ENCLOSURE 2

CALCULATION N-4072-001 CCN-9 FUEL HANDLING ACCIDENT INSIDE FUEL HANDLING BUILDING – CONTROL ROOM & OFFSITE DOSES

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Scuthern California Edison Company ENGINEERING CHANGE	CALC NO. N-4072-001		ECN NO./ PRELIM, CON NO). N-8	PA	.GE 1	TOTAL NO. OF PAGES 24
CALCULATION CHANGE NOTICE (CCN) COVER PAGE	BASE CALC. REV. 6	UNIT 2&3		CCN CONVE CCN NO. CC	nsion	<u> </u>	CALC. REV.
	CALCULATION SUBJ	ECT: Fuel I & Offsite	landling Accid Doses	lent Inside	Fuel Hai	ndling B	ullding -
CALCULATION CROSS-INDEX	ENGINEERING SYST DESIGNATOR 15	EM NUMBER	PRIMARY STATION	SYSTEM		Q-CLASS 11	
Sile Programs/Procedure Impact? Sile No. YES, AR No.	CONTROLLED PROG DATABASE ACCORD S0123-XXIV-5.1			<i>N</i> DATABASE N. O, LISTED BEL	ame(s) ow	VERSION	I/RELEASE NO. (S)
10CFR50.59/72.48 Review: AR No. 040700770-08		DATABASE	<u> </u>	I/A	<u>.</u>	<u> </u>	N/A
 BRIEF DESCRIPTION OF ECN/CCN Appendix A is revised to evaluate their transfer cask containing 24 Unit 2 (or U Building. The drop is assumed to occur evaluation evaluating the drop of a trans Unit 2 or Unit 3 Fuel Handling Building Pages Revised: 7, 14, 250 the Pages Added: 262 through Pages Deleted: None 	radiological conse Unit 3) fuel assem ur prior to the trans nsfer cask contain s. nrough 261 270	quences a blies into ti sfer cask b ing 24 Uni	t the Exclusion he cask pool of being welded cl t 1 fuel assemb	Area Bound the Unit 2 (osed. App olies into the	dary duə (or Unit 3 endix A r cask poo	to the dri) Fuel Ha etains its of of eith	op of a andling e similar er the
INITIATING DOCUMENT (ECP. OTHER) AR 040 2. OTHER AFFECTED DOCUMENTS: VES NO OTHER AFFECT 3. APPROVED B Mark DRUCKER (POS T2RE42 & ORIGINATOR (Print name/sign/date) Approval requires POS T3EN64 Qualification Veril	D700770-07 ED DOCUMENTS EXIST 16/2006 T3EN64) ied	FLS (S Approv	ENTIFIED ON ATTAI	CHED FORM 26	1ev. <u>N/A</u> 503. [//6	106 VFN Initial	
TOM REMICK (POS T2RE42 & T3E IRE (Print name/sign/date) Approval requires POS T3EN64 Qualification Verit	ied: <u>TR</u>			200			(1). 40
4. CONVERSION TO CON DATE	121/06			8 1	SCE/CDM	<u>et</u> 1-songs	e hidden

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CALCULATION CROSS-INDEX

Sheet 7_of 270_

ECN NO./ PRELIM. CCN NO. N-8

PAGE 2 OF 24 CCN CONVERSION: CCN NO. CCN- 9

Calculation No. <u>N-407</u>

N-4072-001

Calc. rev. number and responsible	INPUTS These interfacing calculations documents provide input to the calculation, and if revised may rovision of the subject calcul	and/or subject require ation.	OUTPUTS Results and conclusions of the s calculation are used in these inte calculations and/or documer	subject erfacing hts.	Does the output interface calc/document require revision?	Identify output interface calc/document CCN, ECP, TCN/Rev., or
and date	Calc/Document No.	Rev. No.	Calc/Document No.	Rev. No.	YES/NO	tracking number
Rev. 6	Procedure SO23-X-7	10				
	Procedure SO23-X-7.2	6	······································			
	AOI SO23-13-20	· 7				
	Unit 1 Calculation DC-3782	0 & CCN 1				
	Calculation SNM-DBASE-11	11				
	Unit 2 Calculation NFM-2-PH-1216	0				
	Unit 3 Calculation NFM-3-PH-1216	0	·			
CCN N-8	SO1-207-1-M210	2	UFSAR 2/3-15.10 (Section 15.10.7.3.5)	32	YES	AR 040700770 - 18
VEN	RGR-U2/3-C14	1	DBD-SO23-TR-AA (Section 4.3.17)	7	YES	ECN # A40767
199						
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L <u></u>			<u> </u>	<u> </u>		

		E&TS	DEPARTME	ENT								
	C	ALCUL	ATION	SHEE	Т		ECN N PRELI	IO,/ M. CCN NO,	N-8	PAGE		24
Pro	ect or ECP		·	-	Calo	c. No. <u>N-407</u> 2	2-001		CONVER NO. CCI	RSION: N9		_
Sub	ject <u>Fuel Handli</u>	ng Accident	Inside Fuel Ha	andling Bui	lding -	CR & Offsite	Doses		Ę	Sheet 14	_of <u>2</u>	270
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DA	TE	IRE	DA	TE	R
6	N. YACKLE		T. REMICK									Ľ. V.
	M. DRUCKER		T. REMICK						·			₩
	For conserva removal by I	Fuel Har	alculation de ant Cleanup (F	PACU) Fil Tab	ter Ui le 2.1 the I	-1 Fuel Handlin	4ME3	and part 370 or S2 Iding Do	(3)150- ses	4ME371.	অ	
		Loc	ation		С	riteria (Rem)		Dos	e (Rem	l)		
	Control Ro [CR isolate	oom (event ed at 3 minu	duration dose ites])		20	CI	10 CFM R Unfiltered In Jeakage 3438 MWt 1.72 Radial Peaking	- 100 CR U 34 1.7 F	0 CFM infiltered In- eakage 38 MWt 25 Radial Peaking		
	Beta Skine	innalation kin Immersi Body Gami	on ma Immersion	and		30 30 5		5.6 1.2 < 0.1		9.3 1.2 <0.1		
	EAB (2-ho Thyroid Beta Sk Whole I Shine	ur dose) I Inhalation sin Immersi Body Gann	on na Immersion	and	no	75 dose criterior 6	n	18.4 0.1 < 0.1		18.8 0.1 <0.1		
	LPZ (event Thyroid Beta Sk Whole J Shine	duration d I Inhalation in Immersi Body Gam	ose) on na Immersion	and	no	75 dose criterior 6	n	0.5 < 0.1 < 0.1	<	0.5 <0.1 <0.1		

The EAB dose consequences of a transfer cask drop in the Units 1, 2 or 3 cask loading area are presented in Appendix A. The transfer cask can be loaded with up to 24 Unit 1, 2 or 3 spent fuel assemblies.

