#### F-3.4.1-1 Rev 6

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ORIGINATING ORGANIZATION: Westinghouse Electric Company LLC

## TITLE: Process Mass Balance for AP1000 Solid Waste

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## **Process Mass Balance for AP1000 Solid Waste**

## UKP-GW-GL-004, Revision 1

Westinghouse Electric Company LLC 1000 Westinghouse Drive Cranberry Township, PA 16066

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#### **REVISION HISTORY**

Revision	Description of Changes
0	Initial Submittal
1	Added radwaste building and spent fuel pool area LLW exhaust filters. HLW package calculation amended to include rod clusters stored within the fuel assemblies during dry storage.
	Incorporates Design Change Proposals APP-GW-GEE-2083, Rev. 0; APP-GW-GEE-2084, Rev. 0; APP-GW-GEE-2085, Rev. 0.

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#### **Process Mass Balance for AP1000 Solid Waste**

Process Mass Balance for AP1000 Solid Waste, Aker Solutions Document Number 63000333-000-000-111-C-0001 provides information relating to the number of solid waste packages and annual volume of waste that will be produced over the 60 year operating life of an AP1000<sup>™</sup> nuclear power plant. It supports the UK Generic Design Assessment of the AP1000 plant.

# AkerSolutions

Phoenix House Surtees Business Park 3 Surtees Way Stockton-on-Tees TS18 3HR

## Westinghouse Electric Company

**Process Mass Balance** 

for

**AP1000 Solid Waste** 

## AP1000 RADWASTE

## AKER SOLUTIONS PROJECT NO: 63000333

## CLIENT PROJECT NO:

H&SF		OCUMENT NUMBER	63000 PER File	333	000 -	000 - 111 -	C - 0001
	Status						Client
Rev	PEM	Description	Date	Ву	Checked	Approved	Approved
6	S3	Encapsulation drum volume updated from 3m <sup>3</sup> to 2.2m <sup>3</sup> in line with comments from NDA	16/04/2009	A Carson	D Mayes	J McLeary	
7	S3	Update in line with new waste values	16/11/2009	A Carson	D Mayes	J McLeary	See Westinghouse Cover Sheet
8	S3	Update to make title appropriate for the scope of the calculations	08/02/2010	A Carson	D Mayes	J McLeary	See Westinghouse Cover Sheet
9	S3	Radwaste building and Spent Fuel Pool exhaust LLW dry filters added. HLW packages calculation amended to include rod clusters within fuel assemblies in dry storage.	23/03/2011	P Watson- Jones	A Carson	G Stephenson	See Westinghouse Cover Sheet

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	REVISION SUMMARY
Revision	Description of Change
1	Preliminary Issue
2	Revision of calculations using waste arisings and activities values updated by Westinghouse on 10/07/08 (Client Doc Nu. 63000333-02-00244-RevB)
3	Revision of calculations to reflect revised waste arisings specification from WEC (Reference correspondence 63000333- 02-000244) 10 July 2008, and included in Process Basis of Design document (Reference= 630000333-001-000-111-S- 0001 Rev4)
4	No changes to calculation from Revision 3. Calculation raised to Revision 4, S3 PEM status for incorporation in E.R.
5	Contact names deleted from Tables 1 and 10. Glossary added
6	Encapsulation drum volume updated from 3m <sup>3</sup> to 2.2m <sup>3</sup> in line with comments from NDA
7	Updated in line with new waste values from Westinghouse. Calculation re-written and all unncessary calculation removed to provide consistency with other documents
8	Update to make title appropriate for the scope of the calculations
9	LLW dry filters from Radwaste building and Spent Fuel Pool exhausts added. LLW wet and dry filter volumes amended to be consistent with the Environment Report. HLW packages calculation amended in line with assumption that rod clusters will remain within fuel assemblies when loaded into MPCs.

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42								F		
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1 2 1.0 Purpose of Calculation								-
3 4 The purpose of this calculation is provide i	nformation relating to	the numbe	er of solid w	aste nack:	ades and	annual vol	ume of waste th	at will
	-				ayes anu			
			iong plant					-
6 7 This calculation will provide details of the a	annual volume of and	number of		and HI W i	nackaries	produced	from the operati	00
$\frac{7}{8}$ and maintenance activities over the lifetim					puokugeo	produced		-
9								-
<u> </u>								-
11 The Design Basis used to perform the follo	wing calculations are	described	helow:					
12		acsonaca						
13 1. Actual 3m <sup>3</sup> drum and box capacity is 2	2 2m <sup>3</sup> (waste capacity)	)				Ref 1		-
$_{14}$ 2. ILW resin loading per drum is 25% by		,				Ref 2		
15 3. LLW resin loading per drum is 50% by						Ref 5		
16 4. Fault plant conditions occur 1 in every	5 years of operation					Ref 3		
17 5. LLW will be loaded into 200L drums						Ref 5		
18 6. HHISO has internal volume of 14.8m <sup>3</sup>	i					Based	on Croft Desigr	n –
19						No. 29	910	
20 7. 200L (39 of) drums can be loaded int	o 1 HHISO container					Based	on experience	
21 8. Volume Reduction Factor from comag	oction is 3.6					Ref 4		
22 9. Density of wet carbon is 0.45Te/m3						Ref 6		
23 10. Density of Ion Exchange Resin is 1.12	2 Te/m3					Ref 7		
24 11. Filter length is 624mm and filter radius	s is 259mm					Ref 8		
25 12. ILW filter loading per box is 30%						Based	on experience	
26 13. Fuel changed on 18 month equilibriur	n cycle (64 assemblies	s)				Ref 3		
27 14. Initial fuel assembly loading in reactor	is 157 fuel rods, 53 C	control				Ref 3		
28 Rod clusters and 16 Gray Rod cluster	S							
29 15. All Control Rod and Gray Rod cluster	s replaced at same tim	ne				Assun	ned	_
30 16. All wastes will be kept separate from		•						_
31 17. LLW Dry filters and Carbon are non-c			lume reduc	tion prior to	o disposa	I		-
32 18. Voidage when loading 200L drums ha								-
33 19. Control Rod and Gray Rod Custers w				s with spen	it fuel	D (0		-
34 20. Holtec International MPC's can be loa						Ref 3		-
<ul> <li>35 21. Holtec International MPC's will be use</li> <li>36 22. LLW pumps and stacks are loaded di</li> </ul>		-		adod with '	2001 drur	00		-
36 22. LLW pumps and stacks are loaded di 37						115		-
38								
39 <b>3.0 Method</b>								F
40								F
41 The calculation method is outlined within t	he body of the calcula	tion ( page	es 8	to 39).	The wast	es have be	en seperated in	to
42 operational and maintenance wastes. In s	-			-			-	F
43 into compactible and non-compactible. In		•	•					F
44 outlined in a table at the end of the waste	stream calculation.							
45								
46								
47								
48								L
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1	4.0 Results									-		
2	Individual results are provided within the boo	dy of the calculation	The annu	ial waste vo	lume and	number o	f wasto na	ckages produced	l ner	_		
4	waste stream is calculated (taking into acco							ings are then	i pei	-		
5	summarised and split into the specific total r					,		5	of			
6	the plant (See pages 40 and 43).											
7												
8	5.0 Conclusions											
9												
10	This calculation has demonstrated the numb	per of solid waste co	ntainers g	enerated ov	ver the ope	rating life	time of an	AP1000 and has	;			
11	found that the following number of waste pa	ckages will be produ	iced from	operation a	nd mainter	ance act	ivities over	the 60 year				
12	operating life of the AP1000;											
13									_			
14	LLW = 636 HHISO's								_			
15	ILW = 1116 3m <sup>3</sup> boxes/drums HLW = 83 Holtec Internatio											
	HLW = 83 Holtec Internatio											
17 18	The calculations used to determine these va	alues can be seen or	nades 8	to 39 of this	calculatio	n and the	results fro	m these calculat	ions	-		
10										_		
20												
21	This calculation has demonstrated the annu	al volume of waste of	enerated	over the op	erating life	time of a	n AP1000 a	and has found th	at the			
22	following average volume of waste will be p									_		
23						, <b>,</b> ,				_		
	Raw LLW = 175.60 m <sup>3</sup>									_		
25	Raw ILW = 10.25 m <sup>3</sup>											
26												
27	Packaged LLW = 82.43 m <sup>3</sup>											
28	Packaged ILW = 40.86 m <sup>3</sup>											
29				4- 00 - <b>f</b> 4b i-					-			
30	The calculations used to determine these va						results fro	om these calculat	ions			
31	are summarised in Table 29 to Table	33 IN Section 12 (30		Summary)	or this call	culation.			_	_		
32										-		
33 34									F	_		
35									F			
36									F			
37									Ĺ			
38										1		
39												
40									Ļ			
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42									F			
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1	6.0	Calculation of the	Number	of Solid I	Radioactiv	ve Waste	Packages	S Produce	ed from P	lant Oper	ations		
2	The num	ber of waste packag	ges of sol	id Radwas	te produce	ed annual	ly and ove	r the operation	ation perio	od of the p	lant is cald	ulated	
3	in this se	ction, and the result	s summa	rised in	Table 25	and	Table 27						
4													
	6.1	Primary Resin											
6		mary resin is compr	ised of th	e following	ı.			Normal	Max				
7	1	CVCS Mixed Bed F		ie ionowing	j,		=	0.94	1.89	m <sup>3</sup> / year		Annondiv	2
			<b>NESIII</b>							-		Appendix	
8	2	CVCS Cation Bed					=	0.47	0.94	m <sup>3</sup> / year		Appendix	
9	3	SFS Demineralizer					=	1.42	2.83	m <sup>3</sup> / year		Appendix	
10	4	WLS unit 1 INORG	ANIC res	sin			=	1.13	2.27	m <sup>3</sup> / year		Appendix	2
11	5	WLS units 2,3,4					=	3.82	7.65	m <sup>3</sup> / year		Appendix	2
12													
13	The spen	t primary ILW resin	will be er	ncapsulate	d in 3m <sup>3</sup> d	lrums.							
14	Actual dr	um working capacity	y is			=	2.2	m³			Ref 1		
15	The resin	loading per drum (l	by volum	e) is		=	25%				Ref 2		
16				- ,									
	Thoroford	volumo of rooin to	ho onoor	oulated pa	or drum	_	Volumo	f Drum v	rooin lood	ing per dru	100		
17	mereiore	e volume of resin to	be encap	osulated pe		=				ing per un	1111		
18						=	2.2	X 3	25%				
19						=	0.55	m³					
20													
21	The expe	cted normal volume	e of prima	iry spent re	esin produ	ced per ye	ear =	7.79	m³/yr				
22													
23	Therefore	e the normal numbe	r of drum	s produced	d per year		=	Volume o	of resin pe	r year / vo	lume of re	sin per dru	ım
24							=	7.79	١	0.55			
25							=	14.1603	≤	15	drums pe	r year	
26													
20 27	The mavi	mum volume of prin	narv sner	nt resin nro	duced ner	vear =		15.58	m <sup>3</sup> /yr				
	THE HIAX			it realin pre		ycar –		10.00	III /yi				
28	<b>T</b> I (								<i>c</i> .	1		· .	
29	Inerefore	e the maximum num	iber of dr	ums produ	cea per ye	ear	=			-	lume of re	sın per arı	ım
30							=	15.58	١	0.55			
31							=	28.3206	≤	29	drums pe	r year	
32													
33	Maximum	n arisings result from	n fault pla	ant conditio	ons.								
34													
35	Fault plar	nt conditions occur	1	in every	5	years					Ref 3		
36	•												
30 37	Therefore	e the number of drur	ms produ	ced in 5 ve	ears of one	eration	=	(4 x norm	al arising	s) + (1 x m	naximum a	risinas)	
			produ	yc			=	(4 x 110111	14.1603	, ,	28.3206		
38								,					
39							=	84.9618	≤	85	drums		
40							<u> </u>					-	
41	The num	ber of drums produc	ced in 20,	40 and 60	) years car	n be calcu	lated in a	similar wa	y and are	shown in		Table 1	below;
12													
43		No. of years		f drums									
44		operation	pro	duced									
45		5		85									
46		20	3	340									
40 47		40		680									
+/		60		020	-								
40		00	1 1	020	1								
48 49		Table 1 : Numbe				00 4 "	M = -!						

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1														
2	6.2	Secondary Resir	1											
3														
4	Spent Se	condary resin com		-	;				Normal	Мах				
5	1	Condensate polis						=	3.85	7.70		Appendix		
6	2	Steam Generator	Blowdown	Material (R	esin and	Membrar	ne)	=	0.00	0.00	m <sup>3</sup> / year	Appendix	2	
7														
		t secondary LLW r		e encapsula	ted in 20	0L drums								
-		um working capaci	-			=	0.2	m <sup>3</sup>			Ref 5			
10	The resin	loading per drum	(by volume	e) is		=	50%				Ref 5			
11														
12	Therefore	e volume of resin to	be encap	sulated per	drum	=		of Drum x	resin loadi	ing per dru	um			Н
13						=	0.2	X	50%					
14						=	0.1	m <sup>3</sup>						-
15														
16	The norm	al volume of seco	ndary spen	t resin prod	uced per	year =		3.85	m³/yr					
17														
18	Therefore	e the normal numb	er of drums	s produced	per year		=			-	lume of re	sin per dru	um	
19							=	3.85	1	0.1				
20							=	38.516	≤	39	drums pe	r year		
21									0					
22	The maxi	mum volume of pr	mary spen	t resin prod	uced per	year =		7.70	m³/yr					
23	<b>T</b> I (								<b>c</b> .	,		· .		
24	Ineretore	e the maximum nur	nber of dru	ims produce	ea per ye	ar	=			-	lume of re	sın per arı	um	
25							=	7.70	١	0.1				_
26							=	77.032	≤	78	drums pe	r year		
27			6 H I											
	Maximum	n arisings result fro	m fault plai	nt condition	S.									
29	E a cité a la c	4			-						D-60			
	Fault plar	nt conditions occur	1	in every	5	years					Ref 3			
31	Therefore			ad in Europ	no of one	ration	_	(4)				ricione)		
	Therefore	e the number of dru	ims produc	ed in 5 yea	irs of ope	ration	=		-		naximum a	insings)		
33							=	(4 x 231.096	38.516 ≤	) + 232	77.032 drums			
34							-	231.090	2	232	arums			
35	The num	per of drums produ	iced in 20	40 and 60 y	leare con	he calou	lated in a r	similarwa	v and are	shown in		Table 2	below;	$\vdash$
36	THE HUIII				rears Udl			annar Wa	y and are				JCIUW,	$\vdash$
37		No of years	Nort	drums										$\vdash$
38		No. of years operation		luced										$\mathbb{H}$
39		5		32										$\square$
40		20		25										$\square$
41 42		40		349										$\vdash$
42		60		774										$\vdash$
43		Table 2 : Numb			d over L	OP for LL	.W resin							$\square$
44 45														
45														$\square$
40														
47														
40														$\square$
49 50														H
55			1				ons E & C Ltd.							

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1															
2	6.3	Wet Cha	rcoal												
3															
4	Spent We			s of the fo	llowing;				Normal	Max					
5		WLS unit	1 charcoa	al				=	0.57	1.13	m <sup>3</sup> / year		Appendix	: 2	_
6															_
7					could be e				-	-	Resin. H	owever for	r the purp	oses	_
8					at the sper			ncapsulate	d seperate	əly.					_
9					ulated in 3r	n <sup>3</sup> drums	i.		2			5.44			_
10		um workin		-			=	2.2	m <sup>3</sup>			Ref 1			_
11	The carb	on loading	per drum	n (by volun	ne) is		=	25%				Ref 2			╞
12															_
13	Therefore	e volume o	of carbon t	to be enca	apsulated p	per drum	=		of Drum x (		ading per	drum			╞
14							=	2.2	X 3	25%					┢
15							=	0.55	m <sup>3</sup>						$\vdash$
16			_							3.					-
17	The norm	al volume	of spent	Wet Carbo	on produce	ed per ye	ar =		0.57	m³/yr					_
18	Therefor	the recent		n of drumos			-		Mahuma a	f aanhan r		ualuma af			┢
19	Ineretore	e the norm	iai numbe	r of arums	s produced	i per year		=			-	volume of	carbon pe	arum	_
20								=	0.57	1	0.55	drumo no	r voor		-
21								=	1.030	≤	2	drums pe	ryear		-
22	The meyi	mum volu	me of one	ant Wat Cr	orbon prod	luced per	voor -		1 1 2	3.					_
23	The max		me or spe	int wet Ca	arbon prod	uced per	year –		1.13	m³/yr					┢
24	Thorofor	the mavi		abor of dru	ums produc	ood por v	oor		Volumo o	f oorbon r	or year /	volumo of	oorbon n	ar drum	┢
25	THEFEIOR					Jeu per ye	201	=	1.13		0.55	volume of	carbon pe		┢
26								=	2.060	` ≤	3	drums pe	r voar		+
27								-	2.000		5	urums pe	i yeai		┢
28 29	Maximun	arieinae	result from	n fault nlau	nt conditio	ne									
	Maximun	i ansings i		ii iault piai		15.									┢
30	Fault play	nt conditio		1	in every	5	years					Ref 3			-
31	i aut pla			· · ·		J	years								-
32 33	Therefore	the numb	her of drui	ms produc	ced in 5 ye	ars of on	eration	=	(4 x norm	al arising	s) + (1 x m	naximum a	arisinas)		-
33 34	1110101010							=	(4 x	1.02984	, ,	2.05968	linelinge)		-
34 35								=	6.17904	≤	7	drums			-
36															-
37	The num	per of drui	ms produc	ced in 20.	40 and 60	vears ca	n be calcu	lated in a	similar wa	v and are	shown in		Table 3	below;	-
38						,				,					-
39		No. of	years	No. of	f drums	1									
40			ation		duced										-
41		ļ	5		7										
42		2	0	2	25										1
43		4	0	Ę	50										1
44		6	0	7	75										1
45		Table 3	: Numbe	r of drum	ns produce	ed over l	OP for W	et Carbor	ו (ILW)						1
46															T
47															T
48															T
															1
49															

