

## **Detailed presentation of the process of the methodology application (completing the table)**

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## Completed methodology

### Spent fuel and radioactive waste inventory presentation

Country: \_\_\_\_\_

Date of inventorying: \_\_\_\_\_

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)	→
SF												
1.1. NPP												
1.2. Other reactors												
Radioactive waste												
2. HLW, [m <sup>3</sup> ]												
3. ... class, [m3]												
4. ... class, [m3]												
Equivalence with IAEA GSG-1	2.	HLW	HLW	HLW	HLW							
	3.											
	4.											

Footnotes when necessary

## Presenting

- SF – [tHM];
- RW – [m<sup>3</sup>]; “as disposed”, “as is” – can be,
- Disused sealed radioactive sources – [pieces];
- The “**SERVICER**” is country where the SF is to be reprocessed or any another service to be provided according to the international agreement;
- The “**USER**” is the country that used the nuclear fuel and sends it to “SERVICER” accordingly to international agreement for the reprocessing (other specified service);
- SF/RW transboundary movement can be reported by both parties (methodology should provide it).

## Definitions

- **Implementer** – organisation responsible for developing, building and/or operating of nuclear facilities;
- **Methodology implementer** – national/international organisation/initiative/programme that uses the methodology in its activity.
- **Methodology user** – person which uses the methodology for presenting of inventory data (authorised) or to study national/international status of RW/SF management (authorisation not obligatory).

These definitions are used for methodology objectives.

## Footnotes

- Superscript markers – **125.3<sup>1</sup>** and short explanations in footnote when needed;
- Distribution on parts when RW – mix of solid and liquid, “as is” and “as disposed”, etc. <sup>1</sup> **125.3= 80 (liq)+10(sol)+25.3(cond)**;
- Sum of RW volume on different items - class, disposal route, etc. when needed;
- Distribution of RW volumes on origin or SF on types of reactors when requested;
- Description of specific situations when needed;
- Deciphering acronyms or abbreviations when necessary;
- Others

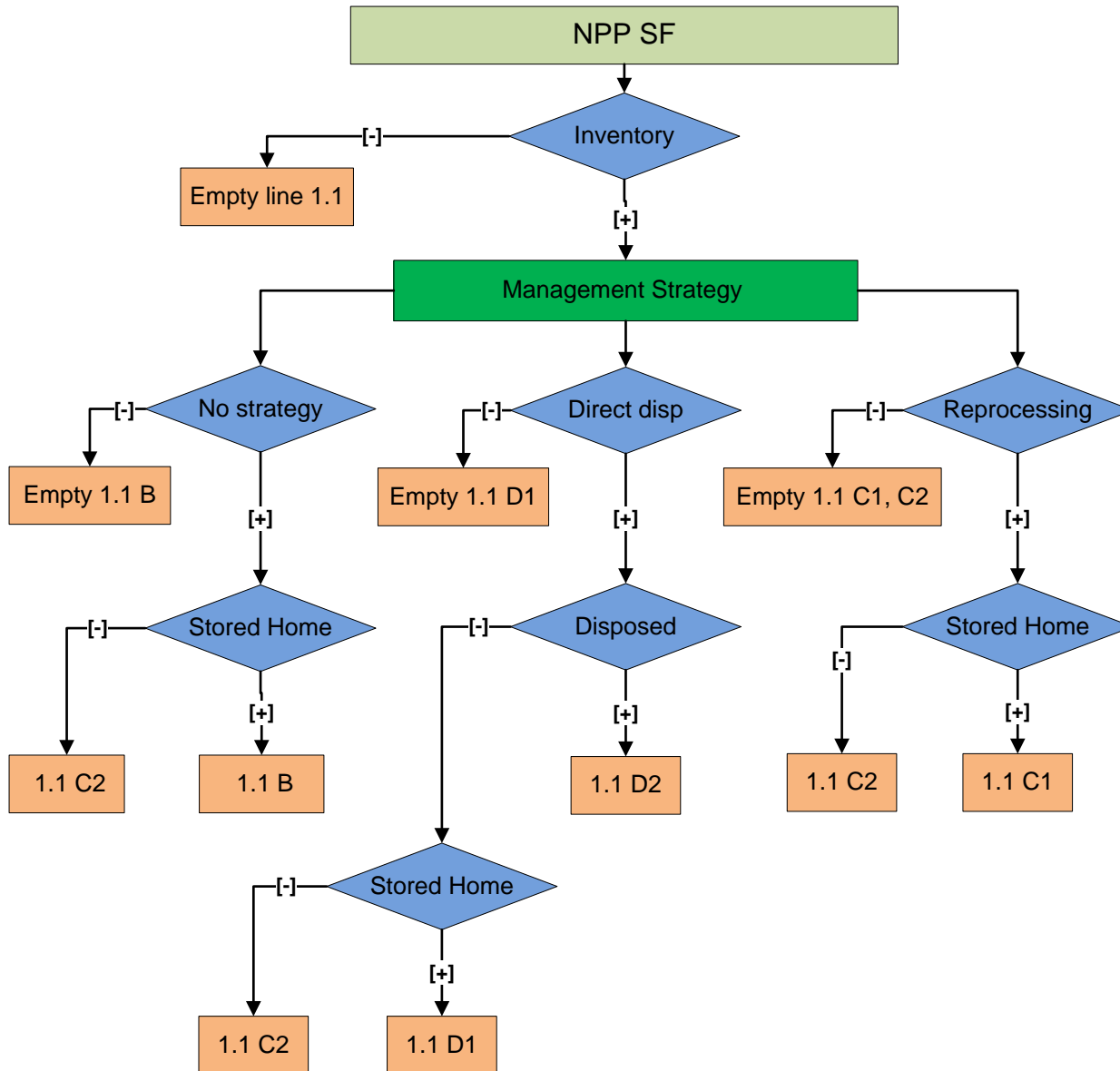
## Disposal routes (main group)

Type of facility	Features	RW classes (in terms of GSG-1) that can be disposed of	SSR-5 equivalent (1.14)
<b>UF</b>			
UF-1	<ul style="list-style-type: none"> <li>- no direct, open connection with surface during construction or operation stage (i.e. ramp, shaft or borehole access);</li> <li>- intensive application of artificial barriers;</li> <li>- heat emission is considered in design;</li> <li>- package for SF/HLW/ILW – be sure.</li> </ul>	SF; HLW; ILW; LLW; VLLW; (NORM; TENORM) – solid	Geological disposal
UF-2	<ul style="list-style-type: none"> <li>- no direct, open connection with surface during construction or operation stage (i.e. ramp, shaft or borehole access);</li> <li>- rather wide application of artificial barriers;</li> <li>- heat emission is not considered in design;</li> <li>- package for ILW – be sure.</li> </ul>	ILW; LLW; VLLW; (NORM; TENORM)	Disposal on intermediate depth + geological disposal + borehole disposal
<b>NSF</b>			
NSF-1	<ul style="list-style-type: none"> <li>- open air at construction stage; sometimes also during operation;</li> <li>- rather wide application of artificial barriers;</li> <li>- heat emission is not considered in design;</li> <li>- package for ILW – be sure.</li> </ul>	ILW; LLW; VLLW; (NORM; TENORM)	Near-surface disposal + disposal on intermediate depth (particularly)
NSF - 2	<ul style="list-style-type: none"> <li>- open air at construction stage; sometimes also during operation;</li> <li>- minimally reasonable application of artificial barriers;</li> <li>- heat emission is not considered in design;</li> <li>- package for LLW – be sure.</li> </ul>	LLW; VLW; (NORM; TENORM)	Near-surface disposal; Landfilling