	E&TS	DEPARTM	ENT		_				
CA	ALCUL	ATION	SHEE	Т		ECN NO <i>J</i> PRELIM. CO	N NO. N-8	PAGE 4 OF	24
Project or ECP			-	Cal	c. No. <u>N-4072</u>	-001	CCN CONVERS	SION: 9	
Subject <u>Fuel Handli</u>	ng Accident	Inside Fuel Ha	andling Bui	lding	- CR & Offsite [Doses	She	eet <u>250</u> of <u></u>	270_
REV ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	R
6 N. YACKLE		T. REMICK							- v
M. DHUCKER		I. REMICK			I				Ť
A1.0 PURPO	OSE								
	·								
ALL LASK D	rescription								
The purpose of	this Append	ix is to assess	the dose co	nsequ	ences of a trans	fer cask dr	op in the Unit	1 Spent	
Fuel Building c	ask loading	area, or a trans	fer cask dro	op in t	the cask pool of	either the	Unit 2 or Unit	3 Fuel	
Handling Build	ing. A trans	fer cask drop is	s currently	not po	ostulated to occu	r in the U	nit 1 spent fue	l pool	
area because a s	single failure	e proof crane w	all be used	tor al	be used at Unit	1 calculates 2 and 3 t	tion is included	l IOF fer cask	
out of the cask	pools, a droi	can be postul	ated when t	he cas	sk is placed on t	he upper s	helf (i.e., step)) of the	
cask pool for lif	ting yoke ch	ange-out, prior	r to the tran	sfer c	ask being welde	d closed.	During this ev	olution,	
the cask is not r	estrained an	d could fall bac	ck into the l	lower	portion of the c	ask pool if	an earthquake	e occurs.	
The fuel rods fr	om all 24 U	nit 1 or Units 2	3 fuel asse	mblie h the	s that may be p	resent in a	transfer cask	are	
and noble gas re	emaining in a	the fuel rod gat	nipact with volume ar	n uie re exp	ected to be relea	sed from	the unwelded to	ransfer	
cask.				1					
The evolution	to across the	dronning of a	transfor ou	ale cor	taining Unite 7	2 fiel acc	mbliec provid	ec	
closure for AR	Assignment	040700770-07		SK CUI		J 1001 255	mones provid		
A1.2 Dose A	.cceptance (Criteria							
Standard Review	w Plan (SRF	P) 15.7.5 (Refe	rence A6.2	e, Sec	tion II.1) states	that the ra	diological		11
consequences of	f a postulate	d spent fuel cas	sk drop acc	ident	are acceptable i	f the calcu	lated whole-bo	ody and	
thyroid doses at	the exclusion	on area bounda	ry (EAB) a	nd lov	w population zon	ne (LPZ) o	uter boundary	are	
"well within" th	e exposure g	uideline values	5 of 10 CFF	C Part	100, paragraph	11 (i.e., 3	00 rem for the	thyroid	
10 CFR Part 10	ine whole-do	midelines Per	SRP 15.7.	.3, w .5 the	se "well within"	s 25 perci	values are 75	rem for	11
the thyroid dose	and 6 rem f	for the whole-b	ody dose. S	SRP 1	5.7.5 does not s	pecify a b	eta-skin dose c	riterion.	
Per Section A5.	0. this analy	sis conservativ	elv models	a puf	f release of activ	vity to the	environment.	In this	11
model, the sole	difference b	etween the excl	usion area	bound	lary (EAB) and	low popul	ation zone (LP	Z) doses	
would be in the	modeling of	the EAB and I	LPZ atmosp	oheric	dispersion facto	ors (X/Qs)	. Per Design		
Input 4.7, the 0	to 2 hour E	AB X/O is app	roximately	two o	rders of magnit	ide greate	than the 0 to 2	2 hour 1	1

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LPZ X/Q. Therefore, the EAB doses will be approximately two orders of magnitude greater than the LPZ doses. Since the EAB and LPZ have the same dose acceptance criteria, this analysis will only evaluate the radiological consequence at the EAB.

	E&TS	DEPARTM	ENT		F				
CA	ALCUL	ATION	SHEE	Т		ECN NO J PRELIM. CO	NNO. N-B	PAGE 5 OF	24
Project or ECP			-	Cal	c. No. <u>N-4072</u>	-001	CCN CONVER	N - 9	
Subject_Fuel Handli	ng Accident	Inside Fuel Ha	andling Bu	ilding -	CR & Offsite I	Doses	Sh	neet <u>251</u> of	270
REV ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	R
6 N. YACKLE		T. REMICK							Ε V
M. DRUCKER	وربية فيستعطين	T. REMICK							₩
M. DRUCKER A2.0 RESUL A2.1 Droppin 10 Yea The EAB whole transfer cask dra and 0.0027 rem decayed to zero. specified in Sect handling buildin Section 8.11, Ta The EAB beta s respectively. Th Table 2.1-1. Ho handling accider Analysis DBD.	LTS/CONC ng of a Tra s body gamm op in the Un (i.e., < 0.1 The whole tion A1.2, a g (FHA-FH able 8.11-1a kin doses fo nese beta ski powever, as n nt. Therefo	T. REMICK CLUSIONS AN ansfer Cask Conna doses due to it 2 or Unit 3 F rem), respective body gamma a nd are less seve (B) as reported b). r a transfer cass in doses exceed oted in Section re, the EAB be ansfer Cask Co	ND RECO ontaining 2 a transfer Fuel Handli ely. The th and thyroid ere than the in Section sk drop at U the 0.1 ren n A1.2, the tha skin dos	MME 4 Unit cask d ng Bui hyroid doses se of t 2.1 Ta Unit 1 m desig re is no e need 4 Unit	ENDATIONS 1 Fuel Assem rop in the Unit ildings (FHBs) dose is zero, sin are small comp he design basis ble 2.1-1 (base and Units 2/3 a gn basis FHA-F b EAB beta skin not be docume s 2/3 Fuel Asse	blies That 1 Spent Fr are 0.0094 are all the bared to th fuel hand d on the re re 0.78 ren HB dose and the dose critic inted in the comblies The	Have Decay and Building, of trem (i.e., < 0 iodine isotope e EAB dose of ling accident in esults presente m and 0.22 rem reported in Sea erion for a fue UFSAR or A	ed for or a 0.1 rem) s have riteria n the fuel id in n, ction 2.1 ccident ayed for	
5 Years The EAB doses containing 24 U through A8.7. I nearest 0.1 rem. The EAB whole (i.e., < 0.1 rem). Section A1.2, ar Table 2.1-1 (bas The EAB thyroid The thyroid dose of the design bas Section 8.11, Ta The EAB beta sl to 0.4 rem). Thi Table 2.1-1. Ho handling accider	due to the d nits 2/3 fuel Due to the in Doses less body gamm The whole ad is less sev ed on the re d dose due t meets the I sis FHA-FH ble 8.11-1a kin doses for s beta skin o wever, as n at. Therefor	ropping of a tra assemblies tha herent uncertai than 0.1 rem a a dose due to a body gamma o vere than that o sults presented o a transfer cass EAB 75 rem do B as reported i). r a transfer cass dose exceeds th oted in Section e, the EAB bet	ansfer cask at have deca inties in any re reported a transfer ca dose meets f the design in Section sk drop in the se criterion n Section 2 k drop in the contraction 2 k	in the ayed for y dose as such as k dro the EA h basis 8.11, ' he Unit specific .1 Tab	Unit 2 or Unit or 5 years are ca analysis, the re- ch. op in the Unit 2 AB 6 Rem dose FHA-FHB as Table 8.11-1a). t 2 or Unit 3 FI fied in Section . ole 2.1-1 (based 2 or Unit 3 FI basis FHA-FH basis FHA-FH basis FHA-FH	3 Fuel Ha alculated i sults are r or Unit 3 criterion s reported in HB is 0.04 A1.2, and on the res IB is 0.37 B dose rep a dose crite ted in the	ndling Buildin a Sections A8. ounded up to t FHB is 0.004: pecified in a Section 2.1 6 rem (i.e., < 0 is less severe t sults presented 3 rem (i.e., rou orted in Section crion for a fuel UFSAR or Acc	g (FHB) .5 the 5 rem 0.1 rem). than that in unded up on 2.1	

