereby delayed until 42 minutes after the start of the LOCA. This assumption is conservative since the CSS injection phase spray removal rates for elemental iodine are much lower than the removal rates during CSS recirculation phase. Therefore, a longer CSS injection phase results in slower removal of elemental iodines from the containment atmosphere.

The containment spray is assumed to operate for four hours after the onset of the LOCA. This ensures that a significant portion of the aerosol and elemental iodine

releases are removed from the containment atmosphere. Since there is no Decontamination Factor (DF) cut-off for spray removal of aerosols, limiting the spray operation to a maximum of four hours results in conservative estimates of the airborne activity in the containment. The elemental iodine DF cutoff values are reached prior to four hours.

After four hours, the sprayed region is modeled with the unsprayed region natural deposition removal rates.

TIME PERIOD	ELEMENTAL IODINE REMOVAL RATE (1/hour)	ELEMENTAL IODINE DECON. FACTOR (unitless)	PARTICULATE IODINE AND HALOGENS REMOVAL RATE (1/hour)	ALKALI METALS REMOVAL RATE (1/hour)	OTHER PARTICULATES REMOVAL RATE (1/hour)
0 to 0.5 minutes	0	N/A	0	0	0
0.5 to 1 minute	4.26	110	0.0294	0.0294	0
1 to 5 minutes	5.28	110	5.18	5.18	5.15
5 to 20 minutes	5.28	110	5.18	5.18	5.15
20 to 30 minutes	5.28	110	5.18	5.18	5.15
30 to 42 minutes	5.28	110	5.19	5.19	5.18
42 minutes to 1 hour	24.26	170	5.19	5.19	5.18
1 to 1.8 hours	24.26	170	5.19	5.19	5.18
1.8 to 2 hours	24.26	170	3.88	3.88	3.88
2 to 3.8 hours	24.26	160	1.41	1.41	1.41
3.8 to 4 hours	24.26	160	0.91	0.91	0.91
4 to 8 hours	4.26	140	0.116	0.116	0.116
8 to 13.8 hours	4.26	110	0.116	0.116	0.116
13.8 to 22.2 hours	4.26	84	0.086	0.086	0.086
22.2 to 24 hours	4.26	84	0	0	0
1 to 2 days	4.26	64	0	0	0
2 to 4 days	4.26	48	0	0	0
4 to 30 days	4.26	25	0	0	0

TABLE 4.5-6: (	CONTAINMENT S	SPRAYED	<b>REGION F</b>	REMOVAL	RATES
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TIME PERIOD	ELEMENTAL IODINE REMOVAL RATE (1/hour)	ELEMENTAL IODINE DECCN. FACTOR (unitless)	PARTICULATE IODINE AND HALOGENS REMOVAL RATE (1/hour)	ALKALI METALS REMOVAL RATE (1/hour)	OTHER PARTICULATES REMOVAL RATE (1/hour)
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0 to 0.5 minutes	0	N/A	0	0	0
0.5 to 1 minute	4.26	110	0.0294	0.0294	0
1 to 5 minutes	4.26	110	0.0294	0.0294	0
5 to 20 minutes	4.26	110	0.0294	0.0294	0
20 to 30 minutes	4.26	110	0.0294	0.0294	0
30 to 42 minutes	4.26	110	0.0395	0.0417	0.0312
42 minutes to 1 hour	4.26	170	0.0395	0.0417	0.0312
1 to 1.8 hours	4.26	170	0.0395	0.0417	0.0312
1.8 to 2 hours	4.26	170	0.0893	0.0893	0.0893
2 to 3.8 hours	4.26	160	0.0893	0.0893	0.0893
3.8 to 4 hours	4.26	160	0.116	0.116	0.116
4 to 8 hours	4.26	140	0.116	0.116	0.116
8 to 13.8 hours	4.26	110	0.116	0.116	0.116
13.8 to 22.2 hours	4.26	84	0.086	0.086	0.086
22.2 to 24 hours	4.26	84	0	0	0
1 to 2 days	4.26	64	0	0	0
2 to 4 days	4.26	48	0	0	0
4 to 30 days	4.26	25	0	0	0

#### TABLE 4.5-7: CONTAINMENT UNSPRAYED REGION REMOVAL RATES

## Section 4.5.2 ESF Recirculation Loop Leakage

The ESF recirculation loop circulates containment sump water outside of the containment via the SIS and CSS purps following receipt of a RAS. Per RG 1.183 Appendix A Section 5, ESF systems that recirculate sump water outside of the primary containment are assumed to leak during their intended operation. This release includes leakage through valve packing glands, pump shaft seals, flanged connections, and other similar components.

Regulatory Guide 1.183 Appendix A provides assumptions for use in evaluating the radiological consequences of the ESF recirculation loop leakage pathway for a LOCA. These assumptions supplement the guidance provided in the main body of RG 1.183.

This Section presents the assumptions, design input, and methodology employed in evaluating the radiological consequences of SONGS Units 2 and 3 LOCA ESF recirculation loop leakage path. The characteristics of the LOCA ESF recirculation loop leakage model are summarized in Table 4.5-8. The control room and offsite doses associated with ESF leakage are summarized in Section 4.5.7.

## TABLE 4.5-8: LOCA ESF RECIRCULATION LOOP LEAKAGE ANALYSIS PARAMETERS

LOCA ESF RECIRCULATION LOOP LEAKAGE PARAMETER	MODELED VALUE
Timing of core activity release into containment sump	
Gap release phase	instantaneous at time zero
Early in-vessel phase	instantaneous at time zero
Core inventory fraction released into containment sump	
Noble gases (Xe, Kr)	0
Halogens (I, Br)	0.40
Alkali metals (Cs, Rb)	0.30
Tellurium metals (Te, Sb, Se)	0.05
Barium, Strontiurn (Ba, Sr)	0.02
Noble metals (Ru, Rh, Pd, Mo, Tc, Co)	0.0025
Cerium group (Ce, Pu, Np)	0.0005
Lanthanides (La, Zr, Nd, Eu, Nb, Pm, Pr, Sm, Y, Cm, Am)	0.0002
ESF recirculation loop dilution volume, cubic feet	46,647
ESF recirculation loop leakage rate to the environment, ft <sup>3</sup> /minute	
0 to 20 minutes	0
20 minutes to 30 days	7.00E-03
ESF recirculation loop leakage flashing fractions and partition coefficients	
lodine isotopes flashing fraction, percent	10
Noble gases (Xe, Kr) partition coefficient	1.0E-06
Particulate isotopes partition coefficient	1E+06
Chemical form of lodine released to environment, percent of iodine	
Cesium iodide (CsI) (particulate iodine)	0
Elemental iodine	97
Organic iodide	3
ESF Leakage release point (Main Plant Vent) to Control Room Atmospheric Dispersion Factors, seconds/m <sup>3</sup>	per Section 4.4

# Section 4.5.2.1 ESF Leakage Source Term

Regulatory Guide 1.183 Appendix A Section 1 states that acceptable assumptions regarding core inventory and the release of radionuclides from the fuel are provided in RG 1.183 Regulatory Position 3.

Consistent with RG 1.183 Regulatory Position 3.4, the core isotopes released into the containment are grouped into chemically similar groups in accordance with RG 1.183 Table 5. The elements of each group are as listed in Table 4.5-8. Consistent with RG 1.183 Regulatory Position 3.2, the core inventory release

fractions are app'ied to the equilibrium reactor core isotope inventory at shutdown as described in Section 4.1.

Consistent with FIG 1.183 Appendix A Section 5.1, all fission products, with the exception of noble gases, released from the fuel to the containment during the gap and early in-vessel activity release phases are assumed to instantaneously and homogeneously mix in the primary containment sump coincident with the start of the LOCA. The dose analysis conservatively assumes that all fission product activity is released to the containment sump prior to the start of ESF recirculation operation at 20 minutes, which is sooner than the conclusion of the in-vessel activity release phase at 1.8 hours.

The AST ESF leakage dose analysis assumes that the ESF recirculation loop dilutes the core activity release into a volume of 348,946 gallons (46,647 cubic feet). This volume represents the minimum containment emergency sump volume available at the start of the post-LOCA SIS and CSS recirculation mode of operation. The modeling of the minimum sump volume conservatively maximizes the ESF recirculation loop activity concentration.

Consistent with Flegulatory Guide 1.183 Appendix A Section 2, with the exception of elemental and organic iodine and noble gases, fission products are assumed to be in particulate form (i.e., subject to HEPA filtration).

# Section 4.5.2.2 ESF Leakage Activity Release Model

Consistent with FIG 1.183 Appendix A Section 5.2, the ESF leakage is assumed to start at the earliest time the recirculation flow starts in the ESF recirculation system, and end at the latest time the releases from these systems are terminated. Per the containment pressure/temperature response analysis for the LOCA event, the CSS and SIS recirculation mode of operation begins as early as 20.2 minutes after the start of the LOCA for a two-train recirculation mode. This start time has been conservatively rounded down to 20 minutes after the start of the LOCA for use in the AST ESF leakage dose analysis. The ESF leakage is assumed to continue for the duration of the 30-day LOCA event.

The maximum expected leakage rates from all components in the recirculation systems are 1,770 cc/hr from the HPSI system, 3,000 cc/hr from the LPSI system, and 1,180 cc/hr from the CSS. Consistent with RG Guide 1.183 Appendix A, Section 5.2, the modeled ESF recirculation loop leakage rate of 11,900 cc/hr (7.00E-03 cfm) represents two times the sum of the simultaneous maximum expected leakage from these systems.

The ESF leakage AST dose analysis assumes that 10 percent of the iodine in the ESF Recirculation Loop leakage flashes to vapor and is therefore capable of migrating to the outside environment. The ten percent flashing fraction is consistent with the guidance of RG 1.183 Appendix A Section 5.5, which states

that if the water temperature is less than 212 Fahrenheit, then 10 percent of the iodine in the leakage is assumed to become airborne unless a smaller amount is justified based on actual sump pH history and ventilation rates. Per the containment pressure/temperature response analysis for the LOCA event, the temperature of the containment sump liquid has been reduced to below 212 Fahrenheit when the CSS and SIS recirculation mode of operation begins at 20 minutes.

Consistent with FiG 1.183 Appendix A, Section 5.6, the composition of iodine available for release to the environment is assumed to be 97% elemental iodine, 3% organic iodide, and 0% particulate iodine.

Consistent with FiG 1.183 Appendix A Section 5.3, all particulate isotopes in the recirculating liquid are retained in the liquid phase. Radioactive decay of some particulate isotopes in the recirculating liquid yields noble gas isotopes. In the dose program model, a particulate partition coefficient (i.e., liquid concentration divided by gas concentration) of 1.0E+06 is used in order to retain particulates within the recirculating liquid where noble gas daughters are then formed by decay.

Per RG 1.183 Appendix A Section 5.3, with the exception of iodine, all radioactive materials in the recirculating liquid are retained in the liquid phase. This guidance implies that a release of noble gases (krypton and/or xenon) via the ESF leakage need not be considered (most likely because noble gas isotopes present in the containment sump water would be released into the containment air prior to being recirculated). However, noble gas isotopes are formed by the decay of other isotopes that are present in the ESF recirculating liquid. Therefore, the ESF leakage AST dose analysis conservatively assumes that 100 percent of the noble gases in the ESF Recirculation Loop leakage will become airborne (i.e., a noble gases can migrate to the outside environment.

The activity released from the ESF leakage into the Penetration Areas and Safety Equipment Building is exhausted to the environment via the main plant vent, and transported by atmospheric dispersion to the control room HVAC intake and to the offsite EAB and LPZ dose receptors. Section 4.4 and its Table 4.4-11 present the San Onofre site-specific 95th percentile meteorology atmospheric dispersion factors used for the main plant vent to control room release pathway. No credit is taken for radioactive decay of the isotopes during this atmospheric dispersion transi: to the control room or offsite dose locations. Consistent with RG 1.183 Regulatory Positions 4.1.7 and 4.2.2, no correction is made for depletion of the effluent plume by deposition on the ground.

### Section 4.5.3 RWST Release

The ESF recirculation loop circulates containment sump water outside of the containment via the SIS and CSS pumps following receipt of a RAS. Per RG 1.183 Appendix A Section 5, ESF systems that recirculate sump water outside of the primary containment may leak through valves isolating interfacing systems, including the RWST.