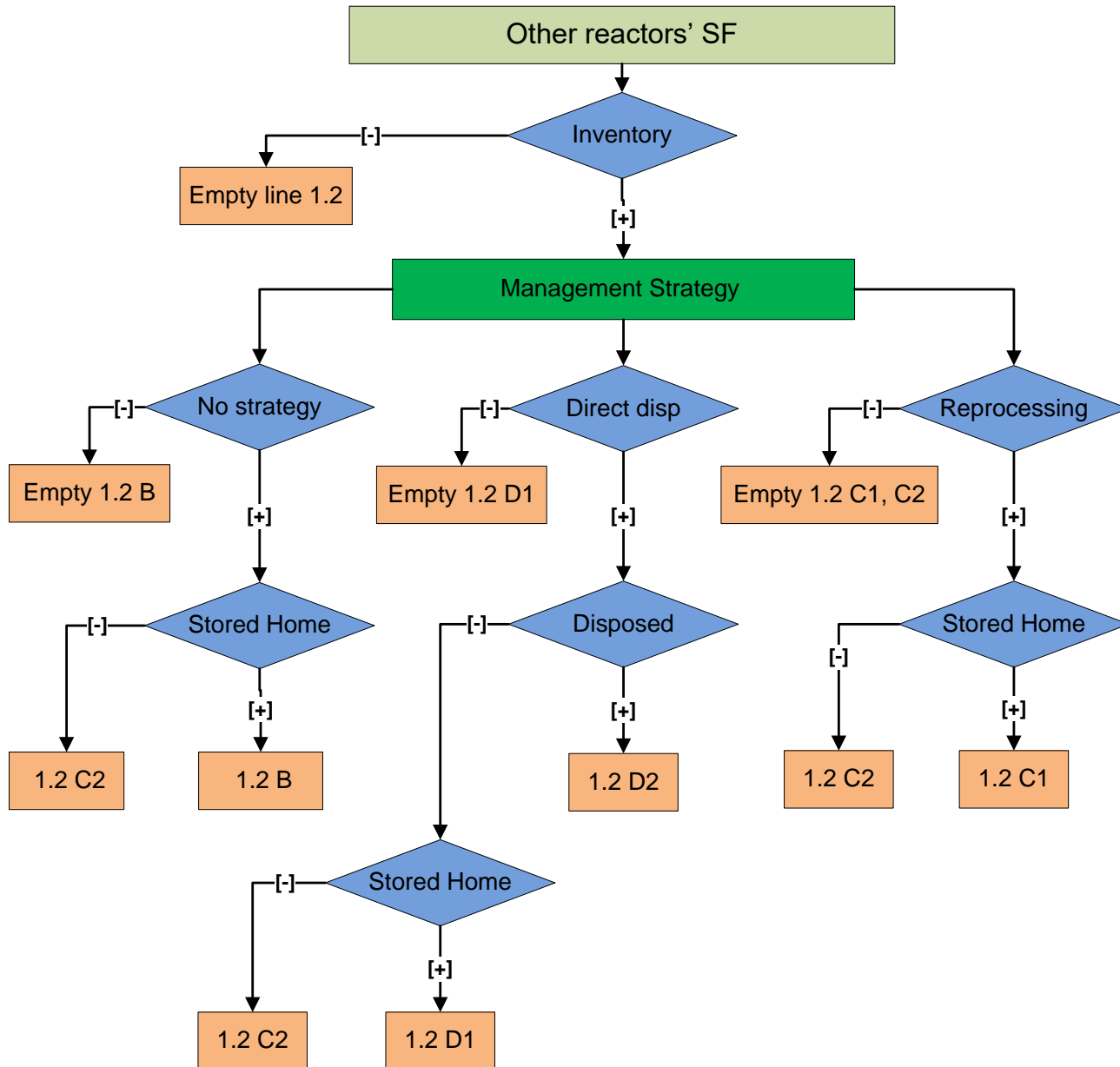
## Disposal routes (additional group)

Type of route	Features	RW classes (in terms of the GSG-1) that can be disposed of	SSR-5 equivalent (1.14)
<b>OTHER DISPOSAL ROUTES</b>			
BH – 1	<ul style="list-style-type: none"> <li>- no direct, open connection with the surface during construction and operation stage;</li> <li>- no excavated underground space for RW emplacement;</li> <li>- heat emission is not considered in design;</li> <li>- package for RW – possible.</li> </ul>	DSRS, ILW, LLW	Intermediate depth boreholes
BH – 2	<ul style="list-style-type: none"> <li>- no direct, open connection with the surface during construction and operation stage;</li> <li>- no excavated underground space for RW emplacement;</li> <li>- heat emission is considered in design;</li> <li>- package for RW required.</li> </ul>	SF, HLW, DSRS (1 <sup>st</sup> category)	Deep boreholes
BH – 3	<ul style="list-style-type: none"> <li>- no direct, open connection with the surface during construction or operation stage;</li> <li>- conditional application of artificial barriers (only around boreholes);</li> <li>- heat emission is considered in design;</li> <li>- package for waste – no package.</li> </ul>	Liquid ILW; LLW	No equivalent
SDL	Past practice of disposal, banned now, performed as dumping of liquid RW into sea/ocean.	LLW	Now banned
SDS	Past practice of disposal, banned now, performed as dumping of solid RW into sea/ocean.	ILW; LLW	Now banned