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E&TS DEPARTMENT

CALCULATION SHEET

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Subject Fuel Handling Accident Inside Fuel Handling Building - CR & Offsite Doses

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REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	R
6	N. YACKLE		T. REMICK							E V
	M. DRUCKER		T. REMICK							₩
										T

A3.0 MODELING ASSUMPTIONS

- A3.1 All fuel rods in the 24 assemblies loaded into the canister inside the transfer cask are conservatively assumed to be intact when they are loaded. All the fuel rods are then assumed to rupture as a result of the cask drop.
- A3.2 All of the radioactive material released into the Fuel Storage/Fuel Handling Building atmospheres is assumed to be instantaneously released to the outside environment as a puff release. The dose received at the exclusion area boundary (EAB) for a puff release is the same as the integrated dose for a two hour release.
- A3.3 A minimum of 10 years has elapsed since permanent discharge from the core for all Unit 1 fuel assemblies that are loaded into the canister/transfer cask.
- A3.4 A minimum of 5 years has elapsed since permanent discharge from the core for all Units 2 & 3 fuel assemblies that are loaded into the canister/transfer cask. This minimum decay time is consistent with the Certificate of Compliance for the Units 2/3 Spent Fuel Storage Cask 24PT4-DSC (Reference A6.2c, Section 2.2.c).

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		C	ALCUL	ATION	SHEE	Т		ECN NO./ PRELIM. CC	NNO. N-8		24
Pro	ject or E	CP			_	Cal	c. No. <u>N-4072</u> -	001		ISION: 9	
Sub	oject <u>Fu</u>	el Handli	ng Accid∋nt	Inside Fuel H	andling Bui	lding ·	- CR & Offsite [oses _	St	neet_253_of	270
REV	ORIG	INATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	R
6	N. YAG	CKLE		T. REMICK							E V
	M. DR	UCKER		T. REMICK	L						1
	A4.0 A4.1	DESIG The Un Unit 1 (All fiss	N INPUTS it 1 spent fu Cycle 11. E	el pool contain ind of Cycle 11 the spent fuel 1	s all assemi shutdown ods in the I	blies o occuri Init 1	off-loaded subse red on Novembe spent fuel pool	quent to sl r 30, 1992 have there	hutdown at th 2 (Reference A efore decayed	e end of A6.2a). for a	
		minimu occur n	m of 10 yea o earlier tha Per Referen Unit 2 sper	rs prior to the c n January, 200 nce A6.2a, the s at fuel pool is A	earliest estin 3. most recent ssembly G	mated ly off 029.	removal from the poor from the	he spent fu pent fuel a htly discha	assembly store	ch will cd in the d of Unit	
			Per Referen Unit 3 spen 1990). The Unit 1 (Reference and the asso	nce A6.2a, the r at fuel pool wer assembly with A6.2a). Since emblies which h	most recent e permanen the highest the Unit 1 s have been s	ly off tly dis burnu spent : tored	loaded Unit 1 sp scharged at the o up is located in t fuel pool contain the shortest time	pent fuel a end of Uni he Unit 1 ns the high e since rea	ssemblies stor t 1 Cycle 10 (spent fuel poo test burned as ctor shutdown s for Unit 1 a	red in the June 30, ol ssembly, n, the	
	A4.2	Per Ref invento:	stored in ei erence A6.1 ries at reacto	ther the Unit 2 a, Table 1, Col or shutdown (no Assembly I	or Unit 3 sp umn 5, Uni o decay) are Table odine and at Reactor	e A4.1 Noble	e Gas Inventori down	nd noble g l. es	as radioisotor	De	
				ISOTOP	E		ACTIVIT (ci/ass	Y (A₀) y)			
				I-131			25160	0			
				I-132			33950	0			
	-			I-133		46820	0				
				I-134			52610	0			
				I-135			45350	0			
1				Xe-131n			2650				

	E&TS	S DEPARTM	ENT		-				
CA		LATION	SHEE	T		ECN NO J PRELIM. CO	N NO: N-8		24
Project or ECP		<u> </u>	-	Calc	. No. <u>N-4072</u> -	001	CCN CONVER CCN NO. CCN	SION: 1 9	
Subject Fuel Handlin	ng Accider	nt Inside Fuel Ha	andling Bu	ilding -	CR & Offsite [)oses	Sh	eet <u>254</u> of	270
REV ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	R
6 N. YACKLE		T. REMICK							V V
M. DRUCKER	M. DRUCKER T. REMICK								₩.
		• •					الصحد		
		ISOTOP	'Е		ACTIVIT (ci/ass	Y (A ₀) y)			
		Xe-133n	n		1270	0			
		Xe-133			58660	0			
		Xe-135n	n		14010	0			
		Xe-135			18980	0			
		Xe-137			43760	0			
1		Xe-138			43570	0			
		Kr-83m	ł		36940)			
		Кл-85т			87900)			
		Кг-85			5120				
	•	Kr-87			18660	0			
		Кг-88			23500	0			
		Kr-89			34140	0			
	-								

- A4.3 Per Reference 6.4i, Section C.1d, all of the gap activity in the damaged Unit 1 fuel rods is released from the damaged fuel rods. This gap activity consists of 10 percent of the total noble gases other than Krypton-85, 30 percent of the Krypton-85, and 10 percent of the radioactive iodine in the rods at the time of the accident.
- A4.4 The decay constants for the all isotopes listed in Table A4.1 are shown in Table A4.2. The values for all isotopes are taken from References 6.6a (Theoretical Manual).

	Luio	DEFANIN			r r			
CA	LCUL	ATION	SHEE	T		ECN NO./ PRELIM. CC	N NO. N-8	PAGE 9 OF
oject or ECP			-	Cal	c. No. <u>N-4072</u> -	001		RSION: Q
ubject <u>FuelHandlir</u>	ng Accident	Inside Fuel H	andling Bu	ilding ·	CR & Offsite D)oses	S	heet 255 of 2
	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE
N. YACKLE		T. REMICK						
M. DRUCKER	هيده وزيري ويستعتني	T. REMICK	L				l	
		Is	Tab sotopic De	le A4.2 cay Co	2 onstants			
		ISOTOP	Έ		DECAY CONS (sec) ⁻	STANT ()	b	
		I-131			0			
		I-132			0.00008	343		
		I-133			0.0000	09		
		I-134			0.0002	2		
		I-135			0.00002	.91		
		Xe-131n	'n		0			
		Хс-133л	n ·		0.0000	04		
		Xe-133			0.0000	02		
		Хе-135п	n		0.0007	38		
		Xe-135			0.00002	12		
		Xe-137			0.00302	24		
		Xe-138			0.00081	51		
		Kr-83m	·		0.00010	52		
		Kr-85m			0.00004	43		
		Kr-85		_	0			
		Kr-87			0.00015	14		
		Kr-88			0.00006	73		
	Į	Kr-89			0.00363	32		