Regulatory Guide 1.183 Appendix A provides assumptions for use in evaluating the radiological consequences of ESF leakage to the RWST and its subsequent release pathway to the environment. These assumptions supplement the guidance provided in the main body of RG 1.183.

This Section presents the assumptions, design input, and methodology employed in evaluating the radiological consequences of SONGS Units 2 and 3 LOCA RWST release path. The characteristics of the LOCA RWST release model are summarized in Table 4.5-9.

The control room and offsite doses associated with the RWST release are summarized in Section 4.5.7.

LOCA RWST RELEASE PARAMETER	MODELED VALUE
Timing of core activity release into containment sump	
Gap release phase	instantaneous at time zero
Early in-vessel phase	instantaneous at time zero
Core inventory fraction released into containment sump	
Noble gases (Xe, Kr)	0
Halogens (I, Br)	0.40
Alkali metals (Cs, Rb)	0.30
Tellurium metals (Te, Sb, Se)	0.05
Barium, Strontium (Ba, Sr)	0.02
Noble metals (Ru, Rh, Pd, Mo, Tc, Co)	0.0025
Cerium group (Ce, Pu, Np)	0.0005
Lanthanides (La, Zr, Nd, Eu, Nb, Pm, Pr, Sm, Y, Cm, Am)	0.0002
ESF recirculation loop dilution volume, cubic feet	46,647
RWST dilution volumes, cubic feet per tank	
RWST air region volume	35,880
RWST water region volume	7,345

## TABLE 4.5-9: LOCA RWST RELEASE ANALYSIS PARAMETERS

L'OCA RWST RELEASE PARAMETER	MODELED VALUE
RWST inflow due to ESF pump mini-flow isolation valve leakage	
Mini-flow valve leakage flashing fraction, percent	10
Mini-flow valve leakage rates, cfm	
Total mini-flow leakage rate to the RWST	
0 to 20 minutes	0
20 minutes to 30 days	0.4010
Mini-flow valve reakage rate to the RWST water region	
0 to 20 minutes	0
20 minutes to 30 days	0.3609
Mini-flow valve eakage rate to the RWST air region	
0 to 20 minutes	0
20 minutes to 30 days	0.0401
RWST water region inflow due to RWST discharge check valve leakage, cfm	
0 to 1.08 hours	0
1.08 to 2 hours	1.2859
2 to 8 hours	1.2778
8 to 24 hours	0.9622
24 to 96 hours	0.5103
96 to 119.72 hours	0.1078
119.72 to 720 hours	0
Partition coefficients between ESF recirculation loop and RWST air region	
lodine	1.0
Particulates	1E+06
Mixing and partition coefficients between RWST air and water regions	
Mixing rate between RWST air and water regions, cfm	0.4010
Iodine partition coefficient	200
Noble gases (Xe, Kr) partition coefficient	1E-06
Particulates partition coefficient	1E+06
RWST air region release rate to the environment, cfm	
0 to 20 minutes	0
20 minutes to 1.08 hours	0.4010
1.08 to 2 hours	1.6869
2 to 8 hours	1.6788
8 to 24 hours	1.3632
24 to 96 hours	0.9113
96 to 119.72 hours	0.5088
119.72 to 720 hours	0.4010
Chemical form of lodine released to environment, percent of iodine	
Cesium iodide (CsI) (particulate iodine)	0
Elemental iodine	97
Organic iodide	3
RWST release via FIWST vent to Control Room Atmospheric Dispersion Factors, seconds/m <sup>3</sup>	per Section 4.4

# Section 4.5.3.1 RWST Release Source Term

The RWST release source term is the same as the ESF leakage source term described in Section 4.5.2.1.

ESF back-leakage into the RWST occurs after the RWST water level has drained down, and a RAS has been generated. In evaluating the post-LOCA RWST release AST dose consequences, the most conservative scenario for leakage out of the RWST is when the RWST air volume is minimized (and the water volume is maximized). Minimizing the air volume will minimize dilution of the activity entering the RWST air space prior to its release to the atmosphere.

The RWST level setpoint for a RAS is  $18.5\% \pm 3.8\%$ . The minimum RWST air volume occurs when RAS is quickly initiated at the 22.3% upper tolerance of the RWST level setpoint. At this setpoint, the RWST minimum air volume is 35,880 cubic feet, and the RWST maximum water volume is 7,345 cubic feet.

# Section 4.5.3.2 RWST Activity Release Model

During the ESF recirculation operation, ESF leakage may enter the RWST via various pathways. The pathways are dependent on whether the LOCA occurs with or without an assumed Diesel Generator (DG) failure. Due to the time dependency associated with the pathway leakage rates, the Current Licensing Basis reports the maximum 0 to 2 hour EAB dose for the scenario of the post-LOCA RWST release with an assumed DG failure, and the maximum event duration control room and LPZ doses for the scenario of the post-LOCA RWST release dose analysis evaluated the two leakage scenarios and determined that the variable 2-hour window EAB dose and the event duration control room and LPZ doses are more severe for the scenario of the post-LOCA RWST release without an assumed DG failure. The characteristics of the RWST release without an assumed DG failure. The characteristics of the RWST release without an assumed DG failure. The characteristics of the RWST release without an assumed DG failure are detailed in this section.

Two ESF leakage pathways to the RWST characterize the scenario of a RWST release without an assumed DG failure. The first pathway is RWST air region inflow due to ESI<sup>-</sup> pump minimum flow (mini-flow) isolation valve leakage. The second pathway is RWST water region inflow due to RWST discharge check valve leakage. ESF leakage to the RWST for potential release paths with three or more normally closed isolation valves in series is assumed to be negligible.

# Section 4.5.3.2.1 RWST Inflow Due to ESF Pump Mini-Flow Isolation Valve Leakage

The SIS and CSS pumps minimum flow return paths to the RWST are isolated following a RAS by two sets of 4-inch mini-flow isolation valves. Valves

1204-HV-9306 and 9307 are in series in one flow path, and valves 1204-HV-9347 and 9348 are in series in a second flow path. The maximum allowable leakage rate for each of the valves is 0.75 gpm. Consequently, for either path with its two valves in series, the maximum allowable path leakage rate is assumed to be 0.75 gpm. For the scenario of a LOCA without an assumed DG failure, the total leakage rate past the valves in the two parallel flow paths is 1.5 gpm. Consistent with RG 1.183 Appendix A, Section 5.2, the modeled ESF recirculation loop leakage rate of 3.0 gpm (0.4010 cfm) represents two times the sum of the simultaneous maximum allowable leakage from these systems. The 0.4010 cfm leakage past the mini-flow isolation valves is released into the RWST air space.

Consistent with RG 1.183 Appendix A Section 5.2, ESF leakage to the RWST is assumed to start at the earliest time the recirculation flow starts in the ESF recirculation system, and end at the latest time the releases from these systems are terminated. F'er the containment pressure/temperature response analysis for the LOCA event, the CSS and SIS recirculation mode of operation begins as early as 20.2 minutes after the start of the LOCA for a two-train recirculation mode. This start time has been conservatively rounded down to 20 minutes after the start of the LOCA for use in the AST RWST release dose analysis. The ESF leakage and coincident RWST release to the environment are assumed to continue for the duration of the 30-day LOCA event.

The RWST release AST dose analysis assumes that 10 percent of the iodine in the ESF Recirculation Loop leakage into the RWST air space flashes to vapor. The ten percent flashing fraction is consistent with the guidance of RG 1.183 Appendix A Section 5.5, which states that if the water temperature is less than 212 Fahrenheit, then 10 percent of the iodine in the leakage is assumed to become airborne unless a smaller amount is justified based on actual sump pH history and ventilation rates. Per the containment pressure/temperature response analysis for the LOCA event, the temperature of the containment sump liquid has been reduced to below 212 Fahrenheit when the CSS and SIS recirculation mode of operation begins at 20 minutes.

To address the 10 percent ESF leakage flashing, 10 percent of the ESF pump mini-flow leakage is modeled as entering the RWST air region, and 90 percent of the ESF pump mini-flow leakage is modeled as entering the RWST water region.

# Section 4.5.3.2.2 RWST Inflow Due to RWST Discharge Check Valve Leakage

Following a RAS, each of the two RWSTs is isolated from the ESF recirculation loop by an RWST isolation valve located near the RWST. In the event that the isolation valve fails to close following a RAS, an RWST discharge check valve (1204-MU-001 or 1204-MU-002) is the only barrier between the containment and the RWST. The maximum allowable leakage rate through both check valves is 5 gpm. Consistent with FiG 1.183 Appendix A, Section 5.2, the modeled ESF recirculation loop leakage rate of 10 gpm represents two times the maximum allowable leakage. The leakage past the check valves is released into the RWST water space.

Should the check valve leak, a certain amount of containment sump water will enter the line and start moving toward the RWST. The flow rate is simply the leak rate of the check valve, but the speed at which the hot water from the sump moves toward the RWST depends on the pressure differential between the post-LOCA containment and the RWST and on the temperature difference between the cold RWST water and the hot containment sump water.

A valve seat leak analysis has determined that with the RWST isolation valve open and the check valve leaking at 10 gpm, the sump water will reach the RWST isolation valve and enter the RWST in approximately 1.08 hours after the start of the LOCA. Neglecting the effect of thermal buoyancy (i.e., assuming instant cooling of the leaking sump water to the RWST temperature) would extend the travel time to approximately 8.7 hours.

As the LOCA event progresses, the containment pressure decreases, and the leakage rate past the check valve decreases. Table 4.5-9 summarizes the time-dependent RWST water region inflow due to RWST discharge check valve leakage. The RWST water region inflow due to RWST discharge check valve leakage is maximized by modeling the post-LOCA containment pressure and temperature history that yields the highest containment pressure. Eventually, the driving force for the check valve leakage ends.

### Section 4.5.3.2.3 Mixing of RWST Water and Air Activity Inventories

Because the iodine concentrations in the RWST air space and water space are not at their equilibrium values at the onset of ESF recirculation loop leakage, the mixing rate between the RWST water and air regions will impact the dose consequences.

At equilibrium conditions, the ratio of the iodine concentration in the RWST water space to the iodine concentration in the RWST air space is defined by an iodine partition coefficient (i.e., liquid concentration divided by gas concentration). Per NUREG/CR-0009, the partition coefficient is numerically determined by the physical sorption of  $I_2$  and by rapid ionization reactions that occur in solution. Per NUREG/CR-0009 page 61, for borated solutions (such as the RWST) a partition coefficient of 200 is achievable. Therefore, a partition coefficient of 200 can be used to establish the equilibrium between the iodine concentrations in the RWST air and water spaces.

As RWST water and air region mixing occurs, the ratio of the iodine concentration in the RWST water space to the iodine concentration in the RWST air space tends to a partition coefficient of 200. Mixing is facilitated by the turbulence added to the RWST water by the RWST discharge check valve leakage into the RWST water space, by the turbulence added to the RWST water by the mini-flow valve leakage into the RWST air space that drops down into the RWST water, and by the thermal gradients associated with the RWST water warmed by the introduction of the hot ESF leakage fluid relative to colder RWST air. Per NUREG/CR-0009 page 64, very small thermal sources are sufficient to mix a large vessel.

The higher the mixing rate between the air space and water space, the more rapid the approach to equilibrium. Initially the RWST air activity concentration is greater than when at equilibrium conditions. Minimizing the mixing rate delays the transfer of iodine activity from the RWST air region to the RWST water region, thereby conservatively maximizing the RWST air activity available for leakage to the environment. In the RWST leakage AST analysis, the mixing rate between the RWST air and water spaces is conservatively modeled as the mini-flow valve leakage rate into the RWST. No credit is taken for RWST air and water space mixing associated with the RWST inflow due to RWST discharge check valve leakage. No credit is taken for mixing by thermal gradients.

Consistent with RG 1.183 Appendix A Section 5.3, all particulate isotopes in the recirculating liquid are retained in the liquid phase. Radioactive decay of some particulate isotopes in the RWST liquid space yields noble gas isotopes. A particulate partition coefficient (i.e., liquid concentration divided by gas concentration) of 1.0E+06 is used in order to retain particulates within the RWST liquid space where noble gas daughters are then formed by decay.

