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SYNTHESIS

This study deals with EPR decommissioning waste evaluation. The assumption is that decommissioning starts immediately after 60 years of EPR operation in order to maximise activated matters volumes. This study also includes a waste packaging minimisation and introduces a volume of packaged nuclear wastes.

The wastes assessment based on EPR specific design is presented in the following table. The waste classification is the UK classification e.g. ILW as Intermediate Low Level Waste, LLW as Low Level Waste and VLLW as Very Low Level Waste.

	ILW (t, m^3)	LLW (t)	VLLW (t)	Conventional (t)
Primary Circuit	623	2735	1 898	
Decontamination	40			
NSSS Equipment		2 259		
BNI Equipment		2 824	2 605	978
Clean Up		75	455	
	623t, 40m^3	**7 893**	**4 958**	**978**

With these data, a volume assessment for the final repository has been made (at production time and evacuation time). This study leads to the following volume for ILW and LLW :

	ILW (m3)	LLW (m3)
Primary Circuit	1 180	4 036
Decontamination	220	
NSSS Equipment		4 170
BNI Equipment		3 348
Clean Up		115
	1 400	**11 669**

CONTENTS

APPENDIX

1 REVISION HISTORY

Issue	Description of the amendment
A	First Issue

2 REFERENCES

[1] NESH-G/2008/en/0123 Rev A. "Solid Radioactive Waste Strategy Report (SRWSR)"

3 SUBJECT

This study deals with EPR decommissioning waste evaluation. The assumption is that decommissioning starts immediately after 60 years of EPR operation in order to maximise activated matters volumes. This study also includes a waste packaging minimisation and introduces a volume of packaged nuclear wastes.

4 ASSUMPTIONS

4.1 WASTE ASSUMPTIONS

Administrative building, workshops and fences are not included in this study. The quantification of solid radioactive waste is based on considering EPR specificities, clean up feed back and the methodology used for NPP detailed study (PWR 900 MWe) completed some ten years ago.

4.2 RADIOLOGICAL ASSUMPTIONS

The components can be classified as follows :

ILW : only primary circuit (CPP) activated components.

LLW : Components in contact with primary fluid will be considered as LLW and RCP non activated components.

VLLW : Components not in contact with primary fluid will be considered as VLLW. Cable tray, support located in Controlled Area are considered as VLLW whereas cable tray, support located in Non Controlled Area are considered as conventional wastes.

5 INVENTORY OF WASTES

5.1 MASS INVENTORY FOR CPP AND CLASSIFICATION

This values come from the reference [1]. The primary circuit comprising the most activated and contaminated equipment is subject to a specific study.

CPP	Mass (t)	% Stainless steel	% Carbon steel	% Others	Waste classification (*)
Vessel head	116	6%	94%	-	LLW
Vessel head insulation	5,20	73%	-	27% Isover Ultimate©	VLLW
Vessel	225	6%	94%	-	ILW
	185	6%	94%	-	LLW
Vessel insulation	7	100%	-	-	LLW
Lower internal	198,05	100%	-	-	ILW
Upper internal	19,99	100%	-	-	ILW
	54,1	100%	-	-	LLW
Primary pipe	147,8	100%	-	-	LLW
Steam generator	1474	-	-	-	LLW
	726	-	-		VLLW
Reactor coolant pump	108,8	100%	-	-	LLW
	339,2	-	-		VLLW
Pressurizer expansion line	9,13	100%	-	-	LLW
Pressurizer	150	6%	94%	-	LLW
Reactor pit	180	-	20%	80% concrete	ILW
	483	-	20%	80% concrete	LLW
CPP Insulation	345,20	73%	-	27% Isover Ultimate©	VLLW
CPP Support	482,84	-	-	-	VLLW
TOTAL			623,04t		ILW
			2734,83t		LLW
			2624,44t		VLLW

(*)The waste classification is based on production time year 61. The ratio presented in this table is a mass ratio.