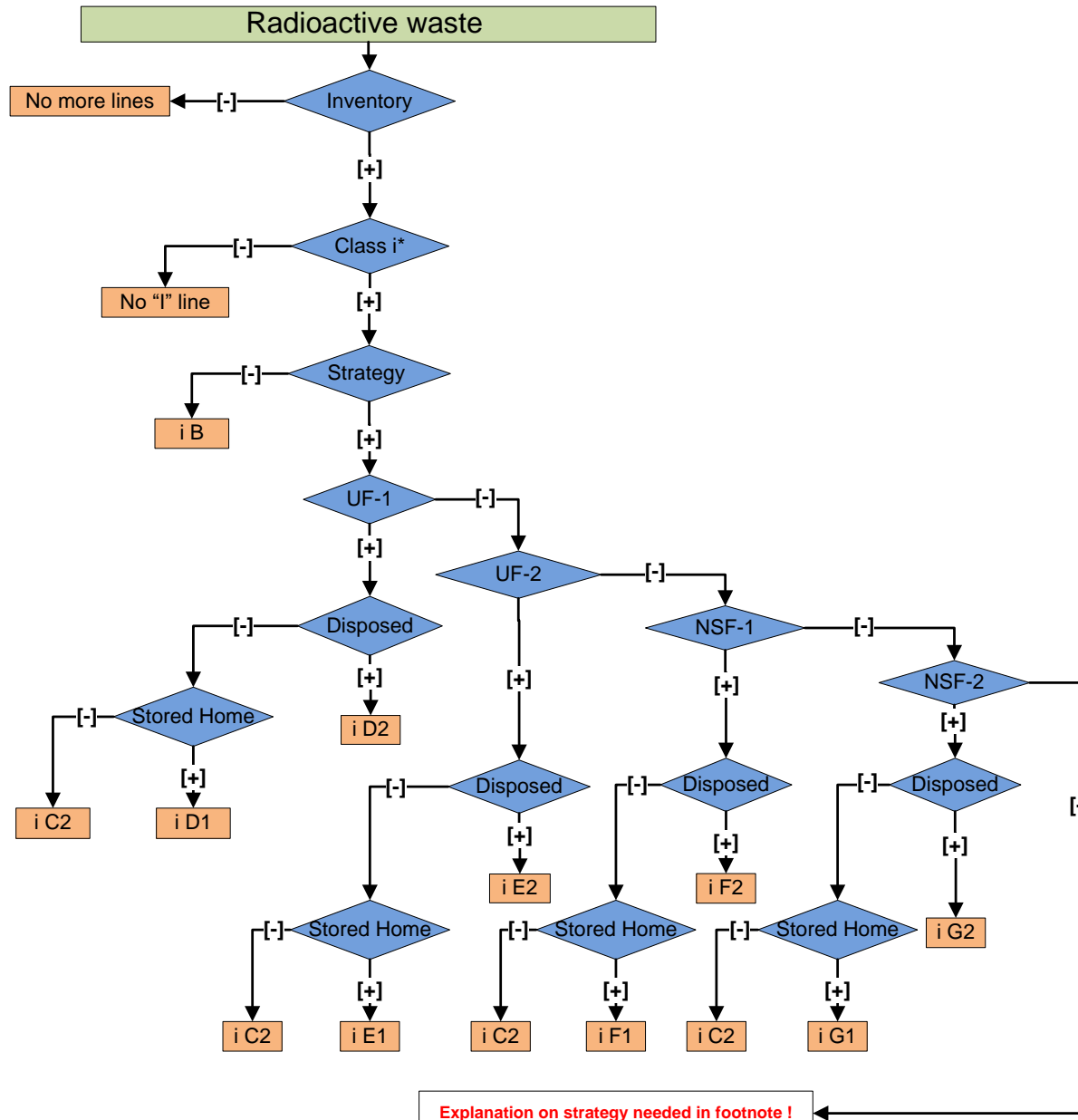
## NPPs' SF



## ORs' SF



RW



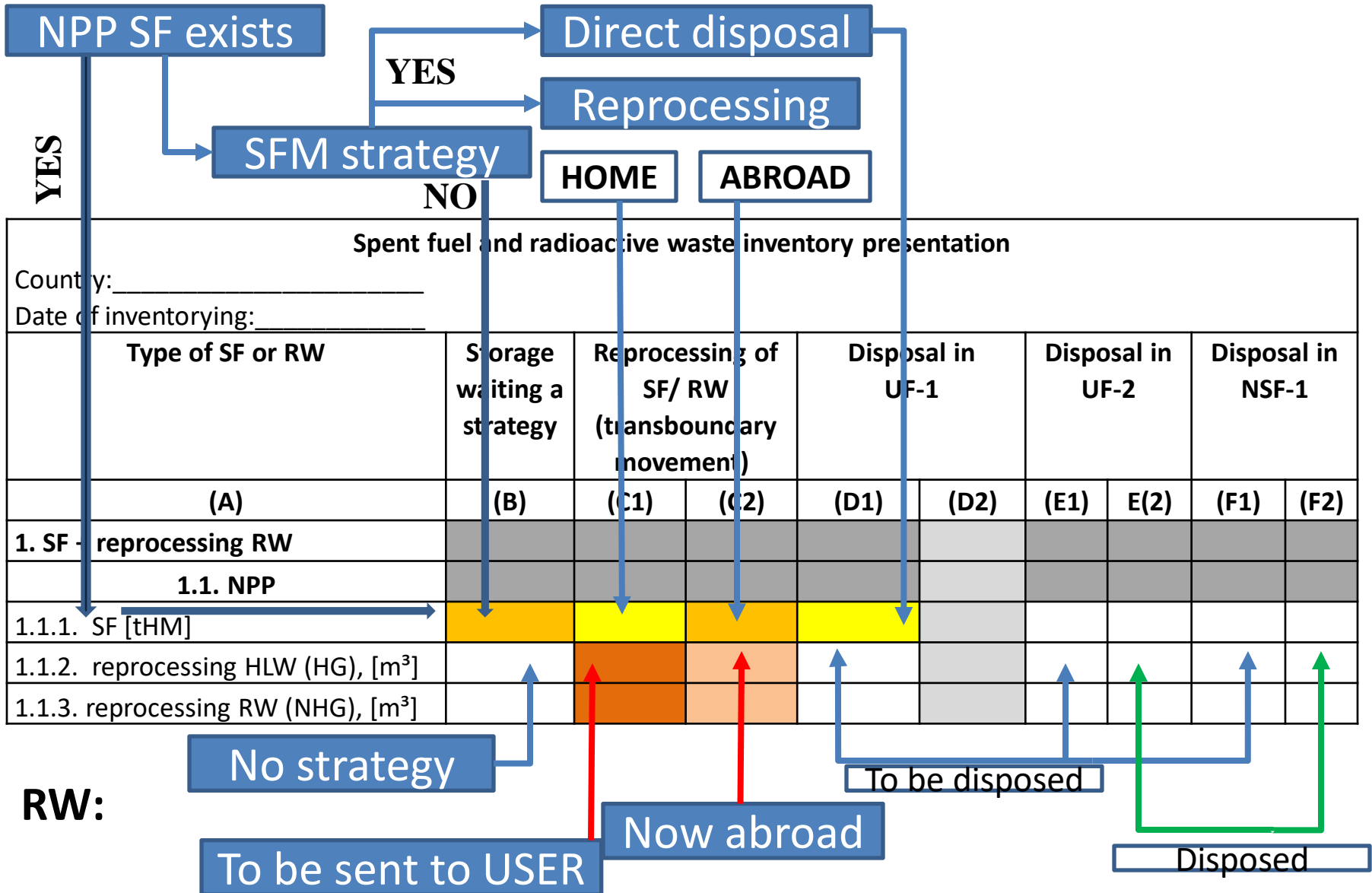
Explanation on strategy needed in footnote !

## Before the table filling

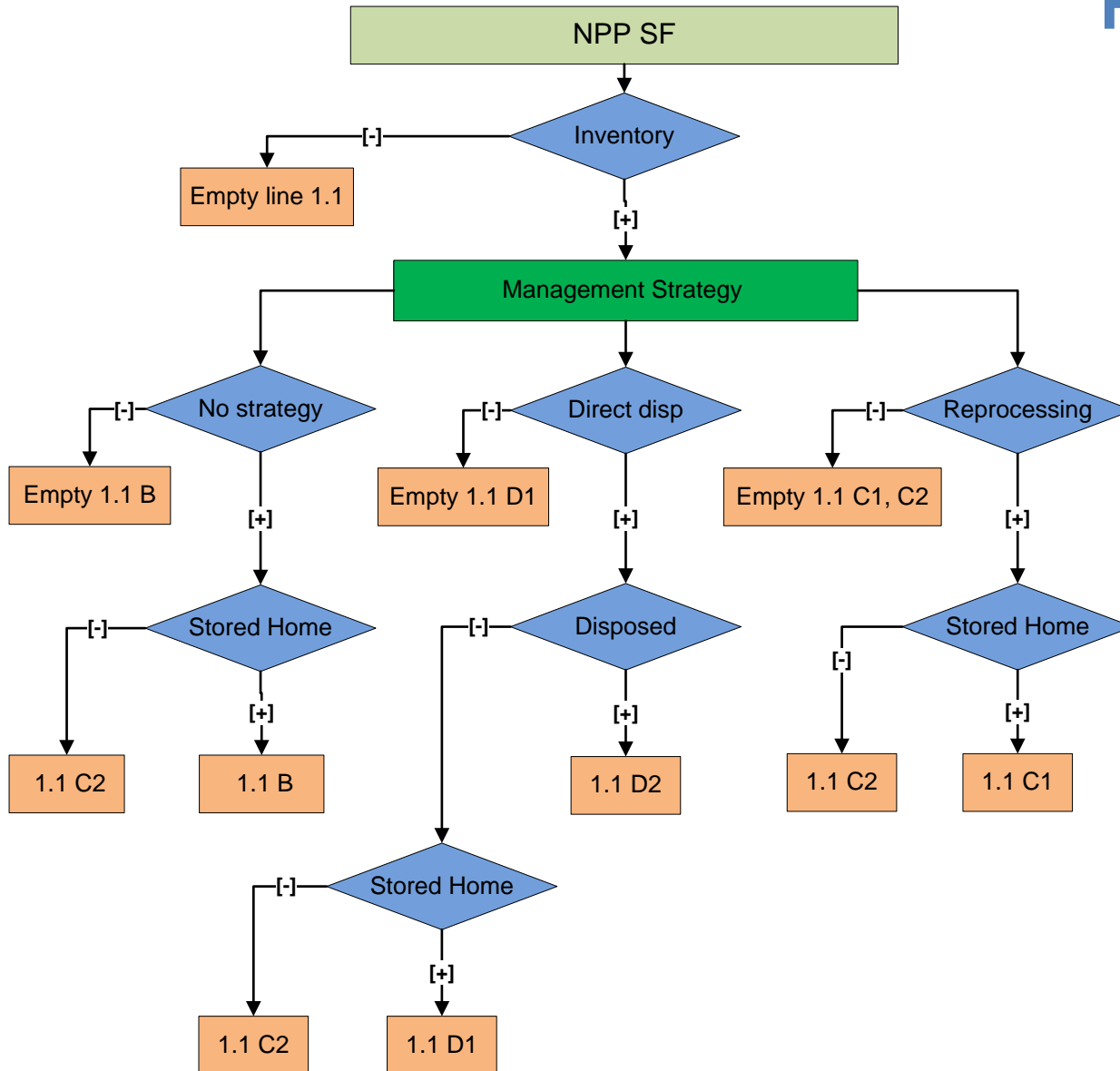
In order to complete the table, information is needed on national:

- SF inventory (NPPs and other reactors) [tHM].
- RW inventory (in national classification); check the format of data in the inventory (m<sup>3</sup>, “as is”, “as disposed”, physical status, stored and disposed of).
- RW classification transfer matrix into GSG-1 scheme (the majority of countries developed it for use in the NEWMDB).
- SF management strategy (law, governmental decree, state programme and other kinds of decisions).
- RW management strategy - disposal of (disposal routes for the RW classes). The absence of a strategy should also be noted.
- SF or RW sent to SERVICER country for reprocessing or other kinds of service for SF (treatment of RW) abroad.
- Foreign SF/RW imported for service from USER countries.