Per RG 1.183 Appendix A Section 5.3, with the exception of iodine, all radioactive materials in the recirculating liquid are retained in the liquid phase. This guidance implies that a release of noble gases (krypton and/or xenon) via the RWST release need not be considered (most likely because noble gas isotopes present in the containment sump water would be released into the containment air prior to being recirculated). However, noble gas isotopes are formed by the decay of other isotopes that are present in the RWST liquid. Therefore, the RWST release AST dose analysis conservatively assumes that 100 percent of the noble gases formed by the decay of the isotopes in the RWST liquid will become airborne (i.e., a noble gas partition coefficient of 1.0E-06). Once airborne, the noble gases can migrate to the outside environment.

### Section 4.5.3.2.4 RWST Releases to the Environment

Consistent with RG 1.183 Appendix A, Section 5.6, the composition of iodine available for release to the environment from the RWST air space is assumed to be 97% elemental iodine, 3% organic iodide, and 0% particulate iodine.

The activity released from the RWST is exhausted to the environment via the RWST vent, and transported by atmospheric dispersion to the control room HVAC intake and to the offsite EAB and LPZ dose receptors. Section 4.4 and its Table 4.4-11 present the San Onofre site-specific 95th percentile meteorology atmospheric dispersion factors used for the RWST vent to control room release pathway. No credit is taken for radioactive decay of the isotopes during this atmospheric dispersion transit to the control room or offsite dose locations. Consistent with IRG 1.183 Regulatory Positions 4.1.7 and 4.2.2, no correction is made for depletion of the effluent plume by deposition on the ground.

## Section 4.5.4 Post-Accident Sampling System (PASS) Leakage

PASS licensing requirements were deleted from the SONGS Units 2 and 3 Technical Specifications per Unit 2 License Amendment 178 and Unit 3 License Amendment 169. Currently, the PASS is maintained at SONGS Units 2 and 3 for severe accident management only. The PASS is capable of analyzing samples of containment air, containment sump water, and reactor coolant.

Until such time that the PASS is isolated from post-LOCA radiation sources, portions of the PASS that are outside of the containment present the potential for a release path due to leakage through valve packing glands, pump shaft seals, flanged connections, and other similar components. Should a design modification be implemented to isolate PASS and thereby eliminate the potential release paths, the dose contribution from PASS leakage will be removed from the LOCA dose analysis.

Although RG 1.183 Appendix A does not provide a specific requirement to evaluate PASS leakage, the SONGS Units 2 and 3 AST dose analysis has applied related RG 1.183 Appendix A ESF leakage guidance to an evaluation of the radiological consequences of the PASS leakage activity release path for a LOCA.

This Section presents the assumptions, design input, and methodology employed in evaluating the radiological consequences of SONGS Units 2 and 3 LOCA PASS leakage path. The characteristics of the LOCA PASS leakage model are summarized in Table 4.5-10.

The control room and offsite doses associated with PASS leakage are summarized in Section 4.5.7.

LIDCA PASS LEAKAGE PARAMETER	MODELED VALUE
Timing of core activity release into reactor coolant system	
Gap release phase	instantaneous at time zero
Early in-vessel phase	instantaneous at time zero
Core inventory fraction released into reactor coolant system	
Noble gases (Xe, Kr)	1.00
Halogens (I, Br)	0.40
Alkali metals (Cs, Rb)	0.30
Tellurium metals (Te, Sb, Se)	0.05
Barium, Strontium (Ba, Sr)	0.02
Noble metals (Ru, Rh, Pd, Mo, Tc, Co)	0.0025
Cerium group (Ce, Pu, Np)	0.0005
Lanthanides (La, Zr, Nd, Eu, Nb, Pm, Pr, Sm, Y, Cm, Am)	0.0002
Reactor coolant system dilution volume, cubic feet	10,179
PASS leakage rate to the environment, ft <sup>3</sup> /minute	
0 to 30 minutes	0
30 minutes to 30 days	4.12E-04
PASS leakage partition coefficients and flashing fractions	
Iodine isotopes flashing fraction, percent	10
Noble gases (Xe, Kr) partition coefficient	1.0E-06
Particulate isotopes partition coefficient	1E+06
Chemical form of lodine released to environment, percent of iodine	
Cesium iodide (CsI) (particulate iodine)	0
Elemental iodine	97
Organic iodicle	3
PASS Leakage release point (Main Plant Vent) to Control Room Atmospheric Dispersion Factors, seconds/m <sup>3</sup>	Per Section 4.4

## TABLE 4.5-10: LOCA PASS LEAKAGE ANALYSIS PARAMETERS

### Section 4.5.4.1 PASS Leakage Source Term

The PASS samples containment sump liquid, reactor coolant, and containment air. The PASS leakage AST dose analysis assumes that reactor coolant is the PASS fluid leaking during the LOCA. Reactor coolant has been modeled since the reactor coolant iodine activity concentration is greater than the containment sump liquid or containment air iodine activity concentration.

Regulatory Guide 1.183 Appendix A Section 1 states that acceptable assumptions regarding core inventory and the release of radionuclides from the fuel are provided in RG 1.183 Regulatory Position 3.

Consistent with RG 1.183 Regulatory Position 3.4, the core isotopes released into the reactor coolant are grouped into chemically similar groups in accordance with RG 1.183 Table 5. The elements of each group are as listed in

Table 4.5-10. Consistent with RG 1.183 Regulatory Position 3.1, the core inventory release fractions are applied to the equilibrium reactor core isotope inventory at shutdown as described in Section 4.1.

All fission products released from the fuel to the reactor coolant are assumed to instantaneously and homogeneously mix in the reactor coolant coincident with the start of the LOCA.

The AST PASS leakage dose analysis assumes that the reactor coolant dilutes the core activity release into a volume of 10,179 cubic feet. This volume has conservatively ornitted the primary side volume that is present in an assumed 2,000 plugged U-tubes in each of the two original steam generators.

Consistent with Flegulatory Guide 1.183 Appendix A Section 2, with the exception of elemental and organic iodine and noble gases, fission products are assumed to be in particulate form (i.e., subject to HEPA filtration).

# Section 4.5.4.2 PASS Leakage Activity Release Model

Consistent with FIG 1.183 Appendix A Section 5.2, the PASS leakage is assumed to start at the earliest time that PASS sampling could start, and end at the latest time the releases from the PASS are terminated. Although the PASS is currently maintained for severe accident management only, this analysis assumes the PASS leakage begins 30 minutes after the start of the LOCA. Chemistry Procedures address the steps associated with collecting a post-LOCA reactor coolant sample. One procedure requires the Nuclear Chemistry Technician to obtain permission from the affected unit Control Operator to operate the PASS. A second procedure addresses steps that must be taken prior to operation of the PASS during accident conditions. These steps include requesting that Health Physics survey the PASS laboratory, assembling the Chemistry sampling team, and implementing health physics requirements. These actions should require more than the 30 minute delay assumed prior to PASS operation. The PASS leakage is assumed to continue for the duration of the 30-day LOCA event.

The maximum expected leakage rate from all components in the PASS is 350 cc/hr. Consistent with RG 1.183 Appendix A, Section 5.2, the modeled PASS leakage rate of 700 cc/hr (4.12E-04 cfm) represents two times the maximum expected leakage from the PASS.

The PASS leakage AST dose analysis assumes that 10 percent of the iodine in the PASS leakage flashes to vapor and is therefore capable of migrating to the outside environment. The ten percent flashing fraction is consistent with the guidance of RG 1.183 Appendix A Section 5.5, which states that if the water temperature is less than 212 Fahrenheit, then 10 percent of the iodine in the leakage is assumed to become airborne. Per the PASS Technical Manual,

Sample Vessel Heat Exchanger SA1212ME752 is used to cool the reactor coolant sample flow from the maximum reactor coolant temperature to allow for low temperature (120 Fahrenheit) sample analysis. The bulk of the PASS reactor coolant leakage from PASS sample station fittings will be at a low temperature.

Consistent with FIG 1.183 Appendix A, Section 5.6, the composition of iodine available for release to the environment is assumed to be 97% elemental iodine, 3% organic iodide, and 0% particulate iodine.

Consistent with FIG 1.183 Appendix A Section 5.3, all particulate isotopes in the reactor coolant are retained in the liquid phase. Radioactive decay of some particulate isotopes in the reactor coolant yields noble gas isotopes. In the Bechtel LocaDose code model, a particulate partition coefficient (i.e., liquid concentration divided by gas concentration) of 1.0E+06 is used in order to retain particulates within the reactor coolant where noble gas daughters are then formed by decay.

The PASS leakage AST dose analysis conservatively assumes that 100 percent of the noble gases (krypton and/or xenon) either initially present or formed by the decay of the isotopes in the PASS reactor coolant leakage will become airborne (i.e., a noble gas partition coefficient of 1.0E-06) and migrate to the outside environment.

The activity released from the PASS leakage into the Radwaste Building is exhausted to the environment via the main plant vent, and transported by atmospheric dispersion to the control room HVAC intake and to the offsite EAB and LPZ dose receptors. Section 4.4 and its Table 4.4-11 present the San Onofre site-specific 95th percentile meteorology atmospheric dispersion factors used for the main plant vent to control room release pathway. No credit is taken for radioactive decay of the isotopes during this atmospheric dispersion transit to the control room or offsite dose locations. Consistent with RG 1.183 Regulatory Positions 4.1.7 and 4.2.2, no correction is made for depletion of the effluent plume by deposition on the ground.

### Section 4.5.5 LOCA EAB and LPZ Model

Regulatory Guide 1.183 Regulatory Position 4.1 provides guidance to be used in determining TEDIE for persons located at or beyond the boundary of the exclusion area, including the outer boundary of the low population zone. Section 4.2 addresses the applicability of this guidance to the SONGS Units 2 and 3 AST LOCA dose analysis as it relates to the offsite dose exposure parameters.

As discussed in Section 4.2, the LOCA dose analysis considers the dose consequences of inhalation and immersion. Radioactive material contained in a

plant structure is assumed to be a negligible radiation shine source to the offsite dose receptors relative to the dose associated with immersion in the radioactive plume released from the facility.

Consistent with RG 1.183 Regulatory Positions 4.1.5, 4.1.6 and 4.4 and Table 6, the LOCA event radiological criterion for the EAB and for the outer boundary of the LPZ is 25 Rem TEDE.

### Section 4.5.6 LOCA Control Room Model

Regulatory Guide 1.183 Regulatory Position 4.2 provides guidance to be used in determining the total effective dose equivalent for persons located in the control room. Section 4.3 addresses the applicability of this guidance to the SONGS Units 2 and 3 AST LOCA dose analysis as it relates to the control room dose exposure parameters.

The CREACUS Emergency mode of operation can be actuated either manually or automatically following a CRIS. The CRIS may be generated automatically by a SIAS or by the detection of high radioactivity concentrations in the control room outside air inflow. Per Section 4.3.2.1.1, the LOCA model credits CREACUS Emergency mode of operation initiation at time zero (i.e., prior to the arrival of any contaminated air reaching the control room outside air intakes) due to a SIAS-induced CRIS.

As discussed in Section 4.3, the LOCA dose analysis considers the dose consequences of inhalation, immersion, and radiation shine from the environmental (or outside) cloud, the control room emergency HVAC filters, the post-LOCA piping, and the containment building.

Consistent with RG 1.183 Regulatory Position 4.4, as an AST dose analysis acceptance criterion the postulated control room dose is evaluated to ensure that it does not exceed the 5 Rem TEDE criterion established in 10 CFR 50.67.

### Section 4.5.7 LOCA Dose Consequences

The resulting LOCA offsite and control room operator doses are listed in Tables 4.5-11 and 4.5-12. The analysis demonstrates that the LOCA event 25 Rem TEDE radiological criterion for the EAB and for the outer boundary of the LPZ is met. The analysis also demonstrates that the LOCA event 5 Rem TEDE radiological criterion for the control room is met.