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1	6.4	ILW Filters												
2	Spent ILV	V filters are comp	rised of the	following;					Normal	Max				
3	1	CVS RC filter car	tridge					=	0.032	0.063	m <sup>3</sup> / year	Appendix	2	
4	2	SFS filter cartridg	le					=	0.032	0.063	m <sup>3</sup> / year	Appendix	2	
5	3	WLS inlet filter ca	artridge					=	0.063	0.127	m <sup>3</sup> / year	Appendix	2	
6	4	WLS outlet filter of	cartridge					=	0.032	0.063	m <sup>3</sup> / year	Appendix	2	
7	5	WSS resin fines f	filter cartrid	ge				=	0.032	0.063	m <sup>3</sup> / year	Appendix	2	
8														
9	The spen	t ILW filters will be	e encapsula	ated in 3m <sup>3</sup>	<sup>3</sup> boxes.									
10	Actual bo	x working capacit	y is			=	2.2	m <sup>3</sup>			Ref 1			
11	The filter	loading per box (b	y volume)	is		=	30%				Assumed			
12														
13	Therefore	volume of filters	to be encap	osulated pe	er box	=	Volume of	of Drum x	filter loadi	ng per box	(			
14						=	2.2	х	30%					
15						=	0.66	m <sup>3</sup> of filte	er per box					
16														
17	No. of filt	ers per box = Volu	ime of filter	s per box /	Volume	of Filter								
		ers per box	=	0.66	1	0.011				(See Pa	30 for filter	volume)		-
19		ers per box	=	59.2368	≤	59	per box			( 3		, ,		-
20	110. 01 110			00.2000			por box							
21	The norm	al volume of ILW	Filters proc	luced per y	/ear =			0.19	m³/yr					
22	The norm			uceu per y				0.13	iii / yi					-
22	Therefore	e the normal numb	er of filters	produced	ner vear		=	Volume	of filters pe	er vear / vo	olume of a	filter		-
	Therefore			produced	por you		=	0.19		0.011				-
24							=	17.0812		18	filters per	Vear		-
25							_	17.0012		10	inters per	year		-
26	The meyi	mum volumo of ll	\// filtoro pr	aduced pe	r voor –			0.29	3,					_
27	The maxi	mum volume of IL	w mers pr	oduced pe	ir year –			0.38	m³/yr					_
28	<b>T</b> I (							N / 1	6.614	,				_
	Ineretore	the maximum nu	mber of filte	ers produc	ed per ye	ar	=			-	olume of fil	ters per a	rum	
30							=	0.38	١	0.011				_
31							=	34.1625	≤	35	filters per	year		_
32		arisings result fro												
33	Fault plar	nt conditions occu	r <mark>1</mark>	in every	5	years					Ref 3			_
34														_
35	Therefore	e the number of fill	ters produc	ed in 5 yea	ars of ope	ration	=	(4 x expe			( maximum	arisings)		_
36							=	(4 x	17.0812		34.1625			_
37							=	102.487	≤	103	filters			
38														
39	Therefore	the number of bo	oxes produc	ced in 5 ye	ars of ope	eration	=	No. of filt	ers / No. c	of Filters p	er box			
40							=	103	١	59				
41							=	1.746	≤	2	boxes per	5 years		
42														
43	The num	per of boxes produ	uced in 20,	40 and 60	years car	n be calcu	lated in a	similar wa	y and are	shown in		Table 4	below;	
44		No. of years	No. o	f boxes										
45		operation	pro	duced										
46		5		2	1									
47		20		7										
48		40		14										
υr		60		21										
49		00												

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1	6.5	Dry Solids	and	Dry Cha										
2		waste and Dry C		prises of th	e following	<b>]</b> ;								
3	1	DAW - compacta												_
4	2	DAW - non-com	pactable											_
5	3	DAW - mixed												_
6	4	Strippable coatin												_
7	5	WGS guard bed												_
8	6	WGS delay bed	s charcoal											_
9														_
10		te stream is split												_
11	⊢or the p	urposes of this ca	aculation it	nas been a	issumed th	hat that th	e carbon i	is a non-co	ompactabl	e waste				+
12	6 5 4	Compactable												_
13	6.5.1	Compactable	hio otro	oomericas	of the fell-	wina:		Normal	Mass					_
14		able waste from t		comprises		wing;		Normal	Max			A	0	_
15		DAW - compacta					=	134.52		m <sup>3</sup> / year		Appendix		_
16	2	Strippable coatir	ngs				=	0	0	m <sup>3</sup> / year		Appendix	2	_
17														_
18	<b>T</b> L			-t										_
19		pactible waste wi um working capa		cted in 200	L arums.		0.0	m <sup>3</sup>			Ref 5			_
20	-		-			=	0.2	m						_
21	volume r	eduction by comp	baction			=	3.6				Ref 4			_
22	The norm		nactible w	ata produc	ad partice	or –		134.52	m <sup>3</sup> /s/r					_
23	The norm	nal volume of con	ipactible wa	aste produc	ea per yea	ar =		134.52	m /yr					-
24	The com	a atad yaluma of	this wests	ia	=	Actual va	dumo of u	ianta / nom	nontion f	actor				_
25	The com	pacted volume of	this waste	15	-	134.52		aste / con/ 3.6		actor				_
26 27					=		m <sup>3</sup> /yr	5.0						_
27					-	57.57	111 / yi							_
	Therefore	e the normal num	ber of drum	is produced	l per vear		=	Volume o	of waste p	er year / v	olume of c	trum		_
30					, poi you		=	37.37	۱ ۱۹۹۹	0.2				_
31							=	186.837	≤	187	drums pe	er vear		_
32												, ,		_
33	The maxi	mum volume of c	compacted	waste prod	uced per y	/ear =		205.61	m <sup>3</sup> /yr					
34				· ·					111 / y1					
35	The com	pacted volume of	this waste	is	=	Actual vo	olume of w	/aste / com	naction f	actor				
36					=	205.61		3.6						$\top$
37	1				=		m <sup>3</sup> /yr	0.0						
38	1					57.71								$\top$
39	Therefore	e the maximum n	umber of dr	ums produ	ced per ve	ar	=	Volume o	of waste p	er year / v	olume of c	drum		$\uparrow$
40					. ,-		=	57.11	1	0.2				$\uparrow$
41							=	285.566	≤	286	drums pe	er year		
42														T
43	Fault plai	nt conditions occu	ur 1	in every	5	years					Ref 3			
44														T
45	Therefore	e the number of d	rums produ	iced in 5 ye	ars of ope	eration	=	(4 x expe	cted arisi	ngs) + (1 x	maximun	n arisings)		T
46	1		-		-		=	(4 x	186.837		285.566			T
47							=	1032.91	≤	1033	drums			T
48														T
49	1													T
50														1

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1	The numb	per of drui	ms produc	ed in 20, 4	40 and 60	years ca	n be calcu	lated in a	similar wa	y and are	shown in		Table 5	below;	
2 3			f years ation		drums luced										
4		-	5	. 10	)33										-
5			20		32										-
6		4	0	82	264										1
7		6	60	12	395										
8		Table 5	: Number	r of drum	s produce	ed over L	OP for co	mpactible	e Dry was	ste (LLW)					
9															
10	6.5.2	Non - Co	mpactabl	е											
11	Non - Cor	npactable	e waste fro	m this str	eam comp	orises of th	ne followin	g;	Normal	Max					
12			on-compac					=	6.63	10.56	m <sup>3</sup> / year		Appendix	2	
13		DAW - m						=	0.14	0.28	m <sup>3</sup> / year		Appendix	2	
14	3	WGS gua	ard bed ch	arcoal				=	0.15	0.30	m <sup>3</sup> / year		Appendix	2	
15			ay beds ch					=	0.15	3.02	m <sup>3</sup> / year		Appendix	2	
16															
17	The non -	compact	able waste	e will be co	ompacted	in 200L d	lrums.								
18	Actual dru	ım workin	g capacity	' is			=	0.2	m <sup>3</sup>			Ref 5			
19															
20	The norm	al volume	e of non - c	ompactat	ole waste	produced	per year =	-	7.07	m³/yr					
21															
22	Therefore	the norm	al number	of drums	produced	l per year		=		of waste p	er year / v	olume of o	drum		
23								=	7.07	١	0.2				
24								=	35.3441	≤	36	drums pe	er year		
25															_
26	The maxi	mum volu	me of non	- compac	cted waste	produce	d per year	=	14.17	m³/yr					_
27															_
28	Therefore	the maxi	mum num	ber of dru	ms produo	ced per ye	ear	=			er year / v	olume of c	drum		
29								=	14.17		0.2				
30								=	70.8581	≤	71	drums pe	er year		_
31						_						<b>D</b> (A			_
32	Fault plan	it conditio	ns occur	1	in every	5	years					Ref 3			
33	<b>T</b> I (		6.1			,			1.		>				
34	Ineretore	the num	per of drun	ns produc	ed in 5 ye	ars of ope	eration	=			ngs) + (1 x		n arisings)		
35								=	(4 x	35.34		70.8581			+
36								=	212.234	≤	213	drums			+
37	The numb	oer of drug	ms produc	ed in 20	40 and 60	Vears oo	n he calou	lated in a	similar wa	v and are	shown in		Table 6	below;	+
38						years ca	n De calcu		Sirindi Wa	iy and are	SHOWITIN			DEIUW,	╉
39			f years ation		drums luced										+
40			5		13										╉
41 42			20		49										+
			0		598										+
43 44			50 00		547										╉
44 45						ed over L	OP for no	on-compa	ctable Dr	v waste i	ncluding l	Drv Carbo	on (LLW)		╈
45					1					,		,	、·/		╉
40															╈
47															╈
40 49															╈
73															┢

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1	7.0	Calculatio	on of the I	Numbe	r of Solid	Radioact	ive Wast	e Packag	es Produc	ed from	Plant Mai	ntenance			
2	The numb	per of waste	e packages	s of sol	id radwast	tes produc	ed by ma	intenance	of the pla	nt is calcu	ulated in th	is section a	ind is		
3	summaris	ed in	Table 25	and	Table 26										
4															
5	7.1	LLW Wet	Filters												
6	Wet LLW	filters comp	orise of the	e follow	ing;										
7	1	Refuelling	pool unde	er wate	r filtration	=	3	filters / ch	nange				Appendix	2	
8		system filt	er cartridg	е											
9	2	Bag filter (	(Sludge)			=	1	filter / cha	ange				Appendix	2	
10															
11	The volun	nes of the v	vet LLW fil	ters are	e;										
12	1	Refuelling			r filtration	=	2.95	ft <sup>3</sup>	=	0.084	m <sup>3</sup> / char	nge	Appendix	2	
13		system filt	er cartridg	е											
14	2	Bag filter (	(Sludge)			=	1.4	ft <sup>3</sup>	=	0.040	m <sup>3</sup> / char	nge	Appendix	2	
15															
16	Frequenc	y of replace	ement is as	s follow	'S;										
17	1	Refuelling			r filtration	=	1	per year					Appendix	2	
18		system filt	er cartridg	е											
19	2	Bag filter (	(Sludge)			=	1	per year					Appendix	2	
20															
21	The volun	ne of wet Ll	LW filters	produce	ed per yea	ar;									
22	1	Refuelling			r filtration	=	0.084	x	1	=	0.084	m <sup>3</sup> / year			
23		system filt	er cartridg	е											
24	2	Bag filter (	(Sludge)			=	0.040	x	1	=	0.040	m <sup>3</sup> / year			
25									Total	=	0.123	m <sup>3</sup> / year			
26															
27	It is assur	ned for the	purposes	of this	calculatior	h that these	e filters w	ill be enca	psulated i	n a simila	r way to th	at of the Se	econdary		
28	Ion Excha	inge Resin	i.e. the vo	lume of	f the waste	e package	will be 50	0% filters.							
29															
30	The Wet I	LW filters	will be end	apsula	ted in 200	L drums.									
31	Actual dru	ım working	capacity is	s			=	0.2	m <sup>3</sup>			Ref 5			
32	The filter	oading per	drum (by	volume	e) is		=	50%				Ref 5			
33															
34	Therefore	volume of	filters to b	e enca	psulated p	er drum	=	volume o	f drum x fi	lter loadir	ng per drur	n			
35							=	0.2	х	50%					
36							=	0.1	m <sup>3</sup> of filte	r per drur	n				
37															
38		per of drum			-		=	Volume o	of filters pe	r year / v	olume of fi	lters per dr	um		
39	The numb	per of drum	s produce	d in one	e year of o	operation	=	0.123	1	0.1					
40	The numb	er of drum	s produce	d in one	e year of o	operation	=	1.232	≤	2	drums pe	er year			
41															
42															
43															
44															
45															
46															
47															
48															
49															
50															

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1															
2	The numb	per of drum	s produced	d in 20	, 40 and 6	0 years car	be calcu	ulated in a	similar w	ay and ar	e shown in		Table 7	below;	
3															
4		No. of	-		of drums										
5		opera		pro	duced										_
6		5			7										_
7		2	-		25										_
8		4			50										_
9		-	0		74				<b>6</b> 14						_
10		Table 7	: Number	r of dri	ums prod	uced over	LOP for	Wet LLW	filters.						_
11	7 0		Filters												+
	7.2	LLW Dry	FIITELS												+
13		filters comp	rise of the	follow	ina:										+
	1				-	iciency Filte	er A	_	4	filtore / -	hongo	Appondix			+
15	2				-	iciency Filte		=	4	filters / c		Appendix 2			+
16 17	3		ent Exh HE		-			=	4	filters / c filters / c		Appendix 2 Appendix 2			+
17	4	Containme						=	4	filters / c		Appendix 2 Appendix 2			-
19	5	Cont Exh				/ filter Δ		=	1	filters / c		Appendix 2 Appendix 2			-
20	6	Cont Exh		-	-			=	1	filters / c		Appendix 2 Appendix 2			-
20	7		Fool Exhau	-	-			=	1	filters / c	Ū.	Appendix 2			-
22	8		Exh Upsti			ency Filter		=	18	filters / c		Appendix 2			_
23	9		Exh HEP			ing i noi		=	18	filters / c		Appendix 2			
24	10					Efficiency F	Total	=	12	filters / c		Appendix 2			
25	11		el Pool Exh					=	12	filters / c		Appendix 2			
26											- <u>J</u> -				
27															
28	Frequenc	y of replace	ement is as	s follow	/S;										
29	1	Containme	ent Exh Up	pstrear	n High Eff	iciency Filte	er A		=	0.33	per year		Appendix	2	
30	2	Containme	ent Exh Up	pstrear	n High Eff	iciency Filte	er B		=	0.33	per year		Appendix	2	
31	3	Containme	ent Exh HE	EPA filt	er A				=	0.2	per year		Appendix	2	
32	4	Containme							=	0.2	per year		Appendix	2	
33	5		downstrea	-	-				=	0.33	per year		Appendix	2	$\perp$
34	6	Cont Exh		-		/ filter B			=	0.33	per year		Appendix	2	$\perp$
35	7	Machine T							=	2	per year		Appendix		$\vdash$
36	8		Exh Upsti		-	ency Filter			=	3	per year		Appendix		$\vdash$
37	9		Exh HEP			<b>F</b> #Gelen 7			=	0.5	per year		Appendix		+
38	10				-	Efficiency F	-iiter		=	3	per year		Appendix		╞
39	11	Spent Fue	el Pool Exh	I HEPA					=	0.5	per year		Appendix	2	+
40	Therefore	the No. of		filters n	roduced r	er year = N	lo of cho	andes per s	voar v No	of filtere	ner chang	<u> </u>			+
41 42			-			the results				Table 8	PCI CHAINY				+
							als sum								+
43															+
44 45															+
45 46															+
40															+
48															+
49															┢
50															T

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								•				F	age 16 of	51
1														
2				F	ilter sou	urce			Nun	nber per	year			
3		1	Containme	ent Exh	n Upstrea	am High Effi	ciency F	ilter A	1.33	≤	2			
4		2	Containme	ent Exh	n Upstrea	am High Effi	ciency F	ilter B	1.33	≤	2			
5		3	Containme	ent Exh	ו HEPA f	ilter A			0.80	≤	1			
6		4	Containme	ent Exh	ו HEPA f	ilter B			0.80	≤	1			
7		5	Cont Exh	downs	tream hig	gh efficiency	filter A		0.33	≤	1			
8		6	Cont Exh	downs	tream hig	gh efficiency	filter B		0.33	≤	1			
9		7	Machine T	ool Ex	haust Fa	n Filter			2.00	≤	2			
10		8	Radwaste	Exh U	pstream	High Efficie	ncy Filte	r	54.00	≤	54			
11		9	Radwaste	Exh H	EPA Filte	er			9.00	≤	9			
12		10	Spent Fue	el Pool	Exh Ups	tream High	Efficienc	y Filter	36.00	≤	36			
13		11	Spent Fue	el Pool	Exh HEF	PA Filter		-	6.00	≤	6			
14		Table 8	: Number	of LL\	N dry filt	ters per yea	ar	Total	111.93	≤	112			
15														
16	Volume of	LLW dry f	ilters	=	4	ft <sup>3</sup>	=	0.11	m <sup>3</sup>			Ref 3		
17														
18	Volume of	drums		=	200	litres	=	0.2	m <sup>3</sup>					
19														
20	Number of	f filters per	drum	=	0.2	1	0.11							
21				=	1.77									
22				=	1	filter / drur	n							
23														
24	The numb	er of drum	s produced	l in one	e year of	operation	=	No. of filt	ers per yea	ar / No. o	f filters per	drum		
25	The numb	er of drum	s produced	l in one	e year of	operation	=	111.93	1	1				
26							=	111.93	≤	112	drums per	r year		
27						_								
28		No. of	years	No. o	f drums									
29		opera	ation	pro	duced									
30		5	5											
31		2	,	Ę	560									
32			0	2	239									
-		4	0	2 4	239 478									
33		6	0 0 0	2 4 6	239 478 716									
		6	0 0 0	2 4 6	239 478 716	luced over	LOP for	Dry LLW	filters.					
33		6	0 0 0	2 4 6	239 478 716	duced over	LOP for	Dry LLW	filters.					
33 34		6	0 0 0	2 4 6	239 478 716	duced over	LOP for	Dry LLW	filters.					
33 34 35		6	0 0 0	2 4 6	239 478 716	duced over	LOP for	Dry LLW	filters.					
33 34 35 36		6	0 0 0	2 4 6	239 478 716	duced over	LOP for	Dry LLW	filters.					
33 34 35 36 37		6	0 0 0	2 4 6	239 478 716	Juced over	LOP for	Dry LLW	filters.					
33 34 35 36 37 38		6	0 0 0	2 4 6	239 478 716	duced over	LOP for	Dry LLW	filters.					
33 34 35 36 37 38 39		6	0 0 0	2 4 6	239 478 716	luced over	LOP for	Dry LLW	filters.					
33 34 35 36 37 38 39 40		6	0 0 0	2 4 6	239 478 716	Juced over	LOP for	Dry LLW	filters.					
33 34 35 36 37 38 39 40 41		6	0 0 0	2 4 6	239 478 716	duced over	LOP for	Dry LLW	filters.					
33         34         35         36         37         38         39         40         41         42		6	0 0 0	2 4 6	239 478 716	duced over	LOP for	Dry LLW	filters.					
33 34 35 36 37 38 39 40 41 42 43		6	0 0 0	2 4 6	239 478 716	duced over	LOP for	Dry LLW	filters.					
33           34           35           36           37           38           39           40           41           42           43           44		6	0 0 0	2 4 6	239 478 716	Juced over	LOP for	Dry LLW	filters.					
33       34       35       36       37       38       39       40       41       42       43       44       45		6	0 0 0	2 4 6	239 478 716	Auced over	LOP for	Dry LLW	filters.					
33           34           35           36           37           38           39           40           41           42           43           44           45           46		6	0 0 0	2 4 6	239 478 716		LOP for	Dry LLW	filters.					
33           34           35           36           37           38           39           40           41           42           43           44           45           46           47		6	0 0 0	2 4 6	239 478 716		LOP for	Dry LLW	filters.					