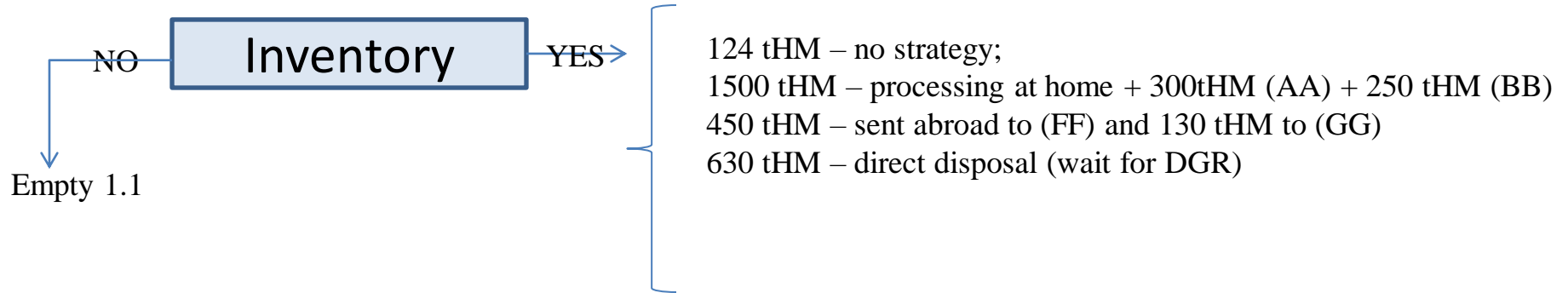
## How to fill



## Filling NPPs' SF



## Filling NPPs' SF



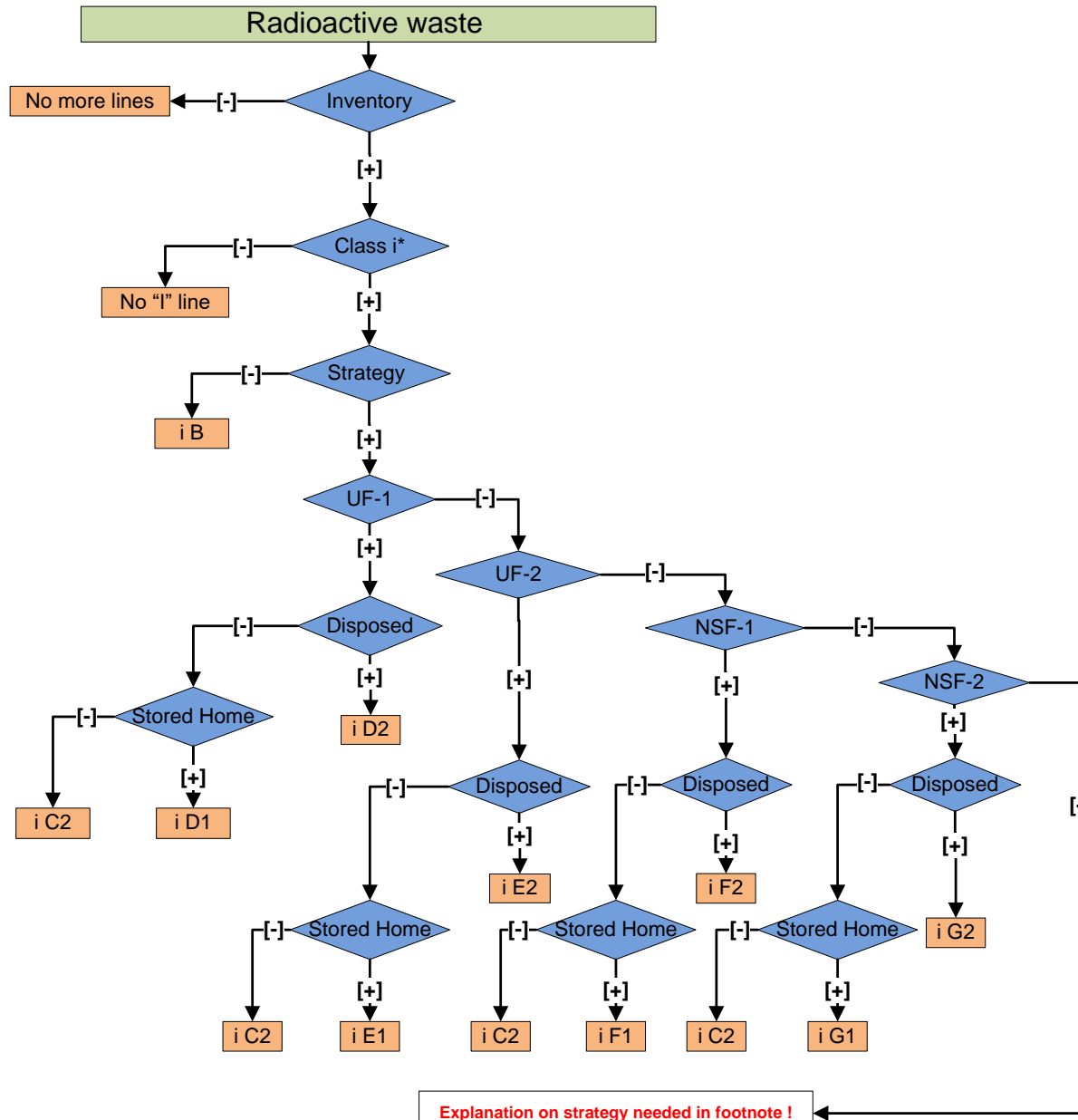
SF/RW types (in national terms)	No strategy	SF reprocessing/ service		Disposal in:								
		home	abroad	UF-1		UF-2		NSF-1		NSF-2		Others
(A)	(B)	(C1)	(C2)	(D1)	(D2)	(E1)	(E2)	(F1)	(F2)	(G1)	(G2)	→
SF												
1.1. NPP	124	2050 <sup>1</sup>	580 <sup>2</sup>	630								
1.2. Other reactors												

<sup>1</sup> – 2050 tHM = 1500 tHM (own) + 300 tHM (AA) + 250 tHM (BB)

<sup>2</sup> – 580 tHM = 450 tHM (FF) + 130 tHM (GG)

→ 230 tHM (PWR) + 220 tHM (BWR) – extended table

## Filling RW



Explanation on strategy needed in footnote !