DOSE RECEPTOR	CONTAINMENT LEAKAGE DOSE (REM TEDE)	ESF I.EAKAGE DOSE (FIEM TEDE)	RWST RELEASE DOSE (REM TEDE)	PASS LEAKAGE DOSE (REM TEDE)	PIPING SHINE DOSE (REM TEDE)
Control Room (30-day accident duration)					
Immersion and Inhalation	<del>7.341E-01</del> <u>7.505E-01</u>	4 <del>.697E-01</del> 4.791E-01	8.420E-01 8.732E-01	<del>1.461E-01</del> <u>1.490E-01</u>	-
Control Room Filter Shine	<del>1.469E-01</del> 1.527E-01	<del>7.55E-02</del> <u>7.701E-02</u>	<del>1.263E-01</del> <u>1.310E-01</u>	<del>2.02E-02</del> 2.060E-02	-
Environmental Cloud Shine	4 <del>.443E-02</del> <u>4.456E-02</u>	<del>3.44E-03</del> <u>3.509E-03</u>	<del>1.134E-03</del> <u>1.176E-03</u>	<del>3.31E-03</del> <u>3.376E-03</u>	-
Containment Building Shine	4 <del>.304E-04</del> <u>4.310E-04</u>	-	-	-	-
Piping Shine	- (	-	-	-	1.06E-01
TOTAL	<del>9.259E-01</del> 9.482E-01	5.487E-01 5.596E-01	<del>9.694E-01</del> <u>1.005E+00</u>	<del>1.696E-01</del> <u>1.730E-01</u>	1.06E-01
Exclusion Area Boundary (Maximum 2-hour dose)	3.548E+00 3.652E+00 (0.6 to 2.6 hrs)	3.398E-01 (0.4 to 2.4 hrs)	1.103E+00 (94 to 96 hrs)	1.370E-01 (0.5 to 2.5 hrs)	-
Low Population Zone (30-day accident duration)	2.309E-01 2.377E-01	2.381E-01	1.311E+00	6.897E-02	-

# TABLE 4.5-11: LOCA RELEASE PATH DOSE CONSEQUENCES

# TABLE 4.5-12: LOCA DOSE CONSEQUENCES

DOSE RECEPTOR	LOCA DOSE (REM TEDE)	ACCEPTANCE CRITERION (REM TEDE)
Control Room (30-day accident duration)	<u>2.7</u> <u>2.8</u>	5
EAB (Maximum 2-hour dose)	<del>5.1</del> <u>5.2</u>	25
LPZ (30-day accident duration)	<del>1.8</del> <u>1.9</u>	25

## Section 4.6 FUEL HANDLING ACCIDENT INSIDE CONTAINMENT (FHA-IC) ANALYSIS

Regulatory Guide 1.183 Appendix B provides assumptions for use in evaluating the radiological consequences of an FHA-IC. These assumptions supplement the guidance provided in the main body of RG 1.183.

This Section presents the assumptions, design input, methodology employed in evaluating, and the radiological consequences of, the SONGS Units 2 and 3 FHA-IC. The characteristics of the FHA-IC model are summarized in Table 4.6-1.

FHA-IC PARAMETER	
Dose acceptance criteria, Rem TEDE	
Control Room	5
EAB	6.3
LPZ	6.3
FHA-IC source term	-
Decay time after reactor shutdown, hours	72
Average fuel rod isotope inventory at 72 hours, curies/rod	per Section 4.1
Radial peaking factor applied to all failed fuel rods	1.75
Number of failed fuel rods - in dropped fuel bundle	16
Number of failed fuel rods - in impacted fuel bundles	210
Core fission product fractions in fuel rod gaps	
lodine-131	0.08
Krypton-85	0.10
Other noble gases (Krypton, Xenon)	0.05
Other Halogeris (Iodine, Bromine)	0.05
Alkali Metals (Cesium, Rubidium)	0.12
Fraction of gap activity released to the refueling water	1.00
Minimum water depth above reactor vessel flange (and above the damaged fuel rods) feet	23
Refueling water decontamination factors	20
Indines (effective DF)	200
Noble Gases	1
Particulates	Infinite
Iodine composition above the refueling water, percent of iodine	
Elemental iod ne	57
Organic iodide	43
	1

### TABLE 4.6-1: FHA-IC ANALYSIS PARAMETERS

FHA-IC PARAMETER	MODELED VALUE
Containment model	
Containment dome air circulators	not modeled
Engineered Sa <sup>*</sup> ety Features Actuation System (ESFAS) - containment purge isolation signal (CPIS)	not modeled
ESFAS – containment isolation actuation signal (CIAS)	not modeled
Containment personnel airlock closure	not modeled
Containment equipment hatch closure	not modeled
Activity release duration from containment, hours	2
Containment net free volume without dome, cubic feet	1.422E+06
Containment air exhaust flow rate, ft <sup>3</sup> /minute	82,000
Offsite dose evaluation model	per Section 4.2
Control Room dose evaluation model	per Section 4.3
FHA-IC Release Points to Control Room Atmospheric Dispersion Factors, seconds/m <sup>3</sup>	per Section 4.4

## Section 4.6.1 FHA-IC Source Term

The fuel handling accident inside containment involves the inadvertent dropping of a fuel assembly during fuel handling operations inside the reactor vessel, and the consequent rupture of fuel pins in both the dropped and impacted fuel assemblies. Consistent with RG 1.183 Appendix B Section 1.1, the number of fuel rods damaged during the accident is based on a conservative analysis that considers the most limiting case. UFSAR Section 15.10.7.3.9 details the structural evaluation of dropped fuel assembly damage. Per the UFSAR, a maximum of 226 fuel rods will fail as a result of a vertical drop of a fuel assembly on to the fuel bundles remaining in the partially loaded core. The 226 failed fuel rods represent 16 failed fuel rods in the dropped fuel assembly and 210 failed fuel rods in the impacted fuel assemblies.

Table 4.1-3 presents the fission product inventory of an average fuel rod in the reactor core. Consistent with the guidance of RG 1.183 Regulatory Position 3.1, to account for differences in power level across the core, a radial peaking factor of 1.75 is applied to the Table 4.1-3 average fuel rod isotope inventory to determine the activity inventory in each of the 226 failed fuel rods as described in Section 4.1.3. Consistent with RG 1.183 Regulatory Position 3.1, the FHA-IC dose analysis models 72 hours of radioactive decay prior to the event, which is consistent with the minimum decay time required by SONGS Units 2 and 3 LCS 3.9.101 prior to movement of irradiated fuel in the reactor vessel.

Consistent with RG 1.183 Appendix E Section 1.2, the fission product release from the breached fuel is based on RG 1.183 Regulatory Position 3.2. Consistent with RG 1.183 Footnote 11, the release fractions are acceptable for use since the fuel has a peak burnup of less than 62,000 MWD/MTU, and a

maximum linear heat generation rate that does not exceed 6.3 kw/ft peak rod average power for burnups exceeding 54 GWD/MTU.

All gap activity in the damaged rods is instantaneously released into the refueling water. Radionuclides that are considered are xenons, kryptons, iodines, bromines, cesiums, and rubidiums. Cesium and rubidium are particulates that are retained in the refueling pool water; therefore, these radionuclides do not contribute to the FHA doses.

Consistent with RG 1.183 Appendix B Section 1.3, the chemical form of radioiodine released from the fuel to the refueling water is assumed to be 95 percent cesium iodide (CsI), 4.85 percent elemental iodine, and 0.15 percent organic iodide. The CsI released from the fuel is assumed to completely dissociate in the refueling water and instantaneously re-evolve as elemental iodine. Consequently, the chemical form of radioiodine in the refueling water, prior to application of a decontamination factor, is 99.85 percent elemental iodine and 0.15 percent organic iodide.

Per Units 2 and 3 Technical Specification LCO 3.9.6, during movement of irradiated fuel assemblies within containment, the refueling water level above the top of the reactor vessel flange shall be greater than or equal to 23 feet. Since the damaged fuel assemblies would be lower than the reactor vessel flange, the water depth above the damaged fuel would be greater than 23 feet. Consistent with RG 1.183 Appendix B Section 2, the 23 foot water depth requirement allows for an overall effective decontamination factor of 200 (i.e., 99.5% of the total iodine released from the damaged rods is retained by the water). The difference in decontamination factors for elemental (99.85%) and organic iodine (0.15%) species results in the iodine above the water being composed of 57% elemental and 43% organic species.

Consistent with FIG 1.183 Appendix B Section 3, the retention of noble gases in the refueling water is negligible (i.e., decontamination factor of 1). Particulate radionuclides are assumed to be retained by the refueling water (i.e., infinite decontamination factor).

# Section 4.6.2 FHA-IC Activity Release Model

Per SONGS Units 2 and 3 TS LCO 3.9.3, the containment personnel airlock may, under certain conditions be open during core alterations and movement of irradiated fuel in containment. In addition, SONGS Units 2 and 3 have submitted license amendment request PCN-534 that will allow the containment equipment hatch to be open during Mode 6 core alterations and movement of irradiated fuel in containment. Consistent with RG 1.183 Appendix B Section 5.3, since the containment may be open during fuel handling operations, the radioactive material that escapes from the refueling water to the containment is assumed to

be released to the environment over a 2-hour time period (i.e., containment closure is not modeled during the FHA-IC event).

Consistent with the 2-hour release model requirement, the FHA-IC AST dose analysis does not model the generation of an Engineered Safety Features Actuation System (ESFAS) containment purge isolation signal (CPIS) or containment isolation actuation signal (CIAS). The containment purge is assumed to remain operational throughout the FHA-IC event. The containment personnel airlock and the containment equipment hatch are assumed to remain open throughout the FHA-IC event.

The containment air volume dilutes the gaseous activity released from the damaged fuel rods. During Mode 6 refueling operations there is no SONGS Units 2 and 3 TS requirement for the containment dome air circulators or containment cooling train fans to be operable. Therefore, no credit is taken for activity dilution within the air of the containment dome space.

The FHA-IC AST dose analysis does not model a reduction in the amount of radioactive material available for release from the containment by any containment engineered safety feature. In addition, airborne activity removal by containment purge filters is not credited.

The release of activity to the environment within the required 2-hour time period is established by specifying a containment air exhaust flow rate that ensures that at least 99.9 percent of the airborne activity will be released to the environment.

Activity released during the FHA-IC event is transported by atmospheric dispersion to the control room HVAC intake and to the offsite EAB and LPZ dose receptors. Activity may be released to the environment via the containment purge system or as leakage through containment penetrations, including the containment personnel airlock or the containment equipment hatch. Leakage from the containment personnel airlock would be exhausted via the main plant vent. Table 4.6-2 presents the San Onofre site-specific 95th percentile meteorology atmospheric dispersion factors for these release pathways as discussed in Section 4.4. Since one set of atmospheric dispersion factors does not consistently yield less dispersion than the others over time, a composite maximum of the three release points is utilized for assessing control room dose consequences. No credit is taken for radioactive decay of the isotopes during atmospheric dispersion transit to the control room or offsite dose locations. Consistent with FIG 1.183 Regulatory Positions 4.1.7 and 4.2.2, no correction is made for depletion of the effluent plume by deposition on the ground.

FHA-IC to CR 95th Percentile Atmospheric Dispersion Factors (seconds/m <sup>3</sup> )					
Time Interval	Containment Shell Release Point	Equipment Hatch Release Point	Plant Vent Stack Release Point	Modeled Value	
0 to 2 hours	<del>8.94E-04</del> 1.01E-03	<del>7.99E-04</del> 8.01E-04	<del>1.14E-03</del> <u>1.15E-03</u>	<del>1.14E-03</del> 1.15E-03	
2 to 8 hours	6.32E-04 6.41E-04	6.30E-04 6.35E-04	6.11E-04 6.23E-04	6.32E-04 6.41E-04	
8 to 24 hours	1.77E-04	: <del>1.77E-04</del> 1.78E-04	2.10E-04 2.14E-04	2.10E-04 2.14E-04	
1 to 4 days	2.34E-04 2.36E-04	2.23E-04	2.20E-04 2.22E-04	2.34E-04 2.36E-04	
4 to 30 days	<del>2.18E-04</del> 2.20E-04	:2.03E-04	<del>1.98E-04</del> <u>2.02E-04</u>	2.18E-04 2.20E-04	

# TABLE 4.6-2: FHA-IC CR ATMOSPHERIC DISPERSION FACTORS

# Section 4.6.3 FHA-IC EAB and LPZ Model

Regulatory Guide 1.183 Regulatory Position 4.1 provides guidance to be used in determining the TEDE for persons located at or beyond the boundary of the exclusion area, including the outer boundary of the low population zone. Section 4.2 of this license amendment request addresses the applicability of this guidance to the SONGS Units 2 and 3 AST FHA-IC dose analysis as it relates to the offsite dose exposure parameters.

As discussed in Section 4.2, the FHA-IC dose analysis considers the dose consequences of inhalation and immersion. Radioactive material in the containment is assumed to be a negligible radiation shine source to the offsite dose receptors relative to the dose associated with immersion in the radioactive plume released from the facility.

Consistent with RG 1.183 Regulatory Positions 4.1.5, 4.1.6 and 4.4 and Table 6, the FHA-IC event radiological criterion for the EAB and for the outer boundary of the LPZ is 6.3 Rem TEDE.

