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"EU DECOMMISSIONING FUNDING DATA"

Document accompagnying the

COMMUNICATION FROM THE COMMISSION

TO THE EUROPEAN PARLIAMENT AND THE COUNCIL

Second Report on the use of financial resources earmarked for the decommissioning of nuclear installations, spent fuel and radioactive waste

{COM(2007) 794 final}

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Sources:

European Commission

DG TREN

EURATOM

Commission outsourced studies

(1) Analysis of the Factors Influencing the Selection of Strategies for Decommissioning of Nuclear Installations: Colenco/Iberdrola. TREN/04/NUCL/S07.40075

(2) EU Decommissioning Funding Methodologies: Wuppertal et al. TREN/05/NUCL/S07.55436

(3) Inventory of Best Practices in the Decommissioning of Nuclear Installations. Brenk/NRI TREN/04/NUCL/S07.40035

(4) Analysis of Environmental, Economic and Social Issues Linked to the Decommissioning of Nuclear Installations: Plejades TREN/04/NUCL/S07.39876

International

IAEA

NEA

1. INTRODUCTION

1.1. BACKGROUND

In October 2004, the Commission presented its first report to the European Parliament on the use of financial resources earmarked for the decommissioning of nuclear power plants[1]. The report was drafted partly, as a result of concerns regarding potential safety implications should adequate decommissioning funds not be available when needed and concerning possible fund mismanagement and the potential for distortion of competition.

The 2004 report was well received and led to an own-initiative report[2] from the European Parliament. It was acknowledged within the report that decommissioning was a complex issue and that more detailed information was required in order to progress the issues raised. With this in mind the Commission has completed an extensive consultation process involving independent technical studies (one of which included a detailed questionnaire) and detailed consultation with experts of the Member States.

In addition, the Commission adopted a Recommendation[3] on decommissioning funds in 2006 following consultation with Member State experts and taking advantage of its research in the field. The second report provides for a normal progression of the Commission's work comparing EU nuclear operators and Member States funding practice with that detailed in the Commission Recommendation. Whereas the 2004 report was limited to power reactors, the present report covers all nuclear installations with an emphasis being placed on those which are at greatest risk should decommissioning funding be inadequately addressed.

1.2. METHODOLOGY

The Commission's 2004 report was based primarily upon a written exchange of views with Member States. The limitations of this method were immediately obvious and an ad-hoc Member State expert group was established in order to ensure better consultation and input to the work of the Commission. The Commission has continued to work with international organisations and researched the EU scene through targeted studies which have brought unparalleled levels of information in this area.

1.2.1. Decommissioning Funding Group

In 2004 the Commission set up an ad-hoc expert group - Decommissioning Funding Group (DFG) - in order to assist the EC in:

- Promoting a clear understanding of the decommissioning policies and strategies and the attendant tasks and activities;
- Providing an up-to-date knowledge on decommissioning cost estimates and the management of the provisions/funds;
- Exploring the ways ahead in terms of further co-operation and harmonisation at European level.

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1 Report on the use of financial resources earmarked for the decommissioning of nuclear power plants, COM(2004)719 final of 26.10.2004

2 European Parliament resolution on the use of financial resources earmarked for the decommissioning of nuclear power plants (2005/2027(INI)), P6_TA-PROV(2005)0432

3 OJ L 330 (28.11.2006)

Since its creation the DFG met twice and provided an open forum for the exchange of views on national approaches. This body was consulted during the drafting of the Commission's 2006 Recommendation[3] on decommissioning funding.

1.2.2. Studies

Technical studies have been completed providing essential input to this report and addressing a wide range of issues related to nuclear decommissioning. The studies were targeted in order:

- To identify and analyse the factors influencing the selection of strategies for the decommissioning of nuclear installations in the 25 European Union (EU) Member States as well as the then Candidate Countries including Bulgaria and Romania. Switzerland was included in the comparison as a non-European Union Country. A consultation was performed by means of detailed and pre-completed questionnaires sent to relevant sources of information among the affected stakeholders. The replies were investigated in order to analyse a sufficiently large number of representative nuclear installations of different types (power plants, fuel cycle facilities, major research centres, etc.), different size and geographical coverage (study 1).