## Filling, HLW



National HLW equivalent to GSG-1 HLW;  
 16800 m<sup>3</sup> will be disposed in DGR (implementation is anticipated in 2030);  
 210 m<sup>3</sup> of liquid HLW stored waiting decision on treatment;  
 12 m<sup>3</sup> vitrified are stored in (FF) to be sent back;  
 25 m<sup>3</sup> vitrified from (AA) and 13 m<sup>3</sup> from (BB) are stored waiting shipment there;

Spent fuel and radioactive waste inventory presentation

Country: \_\_\_\_\_

Date of inventorying: \_\_\_\_\_

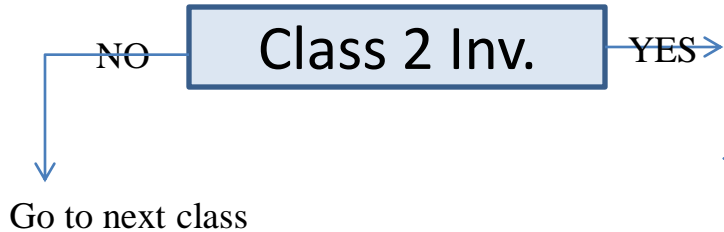
SF/RW types (in national terms)	No strategy	SF reprocessing/ service		Disposal in:								
		home	abroad	UF-1		UF-2		NSF-1		NSF-2		Others
(A)	(B)	(C1)	(C2)	(D1)	(D2)	(E1)	(E2)	(F1)	(F2)	(G1)	(G2)	→
2. HLW, [m <sup>3</sup> ]		38 <sup>3</sup>	12 <sup>2</sup>	17010 <sup>1</sup>								
3. ... class, [m3]												
4. ... class, [m3]												
Equivalence with IAEA GSG-1	2.	HLW	HLW	HLW								
	3.											
	4.											

<sup>1</sup> 17010 m<sup>3</sup> = 16800 m<sup>3</sup> (cond.) + 210 m<sup>3</sup> (liquid)

<sup>2</sup> 12 m<sup>3</sup> – to be imported from (FF)

<sup>3</sup> 38 m<sup>3</sup> = 25 m<sup>3</sup> to be sent in (AA) + 13 m<sup>3</sup> to be sent in (BB)

## Filling, Class 2

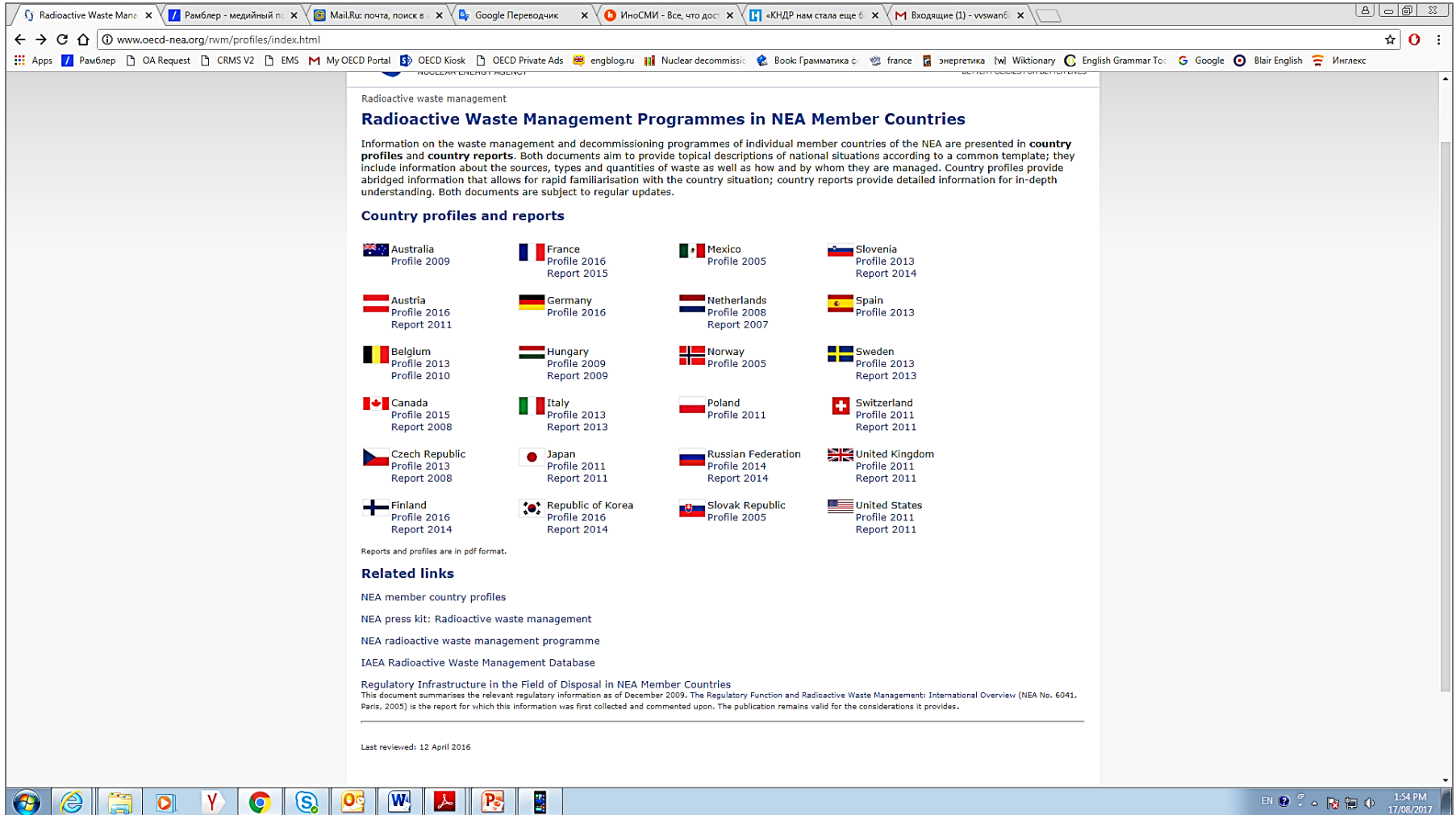


National Class equivalent to GSG-1 ILW (80%) and LLW (10%);  
 3000 m<sup>3</sup> (GSG-1 ILW) will be disposed in DGR (together with HLW);  
 300 m<sup>3</sup> (GSG-1 ILW) stored waiting decision on disposal route;  
 5000 m<sup>3</sup> (GSG-1 ILW-20% and LLW-80%) are disposed in UF-2;  
 1400 m<sup>3</sup> (GSG-1 LLW) are disposed in NSF-1;

Spent fuel and radioactive waste inventory presentation												
Country: _____												
Date of inventoring: _____												
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)	→
2. HLW, [m <sup>3</sup> ]												
3. 2 class, [m <sup>3</sup> ]	300			3000		5000 <sup>1</sup>		1400				
4. 3 class, [m <sup>3</sup> ]												
Equivalence with IAEA GSG-1	2.											
	3.	ILW			ILW		ILW+LLW	LLW				
	4.											

<sup>1</sup> 5000 m<sup>3</sup> = 1000 m<sup>3</sup> (GSG-1 ILW) + 4000 m<sup>3</sup> (GSG-1 LLW)

## Examples. RWMC web page



























The screenshot shows a web browser window displaying the NEA website. The address bar shows the URL [www.oecd-nea.org/nwm/profiles/index.html](http://www.oecd-nea.org/nwm/profiles/index.html). The page content includes:

### Radioactive Waste Management Programmes in NEA Member Countries

Information on the waste management and decommissioning programmes of individual member countries of the NEA are presented in **country profiles** and **country reports**. Both documents aim to provide topical descriptions of national situations according to a common template; they include information about the sources, types and quantities of waste as well as how and by whom they are managed. Country profiles provide abridged information that allows for rapid familiarisation with the country situation; country reports provide detailed information for in-depth understanding. Both documents are subject to regular updates.

#### Country profiles and reports

 Australia Profile 2009	 France Profile 2016 Report 2015	 Mexico Profile 2005	 Slovenia Profile 2013 Report 2014
 Austria Profile 2016 Report 2011	 Germany Profile 2016	 Netherlands Profile 2008 Report 2007	 Spain Profile 2013
 Belgium Profile 2013 Profile 2010	 Hungary Profile 2009 Report 2009	 Norway Profile 2005	 Sweden Profile 2013 Report 2013
 Canada Profile 2015 Report 2008	 Italy Profile 2013 Report 2013	 Poland Profile 2011	 Switzerland Profile 2011 Report 2011
 Czech Republic Profile 2013 Report 2008	 Japan Profile 2011 Report 2011	 Russian Federation Profile 2014 Report 2014	 United Kingdom Profile 2011 Report 2011
 Finland Profile 2016 Report 2014	 Republic of Korea Profile 2016 Report 2014	 Slovak Republic Profile 2005	 United States Profile 2011 Report 2011

Reports and profiles are in pdf format.