# Section 4.6.4 FHA-IC Control Room Model

RG 1.183 Regulatory Position 4.2 provides guidance to be used in determining the total effective dose equivalent for persons located in the control room. Section 4.3 addresses the applicability of this guidance to the SONGS Units 2 and 3 AST FHA-IC dose analysis as it relates to the control room dose exposure parameters.

The CREACUS Emergency mode of operation can be actuated either automatically following a CRIS or manually. The CRIS may be generated automatically by a SIAS or by the detection of high radioactivity concentrations in the control room outside air inflow. Per Section 4.3.2.1.1, the FHA-IC model credits CREACUS Emergency Mode of operation initiation 3 minutes following the start of the event, due to detection of high radioactivity concentrations in the control room outside air inflow.

As discussed in Section 4.3, the FHA-IC dose analysis considers the dose consequences of inhalation, immersion, and radiation shine from the environmental (or outside) cloud, the control room emergency HVAC filters, and the containment building.

Consistent with FIG 1.183 Regulatory Position 4.4, as an AST dose analysis acceptance criterion the postulated control room dose is evaluated to ensure that that it does not exceed the 5 Rem TEDE criterion established in 10 CFR 50.67.

# Section 4.6.5 FHA-IC Dose Consequences

The resulting FHA-IC offsite and control room operator doses are listed in Table 4.6-3. The analysis demonstrates that the FHA-IC event 6.3 Rem TEDE radiological criterion for the EAB and for the outer boundary of the LPZ is met. The analysis also demonstrates that the FHA-IC event 5 Rem TEDE radiological criterion for the control room is met.

DOSE RECEPTOR	FHA-IC DOSE (REM TEDE)	ACCEPTANCE CRITERION (REM TEDE)	
Control Room (30-clay accident duration)	0.3	5	
EAB (Maximum 2-hour dose 0.0 to 2.0 hours)	0.8	6.3	
LPZ (30-day accident duration)	< 0.1	6.3	

#### TABLE 4.6-3: FHA-IC DOSE CONSEQUENCES

## Section 4.7 FUEL HANDLING ACCIDENT INSIDE FUEL HANDLING BUILDING (FHA-FHB) ANALYSIS

Regulatory Guide 1.183 Appendix B provides assumptions for use in evaluating the radiological consequences of an FHA-FHB. These assumptions supplement the guidance provided in the main body of RG 1.183.

This Section presents the assumptions, design input, methodology employed in evaluating, and the radiological consequences of, the SONGS Units 2 and 3 FHA-FHB. The characteristics of the FHA-FHB model are summarized in Table 4.7-1.

FHA-FHB PARAMETER	MODELED VALUE
Dose acceptance criteria, Rem TEDE	
Control Room	5
EAB	6.3
LPZ	6.3
FHA-FHB source term	
Decay time after reactor shutdown, hours	72
Average fuel rcd isotope inventory at 72 hours, curies/rod	per Section 4.1
Radial peaking factor applied to all failed fuel rods	1.75
Number of failed fuel rods	60
Core fission product fractions in fuel rod gaps	
Iodine-131	0.08
Krypton-85	0.10
Other noble gases (Krypton, Xenon)	0.05
Other Halogens (Iodine, Bromine)	0.05
Alkali Metals (Cesium, Rubidium)	0.12
Fraction of gap activity released to the fuel storage pool	1.00
Minimum water clepth above damaged fuel rods, feet	23
Fuel storage pool decontamination factors	
Iodines (effective DF)	200
Noble Gases	1
Particulates	infinite
Iodine composition above the fuel storage pool, percent of iodine	
Elemental iodine	57
Organic iodide	43
Fuel Handling Building model	
ESFAS - Fuel Handling [building] Isolation Signal (FHIS)	not modeled
Post-Accident Cleanup Units (PACUs)	not modeled
Activity release duration from FHB, hours	2
FHB net free volume, cubic feet	365,305
FHB air exhaust flow rate, ft <sup>3</sup> /minute	22,000
Offsite dose evaluation model	per Section 4.2
Control Room dose evaluation model	per Section 4.3

TABLE 4.7-1: FHA-FHB ANALYSIS PARAMETERS

FHA-FHB PARAMETER	MODELED VALUE
FHA-FHB Release Points to Control Room Atmospheric Dispersion Factors, seconds/m <sup>3</sup>	per Section 4.4

# Section 4.7.1 FHA-FHB Source Term

The FHA-FHB involves the inadvertent dropping of a fuel assembly during fuel handling operations, and the consequent rupture of fuel pins in the dropped assembly. Consistent with RG 1.183 Appendix B Section 1.1, the number of fuel rods damaged during the accident is based on a conservative analysis that considers the most limiting case. UFSAR Section 15.7.3.4.2.2 details the structural evaluation of dropped fuel assembly damage. Per the UFSAR, a maximum of 60 fuel rods will fail as a result of a fuel assembly drop in the spent fuel pool.

Table 4.1-3 presents the fission product inventory of an average fuel rod in the reactor core. Consistent with the guidance of RG 1.183 Regulatory Position 3.1, to account for differences in power level across the core, a radial peaking factor of 1.75 is applied to the Table 4.1-3 average fuel rod isotope inventory to determine the activity inventory in each of the 60 failed fuel rods as described in Section 4.1.3. Consistent with RG 1.183 Regulatory Position 3.1, the FHA-FHB dose analysis models 72 hours of radioactive decay prior to the event, which is also consistent with the minimum decay time required by SONGS Units 2 and 3 LCS 3.9.101 prior to movement of irradiated fuel in the reactor vessel.

Consistent with FIG 1.183 Appendix B Section 1.2, the fission product release from the breached fuel is based on RG 1.183 Regulatory Position 3.2. Consistent with FIG 1.183 Footnote 11, the release fractions are acceptable for use since the fuel has a peak burnup of less than 62,000 MWD/MTU, and a maximum linear heat generation rate that does not exceed 6.3 kw/ft peak rod average power for burnups exceeding 54 GWD/MTU.

All gap activity in the damaged rods is instantaneously released into the fuel storage pool. Radionuclides that are considered are xenons, kryptons, iodines, bromines, cesiums, and rubidiums. Cesium and rubidium are particulates that are retained in the spent fuel pool water; therefore, these radionuclides do not contribute to the FHA doses.

Consistent with FIG 1.183 Appendix B Section 1.3, the chemical form of radioiodine released from the fuel to the fuel storage pool is assumed to be 95 percent cesium iodide (CsI), 4.85 percent elemental iodine, and 0.15 percent organic iodide. The CsI released from the fuel is assumed to completely dissociate in the fuel storage pool water and instantaneously re-evolve as elemental iodine. Consequently, the chemical form of radioiodine in the fuel storage pool, prior to application of a decontamination factor, is 99.85 percent elemental iodine and 0.15 percent organic iodide.

Per Units 2 and 3 TS LCO 3.7.16, during movement of irradiated fuel assemblies in the fuel storage pool, the fuel storage pool water level shall be at least 23 feet over the top of the irradiated fuel assemblies seated in the storage racks. As noted in the LCO 3.7.16 Bases, there would be less than 23 feet of water above the top of a dropped single bundle laying horizontally on top of the spent fuel racks. However, as also noted in the LCO 3.7.16 Bases, when the potential of a dropped fuel assembly exists (which is when fuel is being moved) a water level is maintained that vould ensure that there would be greater than 23 feet above the fuel assembly laying on top of the racks. This increased water level is required by Units 2 and 3 TS LCO 3.9.6 when the fuel storage pool is connected to the refueling cavity and by station procedures whenever fuel is being moved.

Consistent with FIG 1.183 Appendix E Section 2, the 23 foot water depth requirement allows for elemental and organic iodine decontamination factors of 500 and 1, respectively, giving an overall effective decontamination factor of 200 (i.e., 99.5% of the total iodine released from the damaged rods is retained by the water). This difference in decontamination factors for elemental (99.85%) and organic iodine (0.15%) species results in the iodine above the water being composed of 57% elemental and 43% organic species.

Consistent with FIG 1.183 Appendix E Section 3, the retention of noble gases in the water in the fuel storage pool is negligible (i.e., decontamination factor of 1). Particulate radionuclides are assumed to be retained by the water in the fuel storage pool (i.e., infinite decontamination factor).

# Section 4.7.2 FHA-FHB Activity Release Model

Consistent with FIG 1.183 Appendix B Section 4.1, the radioactive material that escapes from the fuel storage pool to the FHB is released to the environment over a 2-hour time period (i.e., FHB closure is not modeled during the FHA-FHB event).

Consistent with the 2-hour release model requirement, the FHA-FHB AST dose analysis does no: model the generation of an ESFAS fuel handling [building] isolation signal (FHIS). The FHB normal ventilation exhaust is assumed to remain in operation throughout the FHA-FHB event.

The FHB air volume dilutes the gaseous activity released from the damaged fuel rods.

The FHA-FHB AST dose analysis does not model a reduction in the amount of radioactive material available for release from the FHB by the fuel handling building Post-Accident Cleanup Unit (PACU) filter system. The FHB PACU system consists of two independent, redundant trains that each consists of

charcoal and HEPA filters for the removal of airborne gaseous and particulate activity following an FHA.

The release of activity to the environment within the required 2-hour time period is established by specifying a FHB air exhaust flow rate that ensures that at least 99.9 percent of the gaseous activity will be released to the environment.

Activity released during the FHA-FHB event is transported by atmospheric dispersion to the control room HVAC intake and to the offsite EAB and LPZ dose receptors. Activity may be released to the environment via the FHB normal ventilation exhaust system through the main plant vent, or as leakage through FHB penetrations (e.g., doors). Table 4.7-2 presents the San Onofre site-specific 95th percentile meteorology atmospheric dispersion factors for these release pathways as discussed in Section 4.4. Since one set of atmospheric dispersion factors does not consistently yield less dispersion than the others over time, a composite maximum of the two release points is utilized for assessing control room dose consequences. No credit is taken for radioactive decay of the isotopes during atmospheric dispersion transit to the control room or offsite dose locations. Consistent with RG 1.183 Regulatory Positions 4.1.7 and 4.2.2, no correction is made for depletion of the effluent plume by deposition on the ground.

FHA-FHB to CR 95th Percentile Atmospheric Dispersion Factors (seconds/m <sup>3</sup> )			
Time Interval	FHB Release Point	Main Plant Vent Release Point	Modeled Value
0 to 2 hours	9.45E-049.48E-04	<del>1.14E-03<u>1.15E-03</u></del>	<del>1.14E-03<u>1.15E-03</u></del>
2 to 8 hours	7.48E-047.61E-04	6.11E-046.23E-04	7.48E-047.61E-04
8 to 24 hours	1.93E-041.92E-04	2.10E-042.14E-04	2.10E-042.14E-04
1 to 4 days	2.64E-042.65E-04	2.20E-042.22E-04	2.64E-042.65E-04
4 to 30 days	2.43E-04	1.98E-042.02E-04	2.43E-04

# Section 4.7.3 FHA-FHB EAB and LPZ Model

Regulatory Guide 1.183 Regulatory Position 4.1 provides guidance to be used in determining the TEDE for persons located at or beyond the boundary of the exclusion area, including the outer boundary of the low population zone. Section 4.2 addresses the applicability of this guidance to the SONGS Units 2 and 3 AST FHA-FHB dose analysis as it relates to the offsite dose exposure parameters.

As discussed in Section 4.2, the FHA-FHB dose analysis considers the dose consequences of inhalation and immersion. Radioactive material in the FHB is assumed to be  $\alpha$  negligible radiation shine source to the offsite dose receptors

relative to the dose associated with immersion in the radioactive plume released from the facility.

Consistent with FIG 1.183 Regulatory Positions 4.1.5, 4.1.6 and 4.4 and Table 6, the FHA-FHB event radiological criterion for the EAB and for the outer boundary of the LPZ is 6.3 Rem TEDE.

# Section 4.7.4 FHA-FHB Control Room Model

RG 1.183 Regulatory Position 4.2 provides guidance to be used in determining the TEDE for persons located in the control room. Section 4.3 addresses the applicability of this guidance to the SCNGS Units 2 and 3 AST FHA-FHB dose analysis as it relates to the control room dose exposure parameters.