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1												
	7.3	LLW Gaskets										
3		kata comprise of the followin	a:									
-		kets comprise of the followin	y,					3				
5	1 2	Makeup miniflow hx A & B Letdown hx				=	0.004	m <sup>3</sup> / chan	-	Appendix 2		
6	2	Reactor coolant drain tank	by.			=	0.003	m <sup>3</sup> / chan	-	Appendix 2		
7			IIX			=	0.001	m <sup>3</sup> / chan	-	Appendix 2		
8	4	Residual heat removal hx				=	0.001	m <sup>3</sup> / chan	-	Appendix 2		
9	5	Reactor coolant drain tank				=	0.002	m <sup>3</sup> / char	-	Appendix 2		
10	6	Waste holdup tank A				=	0.002	m <sup>3</sup> / char	-	Appendix 2		
11	7	Waste holdup tank B				=	0.002	m <sup>3</sup> / char	-	Appendix 2		
12	8	Waste monitor tank A				=	0.002	m <sup>3</sup> / chan	-	Appendix 2		_
13	9	Waste monitor tank B				=		m <sup>3</sup> / chan		Appendix 2		_
14	10	Waste monitor tank C				=	0.002	m <sup>3</sup> / char	-	Appendix 2		
15	11	Waste monitor tank D				=	0.002	m <sup>3</sup> / char		Appendix 2		
16	12	Waste monitor tank E				=	0.002	m <sup>3</sup> / char		Appendix 2		
17	13	Waste monitor tank F				=		m <sup>3</sup> / char	0	Appendix 2		
18	14	Effluent holdup tank A				=		m <sup>3</sup> / char	-	Appendix 2		
19	15	Effluent holdup tank B				=	0.002	m <sup>3</sup> / char	-	Appendix 2		
20	16	Effluent holdup tank C				=	0.002	m <sup>3</sup> / char	-	Appendix 3		
21	17	Chemical waste tank				=	0.001	m <sup>3</sup> / char	-	Appendix 2		
22	18	Spent fuel system filter B				=	0.001	m <sup>3</sup> / char	-	Appendix 2		
23	19	Reactor coolant filter A				=	0.001	m <sup>3</sup> / char	-	Appendix 2		
24	20	Reactor coolant filter B				=	0.001	m <sup>3</sup> / char	nge	Appendix 2		
25	21	Makeup filter				=	0.001	m <sup>3</sup> / char	nge	Appendix 2		
26	22	Spent fuel system filter A				=	0.001	m <sup>3</sup> / char	nge	Appendix 2		
27	23	Waste prefilter				=	0.001	m <sup>3</sup> / char	nge	Appendix 2		
28	24	Waste after filter				=	0.001	m <sup>3</sup> / char	nge	Appendix 2		
29	25	Resin fines filter				=	0.001	m <sup>3</sup> / char	nge	Appendix 2		
30					Total	=	0.043	m <sup>3</sup> / char	nge			
31												
32	For the pu	urposes of this calculation it i	s assume	d that thes	e gasket	s are com	pactable.					
33												
34	The LLW	gaskets will be disposed of i	n 200L dri	ums.								
		im working capacity is			=	0.2	m³			Ref 5		
		et loading per drum (by volur	me) is		=	100%				assumed		
	Compacti				=	3.6				Ref 4		
38												
39	Therefore	volume of gaskets to be cor	mpacted p	er drum	=	Volume o	of Drum x	gasket loa	ding per d	lrum		
40					=	0.2	х	100%				
41					=	0.2	m <sup>3</sup> of gas	sket per dr	um			
42												
43												
44												
45												
46												
47												
48												
49												
50												

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				·								Page	18 of 51	
1														
2			Gask	et Source				iency of F						
3								Gaskets		)				
4		1	Makeup miniflo	w hx A & B					02					
5		2	Letdown hx						02					
6		3	Reactor coolant		х				02					
7		4	Residual heat re						02					_
8		5	Reactor coolant						05					
9		6	Waste holdup ta						05					
10		7	Waste holdup ta						05					
11		8	Waste monitor						05					
12		9	Waste monitor						05					_
13		10	Waste monitor						05					-
14		11	Waste monitor						05					_
15		12	Waste monitor						05					
16		13	Waste monitor						05					_
17		14	Effluent holdup						05					
18		15	Effluent holdup						05					
19		16	Effluent holdup						05					
20		17	Chemical waste						67					
21		18	Spent fuel syste				-		00					
22		19	Reactor coolant						00 00					_
23		20 21	Reactor coolant						00					
24		21	Makeup filter	m filtor A					00					
25		22	Spent fuel syste Waste prefilter						00					
26		23	Waste after filte	or.					00					
27		24	Resin fines filte						00					
28		-	: Frequency of		nt of Gas	kote		1.	00			n n n n div (	<b>`</b>	
29			. Trequency of	Replacemen		JACI3					F	oppendix 2	2	
30 31	Therefore	the volume	e of gaskets proc	duced per ve	ar = No. c	of change	es ner vea	r x Volum	e of dask	ets ner cha	nae			
32			e el guerrere pret			on onlang			e er guera		iigo			-
	This is cald	culated ind	lividually for eac	h filter and the	e results	are sum	marised in		Table 11					
34														
35														
36														
37														
38														
39														
40														
41														
42														
43														
44														
45														
46														
47														
48														
														Τ
49														

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1										-				_
2			Ga	sket Source				e of Gask year (m <sup>3</sup> )	ets per					_
3		1	Makeup mini	flow by A & B	1			6.14E-05						_
4			Letdown hx					5.19E-05						_
5				ant drain tank	hx			1.89E-05						-
6 7		5	Residual hea					1.42E-05						
8		4 5		ant drain tank	(			1.13E-04						_
9		-	Waste holdu					1.13E-04						_
10			Waste holdu					1.13E-04						
11			Waste monit					1.13E-04						
12		9	Waste monite	or tank B				1.13E-04						
13		10	Waste monite	or tank C				1.13E-04						$\top$
14		11	Waste monite	or tank D				1.13E-04						
15		12	Waste monite	or tank E				1.13E-04						
16		13	Waste monite	or tank F				1.13E-04						
17		14	Effluent hold	up tank A				1.13E-04						
18		15	Effluent hold	up tank B				1.13E-04						
19		16	Effluent hold	up tank C				1.13E-04						
20		17	Chemical wa	iste tank				3.78E-04						
21			Spent fuel sy					8.49E-04						
22			Reactor cool	ant filter A				8.49E-04						
23			Reactor cool					8.49E-04						
24			Makeup filter					8.49E-04						
25		22	Spent fuel sy					8.49E-04						
26			Waste prefilt					8.49E-04						
27			Waste after f					8.49E-04						
28			Resin fines fi			1		8.49E-04						_
29		Table 11	: Volume of	Gaskets per	Year	Total		8.68E-03		_				_
30														
31	Cotol com	a a sta d \ /a l			Tatal Val			nantion fo	-1					
	rotar com	Jacled Vol	ume per year				/ear / Com	paction la	Stor					_
33				=	0.009	/ m <sup>3</sup> / yea	3.6							_
34				-	0.002	m / yea								_
35 26 T	Therefore	the numbe	r of drums pr	oduced per v	ear	=	Total com	an a stad va	lumo	1	volume per	drum		_
	nereiore		i ol ululis pr			=	0.002	npacted vo	0.2	/	volume per	urum		_
37 38						=	0.002	/ ≤	1					_
39							0.012	_	I					
	The numb	er of drums	s produced ov	/er 5 20 40	and 60 ve	ars can a	ire calculat	ted in a sir	nilar wav	and are sl	nown in	Table 12	below:	
40 .									iniai way				bolon,	
42		No. of	vears N	o. of drums	1									
43		opera		produced										
44		5		1										+
45		20	0	1	1									$\top$
46		40	0	1	1									
47		6	0	1	1									
48		Table 12	: Number of	drums prod	uced over	LOP for	Gaskets.							
49				-										T
50														T

l		erSol	ution	201	Project	Number:	Area :	System:	Discip. Code:	Doc. Type:	Sequen. Number:	Re	ev.	9	
		erson	utior	15	6300	0333	000	000	111	С	0001	Sta	tus:	S3	
													Page	20 of 51	-
	7.4	LLW Insula	ation												-
2															_
3		lation comp		he followi	ng;					2					
4	1	Regenerativ						=	1.661	m <sup>3</sup> / char	-	Appendix			-
5	2	Makeup mir						=	0.608	m <sup>3</sup> / char	-	Appendix			_
6	3	Reactor coo						=	0.405	m <sup>3</sup> / char	-	Appendix			_
7	4	Residual he		val hx				=	5.695	m <sup>3</sup> / char	-	Appendix			_
8	5	Letdown hx						=	1.624	m <sup>3</sup> / char	nge	Appendix	2		_
9							Total	=	9.994	m³					
	For the p	urposes of th	his calcu	lation it is	assumed	that LLW	Insulation	is compa	ctable.						-
11															
12		ation will be			DL drums.				0			D-15			L
13		um working o					=	0.2	m <sup>3</sup>			Ref 5			L
14		ation loading	g per dru	m (by voli	ume) is		=	100%				assumed			L
15	Compact	on factor					=	3.6				Ref 4			_
16															L
17	Therefore	e volume of i	insulatior	n to be co	mpacted p	per drum	=		of Drum x		loading pe	er drum			-
18							=	0.2	x	100%					
19							=	0.2	m <sup>3</sup> of ins	ulation pe	r drum				
20															_
21	Frequenc	y of replace	ment for	each insu	ulation is a	is follows;									
22	1	Regenerativ	ve hx			=	0.017	per year				Appendix	2		
23	2	Makeup mir	niflow hx	A & B		=	0.017	per year				Appendix	2		L
24	3	Reactor coo	olant dra	in tank hx		=	0.017	per year				Appendix	2		L
25	4	Residual he	eat remo	val hx		=	0.017	per year				Appendix	2		L
26	5	Letdown hx				=	0.017	per year				Appendix	2		L
27	Therefore	e the volume	e of insula	ation prod	uced per	year = No	. of chang	es per yea	ar x Volun	ne of insula	ation per c	hange			
28															
29	This is ca	lculated indi	,	for each f	ilter;										
30	1	Regenerativ			=	0.017	х	1.661	=	0.028	m <sup>3</sup> per ye				
31	2	Makeup mir			=	0.017	x	0.608	=	0.010	m <sup>3</sup> per ye				L
32	3	Reactor coo			=	0.017	x	0.405	=	0.007	m <sup>3</sup> per ye				L
33	4	Residual he	eat remo	val hx	=	0.017	х	5.695	=	0.095	m <sup>3</sup> per ye				L
34	5	Letdown hx	[		=	0.017	х	1.624	=	0.027	m <sup>3</sup> per ye				L
35								Total	=	0.167	m <sup>3</sup> per ye	ear			L
36	Total con	pacted Volu	ume per	year	=	Total Vo	ume per y	ear / Com	paction fa	actor					L
37					=	0.167	1	3.6							L
38					=	0.046	m3 / year	r							L
39															Ĺ
40	Therefore	e the number	r of drum	ns produce	ed per yea	ar	=	Total con	npacted v	olume	1	volume p	er drum		L
41							=	0.046	1	0.2					L
42							=	0.231	≤	1					Ĺ
43	The num	per of drums	produce	ed over 5	, 20 , 40 a	nd 60 yea	ars can are	e calculate	ed in a sim	nilar way a	nd are sho	own in	Table 13		Ĺ
44		No. of y		No. of	drums										Ľ
45		operat	ion	prod	luced										Ľ
46		5		:	2										
47		20		:	5										
48		40		1	0	1									
49		60			4	1									F
50		Table 13 :	Numbe	r of drum	s produc	ed over L	OP for LL	.W Insula	tion.						F

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	1	-			-					-			Page 2	21 of 51	<b>—</b>
1	7.5	LLW Pack	king												L
2															
3	LLW pac	king compr	ises of the	e following	;										
4	1	Valves (po	otentially r	adioactive	e)			=	0.451	m <sup>3</sup> / cha	nge	Appendi	ix 2		
5							Total	=	0.451						
6															
7	For the p	ourposes of	this calcu	lation it is	assumed	d that LLW	packing is	s compact	able.						
8															
9	The LLW	/ packing w	ill be disp	osed of in	a 200L d	lrum.									
10		rum working					=	0.2	m <sup>3</sup>			Ref 5			
11	The pac	king loading	ı per drum	ı (bv volun	ne) is		=	100%				assume	d		
12		tion factor					=	3.6				Ref 4			ľ
13															t
14	Therefor	e volume of	fnacking	to be com	nacted p	er drum	=	Volume	of Drum v	nacking k	bading per	drum			t
15			paoning				=	0.2	X	100%	caanig per	J. J. T.			t
15							=	0.2		cking per	drum				t
10									01 pa	stang por					┢
	Frequen	cy of replac	ement for	· I I W nacl	kina is as	follows									-
18	1				-		0.000					Annandi	iu 0		-
19	'	Valves (po	prentially r	adioactive	:)	=	0.200	per year				Appendi	IX Z		┝
20	Thorofor	e the volum	o of pook	ing produc	od por v	oor - No	of obongo	nor voor	v Volumo	of pookin	a por obor				-
21	Therefor		le of pack	ing produc	eu per y		or changes	s per year			ig per chai	iye			-
22	This is a	alaulatad in	ماني باماريم البر	fan aaab m	o oldinovi										-
23	-	alculated in	-		-	0.000				0.000	3				_
24	1	Valves (po	prentially r	adioactive	=	0.200	x	0.451	=	0.090	m <sup>3</sup> per ye				_
25									Total	0.090	m <sup>3</sup> per ye	ear			-
26							-								_
27	Total cor	mpacted Vo	lume per	year	=	Total Vo	lume per y	/ear / Com	paction fa	actor					
28					=	0.090	/	3.6							
29					=	0.025	m <sup>3</sup> / year	-							
30															
31	Therefor	e the numb	er of drun	ns produce	ed per ye	ar	=	Total con	npacted v	olume	1	volume	per drum		
32							=	0.025	1	0.2					
33							=	0.125	≤	1					
34	The num	ber of drum	ns produce	ed over 5	, 20 , 40 ;	and 60 yea	ars can are	e calculate	d in a sim	nilar way a	and are sho	own in	Table 14		
35		No. of			drums										L
36		opera	ation	prod	uced										Ĺ
37		5	5		1										ſ
38		20	0	;	3										Γ
39		40	0	(	6										ſ
40		6	0	6	8										ſ
41		Table 14	: Numbe	r of drum	s produc	ed over L	OP for LL	W Packir	ng.						Γ
42															Γ
43															Γ
44	1														t
45															t
46															t
47															t
47	-														┢
															┢
49															┝
50	1														T

l		<b>er</b> Solut		Project	Number:	Area :	System:	Discip. Code:	Doc. Type:	Sequen. Number:	Rev.	9
		ersolut	ions	630	00333	000	000	111	С	0001	Status:	S3
											Pa	ge 22 of 51
1	7.6	LLW Seals										
2												
3		als comprises of t	-									
4	1	Component coo					=	0.003	m <sup>3</sup> / char	-	Appendix 2	
5	2	Component coc		mp B			=	0.003	m <sup>3</sup> / char	-	Appendix 2	
6	3	Makeup pump A					=	0.003	m <sup>3</sup> / char	-	Appendix 2	
7	4	Makeup pump E					=	0.003	m <sup>3</sup> / char	-	Appendix 2	
8	5	Residual heat re					=	0.003	m <sup>3</sup> / char	-	Appendix 2	
9	6	Residual heat re		В			=	0.003	m <sup>3</sup> / char	-	Appendix 2	
10	7	Spent fuel cooli	• ·				=	0.003	m <sup>3</sup> / char	-	Appendix 2	
11	8	Spent fuel cooli	ng pump B				=	0.003	m <sup>3</sup> / char	-	Appendix 2	
12	9	RCDT pump A					=	0.008	m <sup>3</sup> / char		Appendix 2	
13	10	RCDT pump B					=	0.008	m <sup>3</sup> / char	-	Appendix 2	
14	11	Degassifier vac					=	0.003	m <sup>3</sup> / char	-	Appendix 2	
15	12	Degassifier vac					=	0.003	m <sup>3</sup> / char	-	Appendix 2	
16	13	Containment su					=	0.003	m <sup>3</sup> / char		Appendix 2	_
17	14	Containment su	imp pump B				=	0.003	m <sup>3</sup> / char	nge	Appendix 2	
18						Total	=	0.051				
19												
20	For the p	urposes of this c	alculation it is	assumed	that LLW	Seals are	compacta	able.				
21												
22		seals will be dis	-	200L drur	n.							
23	Actual dr	um working capa	acity is			=	0.2	m <sup>3</sup>			Ref 5	
24	The seal	loading per drun	n (by volume)	is		=	100%				assumed	
25	Compact	tion factor				=	3.6				Ref 4	
26												
27	Therefore	e volume of seals	s to be compa	cted per o	drum	=	Volume o	of Drum x	seal loadi	ng per dru	m	
28						=	0.2	X	100%			
29						=	0.2	m <sup>3</sup> of sea	al per drun	n		
30												
31	Frequen	cy of replacemen	t for each sea	l is as foll	ows;							
32	1	Component coc	oling water pur	mp A	=	0.200	per year				Appendix 2	
33	2	Component coo	ling water pu	np B	=	0.200	per year				Appendix 2	_
34	3	Makeup pump A			=	0.100	per year				Appendix 2	
35	4	Makeup pump E			=	0.100	per year				Appendix 2	_
36	5	Residual heat re			=	0.200	per year				Appendix 2	
37	6	Residual heat re		В	=	0.200	per year				Appendix 2	
38	7	Spent fuel cooli			=	0.200	per year				Appendix 2	
39	8	Spent fuel cooli	ng pump B		=	0.200	per year				Appendix 2	
40	9	RCDT pump A			=	0.050	per year				Appendix 2	
41	10	RCDT pump B			=	0.050	per year				Appendix 2	
42	11	Degassifier vac	uum pump A		=	0.050	per year				Appendix 2	
43	12	Degassifier vac	uum pump B		=	0.050	per year				Appendix 2	
44	13	Containment su	imp pump A		=	0.033	per year				Appendix 2	
45	14	Containment su	imp pump B		=	0.033	per year				Appendix 2	
46												
47												
48												
49												
50												