#### Related links

- NEA member country profiles
- NEA press kit: Radioactive waste management
- NEA radioactive waste management programme
- IAEA Radioactive Waste Management Database

#### Regulatory Infrastructure in the Field of Disposal in NEA Member Countries

This document summarises the relevant regulatory information as of December 2009. The Regulatory Function and Radioactive Waste Management: International Overview (NEA No. 6041, Paris, 2005) is the report for which this information was first collected and commented upon. The publication remains valid for the considerations it provides.

Last reviewed: 12 April 2016

## Italy. National profile.

### SOURCES, TYPES AND QUANTITIES OF WASTE

#### Waste sources and categories

In addition to the radioactive waste that have been generated by NPPs and the associated experimental nuclear fuel-cycle facilities, radioactive waste also arises from use of radioisotopes in medical, research and industrial applications.

In Italy, radioactive waste is classified into three categories and concentrations of the radioisotopes that the possible options for their disposal. Guidance on this technical requirements for waste forms and waste package document Technical Guide no. 26 issued by ENEA-DISP categories of radioactive waste are as follows:

**Category I:** Waste whose activity decays in a few months to is any concern about safety. Such waste may be disposed general waste regulations. It is generally described as very low level waste (LLW).

**Category II:** Waste whose activity decays to the level of a few centuries. The activity of several specific radionuclides must be Such waste is suitable for near surface disposal. It is usually of level waste (LLW).

**Category III:** Long-lived waste not included in categories I and II, such as spent fuel, and alpha-bearing waste from nuclear activities. Such waste will require deep geological disposal described as long-lived and/or high-level waste (LLW/HLW).

For Category II waste, the ISPRA reference document requirements and other specific acceptance criteria for shallow subcategories as follows:

- Solid waste whose activity concentration is below 1 Bq/g, which may be disposed of without further conditioning.
- Waste whose activity concentration is above 1 Bq/g, which needs to be conditioned and must fulfil further requirements for final disposal.

A general criterion is in force in Italy for unrestricted release of waste, which is not subject to regulatory control if the concentration of the waste is below a concentration and a radioactive half-life threshold:

- activity concentration < 1 Bq/g; and
- half-life < 75 days.

If both conditions above are not complied with, a specific

and with the additional condition of activity concentration < 1 threshold of the Italian Law.

In order to implement the above criteria, derived concentration values making reference to EU documents.

Specific clearance levels for unconditional releases have been established according to European Union directives and recommendations. In particular, specific levels of activity concentrations are included in the decommissioning licences for Trino and Garigliano NPPs for solid waste building reuse or demolition.

#### Waste inventory

ISPRA maintains an overall national inventory of the radioactive waste and spent fuel currently stored in the nuclear installations in Italy. Information on activity of radioactive waste in store is given in the tables below by source.

As far as the spent fuel is concerned, in May 2007, SOGIN signed an agreement with AREVA for the reprocessing of 235 t of spent fuel still present in Italy. Implementation of the contract between SOGIN and AREVA in the past few years. Spent fuel stored in the pool of the Casaro NPP has been transferred to France. Spent fuel stored in the Attagadro AFR storage pool and in the TRISO completed by 2013-14. Residual wastes will be returned to Italy starting by 2024.

At present the only fuel that will not be reprocessed is the 1,7 tHM of spent fuel, which is stored at the TIREC experimental reprocessing facility. The transfer into dual purpose dry cask storage is planned.

The amount of spent fuel from research reactors is less than 1 tHM and

Category GT	International classification	Volume (Activity)
26		
Category I	VLLW	4300 m <sup>3</sup> (0,2 TBq)
Category II	LLW short lived	22200 m <sup>3</sup> (700 TBq)
Category III	ILW and HLW	1700 m <sup>3</sup> (2454 TBq)

Category III	ILW and HLW	1700 m <sup>3</sup> (2454 TBq)
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Source (Category)	Volume (Activity)
Industry, Hospital, etc. (I and II)	3650 m <sup>3</sup> (1 TBq)
Reactors (II)	8250 m <sup>3</sup> (435 TBq)
Fuel Cycle facilities (II and III)	6700 m <sup>3</sup> (2540 TBq)
Research	9600 m <sup>3</sup> (135 TBq)

### RADIOACTIVE WASTE MANAGEMENT POLICIES AND PROGRAMMES

#### Waste management policies

There is currently no LLW disposal facility in Italy, and radioactive waste from nuclear and experimental fuel cycle facilities are stored at their sites of origin. Radioactive waste from medical, industry and research activities is collected by private operators for intermediate storage. Most of this waste is stored in untreated form, awaiting appropriate treatment and/or conditioning.

By the end of 1999, the Ministry of Industry, Commerce and Crafts, now the Ministry for Economic Development (MSE), issued strategic guidelines for management of liabilities resulting from past national nuclear activities.

According to this new policy all the nuclear installations should be completely decommissioned by 2024.

#### Programmes and projects

##### LLW repository project and site selection process

As far as the availability of a national site for the LLW disposal and for the long term storage of ILW/HLW is concerned, a policy has been issued in connection with the Agreement for the reprocessing of the 235 t of spent fuel still stored in Italy. The Italian Government was committed to make a national site available in due time.

In fact, this Agreement establishes a national road map for enacting all the modifications and integrations to existing legislative provisions as necessary to rule the implied matter (e.g. selection of a national site for a waste storage facility) and to execute

Source (Category)	Volume (Activity)
Industry, Hospital, etc. (I and II)	3650 m <sup>3</sup> (1 TBq)
Reactors (II)	8250 m <sup>3</sup> (435 TBq)
Fuel Cycle facilities (II and III)	6700 m <sup>3</sup> (2540 TBq)
Research	9600 m <sup>3</sup> (135 TBq)

In connection with the mentioned road map, the Legislative Decree 31/2010 establishes the new procedure for the localization and the construction of a national repository for the LLW disposal and the ILW/HLW long term storage, and assigns to SOGIN the role of the Implementer responsible for the construction and operation of the national repository. Legislative Decree 31/2010 also assigns SOGIN the role to propose areas suitable for the localizations of the facility based upon criteria established by the IAEA and the national Agency for Nuclear Safety. The steps to be made in order to realize a national storage facility foresees public consultations and involvement of the interested Regions and Local Authority in the decisional process.

However, due to the debates after the Fukushima accident, the time schedule foreseen by the Legislative Decree has been postponed.

In 2012, ISPRA has been charged with the task to develop a Regulatory Guide on technical siting criteria for the identification of potential areas where to realize a LLW near surface disposal facility and an Interim storage for ILW and HLW. Final issue of the Guide is foreseen by June 2013.

Waiting for the implementation of this new procedure and for the availability of a national facility, radioactive waste are being stored in the nuclear installations of origin. Action plans are in progress to enhance the safety level of waste by implementing specific treatment and conditioning projects, by refurbishing existing buildings or by realizing new storage facilities on the sites. New facilities will also be used to ensure temporary storage capacity for waste resulting from decommissioning activities.

#### Conditioning and decommissioning

Preliminary dismantling activities as well as the conditioning of the radioactive waste are on going at the shutdown SOGIN nuclear power plants and fuel cycle facilities.

The Garigliano 150 net MWe BWR was operated from 1963 to 1978. The plant has been totally defuelled and several activities have been performed such as a light decontamination and drainage of the vessel, primary circuit and spent fuel pit dry low-level operational wastes compaction, cementation of liquid and semi-liquid (sludge) radioactive waste. The decommissioning licence has been issued in 2012.

The Latina 153 net MWe GCR was operated since 1962 up to 1987. The plant has been totally defuelled; the primary circuit has been filled with dry air, and blowers and portions of the primary circuit outside the reactor building have been dismantled. Dismantling of the turbine building has been completed in 2012.