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bject <u>Fu</u>	el Handli	ng Accident	Inside Fuel Ha	andling Bui	<u>lding -</u>	CR & Offsite D	oses	Sł	neet_256_o	f <u>2</u>
ORIGI	NATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	
N. YAC	CKLE		T. REMICK			· · · · · · · · · · · · · · · · · · ·				
M. DR	UCKER		T. REMICK						_	
A4.5	Per Des the Kr-t the Kr-t m ³ /curit Per Des beta-ski	sign Input 4. 85 beta skin 85 whole bo e-sec. sign Input 4. in immersion	.8, the Kr-85 th immersion dos ody gamma imm .8, the I-129 th n dose conversi rsion dose conv	nyroid inhal se conversion nersion dose yroid dose o ion factor is version factor	ation of on fact e conver conver i 3.710 or is 3	dose conversion for (DCF _{bsi}) is 4 version factor (I rsion factor is 5. DE-04 rem-m ³ /cu .024E-03 rem-n	factor (D .246E-02 DCF _{wbgi}) is 92E+06 r urie-sec, a n ³ /curie-se	CF _{thy}) is 0.0 r rem-m ³ /curie s 5.102E-04 r em/curie, the nd the I-129	em/curie, -sec, and em- I-129 whole	
A4.6	Per Des 2.72E-0	ign Input 4.)4 sec/m³ fo	7, the exclusion r the Units 2/3	n area bour Fuel Handl	idary (ing Bi	(EAB) atmosphe uildings.	eric disper	sion factor (χ	(/Q) is	I
A4.7	Per Ref factor (erence A6.1 χ/Q) is 9.50	a, Design Inpu E-04 sec/m³ fo	t 2, the exc r the Unit 1	lusion Fuel	area boundary Storage Buildin	(EAB) atr g.	nospheric dis	persion	
A4.8	Per Des released 10 perc 12 perc	ign Input 4. I from the di ent of the to ent of the ra	1.1, all of the g amaged fuel roo tal noble gases dioactive iodin	gap activity ds. Per Des other than e in the rod	in the sign In Krypt s at th	damaged Units put 4.1.2, this g on-85, 30 perce e time of the acc	2 & 3 fue gap activit nt of the H cident.	el rods is assu y consists of Krypton-85, a	nmed to be	
A4.8 A4.9	Per Des released 10 perc 12 perc Per Des Table 3 after rea	ign Input 4. I from the da ent of the to ent of the ra ign Analysi .3-1), the U actor shutdo	1.1, all of the gamaged fuel rootal noble gases dioactive iodins NFM-2/3-PH nits 2 & 3 singtown is:	gap activity ds. Per Des other than e in the rod I-1116 (Ref le fuel rod 1	in the sign In Krypt s at th erence	damaged Units aput 4.1.2, this g on-85, 30 perce e time of the acc e 6.1aa, Section sotope iodine and	2 & 3 fue gap activit nt of the H cident. 4.3 and it d noble ga	el rods is assu y consists of Krypton-85, a s referenced s inventory fi	nmed to be nd we years	
A4.8 A4.9	Per Des released 10 perc 12 perc Per Des Table 3 after rea	ign Input 4. I from the da ent of the to ent of the ra ign Analysi .3-1), the U actor shutdo lodine-129 Krypton-85 All other io	1.1, all of the g amaged fuel roo tal noble gases dioactive iodin s NFM-2/3-PH nits 2 & 3 sing own is:	gap activity ds. Per Des other than e in the rod I-1116 (Ref le fuel rod 1 gas isotope	in the sign In Krypt s at th erence adiois 1. 1. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2. 2.	damaged Units aput 4.1.2, this g on-85, 30 perce e time of the acc e 6.1aa, Section cotope iodine and 20E-04 curies/r 90E+01 curies r 00E+00 curies/r	2 & 3 fue gap activit nt of the H cident. 4.3 and it d noble ga od rod	el rods is assu y consists of Krypton-85, a s referenced s inventory fi	nned to be nd ive years	
A4.8 A4.9	Per Des released 10 perc 12 perc Per Des Table 3 after rea Design years af analysis non-nob	ign Input 4. I from the da ent of the to ent of the to ent of the ra ign Analysi .3-1), the U actor shutdo Iodine-129 Krypton-85 All other io Analysis NH fter reactor s s since Regu- ole gas gap a	1.1, all of the g amaged fuel roo tal noble gases dioactive iodin s NFM-2/3-PH nits 2 & 3 sing own is: 5 odine and noble FM-2/3-PH-11 shutdown. Ho latory Guide 1 activity releases	gap activity ds. Per Des other than e in the rod I-1116 (Ref le fuel rod 1 gas isotope 16 documen wever, per .25 Section s from dama	in the sign In Krypt s at th erence radiois 1. 1. 2. 3. 0. 1. 1. 2. 1. 2. 1. 2. 3. 2. 1. 3. 3. 3. 3. 3. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5.	damaged Units aput 4.1.2, this g on-85, 30 perce e time of the acc e 6.1aa, Section cotope iodine and 20E-04 curies/r 90E+01 curies r 00E+00 curies/r presence of trit a Input 4.1.1 tri does not require uel rods.	2 & 3 fue gap activit nt of the H cident. 4.3 and it d noble ga od rod rod tium in an tium is no considera	el rods is assu y consists of Trypton-85, a s referenced s inventory fi average fuel a t considered in ation of non-io	amed to be nd we years rod five n this odine or	
A4.8 A4.9 A4.10	Per Des released 10 perc 12 perc Per Des Table 3 after rea Design years af analysis non-nob	ign Input 4. I from the di- ent of the to ent of the to ent of the ra ign Analysi .3-1), the U actor shutdo Iodine-129 Krypton-85 All other io Analysis NH fter reactor s since Regu- ole gas gap a nit 2 or Unit	1.1, all of the g amaged fuel roo tal noble gases dioactive iodin s NFM-2/3-PH nits 2 & 3 sing own is: 5 odine and noble FM-2/3-PH-11 shutdown. Ho latory Guide 1 activity releases t 3 fuel assemb	gap activity ds. Per Des other than e in the rod I-1116 (Ref le fuel rod 1 gas isotope 16 documen wever, per .25 Section s from dama	in the sign In Krypt s at th rediois 1. 1. 2.1d aged fu 236 ft	damaged Units aput 4.1.2, this g on-85, 30 perce e time of the acc e 6.1aa, Section totope iodine and 20E-04 curies/r 90E+01 curies r 00E+00 curies/r presence of trit n Input 4.1.1 tridoes not require uel rods.	2 & 3 fue gap activit nt of the H cident. 4.3 and it d noble gat od rod rod tium in an tium is no considerat	el rods is assu y consists of Krypton-85, a s referenced s inventory fi average fuel n t considered in ation of non-io	amed to be nd ive years rod five n this odine or	
A4.8 A4.9 A4.10 A4.11	Per Des released 10 perc 12 perc Per Des Table 3 after rea Design years af analysis non-nob Each U: Per Ass	ign Input 4. I from the di- ent of the to ent of the ra ign Analysi .3-1), the U actor shutdo Iodine-129 Krypton-85 All other io Analysis NH ter reactor s since Regu- ble gas gap a nit 2 or Unit umption 3.1	 1.1, all of the gamaged fuel root tal noble gases dioactive iodin s NFM-2/3-PH nits 2 & 3 sing own is: 5 odine and noble FM-2/3-PH-11 shutdown. Ho latory Guide 1 activity releases t 3 fuel assemble, the EAB brook is the table brook is the tab	gap activity ds. Per Des other than e in the rod I-1116 (Ref le fuel rod 1 gas isotope 16 documer wever, per .25 Section s from dama ly contains eathing rate	in the sign In Krypt s at th erence adiois 1. 1. 2.1d C.1d aged fu 236 fu is 3.4	damaged Units aput 4.1.2, this g on-85, 30 perce e time of the acc e 6.1aa, Section sotope iodine and 20E-04 curies/r 90E+01 curies r 00E+00 curies/r presence of trit a Input 4.1.1 trid does not require uel rods. nel rods (Referen 7E-04 m ³ /sec.	 2 & 3 fue 2 & 3 fue 3 ap activit ant of the H cident. 4.3 and it d noble gat od rod rod ium in an tium is no consideration 	el rods is assu y consists of Krypton-85, a s referenced s inventory fi average fuel a t considered in tion of non-io , Item XI.006	amed to be nd we years rod five n this odine or	
A4.8 A4.9 A4.10 A4.11	Per Des released 10 perc 12 perc Per Des Table 3 after rea Design years af analysis non-nob Each U: Per Ass	ign Input 4. I from the di- ent of the to ent of the to ent of the ra ign Analysi .3-1), the U. actor shutdo Iodine-129 Krypton-85 All other io Analysis NH ter reactor s since Regu- ble gas gap a nit 2 or Unit umption 3.1	 1.1, all of the gamaged fuel rootal noble gases dioactive iodin s NFM-2/3-PH nits 2 & 3 singtown is: odine and noble FM-2/3-PH-11 shutdown. Ho latory Guide 1 activity releases t 3 fuel assemble t 3 fuel assemble t 3 fuel assemble t 4 fuel assemble 	gap activity ds. Per Des other than e in the rod I-1116 (Ref le fuel rod 1 gas isotope 16 documen wever, per 25 Section s from dama ly contains eathing rate	in the sign In Krypt s at th erence adiois 1. 1. 2. 1. 2. 1. 2. 1. 2. 1. 2. 1. 2. 2. 1. 2. 2. 3. 4. 2. 3. 4. 2. 2. 3. 4. 2. 2. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5.	damaged Units aput 4.1.2, this g on-85, 30 perce e time of the acc e 6.1aa, Section sotope iodine and 20E-04 curies/r 90E+01 curies r 00E+00 curies/r presence of trit n Input 4.1.1 tridoes not require uel rods. hel rods (Referent 7E-04 m ³ /sec.	2 & 3 fue cap activit nt of the H cident. 4.3 and it d noble ga od rod for ium in an tium is no consideration nce A6.2d	el rods is assu y consists of Krypton-85, a s referenced s inventory fi average fuel n t considered in tion of non-io , Item XI.006	amed to be nd we years rod five n this odine or	