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		erSo	lutio	ns	6300	00333	000	000	111	С	0001	Sta	atus:	S3	
													Page	23 of 51	
1	Therefore	e the volum	ne of seals	s produce	d per year	= No. of o	changes pe	er year x \	olume of	seal per c	hange				
2															
3	This is ca	Iculated in													
4	1	Compone	-			=	0.200	х	0.003	=		m <sup>3</sup> per ye			
5	2	Compone	-	water pur	mp B	=	0.200	х	0.003	=		m <sup>3</sup> per ye			
6	3	Makeup p				=	0.100	х	0.003	=		m <sup>3</sup> per ye			
7	4	Makeup p	ump B			=	0.100	х	0.003	=		m <sup>3</sup> per ye			_
8	5	Residual h				=	0.200	х	0.003	=		m <sup>3</sup> per ye			
9	6	Residual h			В	=	0.200	х	0.003	=		m <sup>3</sup> per ye			
10	7	Spent fue				=	0.200	х	0.003	=		m <sup>3</sup> per ye			
11	8	Spent fuel		oump B		=	0.200	х	0.003	=		m <sup>3</sup> per ye			
12	9	RCDT pur				=	0.050	х	0.008	=		m <sup>3</sup> per ye			
13	10	RCDT pur				=	0.050	х	0.008	=		m <sup>3</sup> per ye			L
14	11	Degassifie				=	0.050	х	0.003	=		m <sup>3</sup> per ye			L
15	12	Degassifie		· ·		=	0.050	х	0.003	=		m <sup>3</sup> per ye			L
16	13	Containme	ent sump	pump A		=	0.033	х	0.003	=		m <sup>3</sup> per ye			
17	14	Containme	ent sump	pump B		=	0.033	х	0.003	=	9.4E-05	m <sup>3</sup> per ye	ear		
18									Total	=	0.005	m <sup>3</sup> per ye	ear		
19															
20	Total com	npacted Vo	olume per	year	=	Total Vo	ume per y	ear / Com	paction fa	actor					
21					=	0.005	1	3.6							
22					=	0.001	m3 / year								
23															
24	Therefore	e the numb	er of drun	ns produce	ed per yea	ar	=	Total com	pacted v	olume	/	volume p	er drum		
25							=	0.001	1	0.2					
26							=	0.007	≤	1					
27	The num	ber of drun	ns produc	ed over 5	, 20 , 40 a	nd 60 yea	ars can are	calculate	d in a sim	nilar way a	nd are sho	own in	Table 15		
28		No. of	years	No. of	drums										
29		opera	ation	prod	luced										
30		5	5		1										
31		2	0		1										
32		4	0		1										
33		6	0		1										
34		Table 15	: Numbe	r of drum	s produc	ed over L	OP for LL	W Seals.							Ľ
35															L
36	7.7	LLW pum	nps												
37															
38	LLW pum	nps compris	ses of the	following;	;										
39	1	Resin tran	nsfer pum	р				=	0.003	m <sup>3</sup> / char	nge	Appendix	<b>〈</b> 2		[
40	2	Degassifie	er seperat	or pump A	4			=	0.028	m <sup>3</sup> / char	-	Appendix			
41	3	Degassifie	er seperat	or pump E	3			=	0.028	m <sup>3</sup> / char	-	Appendix			
42							Total	=	0.059						
	LLW pum	nps will be	disposed	of in HHIS	SO contain	ers									
	HHISO ca			=	14.8	m³						Assumpt	ion No. 6		Γ
45												·			Γ
	Frequenc	y of replac	ement for	each pun	np is as fo	llows;									
47	1	Resin tran	nsfer pumi	ρ		=	0.100	per year				Appendix	< 2		Γ
48	2	Degassifie			A	=	0.017	per year				Appendix			
49	3	Degassifie				=	0.017	per year				Appendix			
		<u> </u>						. ,							

		erSolution		Project	Number:	Area :	System:	Discip. Code:	Doc. Type:	Sequen. Number:	Re	v.	9
		ersolution	IS	6300	00333	000	000	111	С	0001	Stat	us:	S3
						-						Page	24 of 51
1													
2	Therefore	e the volume of pump	os produce	ed per yea	ar = No. of	changes	per year x	Volume of	of pump pe	er change			
3													
4	This is ca	Iculated individually		ump;									
5	1	Resin transfer pump		=	0.100	х	0.003	=		m <sup>3</sup> per ye			
6	2	Degassifier seperate			0.017	х	0.028	=		m <sup>3</sup> per ye			
7	3	Degassifier seperate	or pump B	=	0.017	х	0.028	=		m <sup>3</sup> per ye			
8							Total	=	0.00123	m <sup>3</sup> per ye	ear		
9													
10	LLW purr	nps will not be compa	acted prior	to dispos	al								
11													
12	Therefore	e the number of HHIS	SO produc	ed per ye	ar	=	Total purr	np volume		1	volume pe	er HHISO	
13						=	0.001	1	14.8				
14						=	8.3E-05	≤	1				
15													
16	The num	ber of HHISO's produ	uced over	5,20,40	) and 60 y	ears can	are calcula	ted in a s	similar way	and are s	shown in	Table 16	
17		No. of years	No. of										
18		operation	prod	uced									
19		5	1	1									
20		20	1	1									
21		40	1	1									
22		60	1	1									
23		Table 16 : Numbe	r of HHISO	D's produ	iced over	LOP for	LLW pum	ps.					
24													
25													
20	It is likely	that these pumps w	ould be pla	aced in HI	HISO's tha	at already	contain dr	ums of wa	aste for dis	sposal, ho	wever for t	he purpos	es of this
25		that these pumps won it is assumed that					contain dr	ums of wa	aste for dis	sposal, ho	wever for t	he purpos	es of this
26							contain dr	ums of wa	aste for dis	sposal, ho	wever for t	he purpos	es of this
26	calculatio	n it is assumed that					contain dr	ums of wa	aste for dis	sposal, ho	wever for t	he purpos	es of this
26 27 28	calculatio	n it is assumed that LLW Diaphragms	they are so	eparate ( <i>I</i>			contain dr	ums of wa	aste for dis	sposal, ho	wever for t	he purpos	es of this
26 27 28	calculatio	n it is assumed that	they are so	eparate ( <i>I</i> wing;			contain dr	ums of wa	aste for dis m <sup>3</sup> / char		wever for t Appendix		es of this
26 27 28 29	calculatio 7.8 LLW diap	on it is assumed that LLW Diaphragms ohragms comprises of	they are so of the follow ge pump A	eparate ( <i>i</i> wing;						nge		2	es of this
26 27 28 29 30	calculatio <b>7.8</b> LLW diap	on it is assumed that LLW Diaphragms ohragms comprises of Degassifier discharg	they are so of the follow ge pump A ge pump B	eparate ( <i>i</i> wing;			=	0.003	m <sup>3</sup> / char	nge	Appendix	2 2	es of this
26 27 28 29 30 31	calculatio 7.8 LLW diap 1 2	on it is assumed that <b>LLW Diaphragms</b> ohragms comprises of Degassifier discharg Degassifier discharg	they are so of the follow ge pump A ge pump B np A	eparate ( <i>i</i> wing;			=	0.003 0.003	m <sup>3</sup> / char m <sup>3</sup> / char	nge nge	Appendix Appendix	2 2 2 2	es of this
26 27 28 29 30 31 32	calculatio 7.8 LLW diap 1 2 3	on it is assumed that <b>LLW Diaphragms</b> ohragms comprises of Degassifier discharg Effluent holdup pum	they are so of the follow ge pump A ge pump B np A np B	eparate ( <i>i</i> wing;			=	0.003 0.003 0.003	m <sup>3</sup> / char m <sup>3</sup> / char m <sup>3</sup> / char	nge nge nge	Appendix Appendix Appendix	2 2 2 2 2	es of this
26 27 28 29 30 31 32 33	calculatio 7.8 LLW diap 1 2 3 4	on it is assumed that <b>LLW Diaphragms</b> ohragms comprises of Degassifier discharg Degassifier discharg Effluent holdup pum Effluent holdup pum	they are so of the follow ge pump A ge pump B np A np B np C	eparate ( <i>i</i> wing;			= = =	0.003 0.003 0.003 0.003	m <sup>3</sup> / char m <sup>3</sup> / char m <sup>3</sup> / char m <sup>3</sup> / char	ige ige ige ige	Appendix Appendix Appendix Appendix	2 2 2 2 2 2 2	es of this
26 27 28 29 30 31 32 33 33	calculatio 7.8 LLW diap 1 2 3 4 5	bn it is assumed that <b>LLW Diaphragms</b> bhragms comprises of Degassifier discharg Degassifier discharg Effluent holdup pum Effluent holdup pum	they are so of the follow ge pump A ge pump B np A np B np C o A	eparate ( <i>i</i> wing;			= = = =	0.003 0.003 0.003 0.003 0.003	m <sup>3</sup> / char m <sup>3</sup> / char m <sup>3</sup> / char m <sup>3</sup> / char m <sup>3</sup> / char	nge nge nge nge nge	Appendix Appendix Appendix Appendix Appendix	2 2 2 2 2 2 2 2 2 2	es of this
26 27 28 29 30 31 32 33 34 35	calculatio 7.8 LLW diap 1 2 3 4 5 6	bin it is assumed that <b>LLW Diaphragms</b> bhragms comprises of Degassifier discharg Degassifier discharg Effluent holdup pum Effluent holdup pum Waste holdup pump	they are so of the follow ge pump A ge pump B np A np B np C o A	eparate ( <i>i</i> wing;			= = = = = =	0.003 0.003 0.003 0.003 0.003 0.003	m <sup>3</sup> / char m <sup>3</sup> / char	nge nge nge nge nge nge	Appendix Appendix Appendix Appendix Appendix Appendix Appendix	2 2 2 2 2 2 2 2 2 2 2 2 2 2	es of this
26 27 28 29 30 31 32 33 33 34 35 36	calculatio <b>7.8</b> LLW diap 1 2 3 4 5 6 7	on it is assumed that <b>LLW Diaphragms</b> ohragms comprises of Degassifier discharg Effluent holdup pum Effluent holdup pum Waste holdup pump Waste holdup pump	they are so of the follow ge pump A ge pump B np A np B np C o A	eparate ( <i>i</i> wing;				0.003 0.003 0.003 0.003 0.003 0.003 0.003	m <sup>3</sup> / char m <sup>3</sup> / char	nge nge nge nge nge nge nge nge	Appendix Appendix Appendix Appendix Appendix Appendix	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	es of this
26 27 28 29 30 31 32 33 34 35 36 37	calculatio <b>7.8</b> LLW diap 1 2 3 4 5 6 7 8	on it is assumed that <b>LLW Diaphragms</b> ohragms comprises of Degassifier discharg Degassifier discharg Effluent holdup pum Effluent holdup pum Waste holdup pump Waste holdup pump Monitor pump A	they are so of the follow ge pump A ge pump B np A np B np C o A	eparate ( <i>i</i> wing;				0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003	m <sup>3</sup> / char m <sup>3</sup> / char	nge nge nge nge nge nge nge nge nge	Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	es of this
26 27 28 29 30 31 32 33 34 35 36 37 38	calculatio <b>7.8</b> LLW diap 1 2 3 4 5 6 7 8 9	bin it is assumed that <b>LLW Diaphragms</b> bhragms comprises of Degassifier discharg Degassifier discharg Effluent holdup pum Effluent holdup pum Waste holdup pump Waste holdup pump Monitor pump A Monitor pump B	they are so of the follow ge pump A ge pump B np A np B np C o A	eparate ( <i>i</i> wing;				0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003	m <sup>3</sup> / char m <sup>3</sup> / char	nge nge nge nge nge nge nge nge nge	Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	es of this
26 27 28 29 30 31 32 33 34 35 36 37 38 39	calculatio <b>7.8</b> LLW diap 1 2 3 4 5 6 7 8 9 10	In it is assumed that LLW Diaphragms bragms comprises of Degassifier discharg Degassifier discharg Effluent holdup pum Effluent holdup pum Waste holdup pump Waste holdup pump Monitor pump A Monitor pump B Monitor pump C	they are so of the follow ge pump A ge pump B np A np B np C o A	eparate ( <i>i</i> wing;				0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003	m <sup>3</sup> / char m <sup>3</sup> / char	nge nge nge nge nge nge nge nge nge nge	Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	es of this
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41	calculatio <b>7.8</b> LLW diap 1 2 3 4 5 6 7 8 9 10 11	bhragms comprises of Degassifier discharg Degassifier discharg Effluent holdup pum Effluent holdup pum Waste holdup pump Waste holdup pump Monitor pump A Monitor pump B Monitor pump D	they are so of the follow ge pump A ge pump B np A np B np C o A	eparate ( <i>i</i> wing;				0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003	m <sup>3</sup> / char m <sup>3</sup> / char	ige ige ige ige ige ige ige ige ige ige	Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	es of this
26           27           28           29           30           31           32           33           34           35           36           37           38           39           40           41           42	calculatio <b>7.8</b> LLW diap 1 2 3 4 5 6 7 8 9 10 11 11 12	An it is assumed that <b>LLW Diaphragms</b> Degassifier discharg Degassifier discharg Effluent holdup pum Effluent holdup pum Waste holdup pump Monitor pump A Monitor pump B Monitor pump C Monitor pump D Monitor pump E	they are so of the follow ge pump A ge pump B np A np C o A o B	eparate ( <i>i</i> wing;				0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003	m <sup>3</sup> / char m <sup>3</sup> / char	nge nge nge nge nge nge nge nge nge nge	Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	es of this
26           27           28           29           30           31           32           33           34           35           36           37           38           39           40           41           42           43	calculatio <b>7.8</b> LLW diap 1 2 3 4 5 6 7 8 9 10 11 11 12 13	LLW Diaphragms bragms comprises of Degassifier discharg Degassifier discharg Effluent holdup pum Effluent holdup pum Waste holdup pump Waste holdup pump Monitor pump A Monitor pump C Monitor pump D Monitor pump E Monitor pump F	they are so of the follow ge pump A ge pump B np A np C o A o B	eparate ( <i>i</i> wing;				0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003	m <sup>3</sup> / char m <sup>3</sup> / char	nge nge nge nge nge nge nge nge nge nge	Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	es of this
26           27           28           29           30           31           32           33           34           35           36           37           38           39           40           41           42           43	calculatio <b>7.8</b> LLW diap 1 2 3 4 5 6 7 8 9 10 11 11 12 13	LLW Diaphragms bragms comprises of Degassifier discharg Degassifier discharg Effluent holdup pum Effluent holdup pum Waste holdup pump Waste holdup pump Monitor pump A Monitor pump C Monitor pump D Monitor pump E Monitor pump F	they are so of the follow ge pump A ge pump B np A np C o A o B	eparate ( <i>i</i> wing;		n 23).		0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003	m <sup>3</sup> / char m <sup>3</sup> / char	nge nge nge nge nge nge nge nge nge nge	Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	es of this
26           27           28           29           30           31           32           33           34           35           36           37           38           39           40           41           42           43           44           45	calculatio <b>7.8</b> LLW diap 1 2 3 4 5 6 7 8 9 10 11 12 13 14	An it is assumed that <b>LLW Diaphragms</b> bragms comprises of Degassifier discharg Degassifier discharg Effluent holdup pum Effluent holdup pum Waste holdup pump Waste holdup pump Monitor pump A Monitor pump B Monitor pump C Monitor pump C Monitor pump F Chemical waste pump	they are so of the follow ge pump A ge pump B np A np B np C o A o B	eparate (/	Assumptio	n 23).		0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003	m <sup>3</sup> / char m <sup>3</sup> / char	nge nge nge nge nge nge nge nge nge nge	Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	es of this
26           27           28           29           30           31           32           33           34           35           36           37           38           39           40           41           42           43           44           45           46	calculatio <b>7.8</b> LLW diap 1 2 3 4 5 6 7 8 9 10 11 12 13 14 For the p	LLW Diaphragms bhragms comprises of Degassifier discharg Degassifier discharg Effluent holdup pum Effluent holdup pum Waste holdup pump Waste holdup pump Monitor pump A Monitor pump B Monitor pump C Monitor pump D Monitor pump F Chemical waste pur	they are so of the follow ge pump A ge pump B np A np C o A o B	eparate (/	Assumptio	n 23).		0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003	m <sup>3</sup> / char m <sup>3</sup> / char	nge nge nge nge nge nge nge nge nge nge	Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	es of this
26           27           28           29           30           31           32           33           34           35           36           37           38           39           40           41           42           43           44           45           46           47	calculatio <b>7.8</b> LLW diap 1 2 3 4 5 6 7 8 9 10 11 12 13 14 For the p The LLW	ILW Diaphragms bragms comprises of Degassifier discharg Degassifier discharg Effluent holdup pum Effluent holdup pum Waste holdup pump Waste holdup pump Waste holdup pump Monitor pump A Monitor pump B Monitor pump C Monitor pump C Monitor pump E Monitor pump F Chemical waste pur urposes of this calcur diaphragms will be	they are so of the follow ge pump A ge pump B np A np C o A o B	eparate (/	Assumptio	n 23). Total Diaphrag	= = = = = = = = = = = = = = = = = = =	0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003	m <sup>3</sup> / char m <sup>3</sup> / char	nge nge nge nge nge nge nge nge nge nge	Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	es of this
26           27           28           29           30           31           32           33           34           35           36           37           38           39           40           41           42           43           44           45           46           47	calculatio <b>7.8</b> LLW diap 1 2 3 4 5 6 7 8 9 10 11 12 13 14 14 For the p The LLW Actual dr	LLW Diaphragms bhragms comprises of Degassifier discharg Degassifier discharg Effluent holdup pum Effluent holdup pum Waste holdup pump Waste holdup pump Monitor pump A Monitor pump B Monitor pump C Monitor pump D Monitor pump F Chemical waste pur	they are so of the follow ge pump A ge pump B np A np B np C o A o B mp mp nation it is disposed c is	eparate (/ wing;	Assumptio	n 23).		0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003 0.003	m <sup>3</sup> / char m <sup>3</sup> / char	nge nge nge nge nge nge nge nge nge nge	Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix Appendix	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	es of this

l		erSo	lutio		Project	Number:	Area :	System:	Discip. Code:	Doc. Type:	Sequen. Number:	Rev.	9
12		er50	iutio	ns	630	00333	000	000	111	С	0001	Status:	S3
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1	Therefor	e volume o	f Diaphra	gms to be	compacte	ed per drur	ו =	Volume o	f Drum x l	Diaphragi	m loading	per drum	
2							=	0.2	х	100%			
3							=	0.2	m <sup>3</sup> of diap	ohragm p	er drum		
4	Frequen	cy of replac	ement fo	r each sea	al is as foll	ows;							
5	1	Degassifie	er dischar	ae pump	A	=	0.200	per year				Appendix 2	
6	2	Degassifie				=	0.200	per year				Appendix 2	
7	3	Effluent h			_	=	0.200	per year				Appendix 2	
8	4	Effluent h		-		=	0.200	per year				Appendix 2	
9	5	Effluent h				=	0.200	per year				Appendix 2	
10	5	Waste ho				=	0.200	per year				Appendix 2	
11	6	Waste ho				=	0.200	per year				Appendix 2	
11	7	Monitor p		рБ		=	0.200					Appendix 2 Appendix 2	
	8							per year					
13	8 9	Monitor p				=	0.200	per year				Appendix 2	
14	9 10	Monitor p				=	0.200	per year				Appendix 2	
15		Monitor p					0.200	per year				Appendix 2	
16	11	Monitor p				=	0.200	per year				Appendix 2	
17	12	Monitor p				=	0.200	per year				Appendix 2	
18	13	Chemical	waste pu	Imp		=	0.200	per year				Appendix 2	
19													
20		e the volum				-	lo. of chai	nges per y	ear x Volu	ime of dia	aphragm p	er change	
21	This is ca	alculated in				n;							
22	1	Degassifie	er dischar	rge pump	A	=	0.200	х	0.003	=	0.00057	m <sup>3</sup> per year	
23	2	Degassifie	er dischar	rge pump	В	=	0.200	х	0.003	=		m <sup>3</sup> per year	
24	3	Effluent h	oldup pur	mp A		=	0.200	х	0.003	=	0.00057	m <sup>3</sup> per year	
25	4	Effluent h	oldup pur	np B		=	0.200	х	0.003	=	0.00057	m <sup>3</sup> per year	
26	5	Effluent h	oldup pur	mp C		=	0.200	х	0.003	=	0.00057	m <sup>3</sup> per year	
27	6	Waste ho	ldup pum	рА		=	0.200	х	0.003	=	0.00057	m <sup>3</sup> per year	
28	7	Waste ho	ldup pum	рВ		=	0.200	х	0.003	=	0.00057	m <sup>3</sup> per year	
29	8	Monitor p	ump A			=	0.200	х	0.003	=		m <sup>3</sup> per year	
30	9	Monitor p	ump B			=	0.200	х	0.003	=		m <sup>3</sup> per year	
31	10	Monitor p				=	0.200	х	0.003	=		m <sup>3</sup> per year	
32	11	Monitor p				=	0.200	x	0.003	=		m <sup>3</sup> per year	
33	12	Monitor p				=	0.200	x	0.003	=		m <sup>3</sup> per year	
	12	Monitor p					0.200	x	0.003	=		m <sup>3</sup> per year	
34		Chemical		Imn		=	0.200	x		=		m <sup>3</sup> per year	
35	14	Ghernical	waste pu	b		=	0.200	^	0.003 Total	=		m <sup>3</sup> per year	
36	Total cor	npacted Vo	lume per	Vear	=	Total Ve	ume por v	/ear / Com	Total		0.00793	in per year	
-			nume per	year									
38					=	0.008	/	3.6					
39	Theres	a that is a l	an ef it		=	0.002	m3 / year						
40	ineretor	e the numb	er of aruf	ns proauc	ea per ye	ai	=		pacted vo		1	volume per drum	
41							=	0.002	1	0.2			
42					AC 15		=	0.01101	≤	1	<u> </u>		
43	The num	ber of drun	-	1		and 60 yea T	irs can are	e calculate	d in a sim	ilar way a	nd are sho	own in Table 1	17
44		-	years		f drums								
45			ation	pro	duced								
46			5		1								
47		2	0		1								
48		4	0		1								
49		6	0		1								
50		Table 17	: Numbe	er of drun	ns produc	ed over L	OP for LL	.W Diaphi	agms.				