The CREACUS Emergency mode of operation can be actuated either automatically following a CRIS or manually. The CRIS may be generated automatically by a SIAS or by the detection of high radioactivity concentrations in the control room outside air inflow. Per Section 4.3.2.1.1, the FHA-FHB model credits CREACUS Emergency mode of operation initiation 3 minutes following the start of the event, due to detection of high radioactivity concentrations in the control room outside air inflow.

As discussed in Section 4.3, the FHA-FHB dose analysis considers the dose consequences of inhalation, immersion, and radiation shine from the environmental (or outside) cloud, and the control room emergency HVAC filters. Radiation shine from contaminated air in the FHB is considered negligible due to the presence of numerous intervening concrete walls and the geometric attenuation due to the distance between the FHB and the control room.

Consistent with RG 1.183 Regulatory Position 4.4, as an AST dose analysis acceptance criterion the postulated control room dose is evaluated to ensure that that it does not exceed the 5 Rem TEDE criterion established in 10 CFR 50.67.

# Section 4.7.5 FHA-FHB Dose Consequences

The resulting FHA-FHB offsite and control room operator doses are listed in Table 4.7-3. The analysis demonstrates that the FHA-FHB event 6.3 Rem TEDE radiological criterion for the EAB and for the outer boundary of the LPZ is met. The analysis also demonstrates that the FHA-FHB event 5 Rem TEDE radiological criterion for the control room is met.

DOSE RECEPTOR	FHA-FHB DOSE (REM TEDE)	ACCEPTANCE CRITERION (REM TEDE)
Control Room (30-day accident duration)	< 0.1	5
EAB (Maximum 2-hour dose 0.0 to 2.0 hours)	0.2	6.3
LPZ (30-day accident duration)	< 0.1	6.3

# TABLE 4.7-3: FHA-FHB DOSE CONSEQUENCES

## Section 4.8 MAIN STEAM LINE BREAK (MSLB) ANALYSIS

RG 1.183 Appendix E provides assumptions for use in evaluating the radiological consequences of a Pressurized Water Reactor (PWR) MSLB. These assumptions supplement the guidance provided in the main body of RG 1.183.

A MSLB may occur either inside or outside containment. A steam line break inside containment will release contaminated steam via the break location to the containment air space, where it will be diluted within the containment net free air volume and then slowly leaked to the outside environment at the design basis containment leakage rate. A more severe scenario is that of a steam line break outside containment (SLB-OC) that will release contaminated steam via the break location directly to the environment. This section evaluates a SLB-OC event consistent with the guidance in RG 1.183 Appendix E.

The SONGS Units 2 and 3 CLB evaluates pre-trip and post-trip return-to-power steam line break events. The pre-trip SLB event may result in fuel failure (i.e., clad damage). The post-trip SLB event does not result in fuel failure. This section specifically evaluates a pre-trip SLB-OC event.

The transient response of the pre-trip SLB-OC event is analyzed using the CENTS computer code for the NSSS response, including mass releases and steam generator tube uncovery, and the CETOP computer code for the DNBR response.

This Section presents the assumptions, design input, methodology employed in evaluating, and the radiological consequences of, the SONGS Units 2 and 3 pre-trip SLB-OC. The characteristics of the pre-trip SLB-OC model are summarized in Table 4.8-1.

PRE-TRIP SLB-OC PARAMETER	MODELED VALUE
Dose acceptance criteria, Rem TEDE	
Control Room	5
EAB	25
LPZ	25
SLB-OC source terrn	
Core isotope inventory at reactor shutdown, curies	per Section 4.1
Failed Fuel (clad clamage), percent of core	10
Radial peaking factor	1.75
Core fission product fractions in fuel rod gaps	
lodine-131	0.08
Krypton-85	0.10
Other noble gases: (Krypton, Xenon)	0.05
Other Halogens (Iodine, Bromine)	0.05
Alkali Metals (Cesium, Rubidium)	0.12

#### TABLE 4.8-1: PRE-TRIP SLB-OC ANALYSIS PARAMETERS

PRE-TRIP SLB-OC PARAMETER	MODELED VALUE
Initial Primary Cookant Activity Profile	per Section 4.1
Initial Secondary Coolant Activity Profile	per Section 4.1
Dilution Volumes and Masses	
Reactor Coolant dilution volume, cubic feet	10,179
Reactor Coolant dilution mass, grams	2.015E+08
Secondary dilution water mass, Ibm	1.59E+05
Primary-to-Secondary leakage rate, gpm per Steam Generator (SG)	0.5
SG Water to Steam flashing fractions and partition coefficients	
SG tube uncovery period, seconds	0 to 6,621
Iodine flashing factor during SG tube uncovery, percent	20
lodine partition coefficient	100
Noble gases (Xe, Kr) partition coefficient	1E-06
Particulate isotopes partition coefficient	500
Steam Line Break Mass Release, Ibm	
0 to 16.3 seconds	115,103
16.3 seconds to shutdown cooling at 13,659 seconds	0
Main Steam Safety Valve (MSSV) Mass Release, Ibm	
0 to 30 minutes	47,553
30 minutes to 2 hours	555.5
2 hours to shutdown cooling at 13,659 seconds	0
Atmospheric Dump Valve (ADV) Mass Release, Ibm	
0 to 30 minutes	0
30 minutes to 2 hours	374,719
2 hours to shutdown cooling at 13,659 seconds	356,610
Auxiliary Feedwater (AFW) Steam Turbine Mass Release, Ibm	
0 to 30 minutes	8,078
30 minutes to 2 hours	64,522
2 hours to shutdown cooling at 13,659 seconds	78,944
lodine composition released to the environment, percent of iodine	
Elemental iodine	97
Organic iodide	3
Offsite dose evaluation model	per Section 4.2
Control Room dose evaluation model	per Section 4.3
SLB-OC Release Foints to Control Room Atmospheric Dispersion Factors, seconds/m <sup>3</sup>	per Section 4.4

# Section 4.8.1 Pre-Trip SLB-OC Source Term

The pre-trip SLB-OC transient analysis is characterized by fuel failure (i.e., clad damage). Using the current licensing basis deterministic DNBR fuel failure prediction methodology, the radiological consequences for the pre-trip SLB-OC event have been characterized by no more than 7 percent fuel failure with a Core Operating Limits Supervisory System (COLSS) Required Overpower Margin (ROPM) of 123 percent power. Application of the DNB statistical convolution methodology described in Section 4.1.4 will result in a gain in COLSS DNBR

plant operating margin of 6% (to 117% ROPM) for an equivalent amount of fuel failure as described in Table 4.8-2. The methodology used to offset predicted fuel failure with COLSS required DNBR plant operating margin is per the standard NRC approved Westinghouse methodology for Combustion Engineering digital protection plants as discussed in Section 5.5.4 of the NRC-approved SONGS Reload Analysis Methodology Topical Report SCE-9801-P-A. The pre-trip SLB-OC AST dose analysis conservatively assumes 10 percent fuel failure to bound future operating cycle fuel failure predictions.

Table 4.8-2		
Typical SONGS Pre-Trip SLB-OC Fuel Failures		

COLSS Required Overpower Margin (% Power)	117	119	121	123
Deterministic Fuel Failure (%)	21.7	16.0	11.3	6.4
Statistical Convolution Fuel Failure (%)	6.9	4.5	2.8	1.6

Consistent with RG 1.183 Appendix E Section 2, because more than minimal fuel damage is postulated, the pre-trip SLB-OC AST activity release model does not address primary coolant iodine spiking.

The 10 percent fuel failure estimate is applied to the reactor core fission product inventory presented in Table 4.1-3. Consistent with the guidance of RG 1.183 Regulatory Position 3.1, to account for differences in power level across the core, a radial peaking factor of 1.75 is also applied as described in Section 4.1.3.

Consistent with RG 1.183 Appendix E Section 1, the fission product release from the breached fuel is based on RG 1.183 Regulatory Position 3.2. Consistent with RG 1.183 Footnote 11, the release fractions are acceptable for use since the fuel has a peak burnup of less than 62,000 MWD/MTU, and a maximum linear heat generation rate that does not exceed 6.3 kw/ft peak rod average power for burnups exceeding 54 GWD/MTU.

Consistent with RG 1.183 Appendix E Section 3, the activity released from the fuel is instantaneously and homogeneously released into the reactor coolant system. Radionuclides that are considered are xenons, kryptons, iodines, bromines, cesiums, and rubidiums.

The initial reactor coolant concentration prior to the introduction of the fission product release from the breached fuel is assumed to be at the maximum TS LCO 3.4.16 limiting condition as specified in Section 4.1.

The AST pre-trip SLB-OC dose analysis assumes that the reactor coolant dilutes the core activity release into a volume of 10,179 cubic feet. This volume has conservatively omitted the primary side volume that is present in an assumed 2,000 plugged U-tubes in each of the two steam generators.

Consistent with RG 1.183 Appendix E Section 4, the chemical form of radioiodine released from the steam generators to the environment is 97 percent elemental and 3 percent organic.

# Section 4.8.2 Pre-Trip SLB-OC Activity Release Model

Activity is introduced into the secondary side via steam generator tube leakage. Consistent with RG 1.183 Appendix E Section 5.1, the pre-trip SLB-OC AST dose analysis models a primary-to-secondary leak rate into any single steam generator of 0.5 gallon/minute consistent with the maximum leak rate allowed by TS LCO 3.4.13.

The initial secondary side activity concentration prior to the introduction of the primary-to-secondary leakage is assumed to be at the maximum TS LCO 3.7.19 limit of 0.10  $\mu$ Ci/gm dose equivalent lodine-131.

Consistent with RG 1.183 Appendix E Sections 5.5.1 and 5.6, the primary-tosecondary leakage is assumed to mix with the secondary water without flashing during periods of total tube submergence. The tubes in one steam generator are uncovered from 17.3 seconds to 6,620 seconds after the break. The tubes in the other steam generator are uncovered from 17.2 seconds to 6,621 seconds after the break. The pre-trip SLB-OC AST dose analysis conservatively assumes that the tubes in both steam generators are uncovered from 0 seconds to 6,621 seconds.

Consistent with RG 1.183 Appendix E Sections 5.5.1 and 5.6, during periods where the tubes are uncovered, a portion of the primary-to-secondary leakage flashes to vapor based on the thermodynamic conditions in the reactor coolant and the secondary coolant. The maximum flashing fraction is 14.41%, which occurs at the start of the event. Conservatively, the pre-trip SLB-OC AST dose analysis models a bounding flashing fraction of 20% during periods of steam generator tube uncovery.

The portion of primary-to-secondary leakage that flashes to steam enters the steam generator steam space, with no credit taken for iodine scrubbing.

Consistent with RG 1.183 Appendix E Section 5.5.3, the unflashed portion of primary-to-secondary leakage mixes with the bulk water. Consistent with RG 1.183 Appendix E Section 5.5.4, an iodine partition coefficient (i.e., liquid concentration divided by gas concentration) of 100 is modeled when evaluating the vaporization of the secondary side water (steam generator liquid). Consistent with RG 1.183 Appendix E Section 5.4, all noble gases released from the primary coolant are released to the environment without reduction or mitigation.

The SONGS Units 2 and 3 steam generators have a maximum full-power steam generator moisture carryover (steam quality) of 0.20 percent. The pre-trip

SLB-OC AST dose analyses address this carryover by modeling a particulate isotope partition coefficient of 500 when evaluating the vaporization of the secondary side water.

Activity is released to the environment via the steam line break location, the MSSVs, the AD\'s, and the AFW turbine exhaust.

Consistent with the guidance in Branch Technical Position (BTP) MEB 3-1 Section B.1.b, the SLB-OC is modeled downstream of a MSIV. A break upstream of a MSIV is not postulated since the SONGS Units 2 and 3 design complies with the BTP MEB 3-1 (ASME Section III and design stress and fatigue limit requirements) for crediting break exclusion zones.

The release through the break begins at time zero and is terminated at 16.3 seconds, the time when MSIVs are fully closed. The total mass release through the break is 104,639 lbm, consisting of inventory loss from both steam generators, and main feedwater flow for duration of 3.83 seconds. The pre-trip SLB AST dose analysis increased the break mass release predicted by the pre-trip SLB mass release analysis by 10 percent to 115,103 lbm to provide margin for any potential increased mass release that may be determined in future cycle-specific transient analysis.