E&TS DEPARTMENT ECN NOJ CALCULATION SHEET PAGE IL OF 2" PRELIM. CCN NO. N-8 CCN CONVERSION: Project or ECP Calc. No. N-4072-001 CCN NO. CCN --Subject Fuel Handling Accident Inside Fuel Handling Building - CR & Offsite Doses Sheet 257 of 270 REV ORIGINATOR DATE IRE DATE REV ORIGINATOR DATE IRE DATE R E N. YACKLE T. REMICK 6 ν 1 M. DRUCKER T. REMICK A5.0 METHODOLOGY All calculations in this Appendix were completed using a spread sheet, or were done by hand using a calculator. The Unit 1 iodine and noble gas radioisotope 10-year decayed assembly inventories were calculated using the following equation for radioactive decay (Reference A6.2b): $A = A_0 e^{-\lambda t}$ Where Inventory of isotope A at time t (ci) Α = A₀ Inventory of isotope A at time t = 0 (ci) = λ decay (transformation) constant of isotope A (sec⁻¹) = t = elapsed time (sec) The preceding equation is not required when evaluating the dropping of a cask loaded with Unit 2 or 3 fuel. Design Input A4.9 presents the Units 2 & 3 iodine and noble gas radioisotope 5-year decayed fuel rod inventories. Since a puff release is assumed for this calculation, the beta skin, whole body and thyroid doses received at the EAB for each isotope is given by the following equation: D_{bsi} or $D_{wbgi} = A_R * \chi/Q * DCF$ $D_{thv} = A_R * \chi/Q * BR * DCF_{thv}$ Where D Dose (beta skin immersion, whole body gamma immersion or thyroid) (rem) Ξ Inventory released for each isotope (ci) A_{R} Ξ Atmospheric dispersion factor (sec/m³) γ/Q = Dose Conversion Factor (beta skin immersion or whole body gamma immersion) DCF Ξ (rem-m³/ci-sec) $DCF_{thy} =$ Dose Conversion Factor (thyroid inhalation) (rem/ci) Breathing Rate at the EAB (m³/sec) BR =

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	C	ALCUL	ATION	SHEE	Т		ECN NO <i>.</i> PRELIM. CO	N NO. N-8	P	AGE 12 OF	24
Proj	ect or ECP	<u></u>		- .	Calc	. No. <u>N-4072</u>	001			DN: Q	
Sub	ject <u>Fuel Handli</u>	ng Accident	Inside Fuel H	andling Buil	ding -	CR & Offsite [Doses		Shee	t_258_of	270
REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRI		DATE	R
6	N. YACKLE	 	T. REMICK			 					
	M. DRUCKER		T. REMICK						, ei		
	The preceding e puff release are	equations are eliminated.	e adapted from	Reference (5.6a, S	Section 4.3; terr	ns that are	e not appl	icable f	for a	
	The inventory r		2011 150t0p0 15	$A_{(assembly)} = A$	4 _(rod) *	N _(rod)					
				$A_{\rm R} = A_{\rm (asso}$	* *	n*f					'
	Where										
	A(assembly	») =	Assembly	y decayed in	ivento	ry (ci/assy)					
	A _(rod)	=	Single Fu	el Rod deca	ayed in	nventory (ci/rod)				!
	N _(rod)	=	Number	of fuel rods	per as	sembly (rod/as	sy)				
	n	=	Number of	of assemblie	es in c	ask (assy)	٢				
	f	=	gap fract	ion (unitless	;)	·					
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		C	ALCUI		SHEE	T		ECN NO./ PRELIM. CC	N NO. N-8	PAGE 13 OF	2 <u>4</u>
Pro	ject or E	CP			_	Cal	c. No. <u>N-4072</u> -	001		sion: 9	
Sub	ject <u>Fu</u>	el <u>Handli</u>	ng Acciden	t Inside Fuel H	andling Bui	ilding -	CR & Offsite E	oses	Sh	eet_259_of 2	270
REV	ORIGI	NATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	R
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┞	M. DRI	JCKER		T. REMICK					I		#
	A6.0	REFE	RENCES								
	A6.1	Calcula	ations								
	A6.1a	SONGS Handlir	5 Unit 1 Ca 1g Accident	lculation No. D ", dated 10/29/9	C-3782, R 92, includir	evision ng CCl	n 0, "SONGS 1 N No. 1 dated 0	E-Plannir 6/02/94.	ng Doses Due 1	to Fuel	
	A6.2	Other I	Documents								
	A6.2a	SNM-E 05/05/9	DBASE-10, 19; Appendi	Software Instal x C Excerpt inc	llation Rep cluding the	ort, "S data b	pecial Nuclear I ase listing for U	Material I nit 1.	Database", dat	ed	
	A6.2b	Cember	, Herman, '	"Introduction to	Health Ph	ysics",	, Second Edition	i, Pergamo	on Press, 1989). T	
	A6.2c	Docum Casks - Limits"	ent SO1-20 T e chnical :	7-1-M210, Rev Specifications f	ision 2,"IS or the Adv	FSI Co anced 1	ertificate of Cor NUHOMS Syst	npliance f em Opera	or Spent Fuel ting Controls a	Storage and	
	A6.2d	Docum	ent RGR-U	2/3-C14, Revisi	ion 1,"SON	igs u	nits 2/3 Cycle 1	4 Reload	Ground Rules	".	
	A6.2e	NUREC July 19	G-0800, Sta 81.	ndard Review I	Plan 15.7.5	, Revis	sion 2, "Spent F	uel Cask I	Drop Accident	s",	
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		CA	ALCUL	ATION	SHEE	Т		ECN NO / PRELIM. CO	N NO. N-8	PAGE 14 OF	24
Proj	ect or E	CP	·		-	Cal	c. No. <u>N-4072</u>	2-001	CCN CONVER	sion: 9 V 9	
Sub	ject <u>Fu</u>	el Handli	ng Accident	Inside Fuel Ha	andling Bui	ilding -	CR & Offsite	Doses	SH	ieet <u>260</u> of	<u>270</u>
REV	ORIGI	NATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	R
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	M. DRI	JCKER		T. REMICK							₽
	A7.0	NOME	NCLATU	RE						·	
		EAB	exc	clusion area bo	undary						
		A ₀	Inv	ventory of isoto	pe A at tim	net = () (ci)				
		λ	dec	ay (transform:	tion) const	ant of	isotope A (sec	-1)			
		DCF	dos	se conversion f	actor						

