

# **Flexibility and Adaptability of the Methodology**

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## Outline

- Reference date
- Specific disposal routes
- Units for presenting data
- Correlation to GSG-1 classification scheme
- „As disposed“ waste volume and „as is“ waste volume
- Conclusions

## Flexibility

### SF/RWM Situation

Current

Past

Future

Total summary

2030

Past practices inv.

2050

JC - reporting

EC - reporting

SF

- Description - ?
- Total activity - ?

RW

- Origin - +
- Activity - ?
- Radionuclides - ?

SF

- Type of reactor - +
- Location - +
- Disposed/not - +

RW

- Decom - +
- Location - +

- All RW classes
- DSRS
- All disposal strategies
- All strategies of SFM
- International SF/RWM service
- Requirements EC/JC (main)

## The Past (assumed definitions)

- **The past practice** - a RW management practice including the practice that was at the time of application regarded as the final disposal of or elimination step and for which the country has now no intention to continue this practice or to maintain the option to restart it or the practice is forbidden, e.g. sea dumping, currently closed disposal facilities;
- **Past practice summary** – the integral value of SF/RW amounts produced, reprocessed and disposed since the starting point of nuclear programme in a country (or since the first SF/RW inventorying in a country) to the moment of the last date of reference in the national report under the Joint Convention.

## Presenting of “the past (i)” (example)

### Spent fuel and radioactive waste inventory presentation

*The past practice - a RW management practice including the practice that was at the time of application regarded as the final disposal of or elimination step and for which the country has now no intention to continue this practice or to maintain the option to restart it, e.g. sea dumping, currently closed disposal facilities*

Country: XX

Date of inventorying: 31.12.2013

SF/RW types (in national terms)	No strategy	SF reprocessing/ service		Disposal in:									
		home	abroad	UF-1		UF-2		NSF-1		NSF-2		LSD	SSD
(A)	(B)	(C1)	(C2)	(D1)	(D2)	(E1)	(E2)	(F1)	(F2)	(G1)	(G2)	(J1)	(J2)
<b>1. SF + reprocessing RW</b>													
<b>1.1. NPP</b>													
1.1.1. SF, [tHM]													
1.1.2. HLW (HG), [m <sup>3</sup> ]													
1.1.3. RW (NHG), [m <sup>3</sup> ]							32400					2000	1800
<b>1.2. Other reactors</b>													
1.2.1. SF, [tHM]													
1.2.2. HLW (HG), [m <sup>3</sup> ]													
1.2.3. RW (NHG), [m <sup>3</sup> ]							4456					150	630
<b>2. A class, [m<sup>3</sup>]</b>							2564						461
<b>3. B class, [m<sup>3</sup>]</b>									54000			600	751
<b>4. C class, [m<sup>3</sup>]</b>											98700		
Equivalence with IAEA GSG-1 classification	1.1.2												
	1.1.3						ILW					LLW	ILW
	1.2.2						ILW					LLW	ILW
	1.2.3						ILW					LLW	ILW
	2.						ILW					LLW	ILW
	3.								LLW			LLW	LLW
4.										VLLW	LLW		

## Presenting of “the past (ii)” (example)

### Spent fuel and radioactive waste inventory presentation

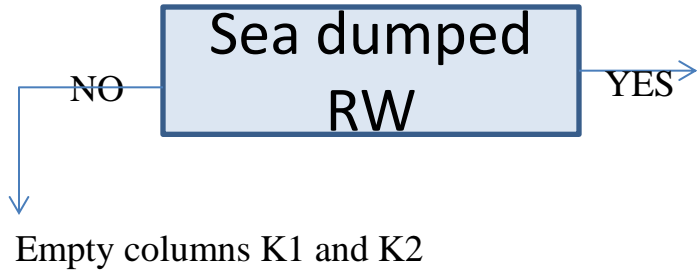
*Past practice summary – the integral value of SF/RW amounts produced, reprocessed and disposed since the starting point of nuclear programme in a country (or since the first SF/RW inventorying in a country) to the moment of the last date of reference in the national report under the Joint Convention.*