The MSSV and ADV mass releases are as shown in Table 4.8-1. The pre-trip SLB AST dose analysis increased the MSSV and ADV mass release predicted by the pre-trip SLB mass release analysis by 10 percent to provide margin for any potential increased mass release that may be determined in future cycle-specific transient analysis. The MSSV mass release begins when the MSSVs open at 1,200 seconds and terminates when the MSSVs close at 1,822 seconds. The ADV mass release begins when the ADVs are opened (by operator action) at 30 minutes, and stay open for the duration of the event. The pre-trip SLB-OC AST dose analysis models the mass releases as being from the MSSV from 1,200 seconds to 1,800 seconds and from the ADVs from 1,800 seconds until the end of the event. This is conservative since, as shown in Section 4.4, the ADV atmospheric dispersion factors are greater than the MSSV atmospheric dispersion factors, thus resulting in higher doses.

The time intervals during which the steam turbine AFW pump is operating, and the mass released during those intervals, are as shown in Table 4.8-1. Two periods of AFW operation are modeled. The first is from 89 seconds to 748 seconds. The second is from 1,921 seconds to the end of the event. The pre-trip SLB AST dose analysis increased the AFW steam turbine mass release predicted by the pre-trip SLB mass release analysis by 10 percent to provide margin for any potential increased mass release that may be determined in future cycle-specific transient analysis. The pre-trip SLB-OC event is terminated when shutdown cooling is initiated at 13,659 seconds. After this time all steam releases from both steam generators cease.

Activity released during the pre-trip SLB-OC event is transported by atmospheric dispersion to the control room HVAC intake and to the offsite EAB and LPZ dose receptors. San Onofre site-specific 95th percentile meteorology atmospheric dispersion factors for the pre-trip SLB-OC release pathways are discussed in Sections 4.2 and 4.4 for the offsite and control room dose receptors, respectively. No credit is taken for plume rise dispersion associated with the ADV release pathway. No credit is taken for radioactive decay of the isotopes during atmospheric dispersion transit to the control room or offsite dose locations. Consistent with FIG 1.183 Regulatory Positions 4.1.7 and 4.2.2, no correction is made for depletion of the effluent plume by deposition on the ground.

# Section 4.8.3 Pre-Trip SLB-OC; EAB and LPZ Model

RG 1.183 Regulatory Position 4.1 provides guidance to be used in determining the TEDE for persons located at or beyond the boundary of the exclusion area, including the outer boundary of the low population zone. Section 4.2 of this license amendment request addresses the applicability of this guidance to the SONGS Units 2 and 3 AST pre-trip SLB-OC dose analysis as it relates to the offsite dose exposure parameters.

As discussed in Section 4.2, the pre-trip SLB-OC dose analysis considers the dose consequences of inhalation and immersion.

Consistent with FIG 1.183 Regulatory Positions 4.1.5, 4.1.6 and 4.4 and Table 6, the SLB event radiological criterion for the EAB and for the outer boundary of the LPZ is 25 Rem TEDE for an event scenario with fuel damage.

# Section 4.8.4 Pre-Trip SLB-OC Control Room Model

RG 1.183 Regulatory Position 4.2 provides guidance to be used in determining the TEDE for persons located in the control room. Section 4.3 of this license amendment request addresses the applicability of this guidance to the SONGS Units 2 and 3 AST pre-trip SLB-OC dose analysis as it relates to the control room dose exposure parameters.

The CREACUS Emergency mode of operation can be actuated either automatically following a CRIS or manually. The CRIS may be generated automatically by a SIAS or by the detection of high radioactivity concentrations in the control room outside air inflow. Per Section 4.3.2, the pre-trip SLB-OC model credits CREACUS Emergency mode of operation initiation 3 minutes following the start of the event, due to detection of high radioactivity concentrations in the control room outside air inflow.

As discussed in Section 4.3, the pre-trip SLB-OC dose analysis considers the dose consequences of inhalation, immersion, and radiation shine from the environmental (or outside) cloud, and the control room emergency HVAC filters.

Consistent with RG 1.183 Regulatory Position 4.4, as an AST dose analysis acceptance criterion the postulated control room dose is evaluated to ensure that that it does not exceed the 5 Rem TEDE criterion established in 10 CFR 50.67.

# Section 4.8.5 Pre-Trip SLB-OC Dose Consequences

The resulting pre-trip SLB-OC offsite and control room operator doses are listed in Table 4.8-3. The analysis demonstrates that the SLB event 25 Rem TEDE radiological criterion for the EAB and for the outer boundary of the LPZ is met. The analysis also demonstrates that the SLB event 5 Rem TEDE radiological criterion for the control room is met.

D()SE RECEPTOR	PRE-TRIP SLB-OC DOSE (REM TEDE)	ACCEPTANCE CRITERION (REM TEDE)	
Control Room (30-day accident duration)	<u>2.12.2</u>	5	ĺ
EAB (Maximum 2-hour dose 0.0 to 2.0 hours)	4.1	25	
LPZ (30-day accident duration)	0.1	25	1

## TABLE: 4.8-3: PRE-TRIP SLB-OC DOSE CONSEQUENCES

#### 5.0 REGULATORY SAFETY ANALYSIS

#### 5.1 No Significant Hazards Consideration

Southern California Edison (SCE) has evaluated whether or not a significant hazards consideration is involved with the proposed amendments by focusing on the three standards set forth in 10CFR50.92, "Issuance of Amendment," as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No.

The proposed changes to the Facility Operating Licenses for San Onofre Units 2 and 3 credit an Alternative Source Term (AST) for the design basis radiological site boundary and control room dose analyses. This change represents full scope implementation of the AST as described in Regulatory Guide 1.183. The proposed changes to the Facility Operating Licenses also expand the allowed use of fuel failure estimates by Departure from Nucleate Boiling (DNB) statistical convolution methodology from only the reactor coolant pump sheared shaft event to the Updated Final Safety Analysis Report (UFSAR) Chapter 15 non-Lossof-Coolant-Accident (LOCA) events that assume a loss of flow (i.e., a loss of AC power) and that fail fuel. The proposed changes reflect the parameters used in the radiological consequences calculations for the LOCA, Fuel Handling Accident inside containment (FHA-IC), Fuel Handling Accident in the Fuel Handling Building (FHA-FHB) and pre-trip Steam Line Break Outside Containment (SLB-OC).

The purpose of this proposed change is to change the design requirements for the Control Room Envelope (CRE). This proposed change will allow an increase in the assumed amount of unfiltered air inleakage through the CRE. Currently, design basis radiological consequence analyses assume CRE inleakage of 0 cfm, plus an assumed 10 cubic feet per minute (cfm) inleakage due to ingress and egress into the Control Room. Analyses to support this change demonstrate acceptable post-accident dose consequences in the Control Room assuming 990 cfm of CRE inleakage (plus 10 cfm due to ingress and egress for a total of 1000 cfm).

This proposed change does not affect the precursors for accidents or transients analyzed in Chapter 15 of the San Onofre Units 2 and 3 UFSAR. Therefore, there is no increase in the probability of accidents previously evaluated. The probability remains the same because the accident analyses performed involve no change to a system, component
or structure that affects initiating events for any UFSAR Chapter 15 accident evaluated.

A re-analysis of the UFSAR Chapter 15 LOCA, SLB-OC, FHA-IC, and FHA-FHB events was conducted with respect to radiological consequences. This re-analysis was performed in accordance with AST methodology provided in Regulatory Guide (RG) 1.183 and with ARCON96 atmospheric dispersion methodology provided in RG 1.194. The reanalysis consequences were expressed in terms of Total Effective Dose Equivalent (TEDE) dose.

Implementation of the AST methodology, as described in 10CFR50.67, specifies control room, exclusion area boundary (EAB), and low population zone (LPZ) dose acceptance criteria in terms of TEDE dose. The dose acceptance criteria for specific events are specified in RG 1.183. The revised analyses for all evaluated events meet the applicable RG 1.183 TEDE dose acceptance criteria for AST implementation.

The previous dose calculations analyzed the dose consequences to thyroid and whole body as a result of postulated design basis events. The previous control room dose calculations were shown to be within the regulatory limits of 10CFR50 Appendix A General Design Criterion 19 with respect to thyroid, beta-skin and whole body dose. The previous LOCA and SLB cffsite dose calculations were shown to be within the regulatory limits of 10CFR100.11 with respect to thyroid and whole body dose. The previous FHA-IC and FHA-FHB offsite dose calculations were shown to be well within (i.e., less than 25 percent of) the regulatory limits of 10CFR100.11 with respect to thyroid and whole body dose.

RG 1.183 Footnote 7 provides a means to compare the thyroid and whole body dose results of the previous calculations with the TEDE results of the AST calculations. This methodology requires multiplying the previous thyroid dose by 0.03 and adding the product to the previous whole body dose. The resultant "effective" TEDE is then compared to the AST TEDE result. This comparison is presented in Table 5-1.

The Table 5-1 comparison shows a decrease in dose consequences when evaluated using AST methodology for all but the LOCA offsite dose receptors. The LOCA EAB dose using AST methodology has increased due to the requirement to calculate the maximum 2-hour window EAB dose versus the previous requirement to calculate the 0 to 2 hour window EAB dose. The LOCA LPZ dose using AST methodology has increased primarily due to changes in the AST Refueling Water Storage Tank (RWST) indine transport model. Although the LOCA EAB and LPZ doses using AST methodology have increased, they remain significantly below the 25 Rem TEDE offsite dose acceptance criterion.

Table 5-1 – Comparison of Previous and AST Doses			
Event – Dose Receptor	"Effective" TEDE of	AST TEDE	
	Previous Dose	(Rem)	
	Analyses (Rem)		
FHA-IC			
Control Room	1.0	2.7 E-01	
EAB	2.0	8.0 E-01	
LPZ	5.6 E-02	2.3 E-02	
FHA-FHB			
Control Room	3.7 E-01	7.3 E-02	
EAB	6.6 E-01	2.1 E-01	
LPZ	1.9 E-02	6.1 E-03	
LOCA			
Control Room	4.5	<u>2.72.8</u>	
EAB	3.7	<del>5.1</del> 5.2	
LPZ	1.2	<del>1.8<u>1.9</u></del>	
SLB-OC			
Control Room	Not evaluated	<del>2.1</del> 2.2	
EAB	8.0	4.1	
LPZ	Not evaluated	0.1	

The proposed changes do not increase the probability of an accident previously evaluated. The proposed changes result in dose consequences that, if compared to previous ones, are in most cases decreased and in other cases only slightly increased (using guidance in footnote 7 of RG 1.183). However, the dose consequences of the revised analyses are below the AST regulatory acceptance criteria.

Therefore, the proposed change does not involve a significant increase in the probability or consequences of any accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No.

The implementation of this proposed change does not create the possibility of an accident of a different type than was previously evaluated in the UFSAR. The proposed change credits the AST for the design basis radiological site boundary and control room dose analyses and expands the allowed use of fuel failure estimates by DNB statistical convolution methodology from only the reactor coolant pump sheared shaft event to the UFSAR Chapter 15 non-LOCA events that assume a loss of flow (i.e., a loss of AC power) and that fail fuel.

The changes proposed do not change how Design Basis Accident (DBA) events were postulated nor do the changes themselves initiate a new kind of accident with a unique set of conditions. The changes proposed are based on a re-analysis of offsite and control room doses for four design basis accidents. The revised analyses are consistent with the regulatory guidance established in RG 1.183. The revised analyses utilize the most current understanding of source term timing and chemical forms. Through this re-analysis, no new accident initiator or failure mode was identified.

Therefore, this proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

Response: No.

The implementation of this proposed amendment does not reduce the margin of safety. The alternative source term radiological dose consequence analyses utilize the regulatory acceptance criteria of 10 CFR 50 Appenclix A General Design Criterion (GDC) 19 and 10 CFR 50.67, as specified in RG 1.183. These acceptance criteria have been developed for the purpose of use in design basis accident analyses such that meeting these limits demonstrates adequate protection of public health and safety. An acceptable margin of safety is inherent in these licensing limits. The radiological analyses results remain within these regulatory acceptance criteria.

Therefore, there is no significant reduction in the margin of safety as a result of the proposed amendment.