DCF_{bsi} dose conversion factor, beta skin immersion (rem-m³/curie-sec)

DCF_{wbgi} dose conversion factor, whole body gamma immersion (rem-m³/curie-sec)

DCF_{thy} dose conversion factor, thyroid inhalation (rem/ci)

BR breathing rate at the EAB (m³/sec)

 χ/Q atmospheric dispersion factor (sec/m³)

Inventory of isotope A at time t (ci)

elapsed time (sec)

Α

t

D Dose (beta skin immersion, whole body gamma immersion, or thyroid) (rem)

A_R Inventory released for each isotope (ci)

A_(assembly) Assembly decayed inventory (ci/assy)

A_(rod) Single Fuel Rod decayed inventory (ci/rod)

n Number of assemblies in cask (assy)

N_(rod) Number of fuel rods per assembly (rod/assy)

f gap fraction (unitless)

D_{wbgi} whole body gamma immersion dose (rem)

D_{bsi} beta skin immersion dose (rem)

D_{thy} thyroid inhalation dose (rem)

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		CA	ALCUL	ATION	SHEE	Т		ECN NO <i>.</i> / PRELIM. CC	N NO. N-8	PAGE	24
ļ	^{>} roj	ect or ECP		·	-	Calc	. No. <u>N-4072</u>	001		NON:Q	
ç	Subi	ect Fuel Handlir	na Accident	Inside Fuel Ha	andling Bui	ldina -	CR & Offsite [)oses	She	 et 261 of 2	270
Γ	REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	R
	6	N. YACKLE		T. REMICK							E V
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		assy	ass	sembly							
		ci	cui	rie							
		sec	sec	ond							
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CA	LCUL	ATION	SHEE	T	ſ	ECN NO / PRELIM. CO	CN NO. N-8	PAGE 6	DF 24
Project or ECP			_	Cald	. No. <u>N-4072</u>	001		SION: Q	
Subject_Fuel Handlin	ng Accident	Inside Fuel Ha	andling Bu	ilding -	CR & Offsite [Doses	<u></u> Sh	eet 262	of 270
	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	F
6 N. YACKLE		T. REMICK							E V
M. DRUCKER		T. REMICK						<u> </u>	
A8.0 COMPO The Unit 1 iodin calculated in a sp in Table A8.1.	e and noble pread sheet	S gas radioisoto using the equa Unit 1 Iodine	pe assemb tion for rad TABL and Noble	ly investionactiv LE A8.	ntory 10 years a ve decay provid 1 Assembly Inver	after react ed above. ntory	or shutdown a The results a	re re shown	}
		ISOTOP	E		UNIT 1 ASS ACTIV (A _{(assemi}) (ci/ass	EMBLY ITY _{3(y)}) y)			
		I-131			0				
		I-132			0				
		1-133			0				
		I-134			0				
		I-135			0				
		Xe-131n	n		0				
		Xe-133n	n		0				
		Xc-133			0				
		Xe-135n			0				
		Xe-135			0		•		
		Xe-137			0				
		Xe-138			0				
		Kr-83m			0		1		
		Kr-85m		1	0				
		Kr-85			2679				
		Kr-87	<u></u>		0				

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CALC	ULATION S			í.				
roject or ECP		HEE	T		PRELIM. CC	N NO. N-8	PAGE 17	$p_F \underline{Z}$
bject_Fuel Handling Acc			Calc	. No. <u>N-4072</u> -	001	CCN CONVER	SION: Q	
bjoor <u>radi naming</u> noe	vident Inside Fuel Han	ndlina Bui	ildina -	CR & Offsite D	loses	Sh	eet 263 (of 2'
	TE IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	
N. YACKLE	T. REMICK							
M. DRUCKER	T. REMICK							
	ISOTOPE			UNIT 1 ASS ACTIVI (A _{(assent})	EMBLY TY ' ^{Iy)}			
	Kr-88			0	,,			
	Kr-89			0				
The Units 2&3 iodine calculated in Table A8 the Units 2 and 3 asser $A_{(assembly)} = A_{(rot)}$	and noble gas radioiso 3.2 by the following eq mbly Krypton-85 activ _{od}) * N (rod) = (19.0 ci/ro	otope asse uation inf vity after od) * (23)	embly i troduce 5 years 6 rods/	nventory 5 year ed in Section Af s of decay is: 'assy) = 4.484E	s after rea 5.0. As a +03 ci/ass	ctor shutdown sample calcu y	n are lation,	
The Units 2&3 iodine calculated in Table A8 the Units 2 and 3 asser $A_{(assembly)} = A_{(ro}$	and noble gas radioiso 3.2 by the following eq mbly Krypton-85 activ od) * N (rod) = (19.0 ci/ro Units 2&3 Iodine 5 Years	otope asse uation in vity after od) * (23) TABL and Nob s After R	embly i troduce 5 years 6 rods/ E A8.: ble Gas eactor	nventory 5 year ed in Section A2 s of decay is: (assy) = 4.484E (assy) = 5.000 (assy) =	s after rea 5.0. As a +03 ci/ass entory	ctor shutdown sample calcu y	n are lation,	
The Units 2&3 iodine calculated in Table A8 the Units 2 and 3 asser $A_{(assembly)} = A_{iro}$ ISOTOPE	and noble gas radioiso 3.2 by the following eq mbly Krypton-85 activ ad) * N (rod) = (19.0 ci/ro Units 2&3 Iodine 5 Years UNITS 2&3 FUEL ROD ACTIVITY AT 5 YEARS [Assumption A3.4 (ci/rod)	tope asse uation in vity after od) * (23) TABL and Nob s After R	embly i troduce 5 years 6 rods/ E A8.: E A8.: Je Gas eactor FUEL UN FUEL Design (ro	nventory 5 year ed in Section A s of decay is: 'assy) = 4.484E 2 s Assembly Inv Shutdown RODS PER ITS 2&3 ASSEMBLY a Input A4.10] ods/assy)	s after rea 5.0. As a +03 ci/ass entory U As A A	ctor shutdown sample calcu y NITS 2&3 SSEMBLY CTIVITY CTIVITY C5 YEARS (ci/assy)	n are lation,	
The Units 2&3 iodine calculated in Table A8 the Units 2 and 3 asser $A_{(assembly)} = A_{(ro}$ ISOTOPE	and noble gas radioiso 3.2 by the following eq mbly Krypton-85 activ ad, * N (rod) = (19.0 ci/rod) Units 2&3 Iodine 5 Years UNITS 2&3 FUEL ROD ACTIVITY AT 5 YEARS [Assumption A3.4 (ci/rod) 1.20E-04	otope asse uation int vity after od) * (23) TABL and Nob s After R	embly i troduce 5 years 6 rods/ E A8. E A8. De Gas eactor FUEL UN FUEL Design (ro	nventory 5 year ed in Section A s of decay is: 'assy) = 4.484E 2 s Assembly Inv Shutdown RODS PER UTS 2&3 ASSEMBLY a Input A4.10] ods/assy) 236	s after rea 5.0. As a +03 ci/ass entory U AS A A A	ctor shutdown sample calcu y NITS 2&3 SSEMBLY CTIVITY CTIVITY C5 YEARS (ci/assy)	n are lation,	