- To take stock of the various approaches followed in the EU Member States and accession countries to quantify the decommissioning costs, analyse them and propose to the European Commission a methodology for allowing an appropriately detailed comparison and to analyse the risks relating to the various methods to set aside financial resources for decommissioning purposes (study 2).

- To establish an inventory of best practices in the decommissioning of nuclear installations mainly across the Member States of the European Union. The main aims of this project were to create an information bank gathering the real and most up-to-date experience from ongoing and completed decommissioning projects and identifying the best practices in decommissioning and to obtain a broad technological coverage of the decommissioning of nuclear power plants and fuel cycle facilities; to derive conclusions on the driving factors for decommissioning strategy selection, planning of decommissioning, project management and key technological choices (study 3).

- To identify the effects of decommissioning of major nuclear installations in the surrounding area, in terms of impact on regional and local economy, focusing on the social issues and the impact on the environment and to identify the measures taken by the concerned actors and the critical aspects of the related consultation procedures (study 4).

Copies of the main reports for these studies can be found on the relevant Commission website[4].

The response from Member States to specific requests for information and in particular the questionnaire varied, affecting sometimes the conclusions of the relevant study.

[4] Web page: http://ec.europa.eu/energy/nuclear/index_en.html

1.2.3. External Cooperation

The Commission has continued to work with the IAEA and NEA in the field of nuclear decommissioning through the dedicated groups such as TEGDE[5] and WPDD[6].

A group was established by the Working Party on Nuclear Safety as part of the Council's consultation process organised under the auspices of the Council Working Party on Atomic Questions. The Commission services have actively participated in the work of this group whose work was based primarily on the results of the Commission questionnaire referred to in section 1.2.2 above.

1.3. Conclusions

The decommissioning of nuclear plants is set to become an increasingly important issue in the years ahead. It is a fair assumption under the present policies that about one third of the reactors currently operating in the European Union will need to be decommissioned by 2025.

According to the results of the Commissions work, it seems that many operators have set up funding arrangements according to the polluter pays principle and that adequate decommissioning funds would be available when required. There are however several instances where this principle is not fully implemented:

- In the UK, following State Aid approval of British Energy restructuring and the creation of the NDA.
- The financing situation for decommissioning of Slovakia's A1 reactor has also to be clarified following the re-organisation of the National Fund.
- The Community financial assistance for decommissioning being provided to Lithuania, Slovakia and Bulgaria provides a further exception to the principle. But such assistance is provided in recognition of the financial burden the related early closures create and was decided with the political support of the European Council and the European Parliament.

Despite specific national legislation, there are grounds for progress in several aspects of fund adequacy, management and use, in particular through detailed monitoring and reporting at both national and EU level.

Differences in decommissioning strategies and fund management may lead to a distortion on the liberalised EU energy markets. Decommissioning costs including the final disposal of the waste has to be seen as part of the electricity production costs and should be compatible with state aid rules.

Member States need to ensure more transparency in reporting on the financial resources for decommissioning. Liability assessments should follow agreed accounting principles with publicly available estimates and provisions.

Differences between Member States are partly due to the structure and ownership of energy utilities before the creation of the internal market in electricity. The liberalisation of energy markets has brought an increased need for transparency and more harmonisation in the management of these financial resources. More detailed and better structured information thus

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5 TEGDE: Technical Group for Decommissioning (IAEA)

6 WPDD: Working party for dismantling and decommissioning (NEA)

needs to be obtained from the Member States. The contacts established with a view to compiling this second report should be pursued with a view to introducing a methodology for making meaningful comparisons between the various Member States.

The Commission believes it is important to continue the effort and the cooperation with all parties concerned. The main scope is to ensure both that financial resources are set aside to meet the requirements of nuclear plant decommissioning and that they will actually be available as and when required. The resources need to be managed with full transparency ensuring adequate funds for a high level of nuclear safety with respect to decommissioning and radioactive waste management. The information on decommissioning financing cannot be retained on the basis of confidentiality. The nuclear industry frequently cites the argument that decommissioning is technically complex and funding issues commercially sensitive. The varying levels of confidentiality applied across the EU lead the Commission to conclude that this argument is sometimes exaggerated to the extent that it could be considered as being used to divert attention from a shortfall in fund availability and/or adequacy.