Based on the above, SCE concludes that the proposed amendments present no significant hazards consideration under the standards set forth in 10CFR50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

5.2 Applicable Regulatory Requirements/Criteria

#### <u>GDC 19</u>

Control Room – A control room shall be provided from which actions can be taken to operate the nuclear power unit safely under normal conditions and to maintain it in a safe condition under accident conditions, including loss-of-coolant accidents. Adequate radiation protection shall be provided to permit access and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 5 rem whole body, or its equivalent to any part of the body, for the duration

of the accident. Equipment at appropriate locations outside the control room shall be provided (1) with a design capability for prompt hot shutdown of the reactor, including necessary instrumentation and controls to maintain the unit in a safe condition during hot shutdown, and (2) with a potential capability for subsequent cold shutdown of the reactor through use of suitable procedures. Applicants for and holders of construction permits and operating licenses under this part who apply on or after January 10, 1997, applicants for design certifications under part 52 of this chapter who apply on or after January 10, 1997, applicants for and holders of combined licenses under part 52 of this chapter who do not reference a standard clesign certification, or holders of operating licenses using an alternative source term under §50.67 shall meet the requirements of this criterion, except that with regard to control room access and occupancy, adequate radiation protection shall be provided to ensure that radiation exposures shall not exceed 0.05 Sv (5 rem) total effective dose equivalent (TEDE) as defined in §50.2 for the duration of the accident.

10CFR50, Appendix A, General Design Criterion 19 requires that the control room be designed such that the radiological dose to the operators following a design basis accident be less than 5 rem whole body, or its equivalent to any part of the body.

GDC-19 is the current licensing basis for the San Onofre Units 2 and 3 control room. Radiological consequences of design basis accidents are currently shown to be less than the criterion of 5 rem whole body, or its equivalent to any part of the body. Following approval of this license amendment request, the provisions of GDC-19 will continue to apply to San Onofre Units 2 and 3 except that with regard to control room access and occupancy, adequate radiation protection shall be provided to ensure that radiation exposures shall not exceed 0.05 Sv (5 rem) total effective dose equivalent (TEDE) as defined in §50.2 for the duration of the accident.

### 10CFR100.11(a)

...(1) An exclusion area of such size that an individual located at any point on its boundary for two hours immediately following onset of the postulated fission product release would not receive a total radiation dose to the whole body in excess of 25 rem or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure.

(2) A low population zone of such size that an individual located at any point on its outer boundary who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of its passage) would not receive a total radiation dose to the whole body in excess of 25 rem or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure....

Paragraphs (a)(1) and (a)(2) of 10CFR100.11 describe the current accident analysis dose acceptance criteria for the exclusion area boundary and the low population zone for San Onofre Units 2 and 3. Following approval of this license amendment request, the dose acceptance criteria for the exclusion area boundary and low population zone will be the 25 rem TEDE criteria specified by 10CFR50.67.

### 10CFR50.67

(a) Applicability. The requirements of this section apply to all holders of operating licenses issued prior to January 10, 1997, and holders of renewed licenses under part 54 of this chapter whose initial operating license was issued prior to January 10, 1997, who seek to revise the current accident source term used in their design basis radiological analyses.

(b) Requirements. (1) A licensee who seeks to revise its current accident source term in design basis radiological consequence analyses shall apply for a license amendment under §50.90. The application shall contain an evaluation of the consequences of applicable design basis accidents previously analyzed in the safety analysis report.

(2) The NRC may issue the amendment only if the applicant's analysis demonstrates with reasonable assurance that:

(i) An individual located at any point on the boundary of the exclusion area for any 2-hour period following the onset of the postulated fission product release, would not receive a radiation dose in excess of 0.25 Sv (25 rem) total effective dose equivalent (TEDE).

(ii) An individual located at any point on the outer boundary of the low population zone, who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of its passage), would not receive a radiation dose in excess of 0.25 Sv (25 rem) total effective dose equivalent (TEDE).

(iii) Adequate radiation protection is provided to permit access to and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 0.05 Sv (5 rem) total effective dose equivalent (TEDE) for the duration of the accident.

Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," provides guidance to licensees of operating power reactors on acceptable applications of alternative source terms. Regulatory Guide 1.194, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants," describes methods acceptable to the NRC staff for determining atmospheric relative concentration ( $\chi$ /Q) values that will be used in control room radiological habitability assessments performed in support of applications for license amendment requests. The LOCA, FHA-IC, FHA-FHB, and SLB-OC were reanalyzed consistent with the guidance of RGs 1.183 and 1.194.

Using the methods described in RG 1.183 and 1.194, the results of the new analyses for the LOCA, FHA-IC, FHA-FHB, and SLB-OC meet the criteria of 10 CFR 50.67 as shown in Table 5-2. These results demonstrate that the 10CFR50.67 dose acceptance criteria for exclusion area boundary, low population zone, and control room are met for these four events. In addition, the analysis results described in Section 4 above also show that the exclusion area boundary and low population zone dose acceptance criteria from Regulatory Guide 1.183, Table 6 are met.

Table 5-2 – Comparison of AST Doses with AST Dose Criteria		
Event – Dose Receptor	AST TEDE (Rem)	AST TEDE Dose Acceptance Criteria (Rem)
FHA-IC		
Control Room	0.3	5
EAB	0.8	6.3
LPZ	< 0.1	6.3
FHA-FHB		
Control Room	< 0.1	5
EAB	0.2	6.3
LPZ	< 0.1	6.3
LOCA		
Control Room	<u>2.7</u> 2.8	5
EAB	<del>5.1</del> 5.2	25
LPZ	<del>1.8</del> 1.9	25
SLB-OC		
Control Room	<u>2.12.2</u>	5
EAB	4.1	25
LPZ	0.1	25

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by cperation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

### 6.0 ENVIRONMENTAL CONSIDERATION

A review has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10CFR20, or would change an inspection or surveillance requirement. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational

radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10CFR51.22(c)(9). Therefore, pursuant to 10CFR51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

### 7.0 REFERENCES

- 1. Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors" July 2000
- 2. Generic Letter 2003-01, "Control Room Habitability," dated June 12, 2003
- Letter from A. E. Scherer (SCE) to Document Control Desk (NRC), dated September 17, 2004, Subject: Response to Generic Letter 2003-01, "Control Room Habitability" Tracer Gas Test Results, San Onofre Nuclear Generating Station Units 2 and 3
- 4. Letter from A. E. Scherer (SCE) to Document Control Desk (NRC), dated August 5, 2003, Subject: Response to Generic Letter 2003-01, "Control Room Habitability," San Onofre Nuclear Generating Station Units 2 and 3
- 5. NUREG 07'37, "Post-TMI Requirements"
- 6. Letter from L. Raghavan (NRC) to Harold B. Ray (SCE), dated March 26, 2001, Subject: "San Onofre Nuclear Generating Station, Units 2 and 3, Issuance of Amendments on Post-Accident Sampling Program"
- 7. Regulatory Guide 1.195, "Methods and Assumptions for Evaluating Radiological Consequences of Design Basis Accidents at Light-Water Nuclear Power Reactor," May 2003
- Regulatory Guide 1.194, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants," June 2003
- 9. NUREG/CR-6604, USNRC, April 1998. S.L. Humphreys et al., "RADTRAD: A Simplified Model for Radionuclide Transport and Removal and Dose Estimation"
- 10.K.F. Eckerman et al., "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion," Federal Guidance Report 11, EPA-520/1-88-020, Environmental Protection Agency, 1988
- 11.NUREG/CR-1413, D. C. Kocher, May 1980, "A Radionuclide Decay Data Base-Index and Summary Table"
- 12.K.F. Eckerman and J.C. Ryman, "External Exposure to Radionuclides in Air, Water, and Soil," Federal Guidance Report 12, EPA-402-R-93-081, Environmental Protection Agency, 1993

- 13. Regulatory Guide 1.197, "Demonstrating Control Room Envelope Integrity at Nuclear Power Reactors," May 2003
- 14. Regulatory Guide 1.196, "Control Room Habitability at Light-Water Nuclear Fower Reactors," May 2003
- 15.NUREG/CR-6331, Revision 1, USNRC, May 1997, J. V. Ramsdell, Jr., and C.A. Simonen, "Atmospheric Relative Concentrations in Building Wakes"
- 16.NUREG/CR-6189, "A Simplified Model of Aerosol Removal by Natural Processes in Reactor Containments"
- 17. NUREG/CR-5966 "A Simplified Model of Aerosol Removal by Containment Sprays"
- 18. CENPD-183-A, "C-E Methods for Loss of Flow Analysis", June 1984 (PROPRIETARY)

# ATTACHMENT A

## ACRONYMS

.

# ACRONYMS

Acronym	Nleaning
ADV	Atmospheric Dump Valve
AFW	Auxiliary Feedwater
AST	Alternative Source Term
BPC	Bechtel Power Corporation
CEDE	Committed Effective Dose Equivalent
CEOG	Combustion Engineering Owner's Group
CIAS	Containment Isolation Actuation Signal
CLB	Current Licensing Basis
COLR	Core Operating Limits Report
COLSS	Core Operating Limits Supervisory System
CPIS	Containment Purge Isolation Signal
CR	Control Room
CRE	Control Room Envelope
CREACUS	Control Room Emergency Air Cleanup System
CRH	Control Room Habitability
CRIS	Control Room Isolation Signal
CSS	Containment Spray System
DACU	L'ome Air Circulator Unit
DBA	Cesign Basis Accident
DDE	Ceep Dose Equivalent
DE I-131	Dose Equivalent Iodine-131
DF	Decontamination Factor
DG	Diesel Generator
DNB	Leparture from Nucleate Boiling
DNBR	Eveparture from Nucleate Boiling Ratio
Ē	Average Disintegration Energy
EAB	Exclusion Area Boundary
EAC	Emergency Air Conditioner
ECCS	Emergency Core Cooling System
ECU	Emergency Cooling Unit
EDE	Effective Dose Equivalent
EPIP	Emergency Planning Implementing Procedure
EQ	Environmental Qualification
ESF	Engineered Safety Features
ESFAS	Engineered Safety Features Actuation System
EVS	Emergency Ventilation Supply
FGR	Federal Guidance Report
FHA	Fuel Handling Accident
FHA-FHB	Fuel Handling Accident in the Fuel Handling Building
FHA-IC	Fuel Handling Accident – Inside Containment

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FHB	Fuel Handling Building
FHIS	Fuel Handling Isolation Signal
GL	Gieneric Letter
HPSI	High Pressure Safety Injection
HVAC	Heating, Ventilation, and Air-Conditioning
IMSF-SF	Increased Main Steam Flow with Single Failure
LCO	Limiting Condition for Operation
LCS	Licensee Controlled Specification
LOCA	Loss of Coolant Accident
LPSI	Low Pressure Safety Injection
LPZ	Low Population Zone
MFIV	Main Feedwater Isolation Valve
MSIV	Main Steam Isolation Valve
MSLB	Main Steam Line Break
MSSV	Main Steam Safety Valve
PACU	Fost-Accident Cleanup Unit
PASS	Fost-Accident Sampling System
PNNL	Facific Northwest National Laboratory
PWR	Fressurized Water Reactor
RAS	Flecirculation Actuation Signal
RG	Flegulatory Guide
ROPM	Flequired Overpower Margin
RPF	Fadial Peaking Factor
RWST	Flefueling Water Storage Tank
SAFDL	Specified Acceptable Fuel Design Limit
SCE	Southern California Edison
SCP	Standard Computer Program
SIAS	Safety Injection Actuation Signal
SIS	Safety Injection System
SLB	Steam Line Break
SLB-OC	Steam Line Break – Outside Containment
SONGS	San Onofre Nuclear Generating Station
SRP	Standard Review Plan
TEDE	Total Effective Dose Equivalent
TID	Technical Information Document
TS	Technical Specification
TSP	Tri-Sodium Phosphate
UFSAR	Updated Final Safety Analysis Report

ATTACHMENT B

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LIST OF REGULATORY COMMITMENTS

#### LIST OF REGULATORY COMMITMENTS

- 1. Following approval of this license amendment request, future revisions to UFSAR Chapter 15 design basis accident control room and offsite radiological consequence analyses will be performed using AST methodology.
- 2. Following approval of this license amendment request, the manual dose calculation methodology as described in Emergency Planning Implementation Procedures (EPIPs) and other Emergency Planning guidance documents will be revised to reflect AST methodology.
- 3. Raddose V dose assessment software will be evaluated by June 30, 2005, to determine what specific changes may be warranted in order to maintain consistency with the manual dose assessment calculation methodology.
- 4. Following approval of this license amendment request, future revisions to Accident Monitoring setpoint calculations will reflect the AST source term.
- 5. Following approval of this license amendment request, SCE will provide the revised UFSAR sections to the NFIC as part of its normal UFSAR update required by 10 CFR 50.71(e).