		<b>er</b> Solutio		Project	Number:	Area :	System:	Discip. Code:	Doc. Type:	Sequen. Number:	Re	ev.	9	
		erSolutio	ns	6300	00333	000	000	111	С	0001	Sta	tus:	S3	
	1											Page	26 of 51	1
1	7.9	LLW Charcoal												
2														
3		rcoal comprises of		ing;										
4	1	Cont exh charcoal					=	2.427	m <sup>3</sup> / char	-	Appendix			
5	2	Cont exh charcoal	filter B				=	2.427	m <sup>3</sup> / char	nge	Appendix	2		
6						Total	=	4.853						
7														
	It is assu	ned for the purpose	es of this o	calculation	that LLW	charcoal	in non-con	npactable						
9														
		charcoal will be dis		in 200L dr	ums.									
11		um working capacit				=	0.2	m <sup>3</sup>			Ref 1			
12	The char	coal loading per dru	ım (by vol	ume) is		=	100%							
13														
14	Therefore	volume of charcoa	al to be en	capsulated	d per drum	=		of Drum x	charcoal l	oading pe	r drum			
15						=	0.2	x	100%					
16						=	0.2	m <sup>3</sup> of cha	arcoal per	drum				
17														
18	-	y of replacement fo	or LLW cha	arcoal is a	s follows;									
19	1	Cont exh charcoal	filter A		=	0.100	per year				Appendix	2		
20	2	Cont exh charcoal	filter B		=	0.100	per year				Appendix	2		
21														
22	Therefore	the volume of LLV	V Charcoa	al produced	d per year	= No. of o	changes pe	er year x \	Volume of	charcoal p	per change	e		
23														
24	This is ca	Iculated individually		charcoal s										
25	1	Cont exh charcoal	filter A	=	0.100	х	2.427	=	0.243	m <sup>3</sup> per ye				
26	2	Cont exh charcoal	filter B	=	0.100	х	2.427	=	0.243	m <sup>3</sup> per ye				
27								Total	0.485	m <sup>3</sup> per ye	ear			
28														
29	Therefore	the number of dru	ms produo	ced per ye	ar	=	Total cha	ircoal volu	ime	1	volume p	er drum		
30						=	0.485	1	0.2					
31						=	2.427	≤	3					
32	The num	per of drums produce	ced over 5	5 , 20 , 40 a	and 60 yea	ars can ai	re calculate	ed in a sin	nilar way a	and are sh	iown in	Table 18		
33		No. of years		f drums										
34		operation	-	duced										
35		5		13										
36		20		49										L
37		40		98										
38		60		46										
39		Table 18 : Numbe	r of drum	ns produc	ed over L	OP for Ll	LW Charc	oal.						
40														
41														L
42														
43														
44														
45														
46														
47														
48														
49														
50														

		erSolutio		Project I	Number:	Area :	System:	Discip. Code:	Doc. Type:	Sequen. Number:	Re	ev.	9	
		ersolutio	ons	6300	0333	000	000	111	С	0001	Sta	tus:	S3	
												Page	27 of 51	Т
1	7.10	LLW Stacks												-
2			a fallauina											_
3		cks comprises of the Electrodeionisation	-		or				3			-		_
4	1				or o ourpelio	r)	=	0.765	m <sup>3</sup> / cha		Appendix			-
5	2	Electrodeionisatio	IT UTILS AQ	D (allemat	e supplie	Total	=	0.898 1.662	m <sup>3</sup> / cha	nge	Appendix	2		_
6						TOLAI	-	1.002						-
7		1.5 11	6 H -											-
8	it is assu	med for the purpos	ses of this c	alculation	that LLW	stacks in	non-comp	actable.						┝
9		/ staska will be disr			- stein - s									+
10		/ stacks will be disp			m <sup>3</sup>						Accurati	an Na C		-
11	HHISO d	apacity	=	14.8	m						Assumpti	011 NO. 6		+
12	Frequen	cy of replacement f	or each sta	ick is as fo	llows:									-
13	1					0.000					Annondia	2		-
14	2	Electrodeionisatio			=	0.083	per year				Appendix			┢
15	2	Electrodeionisatio	on Units A&	B (alternat	_	0.200	per year				Appendix	2		-
16	Therefor	e the volume of sta	icks produc	ed ner ver	ar = No. o	f changes	ner vear v	Volume	of stack n	er change				┢
17	mereior			eu per yee	ai – NO. C	i changes	per year x	volume	of stack p	er change				-
18	This is o	alculated individual	ly for each	stack:										┝
19	1	Electrodeionisatio	-		0.083	x	0.705	=	0.004	m <sup>3</sup> per ye	ar			-
20	2	Electrodeionisatio			0.200		0.765	-	0.064	m <sup>3</sup> per ye				-
21	2	Electionelonisatio	IT UTILS AQ	· –	0.200	X	0.898	_	0.180	m per ye	ear			-
22	For the r	ourposes of this cal	culation the	Altornato	supplier	will be use	nd on the h	acie that t	the amou	at of waste	produced	por voar		-
23		ts the worst case in						asis illai		III OI WASIE	; produced	per year		-
24	represer				vasie.									-
25	Thorofor	e the number of HI		cod por ve	or	=	<b></b>			,	volume p			-
26	THEIEIUI			iceu per ye	ai	=	Total stac 0.180		14.8	1	volume p			-
27						=	0.180	/ ≤						-
28						-	0.012	2	1					-
29	The num	ber of drums produ	iced over 5	20 40 5	and 60 ve	are can ai	e calculate	n a ein	nilar way r	and are sh	own in	Tabla 10		┝
30	The num			HHISO	inu oo ye	ars carrai		u in a sin	illiai way i		OWITIII	Table 19		-
31		No. of years operation		luced										-
32		5	-	1										┝
33		20		1										-
34		40		1										┢
35		60		1										┢
36		Table 19 : Numb			ced over	I OP for	I I W stack	ke						┢
37				o s produ			LLTT SLACE	n.a.						┢
38														┢
39														┢
40														┢
41														┢
42														┢
43														┢
44														┢
45														┢
46														╞
47														╞
48														+
49														+
50														1_

		erSolut	lana	Project	Number:	Area :	System:	Discip. Code:	Doc. Type:	Sequen. Number:	Re	؛۷.	9	
		ersolui	lions	6300	00333	000	000	111	С	0001	Stat	tus:	S3	
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1	8.0	Fuel assembl	ies and	Rod Clu	sters									
2														_
3		tion will calculate		of Multi-pu	irpose Ca	nisters (MI	PC's) requ	ired to sto	re the fue	l produce	d over the	lifetime of		_
		of an AP1000	plant. h is reproduc	od from Do	f 2 atataa	volumoo	fuel rede	o o o o o trol re	ada and a	rov rodo ti	hat are ren	aavad		
•	Appendix from the		n is reproduc		el 5 states	volumes c			ous and g	ray rous li	lat are ren	loved		
6	nom me	Teactor.												-
7	Initial as	sembly loading	within the rea	ctor include	ee.									-
8 9	initial ao													-
-	Fuel Ass	emblies			=	157						Ref 3		
		Rod Clusters			=	53						Ref 3		-
12		d Clusters			=	16						Ref 3		
13					-									┢
	For the r	ourposes of this	calculation it	is assume	d that Con	trol Rod C	lusters an	d Grav Ro	d Cluster	s will rema	ain with the	e fuel		$\square$
		es once remove												F
16	2000/10/													
17	The refu	elling cycle is or	n an 18month	equilibriun	n cycle ba	isis, with a	feed enric	hment of 4	4.9 Weigh	t-percent.	64 fuel as	ssemblies		F
18	-	ced every 18 m			-									
19														
20	Number	of fuel assembli	es replaced p	oer refuellin	ng cycle	=	64							
21	Refuellin	g cycle				=	18	months						
22	Operatin	g life of plant				=	60	years						
23														
24	The total	number of cycle	es can be cal	culated as	follows;									
25					On an at	ing Life of	Dlant							
26	Total nur	mber of refuellin	g cycles			ting Life of fuelling Cy								
27					60×12		<i></i>							
28					$=\frac{60\times12}{18}$	-								
29					10									
30				=	40									
31														
32	Therefor	e the total numb	per of fuel Ass	semblies us	sed throug	phout the li	fetime of t	he plant ca	an be cale	culated as	follows;			_
33														_
34	Total nur	mber of Fuel As	semblies = In	itial Assem	ibly loadin	ig + (No. o	f fuel asse	mblies per	change	x No. of ou	utages)			-
35														$\vdash$
36	Total Nu	mber of Fuel As	semblies	=	157	+	(	64	х	39	)			_
37					0077	<b>F</b> 1 1								$\vdash$
38				=	2653	Fuel Ass	emblies							$\vdash$
39														-
40		ber of fuel asse										assuming	а	$\vdash$
41	different	operating life i.e	e. 5, 20 or 40	years). The	e results c	of these ca	lculations	are shown	in	Table 20	DelOW;			$\vdash$
42		No. cfui												┢
43		No. of years operation		er of Fuel emblies										┢
44		5		214										┢
45	-	20		214 854										╞
46		40		707	-									┢
47		40 60		2653	-									┢
48		Table 20 : Nu			s produc	ed over l	OP							┢
49		1 UNIC 20 . HU		assemble										┢
50	ļ						ons E & C Ltd.							1

		<b>er</b> So	lutio		Project	Number:	Area :	System:	Discip. Code:	Doc. Type:	Sequen. Number:	R	ev.	9	
		er50	IUTIO	ns	6300	00333	000	000	111	С	0001	Sta	itus:	S3	
				·									Pag	e 29 of 51	1
1															_
2	It should	be noted th	nat in tabl	e 20 the i	nitial asse	mbly load	ing in the	reactor is	not accou	nted for u	ntil the end	d of of life	of the plar	nt.	_
3	<b>T</b> 1 (	<u> </u>	<i>.</i>												-
4	1 ne frequ 1	ency of ch Control Re			ol Rod and	d Gray Ro =	a clusters		n below; 20	yrs					-
5 6	2	Gray Rod		13		=	1	in in	20	yrs					-
7	-		Cluctore				•		20	,10					-
8	Therefore	e the numb	er of cycl	es over th	ne operatir	ng LOP = I	LOP / freq	uency of c	change						-
9			-			_		-							F
10	1	Total num	ber of cyc	cles	=	60	1	20	=	3					
11	2	Total num			=	60	1	20	=	3					
12															
13	Therefore	the numb	er of clus	ters over	the lifetim	e of the pl	ant = num	ber of cyc	les x num	ber of Ro	ds change	d per cycl	e		
14															
15	1	Number o	f Control	Rod clust	ers	=	3	х	53	=	159				
16	2	Number o	f Gray Ro	od clusters	S	=	3	х	16	=	48				_
17							<b>.</b>					(0.5			_
18	Iherefore	the comb	ined num	ber of Co	ntrol Rod	and Gray	Rod cluste	ers = No. c	of Control	Rod Clus	ters + No.	of Gray R	od Cluster	rs	_
19	0 1				=	207									-
20	Combine	d Number	of Cluster	rs	-	207									+
21		or of Dod	Clustere	aonorator	d over 5-0	0 40 and	60 1/0070	of operatio		oulotod in	the come	way (by a			-
22 23		per of Rod									Table 21		ssuming a		-
23	unerent	perating in	ie i.e. J, 2	20 01 40 y	ears). The						100.0 21	,			-
25		No. of	vears	Numbe	r of Rod										-
26		opera	-	Clus	sters										F
27		5	i	1	18										-
28		20	C	6	69										
29		40	C	1	38										
30		60	D	2	07										
31		Table 21	: Number	r of Rod (	Clusters p	produced	over LOF	•							
32															
33	N.B	The value	for 5 yea	irs in	Table 21	is averag	ed to prov	vide consis	stency wit	h the rest	of this cale	culation			_
34	<b>T</b> h a 4a4a1		6	and a line of a second		ataus Nie			. N f						_
35	The total	number of	iuei asse	emplies ar	ia Roa ciu	sters = nc	b. of fuel a	ssemblies	5 + INO. OF	Rod Clust	ers				-
36	Desulte	f this salar	dation ave					lavu in	Table 22						-
37	Results o	f this calcu	nation ove	er 5, 20, 4	0 810 60	years are	snown be	IOW III							-
38				No. of F	uol										┡
39		No. of yea	ars	assembl											-
40		operation	1	Rod Clus	sters										
41		5	j		32										
42		20	-		23										L
43		40	-		345										L
44		60	-		360	<u> </u>									L
45		Table 22	: Total nu	umber of	Fuel Ass	emblies a	ind Rod C	lusters p	roduced	over LOP	•				L
46															╞
47	N.B.	It should b												60	╞
		vear data	Also the	initial rea	ctor loadir	na is taken	into acco	unt after 6	i0 vears o	f operatio	n. This is d	considered	to be an		1
48															Г
		operationa							,						_

		erSo	lutio		Project	Number:	Area :	System:	Discip. Code:	Doc. Type:	Sequen. Number:	Re	ev.	9	
		<b>er</b> 50	nutio	ns	630	00333	000	000	111	С	0001	Sta	tus:	S3	
						-				-			Page	e 30 of 51	<del></del>
1															L
2	It is assu	med that tl	he fuel as	semblies	and Rod o	clusters wi	ll be loade	ed into Hol	tec Intern	ational MP	C's for sto	rage on-s	ite (Ref 3)		L
3															
4	It is also a	assumed t	hat the R	od Cluste	rs will rem	ain within	the fuel as	ssemblies	when the	y are load	ed into the	MPCs			_
5															_
6	Therefore	e the No.of	f MPC's re	equired =	Total num	ber of Fue	el assembl	lies / No. o	of Assemb	olies per M	PC				_
7															_
8	Number o	of Fuel ass	semblies p	ber MPC		=	32					Ref 3			_
9		to of this o		for 00 4		in a rain of a r	anation in	diantaurad	i.e.	Table 00	halaun				_
10	The resul	ts of this c	aculation	1 TOF 20, 4	0 and 60 y	years of op	beration is	displayed	in	Table 23	below;				-
11		No. of													_
12		No. of opera		No. of	MPC's										-
13		2		-	27	-									┢
14		4			54										┢
15		6			33										┢
16 17		-	-			oduced o	ver LOP								┢
17 18		20010 20			co pi										┢
10	The value	e for after :	5 vears or	peration h	as not be	en include	d in	Table 22	hecauso	it is irreve	ant as the	fuel acco	mblies will		┢
										ternational		1001 0000	Indico wii		-
21					years (re		to being le		i lolteo ili	ternational	WI 00				-
	lt should	also be no	ted that the	he MPC v	alues outl	ined in	Table 23	assume t	hat the M	PC's will b	e used for	final disp	osal		-
23	it officiale						10010 20	uccume t				initial alop	ooun.		-
24															
25															-
26															-
27															
28															
29															
30															
31															
32															
33															
34															
35															
36															
37															
38															$\vdash$
39															
40															╞
41															$\vdash$
42															┝
43															┢
44															┢
45															╞
46															╞
47															┢
48															┢
49															┢
50															

l	Ak		lutio		Project	Number:	Area :	System:	Discip. Code:	Doc. Type:	Sequen. Number:	Re	ev.	9	
		<b>er</b> 50	DIUTIO	ns	6300	00333	000	000	111	С	0001	Sta	tus:	S3	
											1		Page	e 31 of 51	1
	9.0	LLW Dry	Filter Dir	nensions	;										
2	Ciltor Jone			0.004			4 000	a				Def			
	Filter leng		=	0.624		=	1.902					Ref 8			
	Filter radi	us	=	0.259	m	=	0.789	π				Ref 8			
5 6	These ha	ve heen c	onverted	usina the	conversio	n factors i	n Annendi	x 1							
0 7	These ha	ve been o	onventeu	doing the			in Appendi								
	Filter volu	me	=	4	ft <sup>3</sup>	=	0.11327	m <sup>3</sup>				Ref 3			
9		ine	_	-	n.	_	0.11327								
	For the n	irnoses o	f this calci	ulation it is	sassumed	that all I	l W dry filt	ers have t	hese dime	ensions ar	nd are nor	-compacta	ahle		
11					lassamee							oompuou			
12	9.1	200l Drui	m Dimens	sions											
13															
	Drum len	gth	=	0.886	m	=	2.701	ft				Ref 3			-
	Drum rad	-	=		m	=	0.937					Ref 3			
16															
	Drum volu	ume	=	0.2	m <sup>3</sup>							Ref 3			
18															
19	Number o	of filters pe	er drum	=	0.2	1	0.11327								
20				=	1.76573										
21				=	1	filter / dru	ım								
22															
23	The filter	loading pe	er drum (b	y volume)	)	=	0.11327	1	0.2						
24						=	57%								
25															
26	9.2	ILW Filte	r Cartridg	ge Dimen	sions										
27															
	Filter Len		=	19	Inch	=	0.483	m				Ref 9			
	Filter radi	us	=	3.375	Inch	=	0.086	m				Ref 9			
30	<b>T</b> I I			·			A 11								
31	These ha	ve been c	onverted	using the	conversio	n factors I	n Appendi	X 1							
32	Volume =		-2 1	_											
	volume =	TT x radiu	s xiengu												
34				_		0.00705		0.4000							
35 36	Filter Volu	lime	=	Π	X	0.00735	Х	0.4826							
	Filter Volu	ime	=	0.011	m <sup>3</sup>										╞──
38			_	0.011											-
39															┢──
40															
41															
42															
43															
44															
45															
46															
47															
48															
49															
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l		erSolu	tione	Project	Number:	Area :	System:	Discip. Code:	Doc. Type:	Sequen. Number:	R	ev.	9	
		ersolu	llions	630	00333	000	000	111	с	0001	Sta	atus:	S3	
							•					Page	32 of 51	
1	10.0	Calculation of	of the Annual	Volume of	f waste p	roduced f	from plant	Operatio	ons					
2	The annu	ual volume of s	solid Radwaste	produced	annually o	over the o	peration pe	eriod of th	e plant is o	calculated				_
3	in this se	ction, and the	results summa	rised in	Table 25	and	Table 27							_
4														_
5	10.1	Primary Res												_
6			comprised of th	e following	];			Normal	Max	3.			_	_
7	1	CVCS Mixed					=	0.94	1.89	m <sup>3</sup> / year		Appendix		_
8	2	CVCS Cation					=	0.47	0.94	m <sup>3</sup> / year		Appendix		_
9	3	SFS Deminer		i			=	1.42	2.83	m <sup>3</sup> / year		Appendix		-
10	4 5			in			=	1.13 3.82	2.27 7.65	m <sup>3</sup> / year m <sup>3</sup> / year		Appendix		-
11 12	5	WLS units 2,3	5,4			Total	=	5.62 7.79	15.58	m <sup>3</sup> / year		Appendix	2	-
12						· Jul		1.13	0	/ year				┢
13	Maximur	n arisings resu	It from fault pla	nt conditio	ons.									$\uparrow$
15														
16	Fault pla	nt conditions o	ccur 1	in every	5	years					Ref 3			
17								(4 )	14.1.1	) (1 )				
18	Therefor	e the average	raw volume of	waste proc	duced per	year	=	$(4 \times Norm)$	nal Arisin	$gs$ )+(1× $\Lambda$	<i>MaxAri</i> sm	(gs)		
19										5				
20														
21							=	9.35	m <sup>3</sup> / year					
22														
23	It is inten	ded to encaps	ulate the prima	ry resins i	n 3m³ dru	ms.								
24														
25	Actual dr	um working ca	apacity is			=	2.2	m <sup>3</sup>			Ref 1			_
26	The resir	n loading per d	rum (by volume	e) is		=	25%				Ref 2			
27	-									/				_
28	Ineretor	e the annual a	verage volume	of packag	ed waste	=	-		ne of wast	e / Wa	iste loadin	g per drum		_
29						=	9.35	1	25%					_
30						-	37.3032	m <sup>3</sup> / year						-
31	10.2	Secondary F	Posin											-
32	10.2	Occontaily h	Com											-
33 34	Spent Se	condary resin	comprises of tl	ne followin	a.				Normal	Мах				-
35	1	-	polisher spent r		J,			=	3.85	7.70	m <sup>3</sup> / vear	Appendix	2	
36	2		ator Blowdown		Resin and	Membrai	ne)	=	0.00	0.00		Appendix		┢
37				- (			Total	=	3.85	7.70	m <sup>3</sup> / year		-	T
38											<b>3</b>			T
39	Maximur	n arisings resu	lt from fault pla	nt conditio	ons.									T
40														Γ
41	Fault pla	nt conditions o	occur 1	in every	5	years								
42								(4 x Nor	<i>mal Ari</i> sin	as)⊥(1 v	Max A risi	n as)		
43	Therefor	e the average	raw volume of	waste proc	duced per	year	=	<u>( - ^ 11011</u>	<i>пш П I I</i> SШ		munn1181	<u> </u>		
44										5				
45														
46							=	4.62	m <sup>3</sup> / year					
47														
48														╞
49														╞
50														