Country: XX

Date of inventorying: 31.12.2013 – summary before the date

SF/RW types (in national terms)	No strategy	SF reprocessing/ service		Disposal in:									
		home	abroad	UF-1		UF-2		NSF-1		NSF-2		LSD	SSD
(A)	(B)	(C1)	(C2)	(D1)	(D2)	(E1)	(E2)	(F1)	(F2)	(G1)	(G2)	(J1)	(J2)
<b>1. SF + reprocessing RW</b>													
<b>1.1. NPP</b>													
1.1.1. SF, [tHM]	7 (XX) 6 (QQ)	18000 (XX) 1500 (YY) 2400 (ZZ) 5000 (VV)	700(SS) 200(PP)										
1.1.2. HLW (HG), [m <sup>3</sup> ]		1000 (YY) 2000 (ZZ) 4200 (VV)		15600									
1.1.3. RW (NHG), [m <sup>3</sup> ]						8600	2400					2000	1800
<b>1.2. Other reactors</b>													
1.2.1. SF, [tHM]	56 (XX) 45 (UU)	3500 (XX) 600 (ZZ)											
1.2.2. HLW (HG), [m <sup>3</sup> ]		130 (ZZ)		7800									
1.2.3. RW (NHG), [m <sup>3</sup> ]		450 (ZZ)				850	456					150	630
<b>2. A class, [m<sup>3</sup>]</b>						780	564						461
<b>3. B class, [m<sup>3</sup>]</b>								83000	12800			600	751
<b>4. C class, [m<sup>3</sup>]</b>										145900	98700		
<b>Equivalence with IAEA GSG-1 classification</b>	1.1.2		HLW (YY)		HLW								
	1.1.3		ILW (YY) LLW (ZZ)			ILW	ILW				LLW	LLW	ILW
	1.2.2	HLW	HLW		HLW								
	1.2.3		ILW			ILW	ILW				LLW	LLW	ILW
	2.					ILW	ILW					LLW	ILW
	3.							LLW	LLW		LLW	LLW	LLW
	4.									VLLW	LLW		

## Presenting , Past practices (iii) (example)



15600 m<sup>3</sup> of liquid class 3 RW (GSG-1 LLW) are disposed in sea in the past; and 13300 m<sup>3</sup> of solid class 3 RW as well 400 m<sup>3</sup> of solid class2 RW (GSG-1 ILW) are disposed in the sea in the past;  
 5000 m<sup>3</sup> (GSG-1 ILW-20% and LLW-80%) are disposed in UF-2;  
 1400 m<sup>3</sup> (GSG-1 LLW) are disposed in NSF-1;

Spent fuel and radioactive waste inventory presentation									
Country: _____			Date of inventorying: _____						
Type of SF or RW		Disposal in							
		BH-1		BH-2		BH-3		SDL	SDS
(A)		(H1)	(H2)	(I1)	(I2)	(J1)	(J2)	(K1)	(K2)
3. Class 2 [m <sup>3</sup> ]									400
4. Class 3 [m <sup>3</sup> ]								15600	13300
Equivalence with IAEA GSG-1 classification (type)	3.								ILW
	4.							LLW	LLW

## Presenting of Future

- SF/RW management situation as at reference date in future:
  - Status in 2020 – 2025 – 2030 – 2035 – etc.
- For each reference date the separate table is recommended;
- SF inventory forecast at the reference date recommended to be presented, but not accumulated SF production as some amount might be disposed/reprocessed (“present what exists”);
- RW inventory forecast recommended be presented as it will be at the reference date (inventory of stored and disposed RW);
- Final decision on the format and aggregation of data is up to the country or international programme.

## Presenting of Future (example)

Spent fuel and radioactive waste inventory presentation											
Country: <u>XX</u>											
Date of inventorying: <u>31.12.2030</u> - forecast											
SF/RW types (in national terms)	No strategy	SF reprocessing/ service		Disposal in:							
		home	abroad	UF-1		UF-2		NSF-1		NSF-2	
(A)	(B)	(C1)	(C2)	(D1)	(D2)	(E1)	(E2)	(F1)	(F2)	(G1)	(G2)
<b>1. SF + reprocessing RW</b>											
<b>1.1. NPP</b>											
1.1.1. SF, [tHM]	7 (XX) 6 (QQ)	18000 (XX) 1500 (YY) 2400 (ZZ) 5000 (VV)	700(SS) 200(PP)								
1.1.2 HLW (HG), [m <sup>3</sup> ]		1000 (YY) 2000 (ZZ) 4200 (VV)		15600							
1.1.3. RW (NHG), [m <sup>3</sup> ]						8600	2400				
<b>1.2. Other reactors</b>											
1.2.1. SF, [tHM]	56 (XX) 45 (UU)	3500 (XX) 600 (ZZ)									
1.2.2. HLW (HG), [m <sup>3</sup> ]		130 (ZZ)		7800							
1.2.3. RW (NHG), [m <sup>3</sup> ]		450 (ZZ)				850	456				
<b>2. A class, [m<sup>3</sup>]</b>						780	564				
<b>3. B class, [m<sup>3</sup>]</b>								83000	12800		
<b>4. C class, [m<sup>3</sup>]</b>										145900	98700
Equivalence with IAEA GSG-1 classification	1.1.2		HLW (YY)		HLW						
	1.1.3		ILW (YY) LLW (ZZ)			ILW	ILW				LLW
	1.2.2	HLW	HLW		HLW						
	1.2.3		ILW			ILW	ILW				LLW
	2.					ILW	ILW				
	3.							LLW	LLW		LLW
	4.									VLLW	LLW