The Trino 260 net MWe PWR was operated from 1965 to 1987 for the equivalent of about eleven full power years; a limited quantity of spent fuel is still present in the spent fuel pool; no major decommissioning activities have been performed. Decommissioning of the primary circuit has been completed. The decommissioning licence has been issued in 2012.

The Casaro 860 net MWe BWR was operated from 1981 to 1986. Decommissionation of the circulation loops and clean-up have been completed in 2003. Dismantling activities on the turbine building, RHR tower and off-gas system are in progress.

As far as the fuel cycle facilities are concerned, all of them are at present shut down and managing their nuclear materials and/or radioactive waste, before starting decommissionation and dismantling operations.

**SF - separately**

## Italy. EGIRM table

Spent fuel and radioactive waste inventory presentation													
Country: Italy _____													
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		SDL	SDS
(A)	(B)	(C1)	(C2)	(D1)	(D2)	(E1)	(E2)	(F1)	(F2)	(G1)	(G2)	(H1)	(H2)
<b>1. SF</b>													
<b>1.1. NPP, [tHM]</b>		27.7	1848.25 <sup>1)</sup>										
<b>1.2. Other reactors, [tHM]</b>	2.74												
<b>2. HLW, [m<sup>3</sup>]</b>			40 <sup>2)</sup>										
<b>3. ILW, [m<sup>3</sup>]</b>	5540 <sup>4)</sup>		34 <sup>3)</sup>										
<b>4. LLW, [m<sup>3</sup>]</b>								31986 <sup>5)</sup>					23
<b>5. VLLW, [m<sup>3</sup>]</b>								3870 <sup>6)</sup>					
<b>Equivalence with IAEA GSG-1 classification</b>	2.		HLW										
	3.	ILW	ILW										
	4.							LLW					LLW
	5.							VLLW					

<sup>1)</sup> 1848.25 = 963.2 tHM (UK) before 1978 without RW return + 678 tHM (UK) in 1978-2005 with RW return of + 207.75 tHM (Fr)

<sup>2)</sup> 40 = 20 m<sup>3</sup> of vitrified HLW from UK (substitution of ILW-LLW with only HLW is in discussion) - 20 m<sup>3</sup> of vitrified HLW from Fr – volumes refer to canisters

<sup>3)</sup> ILW to be returned from Fr

<sup>4)</sup> 5540 = 2360 m<sup>3</sup> (estimate for the final volume of the conditioned Liquid ILW from pilot reprocessing plants (EUREX and ITREC, still to be conditioned) + 3180 m<sup>3</sup> (estimates for the final volumes after conditioning)

<sup>5)</sup> 31986 = 6371 m<sup>3</sup> (estimate for the final volume of conditioned LLW from pilot reprocessing plants (EUREX and ITREC, mainly still to be conditioned) +

25255 m<sup>3</sup> (estimates for the final volumes after conditioning)

<sup>6)</sup> Estimates for the final volumes after conditioning



## Germany. EGIRM table.

### Spent fuel and radioactive waste inventory presentation

Country: Germany\_\_\_\_\_

Date of inventorying: 31.12.2013

SF/RW types (in national terms)	No strate gy	SF reprocessing/ service		Disposal of in:							
		home	abroad	UF-1		UF-2		NSF-1		NSF-2	
(A)	(B)	(C1)	(C2)	(D1)	(D2)	(E1)	(E2)	(F1)	(F2)	(G1)	(G2)
1. SF											
1.1. NPP, [tHM]				8216							
1.2. Other reactors, [tHM]				9.5							
2. RW with HG, [m <sup>3</sup> ]			859 <sup>1)</sup>	569 <sup>2)</sup>							
3. RW with negligible HG [m <sup>3</sup> ]						120.000 <sup>3)</sup>	83683 <sup>4)</sup>				
Equivalence with IAEA GSG-1 classification	2.		HLW/ILW	HLW							
	3.					LLW/ILW	LLW/ILW				

1) HLW stored in UK and Fr and to be sent back 764 m<sup>3</sup> (Fr) + 103 m<sup>3</sup> (UK)

2) 569 = 554 m<sup>3</sup> after NPP SF reprocessing (volume given “as is” – 180 l canisters) + 15 m<sup>3</sup> after other reactors’ SF reprocessing;

UF-1: future HLW disposal

UF-2: Konrad; Morsleben; Asse

3) RW to be disposed in UF-2 “Konrad”;

4) 83683 = 36753 m<sup>3</sup> (disposed in UF-2 “Morsleben”) + 46930 m<sup>3</sup> (disposed in UF-2 “Asse”)  
(in future, retrieval from “Asse” is planned and will increase the “to be disposed of” volume).

# Nuclear Energy Agency

## Canada: national profile.

### SOURCES, TYPES AND QUANTITIES OF WASTE

In Canada, radioactive waste is generated from uranium mining and processing, nuclear fuel fabrication, operation of nuclear reactors, and radioactive waste treatment and use. This radioactive waste is divided into three categories: nuclear fuel waste, low and intermediate level radioactive waste, and high level radioactive waste.

#### Nuclear fuel waste

In Canada, nuclear fuel waste is defined under the *Nuclear Fuel Waste Act (NFWA)* as "enriched fuel bundles removed from a commercial or research nuclear reactor". It therefore, includes CANDU fuel bundles discharged from power and prototype reactors, as well as the bundles from the shutdown of the NRX research reactor at Whiteshell Laboratories.

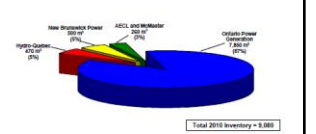
Although not specifically covered under the NFWA, other forms of nuclear fuel waste include AECIL fuel rods, which are discharged from its research reactors, and a small amount of waste that is generated by AECIL's research and development activities, including waste that is produced by test reactors in operation at a number of research sites.

Ontario Power Generation (OPG) is the largest nuclear power producer in Canada. It owns reactors in the province of Ontario. Since 1969, less than 2% of these reactors from OPG and 6 of the currently in operation. Of the remaining 12 reactors, OPG currently has 10 in operation. OPG is responsible for the management of the nuclear fuel waste produced by all of these reactors. In addition, OPG is also responsible for the management of the nuclear fuel waste produced by the New Brunswick Power (NBP) and Hydro-Québec (HQ) each operates one reactor, Point Lepreau and Gentilly, respectively. The four nuclear energy corporations generate a few hundred cubic metres (~100 m<sup>3</sup>) in 2011 nuclear fuel waste from the operation of these reactors each year.

At the present time, there are no plans to improve the fuel bundle from nuclear fuel waste. Current plans are to manage them as a waste product over the long term in a deep geological repository when it becomes available.

Figure 1 below, shows the distribution of nuclear fuel waste inventory by the deep geological repository. The distribution of nuclear fuel waste was as follows: OPG, 87%; HQ, 5%; NBP, 7%; other, mostly AECIL, 1%.

Figure 1 - Nuclear Fuel Waste Inventory, 2010



#### Low and intermediate level radioactive waste (LLRW)

Low and intermediate level radioactive waste (LLRW) includes all non-fuel waste that is not considered acceptable and for which the current waste stream cannot be reasonably reprocessed. At the end of 2010, the volume of historic waste, much of which is contained in, was 1,713,000 m<sup>3</sup>.

LLRW is divided into three broad categories:

- Ongoing waste** - refers to the waste that is generated by nuclear facilities currently in operation.
- Nuclear Legacy Facilities** - refers to waste at AECIL sites that they generated prior to 2009, and being taken by the host of nuclear technologies in Canada.
- Historic Waste** - refers to waste that was managed in the past, in a manner that is not considered acceptable and for which the current waste stream cannot be reasonably reprocessed. At the end of 2010, the volume of historic waste, much of which is contained in, was 1,713,000 m<sup>3</sup>.

#### Uranium mine and mill tailings

Uranium mine and mill tailings are a specific type of radioactive waste generated during the mining and milling of uranium to produce uranium concentrate. These wastes are generally held in containers close to the milling sites. Because of their large volume, the tailings are usually managed where deposited. This is typically in stand-out open pit tailings that have been engineered to contain management facilities, or as engineered above ground tailings management facilities.