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1															
2	The spen	t seconda	ry LLW re	esin will b	e encapsul	ated in 20	00L drums								
3		um workin					=	0.2	m <sup>3</sup>			Ref 5			
4	The resin	loading p	er drum (	by volum	e) is		=	50%				Ref 5			
5															
6	Therefore	the annu	al averag	e volume	of package	ed waste	=	Average	raw volum	ne of waste	e / Wa	ste loading	g per drum		
7							=	4.62	1	50%					
8							=	9.24	m <sup>3</sup> / year						
9															
10	10.3	Wet Chai	rcoal												
11															
12	Spent We	et Carbon	comprise	s of the fo	ollowing;				Normal	Max					
13		WLS unit	1 charco	al				=	0.57	1.13	m <sup>3</sup> / year		Appendix	2	
14															
15	Maximum	n arisings r	esult fror	n fault pla	ant condition	าร.									
16															
17	Fault plar	nt conditio	ns occur	1	in every	5	years								
18									(Av Nom	nal Aminin	aa)   (1 y	Man Anioin	(20.		-
19	Therefore	the avera	age raw v	olume of	waste prod	uced per	year	=	(4 × NOT	mai Arisii	$gs + (1 \times 1)$	<i>MaxAris</i> ir	1 gs )		
20											5				
21															
22								=	0.68	m <sup>3</sup> / year					-
23										,					-
24	The spen	t Wet Carl	bon will b	e encaps	ulated in 3r	n <sup>3</sup> drums									-
25															-
	Actual dru	um workin	g capacit	y is			=	2.2	m <sup>3</sup>			Ref 1			-
27	The resin	loading p	er drum (	by volume	e) is		=	25%				Ref 2			-
28		J J J J J	(		- , -										-
29	Therefore	e the annu	al averag	e volume	of package	ed waste	=	Average	raw volum	ne of waste	e / Wa	ste loading	g per drum		-
30							=	0.68	1	25%					-
31							=	2.72	m <sup>3</sup> / year						
32									<b>,</b>						
	10.4	ILW Filte	rs												-
34	Spent ILV	V filters ar	e compris	sed of the	following;					Normal	Мах				-
35	. 1	CVS RC 1			<u> </u>				=	0.032	0.063	m <sup>3</sup> / year	Appendix	2	1
36	2	SFS filter							=	0.032	0.063		Appendix		1
37	3	WLS inlet							=	0.063	0.127	-	Appendix		Π
38	4	WLS outle		-					=	0.032			Appendix		1
39	5	WSS resi		-	ge				=	0.032			Appendix		1
40	-				-			Total	=			m <sup>3</sup> / year			Π
41												-			1
42	Maximum	n arisings r	esult fror	n fault pla	ant conditio	าร.									1
43		-													-
	Fault plar	nt conditio	ns occur	1	in every	5	years								1
45							-		(1		).(1	M A • •			
46	Therefore	e the avera	age raw v	olume of	waste prod	uced per	year	=	$(4 \times Nor)$	mai Arisin	gs )+(1×1	<i>MaxAri</i> sir	1 <i>gs</i> )		T
47			-			•	-				5				+
48															-
49								=	0.23	m <sup>3</sup> / year					$\vdash$
-10								-	0.20	in i year					-

		e #Colutio		Project I	Number:	Area :	System:	Discip. Code:	Doc. Type:	Sequen. Number:	Re	ev.	9	
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1														
2	The spen	t ILW filters will be	encapsula	ated in 3m <sup>3</sup>	boxes.									
3	Actual bo	x working capacity	is			=	2.2	m <sup>3</sup>			Ref 1			
4	The filter	loading per box (by	volume)	is		=	30%				Assumed			
5														
6	Therefore	the annual averag	e volume	of package	ed waste	=	Average	raw volum	ne of waste	e / Wa	ste loading	g per box		
7						=	0.23	1	30%					
8						=	0.76	m <sup>3</sup> / year						
9														
10	10.5	Dry Solids	and	Dry Char	coal									
11	Dry Solid	waste and Dry Car	bon comp	orises of the	e following	g;			Normal	Мах				
12	1	DAW - compactabl						=	134.52	205.61		Appendix		
13	2	DAW - non-compa	ctable					=	6.63	10.56		Appendix		$\perp$
14	3	DAW - mixed						=	0.14	0.28		Appendix		
15	4	Strippable coatings	5					=	0.00	0.00		Appendix		
16	5	WGS guard bed ch	narcoal					=	0.15	0.30		Appendix		$\perp$
17	6	WGS delay beds c	harcoal					=	0.15	3.02	m <sup>3</sup> / year	Appendix	2	
18														
19	Due to th	e differing natures o	of the was	tes the ave	erage volu	umes will b	be calculat	ed sepera	ately for cla	arity				
20														
21	10.5.1	DAW - compactat	ble											
22														_
23	Maximum	arisings result from	n fault pla	nt conditio	าร.									
24														_
25	Fault plar	t conditions occur	1	in every	5	years					Ref 3			_
26								(4 × Norn	nal Arisin	os)+(1×1	<i>MaxAri</i> sin	os) —		_
27	Therefore	the average raw v	olume of v	waste prod	uced per	year	=		wir min sm	- / (	1001111511	85)		
28										5				
29									0					_
30							=	148.74	m <sup>3</sup> / year					_
31				0001										!
	It is inten	ded to dispose of th	iis waste i	in 200L dru	ms.									_
33								2			D ( 5			_
• ·		um working capacit	-			=	0.2	m³			Ref 5			
35	Volume r	eduction by compac	ction			=	3.6				Ref 4			
36	Thorafa	the appual average		of pooles	d wests	_	Average	rowychurz	o of wart		nnaction f	actor		
37	rneretore	the annual averag	e volume	ограскаде	eu waste	=			ne of waste	⇒ / cor	npaction fa	actor		
38						=	148.74	/	3.6					+
39						=	41.3100	m <sup>3</sup> / year						
40	10 5 2		aatable											+
41	10.5.2	DAW - non-compa	acidule											+
42	Maximum	arisings result from	n fault ala	nt conditio	26									+
		anonyo result itur	n iaun pia		13.									+
44	Fault play	nt conditions occur	1	in every	5	years					Ref 3			+
-	i auit pidi			in every	5	years		,				\		-
46	Thereford	e the average raw v	olume of s	waste prod	uced ner	vear	=	(4×Norm	nal Arisin	gs)+(1×1	<i>MaxAri</i> sin	gs) —		-
47	THEFEIDLE	ane average law V		maste prou	uceu pel	year	_	<u> </u>		5				-
48										J				+
49								7 4 4	m <sup>3</sup> / year					-
50							=	7.41	m / year					_

		e n O e la alta		Project	Number:	Area :	System:	Discip. Code:	Doc. Type:	Sequen. Number:	R	ev.	9
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1													
2	It is inten	ded to dispose of th	is waste ii	n 200L dru	ms.								
3													
4	Actual dru	um working capacity	y is			=	0.2	m <sup>3</sup>			Ref 5		
5	Volume r	eduction by compac	ction			=	1	(Indicates	s non-com	pactable	waste)		
6													
7	Therefore	the annual averag	e volume	of package	ed waste	=	Average	raw volum	ne of waste	e / com	npaction f	actor	
8						=	7.41	1	1				
9						=	7.41	m <sup>3</sup> / year					
10													
11	10.5.3	DAW - mixed											
12													
13	Maximum	arisings result fron	n fault plai	nt conditio	ns.								
14													
15	Fault plan	nt conditions occur	1	in every	5	years					Ref 3		
16								(Ax Nom	al Ariain	aa)   (1 v )	lar Anioin		
17	Therefore	e the average raw v	olume of v	vaste prod	uced per	year	=	(4 × Norn	<i>al Ari</i> sin	$gs + (1 \times n)$		1 gs )	
18										5			
19													
20							=	0.17	m <sup>3</sup> / year				
21													
22	It is inten	ded to dispose of th	is waste ii	n 200L dru	ims.								
23													
24	Actual dru	um working capacity	y is			=	0.2	m <sup>3</sup>			Ref 5		
25	Volume r	eduction by compac	ction			=	1	(Indicates	s non-com	pactable	waste)		
26													
27	Therefore	the annual averag	e volume	of package	ed waste	=	Average	raw volum	ne of waste	e / con	npaction f	actor	
28						=	0.17	1	1				
29						=	0.17	m <sup>3</sup> / year					
30													
31	10.5.4	Strippable coating	gs										
32													
33	Maximum	arisings result from	n fault plai	nt conditio	ns.								
34													
35	Fault plar	nt conditions occur	1	in every	5	years					Ref 3		
36								(1		).(1 1	/ A · ·	)	
37	Therefore	the average raw v	olume of v	vaste prod	uced per	year	=	(4×INorn	<i>al Ari</i> sin	gs )+(1×A		1 gs )	
38										5			
39													
40							=	0.00	m <sup>3</sup> / year				
41								-	,··				
42	It is inten	ded to dispose of th	is waste ii	n 200L dru	ims.								
43													
<u> </u>	Actual dru	um working capacity	y is			=	0.2	m <sup>3</sup>			Ref 5		
44						=	1		s non-com	pactable	waste)		
		eduction by compare	ction								/		
44 45 46		eduction by compac	Ction										İ
45 46	Volume r			of package	ed waste	=	Average	raw volum	ne of waste	e / cor	npaction f	actor	
45 46 47	Volume r	eduction by compace		of package	ed waste	=	-	raw volum /	ne of waste	e / cor	npaction f	actor	
45 46	Volume r			of package	ed waste		Average 0.00 0.00	raw volum / m <sup>3</sup> / year	1	e / cor	npaction f	actor	

		<b>er</b> Solutio		Project	Number:	Area :	System:	Discip. Code:	Doc. Type:	Sequen. Number:	Re	ev.	9	
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1	10 E E	WCS guard had a	haraaal											
	10.5.5	WGS guard bed cl	larcoal											
3	Maximum	arisings result from	n fault plai	nt conditio	ns									
4 5	Maximum		r idait pia											
	Fault plar	nt conditions occur	1	in every	5	years					Ref 3			-
7				,		<b>y</b>		(, ,,						
	Therefore	the average raw vo	olume of v	vaste proc	luced per	year	=	$(4 \times Norn)$	nal Arisin g	$gs$ )+( $l \times I$	<i>MaxAri</i> sin	gs) —		_
9										5				
10														
11							=	0.18	m <sup>3</sup> / year					
12														
13	It is intend	ded to dispose of thi	is waste i	n 200L dru	ums.									
14														_
15	Actual dru	um working capacity	/ is			=	0.2	m <sup>3</sup>			Ref 5			
16	Volume re	eduction by compac	tion			=	1	(Indicate:	s non-com	pactable	waste)			
17														
18	Therefore	the annual average	e volume	of packag	ed waste	=	-	raw volum	ne of waste	e / cor	npaction fa	actor		
19						=	0.18	/	1					
20						=	0.18	m <sup>3</sup> / year	•					
21	10.5.6	WGS delay beds o	haraaal											
	10.5.0	web delay beus c	Indicudi											
23 24	Maximum	arisings result from	n fault plai	nt conditio	ns									_
24 25	Maximum		r idait pia											
	Fault plar	nt conditions occur	1	in every	5	years					Ref 3			
27						5		(, , ,						
28	Therefore	the average raw vo	olume of v	waste proc	luced per	year	=	$(4 \times Norn$	nal Arism	$gs$ )+( $l \times h$	MaxArisin	gs)		
29										5				
30														
31							=	0.72	m <sup>3</sup> / year					
32														
33	It is inten	ded to dispose of thi	is waste i	n 200L dru	ums.									
34														
		um working capacity				=	0.2	m <sup>3</sup>			Ref 5			
	Volume re	eduction by compac	tion			=	1	(Indicates	s non-com	pactable	waste)			_
37	Therefo	. the evenue!		of 10 a - 11 -	a al 4	_	A				an a chair f			_
	rneretore	the annual average	e volume	ог раскад	eu waste	=	-		ne of waste	≠ / COľ	npaction fa	ACIOF		_
39						=	0.72							_
40						-	0.72	m <sup>3</sup> / year						_
41 42														_
42														-
43														-
44														-
46														
47														
48														
49														
50														

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1	11.0	Calculatio	on of the A	verag	e annual	volume of	Solid R	adioactiv	e Waste P	Produced	from Plar	nt Maintena	ince		
2	The avera	ge annual	volume of	solid ra	adwastes	produced by	y mainte	enance of	the plant is	s calculate	d in this s	ection and i	s		
3	summaris	ed in	Table 29	to	Table 33										
4															
5	11.1	LLW Wet	Filters												
6	Wet LLW	filters comp	orised of th	e follo	wing;										
7	1	Refuelling	pool unde	r wate	r filtration	system filte	r cartrido	ge	=	0.084	m <sup>3</sup> / chan	-	Appendix		
8	2	Bag filter (	(Sludge)						=	0.040	m <sup>3</sup> / chan	ge	Appendix	2	_
9															
10	Frequency	of replace													
11	1	-		r wate	r filtration	system filte	r cartrido	ge	=	1	per year		Appendix		_
12	2	Bag filter (	(Sludge)						=	1	per year		Appendix	2	
13	<b>T</b> I (		<b></b>	141 51						111.1.1					$\vdash$
14						ed per year	r = No. c	of changes	per year	x Vol of fil	ters per ch	ange			$\vdash$
15	This is cal	culated ind	lividually fo	r each	filter;										
16															_
17	1	Refuelling	pool unde	r wate	r filtration	system filte	r cartrido	ge	=	1	X	0.083532			
18									=	0.084	m <sup>3</sup> / year				_
19															_
20	2	Bag filter (	(Sludge)						=	1	X	0.039642			
21									=		m <sup>3</sup> / year				_
22								Total	=	0.12317	m <sup>3</sup> / year				_
23															_
24	The Wet L	LW filters	will be enc	apsula	ted in 200	L drums.									
25															
26	The filter I	oading per	drum (by v	/olume	e) is		=	50%				Ref 5			_
27															_
28	Therefore	the annual	average v	olume	of packag	ged waste	=	Average	raw volum		e / load	ding per dru	Im		_
29							=	0.12	/	0.5					_
30							=	0.25	m <sup>3</sup> / year						_
31															_
32	11.2	LLW Dry	Filters												_
33															_
34	•	ilters comp			-	. =				0					_
35	1				-	ciency Filte		=	0.453	m <sup>3</sup> / char	-	Appendix 2			_
36	2				-	ciency Filte	rВ	=		m <sup>3</sup> / char	-	Appendix 2			$\vdash$
37	3		ent Exh HE					=		m <sup>3</sup> / char	-	Appendix 2			$\vdash$
38	4		ent Exh HE					=		m <sup>3</sup> / char	0	Appendix 2			_
39	5		downstrea					=		m <sup>3</sup> / char	-	Appendix 2			$\vdash$
40	6		downstrea			filter B		=		m <sup>3</sup> / char	-	Appendix 2			$\vdash$
41	7		ool Exhau					=		m <sup>3</sup> / char	-	Appendix 2			$\vdash$
42	8		Exh Upstr			ncy Filter		=		m <sup>3</sup> / char	-	Appendix 2			+
43	9		Exh HEPA				<b></b>	=		m <sup>3</sup> / char		Appendix 2			$\vdash$
44	10					Efficiency F	Total	=	1.359	m <sup>3</sup> / char		Appendix 2			$\vdash$
45	11	Spent Fue	el Pool Exh	HEPA	Filter			=	1.359	m <sup>3</sup> / char	nge	Appendix 2	2		$\vdash$
46															+
47															+
48															$\vdash$
49															$\vdash$
50															_