\* Details are in the EGIRM report (NEA No.7371)

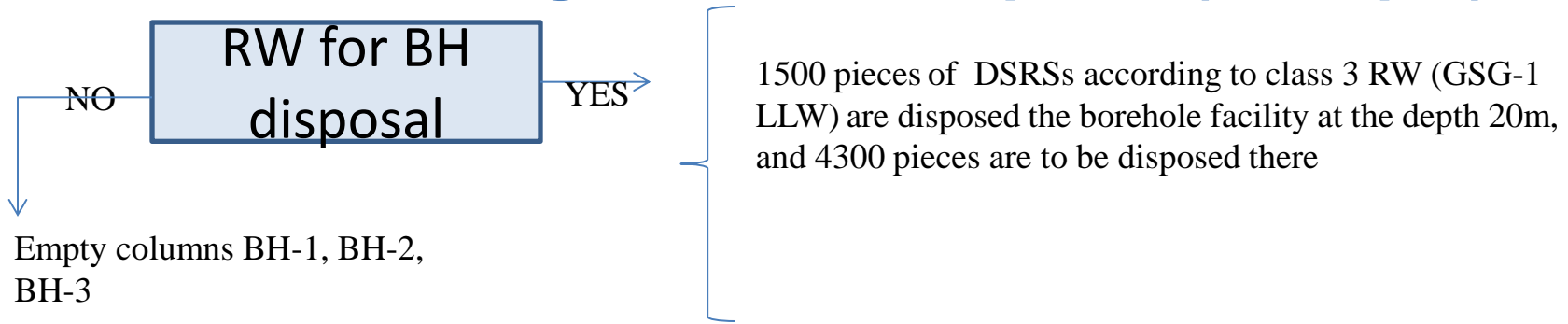
## Specific Disposal Practices

- Disposal of solid waste in different types of boreholes
  - Boreholes with depth between tens and some hundred metres → DSRS, LLW, ILW - BH-1
  - Deep boreholes with the depth of more than thousand metres → HLW, SF - BH-2
  - Deep injection of liquid LLW and ILW into confined aquifers → BH-3

Additional group of columns in the table

Columns can be added when it is necessary or required by programme

## Presenting, borehole disposal (example)



Spent fuel and radioactive waste inventory presentation								
Country: _____			Date of inventorying: _____					
Type of SF or RW	Disposal in							
	BH-1		BH-2		BH-3		SDL	SDS
(A)	(H1)	(H2)	(I1)	(I2)	(J1)	(J2)	(K1)	(K2)
3. Class 2 [m <sup>3</sup> ]								
4. Class 3 [m <sup>3</sup> ]								
5. DSRs [pieces]	4300	1500						
Equivalence with IAEA GSG-1 classification (type)	3.							
	4.							
	5.	LLW	LLW					

## Units for Presenting Data

Data can be presented in each unit required by user.

Recommendation by EGIRM:

**tHM** for SF

**m<sup>3</sup>** for all RW

SF/RW types (in national terms)
(A)
SF, [tHM]
1.1. NPP
1.2. Other reactors
Radioactive waste
2. HLW, [m <sup>3</sup> ]
3. ... class, [m3]
4. ... class, [m3]

## Correlation to the GSG-1 Classification

- All classes of SF and RW can be presented in terms of the national classification
- Table gives a correlation to IAEA GSG-1 classification
- Corresponding of each national waste class to GSG-1 waste classes VLLW, LLW, ILW, HLW or approximate percentages if several GSG-1 classes

SF/RW types (in national terms)		No strategy	SF reprocessing/ service		Disposal in:								
			home	abroad	UF-1		UF-2		NSF-1		NSF-2		Others
(A)		(B)	(C1)	(C2)	(D1)	(D2)	(E1)	(E2)	(F1)	(F2)	(G1)	(G2)	→
Equivalence with IAEA GSG-1	2.	HLW	HLW	HLW	HLW								
	3.												
	4.												