5.2 MASS INVENTORY FOR NSSS EQUIPEMENT AND CLASSIFICATION

Equipment NSSS	Quantity	Mass (t)	Length (m)	% Stainless steel	% Carbon steel	Others	Waste Classification
Exchanger	**10**	**117,6**	**-**	-	-	-	LLW
Tanks	**22**	**435,1**	**-**	-	-	-	LLW
	20	**395,5**	**-**	-	-	-	LLW
Valves	**2080**	**290,4**	**-**	-	-	-	LLW
	91	**12,7**	**-**	-	-	-	LLW
Sensors	**1189**	**17,8**	**-**	-	-	-	LLW
Pipes	**-**	**516,1**	**16332,4**	31,27%	68,73%	-	LLW
Heat Insulator	-	**102,6**	-	-	-	100% Isover Ultimate	LLW
Support Heat Insulator	-	**13,4**	-	77%		23% Al	LLW

Equipment NSSS	Quantity	Mass (t)	Length (m)	% Stainless steel	% Carbon steel	Others	Waste Classification
Pumps	37	136,2	-	-	-	-	LLW
Filter	14	89,8	-	-	-	-	LLW
	20	128,4	-	-	-	-	LLW
Cable	-	3,11	1104,61	-	-	75% Cu	LLW
Total		2258,8					

5.3 MASS INVENTORY FOR BNI EQUIPEMENT AND CLASSIFICATION

In this table CA means Controlled Area and NCA Non controlled Area.

		CA (t)	WASTE	NCA (t)	WASTE
Mechanical Equipment	Heat Exchanger	69	LLW	172	VLLW
	Tanks	292	LLW	11	VLLW
	Valves	141	LLW	24	VLLW
	Sensors	48	LLW	12	VLLW
	Storage racks	185	LLW	0	VLLW
	Pipes	800	LLW	200	VLLW
	Ventilation	134	LLW	33	VLLW
	Handling	1050	VLLW	12	Conventional
	Pumps	45	LLW	135	VLLW
	Miscellaneous (TES, Framework)	1110	LLW	0	-
	Shielded doors	400	VLLW	0	Conventional
Electrical Equipment	Cable tray	407	VLLW	413	Conventional
	Cable	161	VLLW	145	Conventional
	Electrical Equipment rooms	0	VLLW	408	Conventional
		LLW	2824 t		
		VLLW	2605 t		
		Conventional	978 t		
			6407 t		

5.4 MASS INVENTORY FOR CLEAN UP OF BNI AND CLASSIFICATION

This evaluation is based on a French methodology developed in Brennilis (French NPP). First of all, all of the surfaces are analysed in order to estimate which have been contaminated. In this analyse, specific surfaces are detailed : floors, ceilings and walls.

The further table presents an assessment of the "dirty rooms" surface.

Dirty rooms	Surface of walls (m²)	Surfaces of floors (m²)	Surfaces of ceilings (m²)	Total (m²)
ETB	2610	884	882	4376
RB	12149	3561	3163	18873
FB	3528	1467	797	5792
SB	2399	1035	925	4358
NAB	5900	1391	1585	8875
Total	26585	8338	7351	42274

For each surface, the depth of the clean up is established on assumptions divided in three categories called Cat1, Cat2 and Cat3.

For each one, the depth of clean up is defined as follow :

- Cat 1 : 2 mm depth of clean up
- Cat 2 : 6 mm depth of clean up
- Cat 3 : 25 mm depth of clean up

For the cleaning of BNI, the assumptions that have been taken into account are :

- Cat 1 : Ceiling
- Cat 2 : 90% of Floors + Walls
- Cat 3 : 10 % of Floors

This clean up leads to the production of 530 t of concrete nuclear waste (75 t of LLW, 455 t of VLLW). This estimation can be compared to the production of 319 000 t of conventional waste (rebars + concrete) due to the demolition of BNI.

5.5 MASS INVENTORY FOR DECONTAMINATION OF PRIMARY CIRCUIT

A decontamination operation of primary circuit is applied before starting dismantling operations. The contaminated waste classified as ILW at production time are mainly the IERs used for the full decontamination of the reactor primary circuit at its shutdown (year 61). This corresponds to about 30 to 40m^3 of resins [1].

5.6 CONCLUSION

	ILW (t, m^3)	LLW (t)	VLLW (t)	Conventional (t)
Primary Circuit Decontamination	623 t 40 m^3	2735	1898	
NSSS Equipment		2259		
BNI Equipment		2824	2605	978
Clean Up		75	455	
	623t, 40m^3	**7893**	**4958**	**978**

6 WASTE VOLUME INVENTORY

6.1 CHAPTER 5 PCER DATA PRESENTATION APRIL SUBMISSION

The subchapter 4.4 presents the volume for the repository for the total ILW+LLW : **7 000 m^3**.

A volume of **250 m^3** from reactor vessel internals is required for these internals.

For VLLW, a volume is estimated at about **13 000 m^3**.

These data come from the analyse of the final packaging options described in 900 Mwe NPP Study. For ILW + LLW, a volume is estimated roughly at 15 000 m^3. We apply a ratio of 16/(9 x 4) for an EPR and we obtain the value of 7 000 m^3 for the final repository.