	Ake		ution	C <sup>TM</sup>	Project	Number:	Area :	System:	Discip. Code:	Doc. Type:	Sequen. Number:	Re	v.	9	
		501	ution	5	630	00333	000	000	111	С	0001	Stat		S3	
									1				Page	38 of 51	
1	_														┣
2	Frequency														L
3			ent Exh Up		-	•			=	0.333	per year		Appendix	2	
4	2	Containme	ent Exh Up	stream	High Effi	ciency Filte	er B		=	0.333	per year		Appendix	2	
5	3	Containme	ent Exh HE	PA filte	er A				=	0.200	per year		Appendix	2	l
6	4	Containme	ent Exh HE	PA filte	er B				=	0.200	per year		Appendix	2	
7	5	Cont Exh o	downstrear	n high	efficiency	filter A			=	0.333	per year		Appendix		1
	6	Cont Exh o	downstrear	n high	efficiency	filter B			=	0.333	per year		Appendix		
			ool Exhaus	-					=	2.000	per year		Appendix		Γ
-			Exh Upstre			ncv Filter			=	3.000			Appendix		-
10			Exh HEPA		gri Emole	noy i ntoi			=	0.500	per year				┢
					a sea di Basha	<b></b>					per year		Appendix		⊢
12	-		Pool Exh		-	Emclency I	-mer		=	3.000	per year		Appendix		
13	11	Spent Fue	l Pool Exh	пера	riiter				=	0.500	per year		Appendix	2	⊢
14															└──
15			e of Dry LL					-		Volume	of filters pe	r change			
16	This is cale	culated ind	ividually for	r each	filter and	the results	are sum	marised ir	ו	Table 24					
17															
18		Filter sou	rce						Volume p	ber year	(m <sup>3</sup> )				ł
19		1	Containme	ent Exh	upstrear	n High Effi	ciency F	ilter A		0.15					1
20		2	Containme	ent Exh	upstrear	n High Effi	ciency F	ilter B		0.15					
21		3	Containme	ent Exh	HEPA fil	ter A				0.09					
22		4	Containme	ent Exh	HEPA fil	ter B				0.09					<u> </u>
23		5	Cont Exh o	downst	ream high	n efficiencv	filter A			0.04					<u> </u>
23		6	Cont Exh o							0.04					-
		-	Machine T				Inter D			0.23					-
25		7 8	Radwaste				ncv Filte	r		6.12					-
26		9	Radwaste		-	-	ncy i nce	1		1.02					-
27							Efficience	. Filtor		4.08					┣—
28			Spent Fue			_	Enicienc	y Filler							┣
29			Spent Fue					T	-	0.68					
30		Table 24	: Vol. of L	LW dr	y filters p	er year		Total		12.68					⊢
31															⊢
32	The Dry Ll	W filters w	vill be dispo	osed of	in 200L o	trums.									L
33															
34	The filter lo	bading per	drum (by v	olume	) is		=	57%							
35															L
36	Therefore	the annual	average v	olume	of packag	ed waste	=	Average	raw volum	e of wast	e / com	npaction fac	tor		L
37							=	12.68	1	57%					Ī
38							=	22.39	m <sup>3</sup> / year						
39									, - s.						-
40															
															<u> </u>
41															
42															⊢
43															-
44															-
45															-
46															-
47															L
48															
49															
50															ł

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1											
2	11.3	LLW Gaskets									
3	The volum	ne of gaskets produced per y	/oor	=	0.000				See Page	10	
4	The volur	ne of gaskets produced per y	/eai	-	0.009	m²/yr			See Page	19	
5 6	The nack	aged volume of gaskets per	vear	=	0.002	m <sup>3</sup> /vr			See Page	19	
0 7			year		0.002	111 / yi			occ i uge		
8	11.4	LLW Insulation									
9	11.4										
10	The volur	ne of insulation produced per	r vear	=	0.167	m <sup>3</sup> /vr			See Page	20	
11			,			<b>j</b> .					
12	The pack	aged volume of insulation pe	r year	=	0.046	m <sup>3</sup> /yr			See Page	20	
13			-			-					
14	11.5	LLW Packing									
15											
16	The volur	ne of packing produced per y	/ear	=	0.090	m³/yr			See Page	21	
17											
18	The pack	aged volume of packing per	year	=	0.025	m³/yr			See Page	21	
19											
20	11.6	LLW Seals									
21											
22	The volur	ne of seals produced per yea	ar	=	0.005	m³/yr			See Page	23	
23						2					
24	The pack	aged volume of seals per yea	ar	=	0.001	m³/yr			See Page	23	
25	44 7										
26	11.7	LLW pumps									
27	The volur	ne of pumps produced per ye	ar	=	0.001	m <sup>3</sup> /yr			See Page 2	24	
28 29		ne or pumps produced per ye	201	_	0.001	111 / yi			See rage	27	
29 30	The pack	aged volume of pumps per y	ear	=	0.001	m <sup>3</sup> /vr			See Page	24	
31			ou.		0.001	iii / yi			eee ruge		
32	11.8	LLW Diaphragms									
33	1										
34	The volur	ne of diaphragms produced p	ber year	=	0.008	m³/yr			See Page	25	
35						-					
36	The pack	aged volume of diaphragms	per year	=	0.002	m <sup>3</sup> /yr			See Page	25	
37											
38	11.9	LLW Charcoal									
39											
40	The volur	ne of charcoal produced per	year	=	0.485	m³/yr			See Page	26	
41											
42	The pack	aged volume of charcoal per	year	=	0.485	m³/yr			See Page	26	
43											
44	11.10	LLW Stacks									
45		a states in the			0.400	3.			0	07	
46	I ne volur	ne of stacks produced per ye	ear	=	0.180	mĭ/yr			See Page	21	
47	The need	and volume of stacks account	or	_	0.400				See Deer	07	
48	ппе раск	aged volume of stacks per ye	sdi	=	0.180	m <sup>*</sup> /yr			See Page	<u> </u>	
49											
50	ļ										

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1	12	Summary											
2	This sect	ion will summarise the amo	unt of LLW, I	LW and H	LW gener	ated from	the opera	tion of one	AP1000	olant over	the Lifeti	ime	
3	of the pla	nt (LOP) and the average a	innual arising	s of raw a	ind packag	ges waste	S.						
4													
5	12.1	Packages over Lifetime	of Plant										
6	12.1.1	LLW											
7	The volu	me of LLW generated in ter	ms of 200L d	rums is su	Immarised	l in	Table 25	below, thi	s divides t	he waste	into oper	ational	
8	and main	tenace waste. The calculat	ion of these v	alues can	be found	on pages							
9													
10			Years of Operation	5	20	40	60						
11		Waste Stream	operation		0.25	1940	0774						_
12		Secondary Resin		232	925	1849	2774						$\vdash$
13		DRY SOLIDS and Compa		1033	4132 840	8264	12395						
14		DRY CHARCOAL Non - (		213	849	1698	2547						$\vdash$
15			Total	1478	5906	11811	17716						$\vdash$
16		Maintenance Waste		-	05	50	74	-					$\vdash$
17		LLW Wet Filters		7	25	50	74						_
18		LLW Dry Filters		560	2239	4478	6716						
19		LLW Gaskets		1	1	1	1						_
20		LLW Insulation		2	5	10	14						_
21		LLW Packing		1	3	6	8						_
22		LLW Seals		1	1	1	1						
23		LLW Diaphragms		1	1	1	1						
24		LLW Charcoal		13	49	98	146						
25			Total	586	2324	4645	6961						
26		Overall Total		2064	8230	16456	24677						
27		Table 25 : Total number of	LLW drums	produced									
28	10 1 1 1	Oslaulation of Number											_
20	12.1.1.1	Calculation of Number o	r HHISO from	i LLW art	ums								_
30													_
	Assumpti	on 7 states that 39, 200L d	rums can be	oaded into	o 1 HHISC	)							_
32			tatad in	Table 00	halaw ar	a basad a	n this see						
33	The num	pers of HHISO containers s	tated in	Table 26	below, ar	e based o	n this ass	umption; i.	e;				_
34	Total Num	abor of LUUCO – Total Num	a barrafalmunaa	1.20									_
35	rotar Nur	nber of HHISO = Total Nun	iber of drums	1 39									+
36		Voaro of Operatio	n F	20	40	60							
37		Years of Operation		<b>20</b>	<b>40</b>	<b>60</b>							+
38		Operational Waste	38	152	303	455							$\vdash$
39		Maintenance Waste	18	62	122	181							+
40				214	425	636							+
41		Table 26 : Total number	oi nniso pro	Jaucea									+
42		The values in Table 2	06 for mainte		eto includ	a the sure	bor of LLL		ated on no	000 22 07	nd 26 for		+
43	N.B.		26 for mainte							-			+
44		pumps and LLW stacks re directly into HHISO contai											+
45		would be loaded into a HH									-	, y	+
46					-				-				+
47		conservatism the values o	Julieu IOM	aules 10 a	anu 1911a	ve been ñ	annaineo		umps and		67,		+
48		respectively.											$\vdash$
49													+
50	ļ											<u> </u>	┶┷┥

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1														
-	12.1.2	ILW												
3	The volu	me of ILW	generate	ed in terms	of 3m <sup>3</sup> dru	ms and b	oxes is su	Immarised	l in	Table 27	below;			
4														
5					Years of	5	20	40	60					
6		Waste S	tream		Operation	Ũ	20	40						
7		Primary I	Resin			85	340	680	1020					
8		Wet Cha	rcoal			7	25	50	75					
9		ILW Filte	rs			2	7	14	21					
10				То	tal Drums	92	365	730	1095					
11				Тс	otal Boxes	2	7	14	21					
12		Overall 7	Fotal Was	ste packag	jes	94	372	744	1116					
13		Table 27	: Numbe	er of 3m <sup>3</sup> b	oxes/drum	s produ	ced over	LOP						
14						-								
	12.1.3	HLW												
16														
	The num	ber of fuel	assembl	ies. Contro	l rods. Grav	rods an	d hence H	loltec Inter	national N	/PC's that	are generat	ed over the o	perating	, –
		plant is s			Table 28								p er orning	,
		piant is s	ummanse		10010 20	below,								
19					Veere of									
20					Years of Operation	5	20	40	60					
21		Waste S			operation	014	054	4707	0050					
22		Fuel Ass				214	854	1707	2653					
23			Rod Cluste			14	53	106	159					
24		Gray Roo	d Clusters	3		4	16	32	48					
25		Total nu	mber of I	Fuel asser	nblies	232	923	1845	2860					
26		and Rod	Clusters	6										
27		Total Nu	mber of	MPC's req	uired	n/a	27	54	83					
28		Table 28	: Numbe	er of MPC'	s produced	l over LC	OP							
29														
30	12.2	Raw was	ste volum	nes										
31														
32														
33	12.2.1	LLW												
34														
	The raw	volumes c	of operation	onal LLW p	roduced per	r vear are	e shown in	n	Table 29					
36						-								
37					Average	Volume								
38		w	aste stre	am	per Yea									
39		Seconda	rv Resin		4.6		1							
40				le	148.									
40														
41			AW - non-compactable 7 AW - mixed 6											
			rippable coatings				1							
43			Ippable coatings     0       GS guard bed charcoal     0											
44			GS guard bed charcoal GS delay beds charcoal G				-							
45		000 aei	GS delay beds charcoal ( Total 16											
46		<b>.</b>	Total 10 able 29 : Raw volumes of operatio											
47		i able 29	: Raw vo	olumes of	operationa	ILLW								
48														-+
49														
50														

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	1						,	·				Page	42 of 51	-
1														
2	The raw	volumes	of mainter	nance LLW	produced per year	are shown	in	Table 30						
3														
4 5		v	Vaste stre	eam	Average Volume per Year (m <sup>3</sup> )									
6		LLW We	et Filters		0.123									
7		LLW Dry	/ Filters		12.678									
8		LLW Ga	skets		0.009									
9		LLW Ins	ulation		0.167									
10		LLW Pa	cking		0.090									
11		LLW Se	als		0.005									
12		LLW pu	nps		0.001									
13			phragms		0.008	_								
14		LLW Ch			0.485	_								
15		LLW Sta	icks		0.180									
16				Total	13.746									
17		Table 3	) : Raw v	olumes of	maintenace LLW									
18														
19	The aver	age total	raw volun	ne of LLW p	produced per year=	175.60	) m <sup>3</sup>							
20														
21	12.2.2	ILW												
22														
23	The raw	volumes	of ILW pro	oduced per	year are shown in	Table 31								
24						_								
25		v	Vaste stre	eam	Average Volume									
26					per Year (m <sup>3</sup> )									
27		Primary			9.35									
28		Wet Cha			0.68									
29		ILW Filte	ers		0.23									
30				Total	10.25	_								
31		Table 3 <sup>r</sup>	1 : Raw a	nnual volu	mes of ILW									
32							2							<u> </u>
	The aver	age total	raw volun	ne of ILW p	roduced per year =	10.25	5 m°							<u> </u>
34														<u> </u>
35														-
36														-
37														-
38														-
39														┢
40														-
41														-
42 43														┢
43 44														⊢
44 45														-
45 46														-
40 47														-
47														┢
48 49														-
49 50														-
50	ļ					1								1

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17		<b>er</b> 50	olutio	ns	6300	0333	000	000	111	С	0001	Sta	tus:	S3	
	1								-				Pag	e 43 of 51	-
1	12.3	Package	d Annual	Waste V	olumes										
2															-
			mmarise t	he averag	ge volumes	of packag	ged wastes	s, type of p	backages	used and o	correspon	ding numb	per of		_
4	packages	;													-
5															-
6	12.3.1	LLW													-
7															_
8	Table 32	below sur	nmarises	the avera	age annual i	backaged	volumes o	of LLW an	d type of	backage us	sed				
9															-
10		Wa	aste strea	am	Average	-			ontainer						
11					pe	er Year (m	1°)		sed						-
12		Secondar				9.244			Drum						-
13		DAW - co				41.317			Drum						
14		DAW - no		ctable		7.414			Drum						Щ
15		DAW - mi	ixed			0.170			Drum						_
16		Strippable	ble coatings juard bed charcoal lelay beds charcoal		0.000		200L	Drum						_	
17		WGS gua			0.181		200L	Drum						_	
18		WGS dela	ay beds cl	harcoal		0.724		200L	Drum						_
19		LLW Wet	Filters			0.246		200L	Drum						_
20		LLW Dry				22.386			Drum						_
21		LLW Gas	kets			0.002		200L	Drum						_
22		LLW Insu	lation			0.046		200L	Drum						_
23		LLW Pac	king			0.025		200L	Drum						_
24		LLW Sea				0.001		200L	Drum						_
25		LLW pum				0.001		НН	ISO						_
26		LLW Diap	hragms			0.002		200L	Drum						_
27		LLW Cha	rcoal			0.485		200L	Drum						
28		LLW Stac	ks			0.180			ISO						_
29				Tota		82.426			/A						_
30		Table 32	: Summa	ary of LL\	N annual p	ackaged	waste vol	umes							_
31															_
32	The total	average p	ackaged	volume of	f LLW to be	disposed	of per yea	ar is	=	82.43	m <sup>3</sup>				-
33															_
34	The total	average p	ackaged	volume of	f LLW to be	disposed	of in 200 l	L drums p	er year is	=	82.24	m <sup>3</sup>			-
35															-
	This corre	esponds to	o an avera	age of	412	drums pe	er year								
37					-										_
-			W stacks	and LLW	pumps are	too large	to be disp	osed of ir	1 200L dru	ms and wi	II be direc	tly placed	Into HHIS	50	Н
39	Containe	ers													Н
40	10.5.5														Н
41	12.3.2	ILVV													Н
42	Table 00	holow -:	nnerie -	the ever			volume	sf    \∧/ ==	1 ture - f	ookees ::	od				Н
43	Table 33	Delow Sur	nmarises	me avera	age annual p		voiumes o	or i∟vv and	a type of p	ackage us	ea				$\vdash$
44		Wa	aste strea	am	Average per Yea										$\vdash$
45		<b>D</b> · –			-										$\vdash$
46		Primary F Wet Char			37.										$\vdash$
47		ILW Filter			2.7										$\vdash$
48			3	Tota											$\vdash$
49		Takle AC	. 0		-										H
50		able 33	: Summa	ary of anr	nual packag	jea volur	nes of ILV	V						<u> </u>	

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		ers	olutic	ns"	6300	0333	000	000	111	С	0001	Stat	us:	S3	
	n						;	·					Page	44 of 51	
1										2					
	The total	average	packaged	volume of	f ILW to be	disposed	of per yea	r is =	40.86	m³					_
3	This corr	asponds	to an aver	ago numb	er of ILW w	asto nack		oar of	19						-
4 5	THIS COT	esponus	to an aver	age numb			ages per y		19						-
6															-
7															
8															
9															
10															
11															$\vdash$
12															╞
13															$\vdash$
14 15															$\vdash$
16															$\vdash$
17															
18															
19															
20															
21															_
22															_
23 24															-
24 25															-
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							Page 4	15 of 51

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1									
2 14.0 Glos	sary								
3									
4 HHISO	Half Height Isofreight								
5 HLW	High Level Radioactive Wa	aste							
6 Hx 7 ILW	Heat Exchanger Intermediate Level Radioa	ctivo Wasto							
	Low Level Radioactive Wa								
8 LLW 9 LOP	Lifetime of Plant								
10 MPC	Multi-purpose Canister								
10 m C	Reactor Coolant Drain Tar	ık							
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Appendix 1 Conversion Factors								
3 1) Prefixes								
4 Kilo 1.E+03								
5 Mega 1.E+06 6 Giga 1.E+09								
7 Tera 1.E+12								
8								
9 2) ft <sup>3</sup> to m <sup>3</sup>								
10 1 $\text{ft}^3 = 0.028316846 \text{ m}^3$								
11 1ft = 0.3048 m								
12								
13 3) Pounds to kg								
14 1lb = 0.453592 kg								
15								
16         4) Inches to metres           17         1 inch = 0.0254m								
17 1 inch = 0.0254m								
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Appendix 2 Solid Radioactive Waste Arisings from an AP1000

# <u>Key</u>

Cells highlighted in yellow are as per reference data

Conversion factors used are taken from Appendix 1.