## Spent fuel and radioactive waste inventory presentation

Country: XX

Date of inventorying: 31.12.2013

SF/RW types (in national terms)	No strategy	SF reprocessing/ service		Disposal of in:								
		home	abroad	UF-1		UF-2		NSF-1		NSF-2		Others
(A)	(B)	(C1)	(C2)	(D1)	(D2)	(E1)	(E2)	(F1)	(F2)	(G1)	(G2)	→
<b>Spent Fuel</b>												
1.1. NPP, [tHM]	13 <sup>1)</sup>	5062 <sup>2)</sup>	70 <sup>3)</sup>									
1.2. Other reactors SF, [tHM]	101 <sup>4)</sup>	265 <sup>5)</sup>										
<b>Radioactive waste</b>												
2. A class, [m <sup>3</sup> ]		75 <sup>6)</sup>	14 <sup>9)</sup>	234 <sup>8)</sup>								
3. B class, [m <sup>3</sup> ]		65 <sup>7)</sup>				486	2846					
4. C class, [m <sup>3</sup> ]								8300	12800			
5. D class, [m <sup>3</sup> ]										45900	98700	
Equivalence with IAEA GSG-1 classification	2.	HLW	HLW	HLW								
	3.	ILW				ILW	70% ILW 30% LLW					
	4.							LLW	LLW			
	5.									VLLW	VLLW	

- 1) 7 (XX)+6 (QQ)
- 2) 5000 (XX)+45 (YY)+12 (ZZ)+5 (VV)
- 3) 56(SS)+14(PP)
- 4) 56 (XX)+45 (UU)
- 5) 251 (XX)+14 (ZZ)
- 6) 62 (YY) NPP+13 (ZZ) OR
- 7) 12 (YY)+8 (ZZ) NPP+45 (ZZ) OR
- 8) 156 NPP + 78 OR
- 9) 12(SS)+2 (PP) NPP

## Presenting of RW Volumes

To provide adequate comparability of data, the EGIRM recommends that countries present volumes of the conditioned RW (ready for disposal) → “as disposed”

Non-conditioned forms → recalculation of “as is” volumes into “as disposed” is recommended.

When presenting of „as disposed“ volume is onerous or impossible for different reasons, a part of RW can be presented in form of „as is“ → explanations can be given in footnotes.

The EGIRM is developing recommendations on how non-conditioned waste volume calculation should be considered in different situations in countries regarding the level of RWM infrastructure development.

## “Difficulties” with “as disposed” volume

- “As disposed” volume can be different from one disposal concept to another for exactly the same waste e.g.:
  - Vitrified HLW volume  $FR < CH < BE < NL$  but all with the same “AREVA” container containing the waste
  - Volume depends on engineered barrier added to disposal container or added in disposal gallery
  - Same waste can change the volume if “policy” changes e.g. from NSF 1 => UF 1 because of different disposal packaging
  - “as disposed” volumes could vary strongly on disposal policy decision and disposal design

## RW Volume „as is“

What can be reasons for presenting „as is“ volume?

- No strategy for disposal
- RW exists in liquid form – conditioning procedures are not determined (volume reducing like evaporation or volume increasing like cementation)
- Flexible concept for WAC – different waste forms and packages
- For some LLW the disposal policy is currently not clear and “as disposed volume” could vary strongly depending on policy decision

## Policy Decision on Geological Disposal

- Based on transposition of 2011/70/EURATOM directive
- Waste class A goes to geological disposal → ~~NSF~~  
(development of process for site selection)
- No decision on reprocessing of spent fuel from NPP
- No decision on disposal concept
  - =>no “as disposed volume”
- => effect in EGIRM table

## Conclusions (1)

- EGIRM methodology is very flexible.
- The same table can be used in the national reports to different programmes (Joint Convention, EC Directive, Status and Trends...)
- All existing or existed RW classes can be presented.
- All disposal routes can be presented.
- The table has a good reserve to address additional needs and requirements with adding lines and columns.

## Conclusions (2)

- The table can be used for data compiling and aggregation.
- The table can be used for tracking changes in the SF/RW managements in time.
- The table can help in tracking in the international SF/RW management.

The methodology can present national SF/RW inventories and management strategies on different levels of detail.

EGIRM proposes the minimal size of the table sufficient for an understanding of the situation in a country.

**It is up to the user to decide how to extend the table.**

# Thank you for your attention

Questions?