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		C	ALCUL	ATION	SHEE	Т		ECN NO./ PRELIM. CC	N NO. N-8	PAGE 18 OF	24
Proj	ect or E			<u> </u>	-	Cal	c. No. <u>N-4072</u>	001	CCN CONVERS	SION: 9	
Sub	ject <u>Fu</u>	e <u>l Handli</u>	ng Accident	Inside Fuel H	andling Bui	lding -	CR & Offsite D)oses	Sh	eet_264_of	270
REV	ORIGI	NATOR	DATE		DATE	REV	ORIGINATOR	DATE	IRE	DATE	RE
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	A8.1	Droppe Immer	ed Cask of I sion Dose	Unit 1 Fuel in	the Unit 1	Fuel I	Building, Unit 1	EAB WI	hole Body Ga	mma	1
	Per Ta	ble A8.1	above, Assu	umption A3.1 a	and Design	Inputs	A4.3, A4.5 and	I A4.7:			
		A _{(assmbly})=Assembly	decayed inven	tory =	2.	679E+03 ci/ass	у			
		n	=Number o	of assemblies in	a cask =	24	4 assy				
		f	=gap fracti	on = 30%/1	00% =	0.	30				
}		χ/Q	=9.50E-04	sec/m ³							
l		DCFwbg	;=5.102E-04	4 rem-m ³ /curie	-sec.						
{	And			· .							
		D _{ubgi} =	A * χ/Q * D)CF _{wbgi}							
		D _{wbgi} =	A _(assmbly) * n	* f * χ/Q * DC	F _{wbgi}						
		D _{wbgi} =	2.679E+03	ci/assy *24 ass	y*0.30*9.5	0E-04	sec/m ³ *5.102E	E-04 rem-r	n ³ /curie-sec		
		D _{wbgi} =	9.35E-03 re	m							
		-									
ł											
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	C	ALCUL	ATION	SHEE	Т		ECN NO./ PRELIM. CC	N NO. N-8	PAGE 19 OF	24
Project or	ECP			_	Calc	c. No. <u>N-4072</u> -	001		sion:9	
Subject_F	uel Handli	ing Accident	Inside Fuel Ha	andling Bui	ilding -	CR & Offsite [loses	Sh	eet <u>265</u> of	270
REV ORI	GINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	R
6 N.Y/	ACKLE		T. REMICK							v v
M. D	RUCKER		T. REMICK	<u> </u>						+
A8.2	Droppe Dose	ed Cask of I	Unit 1 Fuel in t	the Unit 1	Fuel I	Building, Unit 1	EAB Be	ta Skin Imme	ersion	
Per T	able A8.1	above, Assu	mption A3.1 a	and Design	Inputs	A4.3, A4.5 and	1 A4.7:			
	A _(assmbly))=Assembly	decayed invent	tory =2.0	679E+	03 ci/assy				
	n	=Number o	f assemblies in	a cask =24	assy					
	f	=gap fracti	on = $30\%/1$	00% =0.3	30					
	χ/Q	=9.50E-04	sec/m ³							
	DCF _{bsi}	=4.246E-02	2 rem-m ³ /curie	-sec.						
And,										
	$D_{bsi} = A$	\ * χ/Q * DC	CF _{bsi}							
	$\mathbf{D}_{bsi} = \mathbf{A}$	(assmbly) * n *	f * χ/Q * DCF	bsi						
	$D_{bsi} = 2$.679E+03 ci	/assy *24 assy	*0.30*9.50)E-04 s	sec/m ³ *4.246E-	02 rem-m	³ /curie-sec		
	$D_{hti} = 7$.77E-01 ren	1							
• •	• .									1

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	C	ALCUL	ATION	SHEE	T	ſ	ECN NOJ PRELIM. CO	IN NO. N-8	PAGE OF	24
Project or E	ECP			-	Cal	c. No. <u>N-4072</u>	001		ISION: 9	
Subject <u>F</u> u	iel Handli	ng Acciden	t Inside Fuel H	andling Bu	ilding -	CR & Offsite [Doses	Sł	1eet <u>266</u> of	<u>270</u>
REV ORIG	INATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	R
6 N. YA	CKLE		T. REMICK		4					
A8.3	Droppe Body C	ed Cask of Gamma Imr	Unit 1 Fuel in nersion Dose	the Unit 2	or 3 F	uel Handling F	Building, I	Unit 2/3 EAB	Whole	
Feili	1010 AO. I	above, Assi	umpuon A3.1 a	and DestEn	mputs	A4.5, A4.5 all	J A4.0.			
	A _(assmbly)	= As	sembly decaye	d inventory	Ý	= 2	2.679E+03	3 ci/assy		
	n	=Number o	of assemblies in	n cask =	24	4 assy				
	f	=gap fracti	ion = $30\%/1$	00%	=	0.30				
	χ/Q	=2.72E-04	sec/m ³							
:	DCF_{wbg}	_i =5.102E-0	4 rem-m ³ /curie	-sec.					· .	
And,									:	
	D _{whgi} =	A * χ/Q * D	DCF _{wbgi}							
	D _{wbgi} =	A _(assmbly) * n	* f * χ/Q * DC	F _{wbgi}						
	$D_{whei} = 1$	2.679E+03	ci/assy *24 ass	sy*0.30*2.	72E-04	sec/m ³ *5.102E	E-04 rem-1	n ³ /curie-sec		-
	D=	2.68E-03 re		•						
	Wbgi									
					×					
1										

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			E&TS	DEPARTME	ENT		_				
		C	ALCUI		SHEE	Т		ECN NO./ PRELIM. CO	NNO. N-B	PAGE 21 OF	24
Pro	ject or E				-	Cal	. No. <u>N-4072</u>	001	CCN CONVER	SION: 9	
Sub	ject <u>Fu</u>	iel Handli	ng Acciden	t Inside Fuel Ha	andling Bui	ilding -	CR & Offsite D	loses	Sh	eet <u>267</u> of <u>2</u>	270
REV	ORIG	INATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	R
6	N. YA	CKLE		T. REMICK	a				<u> </u>		v
	A8.4 Per Ta	Droppo Skin In able A8.1	ed Cask of nmersion D above, Ass	Unit 1 Fuel in t Dose umption A3.1 a	the Unit 2 nd Design	or 3 F Inputs	uel Handling E A4.3, A4.5 and	Building, N H A4.6:	Unit 2/3 EAB	Beta	
		A _(assmbly)	=Assembly	decayed invent	ory =2.0	679E+	03 ci/assy				
		n	=Number of	of assemblies in	cask =24	assy					
		f	=gap fract	ion = 30%/10	00% =0.3	30					
		χ/Q	=2.72E-04	sec/m ³							
		DCF_{bsi}	=4.246E-0	2 rem-m ³ /curie-	sec.						
	And,										
		$D_{bsi} = A$	Δ * χ/Q * D(CF _{bsi}							
		$D_{bsi} = A$	(assmbly) * n *	* f * χ/Q * DCF	bsi						
		$D_{bsi} = 2$.679E+03 c	i/assy *24 assy	*0.30*2.72	2E-04 s	sec/m ³ *4.246E-	02 rem-m	/curie-sec		
		$D_{bsi} = 2$.23E-01 ren	n							
]											