For the reactor vessel internals, we have a volume estimated at 350 m^3. We apply the ratio (*16/(9 x4)) and add the specific Thermal Shield (100 m^3) and obtain the value of 250 m^3.

For the VLLW, the estimation of the volume of 30 000 m^3 for packaged wastes. We apply the same ratio and we obtain the volume for an EPR : 13 000 m^3.

6.2 CHAPTER 5 PCER DATA PRESENTATION DUE TO SPECIFIC STUDY

In this document, we present an assessment of EPR specific raw waste. We're going to describe a packed waste produced volume (at production time and evacuation time) with UK specificities.

6.2.1 Activated Waste of Primary Circuit

An indicative assessment of the volume of final packages has been made based on the above data. This analysis was carried out assuming UK Packaging specifications compatible with immediate dismantling and export, as follows:

- shielded 4 metre boxes with an additional shielding of 400mm of concrete for the core shells of the reactor vessel (ILW).
- 3 cubic metre boxes with an additional 100 mm steel shielding for the other metallic wastes (ILW);
- 4 metre boxes for concrete (ILW)
- 500 litre solids drum for Ion Exchange Resins (ILW)
- HHISO 20‘ container for LLW (metallic and concrete wastes)

Ignoring the mass of the package and any associated shielding the typical waste package parameters are given as follows:

- The shielded 4 metre boxes with an additional shielding of 400mm of concrete are expected to comprise 38% of ferritic steel waste, 2% of stainless steel cladding waste and 60% of mortar.
- The 3 cubic metre boxes are expected to comprise stainless steel waste and mortar.
- The 4 metre boxes for concrete (ILW) are expected to comprise concrete waste and mortar matrix.
- The 500 litre drums for Ion Exchange Resins are expected to comprise 20% of resin and 80% of polymer matrix.

For these structures, we need a disposal volume of 1 180 m^3 [1].

6.2.2 Contaminated Waste of CPP, NSSS, BNI Equipment (LLW)

They could be packed in HHISO 20‘ container. We need a disposal volume of 11 554 m^3. The calculations are presented in Appendix 1.

6.2.3 Contaminated Waste of Clean Up (LLW)

They could be packed in HHISO 20‘ container. We need a disposal volume of 115 m^3. The calculations are presented in Appendix 1.

6.2.4 Contaminated Waste of Decontamination (IER)

They could be encapsulated in a solid matrix in an unshielded waste package “500 litre solids drum” for example. For this waste, we need a disposal volume 220 m^3 [1].

6.2.5 Volume for repository (ILW+LLW) due to decommissioning

	ILW(m3)	LLW(m3)
Primary Circuit	1 180	4 036
Decontamination	220	
NSSS Equipment		4 170
BNI Equipment		3 348
Clean Up		115
	1 400	**11 669**

6.3 CHAPTER 5 PCER COMPARISON APRIL AND NOVEMBER ASSESSMENT

Thus the final packaging may lead to a total volume of low, and intermediate level waste of about **13100 m^3**. The difference between this new volume compared to the first evaluation (7 000 m^3) can be explained by the fact the earlier GDA assessment was based on French Packaging specifications and specific compaction techniques used in conditioning the waste. In this new study, present UK Packaging specifications have been applied.

The amount of Very Low Level Waste (VLLW) is too dependant on management and packaging options to allow a simple estimate at the GDA stage. It can be noted that, on the basis of the specific EPR evaluation, an average of 5000 tons of VLLW have been estimated. In the first evaluation, a volume of 13000 m^3 for the VLLW based on volume was established.

The impact of the interim storage on the categorisation of decommissioning waste is shown in the report in reference [1].

1 APPENDIX 1 – LLW PACKAGING

HHISO		LLW		
		Length	Width	Height
	Outside	6058	2438	1295
	Inside (mini)	5867	2330	1054
		Volume used (m3)		14,41
		Volume disposal (m3)		19,13

LLW (HHISO)	**BNI**		**NSS**		**Clean up BNI**		**CPP**		**TOTAL**	
density	0,9	t/m3	0,9	t/m3	0,9	t/m3	0,9	t/m3		
Weight/box	12,97	tonnes	12,97	tonnes	12,97	tonnes	12,97	tonnes		
Weight (t)	2824		2259		75		2735		7893	tonnes
	217,78		174,21		5,78		210,91			
number of box	218		175		6		211		610	HHISO
Volume of 1 box (m3)	19,13									
volume diposal	4169,55		3347,75		114,76		4035,67			
	4170	m3	3348	m3	115	m3	4036	m3	11669	m3