Most of the existing uranium mine and mill tailings are located in the province of Ontario. Saskatchewan. Of the total of twenty-four tailings sites in Canada, only three in Saskatchewan contain more than 100,000 m<sup>3</sup> of tailings. The total quantity of all Canadian uranium mine and mill tailings, from both operational and inactive or shutdown mines, is about 214 million tonnes.

### RADIOACTIVE WASTE MANAGEMENT POLICIES AND PROGRAMMES

#### Waste management policies

The Government of Canada has well-defined policies, legislation and responsible organizations governing the management of radioactive waste in Canada. The *Government of 1996 Policy on Radioactive Waste* provides the national context for radioactive waste management. The framework is a set of principles to ensure that the management of radioactive waste is carried out in an environmentally sound, comprehensive, cost-effective and integrated manner.

The federal government has the responsibility to develop policy, to ensure that the waste is managed in a safe and secure manner, and to ensure that the waste is managed in a safe and secure manner.

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Since its launch, a number of committees have agreed to participate in the NFWMA's ongoing process and under the AFMA approach. These committees, which in the early stages of the process, first agree to undergo an initial screening exercise and any further details to undergo preliminary feasibility studies to determine if there are a suitable site. Following feasibility study, one or more of the committees may decide to undergo more detailed characterization and evaluation work. This is a gradual process and it is likely to take a decade or more from now before a suitable site in a willing community is identified to host a new waste management facility.

The NFWMA is also advancing work on the developing governance and capacity building to provide regulatory support. Adaptive Planned (APMA) implementation of the government-selected plan visit it for preparation, construction, operation and decommissioning.

Implementation of the AFMA approach will be regulatory matters pursuant to the NFWMA. The NFWMA for preparation, construction, operation and decommissioning.

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phase of the PFMA involves construction of completed waste management facilities and ongoing public consultation remains a priority.

Most of the remaining historic waste to be dealt with in Canada is located along the Northern Transportation Route between Fort McMurray, Northern Territories and Fort McMurray, Alberta. The waste results from the past transport of uranium and waste from ore and concentrate from the Northern Territories to Fort McMurray, Alberta. In 2003, the Government of Canada completed a cleanup of contaminated sites at Fort McMurray, and the resulting remaining waste is only stored in a long-term, above ground storage at the local municipal landfill. Storage is currently being developed for the cleanup of the remaining contamination along the Northern Transportation Route, which is estimated to consist of about 1,000 cubic metres of contaminated waste.

#### Uranium mine and mill tailings

All currently active uranium mining sites are situated in northern Saskatchewan. However, Elliot Lake, Ontario was the major uranium mining site in Canada for over 40 years. Since the last Elliot Lake uranium facility closed in 1996, uranium mining companies have completed well over 37 million tonnes of decommissioned mine, mill, and waste management sites. With treatment and mine engineering works carried out by the mine operator at each location. These quality within the area stretched has improved dramatically since the closure and decommissioning of mine and currently active Ontario Dealing Point facilities.

The CNSC has recently published a programme to bring all active uranium mining sites in Canada under regulatory control where appropriate and necessary.

#### Decommissioning and dismantling policies and projects

The Nuclear Safety and Control Act, together with supporting Regulations, explicitly addresses the decommissioning of nuclear facilities. Although other laws, the Act requires that the shutdown and decommissioning of facilities licensed by the CNSC must be carried out according to plans approved by the CNSC. It also includes provisions for ensuring that applicants provide sufficient financial guarantees for funding the decommissioning of these facilities in the CNSC near term.

Decommissioning projects are underway at the AECIL research facilities at Whiteshell and Chalk River, and at AECIL decommissioning projects include sites at Douglas Point and Exhibition in Ontario, and at Gentilly in Quebec. Three reactors, and the NRX reactor at Chalk River and the NRX reactor at Whiteshell, are now partially decommissioned and are in a state of long-term maintenance. AECIL is continuing to submit decommissioning plans for components of its research facilities.

Most active decommissioning systems facilities at the Elliot Lake area of Ontario consist of three facilities: the Ontario and Decontamination Division Mine Limited and the Ontario Fuel, Storage, Spent Assembly, Milling, Leach, Chalk River, and Process Facilities of the Algonquin. In Saskatchewan, decommissioning of the Chalk River uranium mine and mill began in 2002. AREVA Resources Canada has completed decommissioning of the mine and mill, including maintaining and monitoring the site under license from the CNSC.

On April 2, 2007, the Government of Canada and the Government of Saskatchewan announced the first phase of the cleanup of closed uranium mine and mill sites in northern Saskatchewan (primarily the Genar and Lethbridge mines). These facilities were operated from the 1930s until the early 1960s by private companies but were never properly closed. When the sites were closed, there was no regulatory oversight in place to appropriately contain and treat the waste, which has led to environmental impacts on local soils.

The current program of work is being implemented through a Memorandum of Understanding between AREVA and AECIL, whereby AREVA is responsible for the policy development and implementation of the AFMA approach. The program was launched with a five-year, \$350-million investment by the Government of Canada in 2011 with a \$400-million three-year investment from April 2011 to March 2014. Under the NFWMA, AREVA and AECIL have been working on decommissioning and dismantling of facilities, the recovery of treated waste, and the management of the remaining waste. These facilities have been established to characterize, process, and store radioactive waste.

A key ongoing activity in the development of an Integrated Waste Plan that supports the treatment and long-term management of the legacy waste inventory. It will address the identification of priorities and next steps, which will be used to guide the subsequent work. The development and refinement of the strategy will be completed by the end of 2014.

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## Canada. EGIRM table.

Spent fuel and radioactive waste inventory presentation												
Country: <u>Canada</u>												
Date of inventorying: <u>31.12.2013</u> <sup>(c)</sup>												
SF/RW types (in national terms)	No strategy	SF reprocessing/ service		Disposal of in:								
		home	abroad	UF-1		UF-2		NSF-1		NSF-2		Optional
(A)	(B)	(C1)	(C2)	(D1)	(D2)	(E1)	(E2)	(F1)	(F2)	(G1)	(G2)	→
<b>1. SF</b>												
<b>1.1. NPP, [tHM]</b>				46970 <sup>(a)</sup>								
<b>1.2. Other reactors, [tHM]<sup>(b)</sup></b>				489 <sup>(a)</sup>								
<b>2. Other HLW, [m<sup>3</sup>]</b>												
<b>3. LLW, [m<sup>3</sup>]</b>	18892 <sup>(e)</sup>					84210 <sup>(d)</sup>		144737 <sup>(e)</sup>		2104832 <sup>(e)</sup>		
<b>4. ILW, [m<sup>3</sup>]</b>	20700 <sup>(e)</sup>					14070 <sup>(d)</sup>						
Equivalence with IAEA GSG-1 classification	1.1.2											
	1.1.3											
	1.2.2											
	1.2.3											
	2.											
	3.	LLW					LLW		LLW		VLLW <sup>(f)</sup>	
4.	ILW					ILW						
5.												

a) Reference plan for all spent fuel is deep geological disposal.

b) “Other reactors” includes research reactors as well as prototype and demonstration power reactors.

c) Data from “Canadian National Report for the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management”, 5<sup>th</sup> report, Oct 2014.

d) Data in column (E1) is for waste owner OPG.

e) Data in columns (B), (F1) and (G1) is for waste owners other than OPG (i.e., CNL, HQ, NBP, Cameco, etc)

f) Data in column (G1) is mostly low activity contaminated soils from historic practices, considered to be LLW under Canadian classification, but essentially equivalent to GSG-1 VLLW

## Table extension potential

- The table can be extended to address needs of a country or requirements/requests from an international programme;
- The extension ability of the table will be presented in the next item;
- The table extension can provide a value when the common understanding of terms is provided:
  - Types of reactors in accordance with the IAEA typology;
  - Categories of DSRSs in accordance with national categorisation (correlation with IAEA categories is needed);
  - Clear explanation of other terms can be given in appendix to the table (e.g. location, type of research reactor, etc.)