	E&	TS DEPARTME	ENT	_			
	CALCI	JLATION	SHEET	E	ECN NO./ PRELIM. CCN N	10. N-8 P	AGE 22
ct or EC	<u> </u>		Cal	c. No. <u>N-4072-</u>			^{N:} 9
ect_Fuel	Handling Accic	lent Inside Fuel Ha	ndling Building ·	CR & Offsite D	oses	Shee	t_268
ORIGINA	TOR DATE	IRE	DATE REV	ORIGINATOR	DATE	IRE	DAT
N. YACK	LE	T. REMICK					
M. DRUC	ЖER	T. REMICK					
I I I The total Unit 2 or	$A_{ubgi} = A_{(assmbby)}$ $A_{ubgi} = 4.484E+$ $A_{ubgi} = 4.5E-03$ $A_{ubgi} = 4.5E-03$ $A_{ubole body ga}$ $A_{ubole body ga}$ $A_{ubole body ga}$ $A_{ubole body ga}$	* n * f * χ/Q * DCl -03 ci/assy *24 ass rem mma immersion do 2-03 rem.	Fwbgi y*0.30*2.72E-04 se at the EAB du TABLE A8.5	4 sec/m³*5.102E ne to a dropped c 5-1	-04 rem-m³/c	curie-sec 2&3 fuel in t	the
Isotope	U23 Assembly Activity [Table A8.: (ci/assy)	Number of Damaged Assemblies per Cask [Sect. A3.1] (assy/cask)	Damaged Fuel Rod Gap Release Fraction [Sect. A4.8] (unitless)	U23 to EAB Atmospheric Dispersion Factor [Sect. A4.6] (sec/m ³)	Whole Bo Gamma Immersio DCF [Sect. A4 (rem-m ³ /ci	dy Whole Gam on Immer 5] -s) (ren	Body ma sion se n)
1-129	2.832E-0	2 24	0.12	2.72E-04	3.024E-0	3 6.7E	-08

2.72E-04

-

5.102E-04

-

4.5E-03

4.5E-03

Kr-85

TOTAL

4.484E+03

-

24

-

0.30

-

	E&TS	DEPARTM	ENT		_					
C	ALCUI		SHEE	Г	E	ECN NOJ PRELIM. CO	ON NO. N	i- 8	PAGE 23	OF 24
Project or ECP			-	Cal	c. No. <u>N-4072-</u>	001	CCN C CCN N	ONVERS	SION: 9	
Subject_Fuel Hand	ing Acciden	t Inside Fuel Ha	andling Build	ding ·	CR & Offsite D	oses		She	eet <u>269</u>	of <u>270</u>
REV ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE		IRE	DATI	E R
6 N. YACKLE		T. REMICK								E V
M. DRUCKER		T. REMICK								↓
As a sample ca $D_{bsi} = 1$	lculation, th $A_{(assumbly)} * n^{2}$	e Krypton-85 b f * γ/Q * DCF	eta-skin imn	nersio	on dose is:					
$D_{bsi} = 0$ $D_{bsi} = 0$	4.484E+03 d 3.73E-01 rei	i/assy *24 assy n	*0.30*2.721	E-04	sec/m [*] 4.246E-(02 rem-m	r'/curie-	sec		
The total beta s FHB is 3.73E-	skin immersi D1 rem.	on dose at the E	EAB due to a	ı droj	oped cask of Uni	its 2&3 fi	uel in th	e Unit 2	2 or 3	
			TABLE	A8.6	5-1					
Isotope	U23	Number of	Damage	ed	U23 to EAB	Beta	Skin	Beta	Skin	

Isotope	U23 Assembly Activity [Table A8.2]	Number of Damaged Assemblies per Cask [Sect. A3.1]	Damaged Fuel Rod Gap Release Fraction [Sect. A4.8]	U23 to EAB Atmospheric Dispersion Factor [Sect. A4.6]	Beta Skin Immersion DCF [Sect. A4.5]	Beta Skin Immersion Dose
	(ci/assy)	(assy/cask)	(unitless)	(sec/m ³)	(rem-m ³ /ci-s)	(rem)
I-129	2.832E-02	24	0.12	2.72E-04	3.710E-04	8.23E-09
Kr-85	4.484E+03	24	0.30	2.72E-04	4.246E-02	3.73E-01
TOTAL	-	_	-	-	-	3.73E-01

	E&1	FS DEPART	MENT				
	CALCL	LATIO	N SHEE	T	ECN N PRELI	0./ M. CCN NO. N-8	PAGE 24 OF
ct or ECP				Calc. No	N-4072-001		IVERSION: 9
ect_ <u>Fuel H</u>	andling Accid	ent Inside Fue	Handling Bu	ilding - CR &	Offsite Doses	•	Sheet <u>270</u> of
ORIGINAT	OR DATE	IRE	DATE	REV ORIG	INATOR DA	TE IRE	DATE
N. YACKL	E	T. REMIC	к				
M. DRUCK	KER	T. REMIC	к				
A8.7 Di Th Table A8.7 129 and K	ropped Cask (nyroid Inhala) 7-1 documents rypton-85 fror	of Units 2&3 tion Dose the input valu n the damaged the lodine-12	Fuel in the Units and resultand function of the second sec	nit 2 or 3 Fue int thyroid inhuel present in t	l Handling B alation dose d he dropped ca	uilding, Unit 2 ue to the releas sk.	2/3 EAB se of Iodine-
As a samp	le calculation,	the follow-12:	9 myroid innai				
D	$hy = A_{(assmbly)} *$	n*f*χ/Q*H	3R * DCF _{thy}				
D	$_{hy} = 2.832 \text{E-}02$	2 ci/assy*24 as	ssy*0.30*2.72	E-04 sec/m ^{3*}	3.47E-04 m³/s	ec*5.92E+06	rem/curie
D	_{hy} = 4.6E-02 r	em					
The total t is 4.56E-0	hyroid inhalati 2 rem.	on dose at the	EAB due to a	dropped cask	of Units 2&3	fuel in the Ur	uit 2 or 3 FHB
			TABL	E A8.7-1			
Isotope	U23 Assembly Activity	Number of Damaged Assemblies per Cask	Damaged Fuel Rod Gap Release Fraction	U23 to EAB Atmospheric Dispersion Factor	Breathing Rate	Thyroid Inhalation DCF	Thyroid Inhalation Dose
L	lable	1			100	[Sect 145]	1 11
	[Table A8.2] (ci/assy)	[Sect. A3.1] (assy/cask)	[Sect. A4.8] (unitless)	[Sect. A4.6] (sec/m ³)	[Sect A4.11] (m ³ /sec)	(rem/ci)	(rem)
I-129	[1 able A8.2] (ci/assy) 2.832E-02	[Sect. A3.1] (assy/cask) 24	[Sect. A4.8] (unitless) 0.12	[Sect. A4.6] (sec/m ³) 2.72E-04	[Sect A4.11] (m ³ /sec) 3.47E-04	(rem/ci) 5.92E+06	(rem) 4.6E-02
I-129 Kr-85	[1 able A8.2] (ci/assy) 2.832E-02 4.484E+03	[Sect. A3.1] (assy/cask) 24 24	[Sect. A4.8] (unitless) 0.12 0.30	[Sect. A4.6] (sec/m ³) 2.72E-04 2.72E-04	[Sect A4.11] (m ³ /sec) 3.47E-04 3.47E-04	(rem/ci) 5.92E+06 0.00	(rem) 4.6E-02 0.00

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