## PART A - SOLID RADWASTE ARISINGS FROM SYSTEM OPERATIONS

							Estimate	ed Quantity			Arisings/ lifeti	me of plant	
			Rad/	Waste	Physical/Chemical	no	ormal/ yr		maxim	num/ yr	(lop	•	Reference/basis of information
Waste Type	System	Waste Description	Nonrad	Category	Description	ft <sup>3</sup> /yr	m³/yr	%vol of total*	ft <sup>3</sup> /yr	m³/yr	ft <sup>3</sup> /lop	m³/lop	
	CVS	CVCS Mixed Bed Resin	R	ILW	spherical bead / resin compound	33.3	0.94	12%	66.7	1.89	2,399	67.94	Reference 3
	CVS	CVCS Cation Bed	R	ILW	spherical bead / resin compound	16.7	0.47	6%	33.3	0.94	1,201	34.01	Reference 3
Primary Resin	SFS	SFS Demineralizer	R	ILW	spherical bead / resin compound	50	1.42	18%	100	2.83	3,600	101.95	Reference 3
Frinary Resin	WLS	WLS unit 1 INORGANIC resin	R	ILW	spherical bead / resin compound	40	1.13	15%	80	2.27	2,880	81.56	Reference 3
	WLS	WLS units 2,3,4	R	ILW	spherical bead / resin compound	135	3.82	49%	270	7.65	9,720	275.28	Reference 3
					Total Volume Primary Resin	275.0	7.79	100%	550	15.58	19,800	560.75	
								1					
	CPS	Condensate polisher spent resin	R	LLW	replace resin	136	3.85		272	7.70	2,448	69.33	Reference 3. Normal replacement 1 vessel per cycle max 2 per cycle each vessel contains 204 cf.
Secondary Resin		Steam Generator Blowdown Material (Resin and Membrane)				0			0				Reference 3
				Тс	tal Volume Secondary Resin	136.0	3.85		272	7.70	2,448	69.33	
Wet Charcoal	WLS	WLS unit 1 charcoal	R	ILW	wet granular carbon	20	0.57		40	1.13	1,440	40.78	Reference 3
	CVS	CVS RC filter cartridge	R	ILW	metallic cylinder	1.12	0.032		2.24	0.063	81.00	2.29	Reference 3
	SFS	SFS filter cartridge	R	ILW	metallic cylinder	1.12	0.032		2.24	0.063	81.00	2.29	Reference 3
ILW Filters	WLS	WLS inlet filter cartridge	R	ILW	metallic cylinder	2.24	0.063		4.48	0.127	161.00	4.56	Reference 3
	WLS	WLS outlet filter cartridge	R	ILW	metallic cylinder	1.12	0.032		2.24	0.063	81.00	2.29	Reference 3
	WSS	WSS resin fines filter cartridge	R	ILW	metallic cylinder	1.12	0.032		2.24	0.063	81.00	2.29	Reference 3
		1			Total Volume Primary Filters	6.7	0.19		13	0.38	485	13.74	
	WSS	DAW - compactable	R	LLW	compactable paper, tape, clothing	4,750	134.52		7,260	205.61	315,120	8,924	Reference 3

Dry Solids	WSS	DAW - non-compactable	R/N	LLW	other non-compactable	234	6.63	37	3	10.56	15,708	444.86	Reference 3
Dry conds	WSS DAW - mixed	R/N	Mixed	small batteries/corrosive	5	0.14	1	)	0.28	360	10.20	Reference 3	
	WSS	Strippable coatings	R	LLW	latex paint peelings								
Dry Charcoal	WGS	WGS guard bed charcoal	R	LLW	dry granular carbon	5.3	0.15	10	7	0.30	383	10.85	Ref. 3 - 2 replaced every 10 yrs
	WGS	WGS delay beds charcoal	R	LLW	dry granular carbon	5.3	0.15	100	.7	3.02	1,535	43.47	Ref. 3 - 1 replace every refuelling
	Total Volume Dry Carbon					10.6	0.30	11	7	3.32	1,918	54.32	

# PART B - SOLID RADWASTE ARISINGS FROM SYSTEM MAINTENANCE

All values highlighted in yellow are taken from reference 3 Note: a) Wastes from reference 3 marked as 'minimal waste' or those given no waste quantity are neglected b) Inactive wastes listed in reference 3 are not included

			Rad/	Waste	Physical/Chemical			Est	timated Quar	ntity		Source/basis of
Waste Type	System	Waste Description	Nonrad	Category	Description	Waste Cause	Frequency	ft <sup>3</sup> each change	m <sup>3</sup> each change	ft <sup>3</sup> / lop	m³/lop	information
	RXS	Fuel assembly	R	HLW	spent fuel rods	burnup	40%/18mos	485	13.733	19400	549.33	Reference 3. Spent fuel rods, control rods and
Fuel assemblies	RXS	Control rod cluster (Type53)	R	ILW	metallic rod assemblies		once/ 20yrs	198.75	5.628	596.25	16.88	Gray rod clusters all
	RXS	Gray control rod cluster (Type16)	R	ILW	metallic rod assemblies		once/ 20yrs	60	1.699	180	5.10	disposed of together as
						Total Volume	<b>Fuel Assembly</b>	n/a	n/a	20176.25	571.31	fuel assembly.
									•			
	FHS	Refuelling pool under water filtration system filter cartridge	R	LLW	pleated polyester	replace 3 filters	once/yr	2.95	0.084	177	5.01	Reference 3. Two 260gpm underwater
LLW Wet Filters	SGS	Bag filter (Sludge)	R	LLW	Wet granular particles	replace 1 filter	once/yr	1.4	0.040	84	2.38	Reference 3. Note 2
		•	•		•	Total volume L	LW Wet Filters	n/a	n/a	261	7.39	
												•
	VFS	Containment Exh Upstream High Efficiency Filter A	R	LLW	uncompacted fibreglass/metal	replace filter 4 filters	once/ 3yrs	16.00	0.453	320	9.06	Reference 3
	VFS	Containment Exh Upstream High Efficiency Filter B	R	LLW	uncompacted fibreglass/metal	replace filter 4 filters	once/ 3yrs	16.00	0.453	320	9.06	Reference 3
	VFS	Containment Exh HEPA filter A	R	LLW	uncompacted fibreglass/metal	replace filter 4 filters	once/ 5yrs	16.00	0.453	192	5.44	Reference 3
	VFS	Containment Exh HEPA filter B	R	LLW	uncompacted fibreglass/metal	replace filter 4 filters	once/ 5yrs	16.00	0.453	192	5.44	Reference 3
	VFS	Cont Exh downstream high efficiency filter A	R	LLW	uncompacted fibreglass/metal	replace 1 filter	once/ 3yrs	4.00	0.113	80	2.27	Reference 3
LLW Dry Filters	VFS	Cont Exh downstream high efficiency filter B	R	LLW	uncompacted fibreglass/metal	replace 1 filter	once/ 3yrs	4.00	0.113	80	2.27	Reference 3
	VHS	Machine Tool Exhaust Fan Filter	R	LLW	uncompacted fibreglass/metal	replace 1 filter	twice/yr	4.00	0.113	480	13.59	Reference 3
	VRS	Radwaste Exh Upstream High Efficiency Filter	R	LLW	uncompacted fibreglass/metal	replace filter 18 filters	every 4 months	72.00	2.039	12,960	366.98	Reference 3

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	VRS	Radwaste Exh HEPA Filter	R	LLW	uncompacted fibreglass/metal	replace filter 18 filters	once/ 2yrs	72.00	2.039	2,160	61.16	Reference 3
	VAS	Spent Fuel Pool Exh Upstream High Efficiency Filter	R	LLW	uncompacted fibreglass/metal	replace filter 12 filters	every 4 months	48.00	1.359	8,640	244.65	Reference 3
	VAS	Spent Fuel Pool Exh HEPA Filter	R	LLW	uncompacted fibreglass/metal	replace filter 12 filters	once/ 2yrs	48.00	1.359	1,440	40.78	Reference 3
		•				Total Volume	LLW Dry filters	n/a	n/a	26,864	760.68	
												Reference 3. 4" wide
	CVS	Makeup miniflow hx A & B	R	LLW	compressible rigid plastic	gasket replace	1/lop	0.13	0.004	0.13	0.004	1/4" thick gasket
	CVS	Letdown hx	R	LLW	compressible rigid plastic	gasket replace	1/lop	0.11	0.003	0.11	0.003	Reference 3.
	WLS	Reactor coolant drain tank hx	R	LLW	compressible rigid plastic	gasket replace	1/lop	0.04	0.001	0.04	0.001	Reference 3. 2" wide 1/4" thick gasket
		Desidual hast removed by	-	1 1 1 4 /			4.11-12	0.00	0.001	0.00	0.001	Reference 3. 4"
	RHR	Residual heat removal hx	R	LLW	compressible rigid plastic	gasket replace	1/lop	0.03	0.001	0.03	0.001	thickness insulation
	WLS	Reactor coolant drain tank	R	LLW	compressible rigid plastic	gasket replace	3/lop	0.08	0.002	0.24	0.007	Reference 3
	WLS	Waste holdup tank A	R	LLW	compressible rigid plastic	gasket replace	3/lop	0.08	0.002	0.24	0.007	Reference 3
	WLS	Waste holdup tank B	R	LLW	compressible rigid plastic	gasket replace	3/lop	0.08	0.002	0.24	0.007	Reference 3
	WLS	Waste monitor tank A	R	LLW	compressible rigid plastic	gasket replace	3/lop	0.08	0.002	0.24	0.007	Reference 3
	WLS	Waste monitor tank B	R	LLW	compressible rigid plastic	gasket replace	3/lop	0.08	0.002	0.24	0.007	Reference 3
	WLS	Waste monitor tank C	R	LLW	compressible rigid plastic	gasket replace	3/lop	0.08	0.002	0.24	0.007	Reference 3
LIM Cookete	WLS	Waste monitor tank D	R	LLW	compressible rigid plastic	gasket replace	3/lop	0.08	0.002	0.24	0.007	Reference 3
LLW Gaskets	WLS	Waste monitor tank E	R	LLW	compressible rigid plastic	gasket replace	3/lop	0.08	0.002	0.24	0.007	Reference 3
	WLS	Waste monitor tank F	R	LLW	compressible rigid plastic	gasket replace	3/lop	0.08	0.002	0.24	0.007	Reference 3
	WLS	Effluent holdup tank A	R	LLW	compressible rigid plastic	gasket replace	3/lop	0.08	0.002	0.24	0.007	Reference 3
	WLS	Effluent holdup tank B	R	LLW	compressible rigid plastic	gasket replace	3/lop	0.08	0.002	0.24	0.007	Reference 3
	WLS	Effluent holdup tank C	R	LLW	compressible rigid plastic	gasket replace	3/lop	0.08	0.002	0.24	0.007	Reference 3
	WLS	Chemical waste tank	R	LLW	compressible rigid plastic	gasket replace	once/18 mo	0.02	0.001	0.8	0.023	Reference 3
	CCS	Spent fuel system filter B	R	LLW	compressible rigid plastic	gasket replace	once/yr	0.03	0.001	1.8	0.05	Reference 3
	CVS	Reactor coolant filter A	R	LLW	compressible rigid plastic	gasket replace	once/yr	0.03	0.001	1.8	0.05	Reference 3
	CVS	Reactor coolant filter B	R	LLW	compressible rigid plastic	gasket replace	once/yr	0.03	0.001	1.8	0.05	Reference 3
	CVS	Makeup filter	R	LLW	compressible rigid plastic	gasket replace	once/yr	0.03	0.001	1.8	0.05	Reference 3
	SFS	Spent fuel system filter A	R	LLW	compressible rigid plastic	gasket replace	once/yr	0.03	0.001	1.8	0.05	Reference 3
	WLS	Waste prefilter	R	LLW	compressible rigid plastic	gasket replace	once/yr	0.03	0.001	1.8	0.05	Reference 3
	WLS	Waste after filter	R	LLW	compressible rigid plastic	gasket replace	once/yr	0.03	0.001	1.8	0.05	Reference 3
	WLS	Resin fines filter	R	LLW	compressible rigid plastic	gasket replace	once/yr	0.03	0.001	1.8	0.05	Reference 3
							ne LLW Gaskets		n/a	18.39	0.521	
Effluent holdup tank A												
												Reference 3. 4" thickness insulation (assumed all replace
	01/0	Pogoporativo by	П	1 1 \ \ \ /	inculation	inculation replace	1//0-	59.67	1 664	E9 67	1 664	once per life of plant,
	CVS	Regenerative hx	R	LLW	insulation	insulation replace	1/lop	58.67	1.661	58.67	1.661	lop) Reference 3. 4"
LLW Insulation	CVS	Makeup miniflow hx A & B	R	LLW	insulation	insulation replace	1/lop	21.47	0.608	21.47	0.608	thickness insulation
	WLS	Reactor coolant drain tank hx	R	LLW	insulation	insulation replace	1/lop	14.31	0.405	14.31	0.405	Reference 3.
	1120						1/100	11.01	0.100	11.01	0.100	
	RHR	Desidual best removal by	<b>D</b>	LLW	inculation	inculation ranks	1//	201 12	5 605	201.12	E COE	Reference 3. 4" thickness insulation
	CVS	Residual heat removal hx	R R	LLW	insulation compressible rigid plastic	insulation replace	1/lop	201.12	5.695	201.12	5.695 1.624	
	003	Letdown hx	Л	LLVV		insulation replace	1/lop LLW Insulation	<u>57.36</u> n/a	1.624 n/a	57.36 352.93	9.994	Reference 3.
								11/a	in a	552.55	3.334	
	All											
LLW Packing		Valves (potentially radioactive)	R	LLW	compressible rigid plastic	packing replace	once/5yrs	15.94	0.451	191.28	5.42	Reference 3.
	Systems		Γ				ne LLW Packing		n/a	<b>191.28</b>	5.42	Reference 5.
3							IL LEVE FACKING	ind	in a	101.20	0.42	l
g			R	LLW	carbon/SiC	mech seals 2/pmp	once/5yrs	0.1	0.003	2.4	0.07	Reference 3.
j	200	Component cooling water nump A	n			mech seals 2/pmp	once/5yrs	0.1	0.003	2.4	0.07	Reference 3.
	CCS	Component cooling water pump A		1 1 \ \ /		nnech seais Z/DIDD	UNCE/SYIS					Reference 3.
	CCS	Component cooling water pump B	R	LLW	carbon/SiC		0000/10.17	0.1	0.000	1 0	0.02	Deference 2
	CCS CVS	Component cooling water pump B Makeup pump A	R R	LLW	carbon/SiC	mech seals 2/pmp	once/10 yr	0.1	0.003	1.2	0.03	Reference 3.
	CCS CVS CVS	Component cooling water pump B Makeup pump A Makeup pump B	R R R	LLW LLW	carbon/SiC carbon/SiC	mech seals 2/pmp mech seals 2/pmp	once/10 yr	0.1	0.003	1.2	0.03	Reference 3.
	CCS CVS CVS RNS	Component cooling water pump B Makeup pump A Makeup pump B Residual heat removal pump A	R R R R	LLW LLW LLW	carbon/SiC carbon/SiC carbon/SiC	mech seals 2/pmp mech seals 2/pmp mech seals 2/pmp	once/10 yr once/5yrs	0.1 0.1	0.003 0.003	1.2 2.4	0.03 0.07	Reference 3. Reference 3.
	CCS CVS CVS RNS RNS	Component cooling water pump B Makeup pump A Makeup pump B Residual heat removal pump A Residual heat removal pump B	R R R R R	LLW LLW LLW LLW	carbon/SiC carbon/SiC carbon/SiC carbon/SiC	mech seals 2/pmp mech seals 2/pmp mech seals 2/pmp mech seals 2/pmp	once/10 yr once/5yrs once/5yrs	0.1 0.1 0.1	0.003 0.003 0.003	1.2 2.4 2.4	0.03 0.07 0.07	Reference 3. Reference 3. Reference 3.
LLW Seals	CCS CVS CVS RNS	Component cooling water pump B Makeup pump A Makeup pump B Residual heat removal pump A	R R R R	LLW LLW LLW	carbon/SiC carbon/SiC carbon/SiC	mech seals 2/pmp mech seals 2/pmp mech seals 2/pmp	once/10 yr once/5yrs	0.1 0.1	0.003 0.003	1.2 2.4	0.03 0.07	Reference 3. Reference 3.

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61.16	Reference 3
244.65	Reference 3
40.78	Reference 3
760.68	
	Reference 3. 4" wide
0.004	1/4" thick gasket
0.003	
0.000	Reference 3. Reference 3. 2" wide
0.001	1/4" thick gasket
	Reference 3. 4"
0.001	thickness insulation
0.007	Reference 3
0.023	Reference 3
0.05	Reference 3
0.521	
	Reference 3. 4" thickness insulation (assumed all replaced once per life of plant,

	WLS	RCDT pump A	R	LLW	carbon/SiC	mech seal 1/pmp	3/lop	0.3	0.008	0.9	0.03	Reference 3.
	WLS	RCDT pump B	R	LLW	carbon/SiC	mech seal 1/pmp	3/lop	0.3	0.008	0.9	0.03	Reference 3.
	WLS	Degassifier vacuum pump A	R	LLW	carbon/SiC	mech seal 2/pmp	3/lop	0.1	0.003	0.3	0.01	Reference 3.
	WLS	Degassifier vacuum pump B	R	LLW	carbon/SiC	mech seal 2/pmp	3/lop	0.1	0.003	0.3	0.01	Reference 3.
	WLS	Containment sump pump A	R	LLW	carbon/SiC	mech seal 1/pmp	2/lop	0.1	0.003	0.2	0.01	Reference 3.
	WLS	Containment sump pump B	R	LLW	carbon/SiC	mech seal 1/pmp	2/lop	0.1	0.003	0.2	0.01	Reference 3.
						Total Volu	ime LLW Seals	n/a	0.051	19.6	0.55	
	14/00	Desite the set of a second		1134/			40	0.4	0.000		0.00	
	WSS	Resin transfer pump	R	LLW	screw pump	replace pump	once/10 yr	0.1	0.003	0.6	0.02	Reference 3.
LLW pumps	WLS	Degassifier seperator pump A	R	LLW	canned pump	replace pump	once/lop	1	0.028	1	0.03	Reference 3.
	WLS	Degassifier seperator pump B	R	LLW	canned pump	replace pump	once/lop	1	0.028	1	0.03 <b>0.07</b>	Reference 3.
						lotal volur	ne LLW pumps	n/a	n/a	2.6	0.07	
	WLS	Degassifier discharge pump A	R	LLW	buna n	replace diaphragms	once/5yrs	0.1	0.003	1.2	0.03	Reference 3.
	WLS	Degassifier discharge pump B	R	LLW	buna n	replace diaphragms	once/5yrs	0.1	0.003	1.2	0.03	Reference 3.
	WLS	Effluent holdup pump A	R	LLW			once/5yrs	0.1	0.003	1.2	0.03	Reference 3.
	-	Effluent holdup pump B			buna n	replace diaphragms						
	WLS	Effluent holdup pump C	R	LLW	buna n	replace diaphragms	once/5yrs	0.1	0.003	1.2	0.03	Reference 3.
	WLS	• • •	R	LLW	buna n	replace diaphragms	once/5yrs	0.1	0.003	1.2	0.03	Reference 3.
	WLS	Waste holdup pump A	R	LLW	buna n	replace diaphragms	once/5yrs	0.1	0.003	1.2	0.03	Reference 3.
	WLS	Waste holdup pump B	R	LLW	buna n	replace diaphragms	once/5yrs	0.1	0.003	1.2	0.03	Reference 3.
LLW Diaphragms	WLS	Monitor pump A	R	LLW	buna n	replace diaphragms	once/5yrs	0.1	0.003	1.2	0.03	Reference 3.
	WLS	Monitor pump B	R	LLW	buna n	replace diaphragms	once/5yrs	0.1	0.003	1.2	0.03	Reference 3.
	WLS	Monitor pump C	R	LLW	buna n	replace diaphragms	once/5yrs	0.1	0.003	1.2	0.03	Reference 3.
	WLS	Monitor pump D	R	LLW	buna n	replace diaphragms	once/5yrs	0.1	0.003	1.2	0.03	Reference 3.
	WLS	Monitor pump E	R	LLW	buna n	replace diaphragms	once/5yrs	0.1	0.003	1.2	0.03	Reference 3.
	WLS	Monitor pump F	R	LLW	buna n	replace diaphragms	once/5yrs	0.1	0.003	1.2	0.03	Reference 3.
	WLS	Chemical waste pump	R	LLW	buna n	replace diaphragms	once/5yrs	0.1	0.003	1.2	0.03	Reference 3.
						Total volume LL		n/a	n/a	16.8	0.48	
	VFS	Cont exh charcoal filter A	R	LLW	granulated charcoal	replace charcoal	once/10yrs	85.7	2.427	514.2	14.56	Reference 3.
LLW Charcoal	VFS	Cont exh charcoal filter B	R	LLW	granulated charcoal	replace charcoal	once/10yrs	85.7	2.427	514.2	14.56	Reference 3.
						Total Volume	LLW Charcoal	n/a	n/a	1028.4	29.12	
	600			1.1.1.4/	Desistant Martin	Destace for t	110	07	0 707	405	0.00	
	BDS	Electrodeionisation Units A&B	R	LLW	Resin/membrane Module	Replace stack	once/12yrs	27	0.765	135	3.82	Reference 3.
LLW Stacks	DDC	Electrodeionisation Units A&B		1.1.147		Devices starts		04 7	0.000	200	40.70	Defense a
	BDS	(alternate supplier)	R	LLW	Resin/membrane Module	Replace stack	once/5yrs	31.7	0.898	380	10.76	Reference 3.
						i otai volur	ne LLW Stacks	n/a	n/a	380	10.76	Note 3

Notes:

1 Calculations page 4 to page 26

2 Filter used to collect sludge (limescale buildup, leaks from primary circuit etc) from Steam generator. This is considered to be a maintenance activity. Volume is based on an average of 4 years arisings of 1 ft<sup>3</sup> cu and 1 year maximum arisings of 3 ft<sup>3</sup>

3 Electrodiionisation Units from the alternative supllier used in calculatuion as this represents the worst case in terms of waste generated

4 In part B of this table, due to differences in time between required maintenance on equipment on totals per change are not applicable.