The benefits of harmonised decommissioning funding methodologies should be explored in the EU. This assessment should take into account the differences in strategies between the Member States avoiding compromising safety and security. Common approaches in the case of new constructions should be rigorously pursued.

The Commission should focus on the adequacy of funding, its financial security and the ring fencing that is required in order to ensure the funds are only used for the purposes intended. For future nuclear constructions a common approach to methodology should be progressed but for currently operating systems the Commissions activities need to be based upon independent evaluation and reporting.

Chapter 3 of the present working document contains a table of accumulated funds in relation to total liability and plant operational lifetime. The content of this working document is based upon the information provided by the Member States collected via reference studies undertaken since 2004. Member States are requested to correct, if necessary, the information provided and the Commission will reissue the document at appropriate intervals.

This accompanying working document will be used as a basis for future continued consultation with Member State experts.

2. EU MEMBER STATE OVERVIEW

This chapter summarises the decommissioning scene within the EU and is based preliminary upon the Commission's work and, the referenced studies (1) – (4) undertaken since 2004. The intention is to provide an overview reflecting the situation at mid of 2007.

Table 2.1 summarises the nuclear power reactors within the EU with figure 2.1 providing the corresponding overview. Table 2.2 and figure 2.2 provide an indication of the growing size of the decommissioning effort required over the next two decades. Of particular note is the number of reactors anticipated for closure over the next 20 years amounting to approximately one third of the current EU nuclear generating capacity.

Of the three basic decommissioning strategies, only immediate and deferred dismantling are selected within the EU (table 2.3), though several Member States consider entombment as a potential option during the selection process. Within these two categories there are also large variations in interpretation as to the exact timing of the different phases, which has led to sub-categories being defined such as "rapid-immediate" strategy or conversely, an immediate strategy with a 20+ year period of deferral. There has been a definite trend towards early decommissioning in recent years, in particular for those countries such as France or the United Kingdom that previously had favoured a deferred decommissioning strategy with a very long period of safe enclosure. The new EU Member States have chosen both early and deferred decommissioning strategies with a non-uniform tendency.

The primary reasons given for selecting an early decommissioning strategy range from social aspects (preservation of jobs,) preservation of plant know-how (fear of loss of knowledge in case of deferred dismantling) to the necessity to demonstrate to the public that decommissioning of nuclear installations to green field is possible.

Selection of a deferred decommissioning strategy is often motivated by economic reasons, by specific waste management issues such as the lack of a disposal route for graphite or the lack of a final repository. Nevertheless, a large number of countries have chosen an early decommissioning strategy despite the lack of a repository, making use of existing or ad hoc built interim waste storage facilities. It can be concluded that early decommissioning is possible independent of the size of the nuclear programme or the availability of a repository.

While power reactors tend to dominate the discussion on decommissioning, other nuclear installations, such as research reactors (see table 2.4) or nuclear fuel cycle facilities (see table 2.5 and 2.6), should not be neglected as the radiological and financial implications following closure can be very significant.

Country	Number of nuclear power reactors					
	Operational	Shut down	Actual Situation of shut down nuclear power reactors			Total
NPP in EU			Under decommissioning	Dismantled	In safe enclosure	
Belgium	7	1	1			8
Czech Republic	6					6
Denmark						
Germany	17	19	15	2	2	36
Estonia						
Greece						
Spain	8	2	1		1	10
France	59	11	11			70
Irland						
Italy	0	4	4			4
Cyprus						
Latvia						
Lithuania	1	1	1			2
Luxembourg						
Hungary	4					4
Malta						
The Netherlands	1	1	1			2
Austria						
Poland						
Portugal						
Slovenia	1					1
Slovakia	5	2	2			7
Finland	4					4
Sweden	10	3	3			13
United Kingdom	19	26	26			45
Bulgaria	2	4	4			6
Romania	1					1
Total	145	74	69	2	3	219

Table 2.1: Nuclear power reactors in the European Union (Status 30.06.2007)

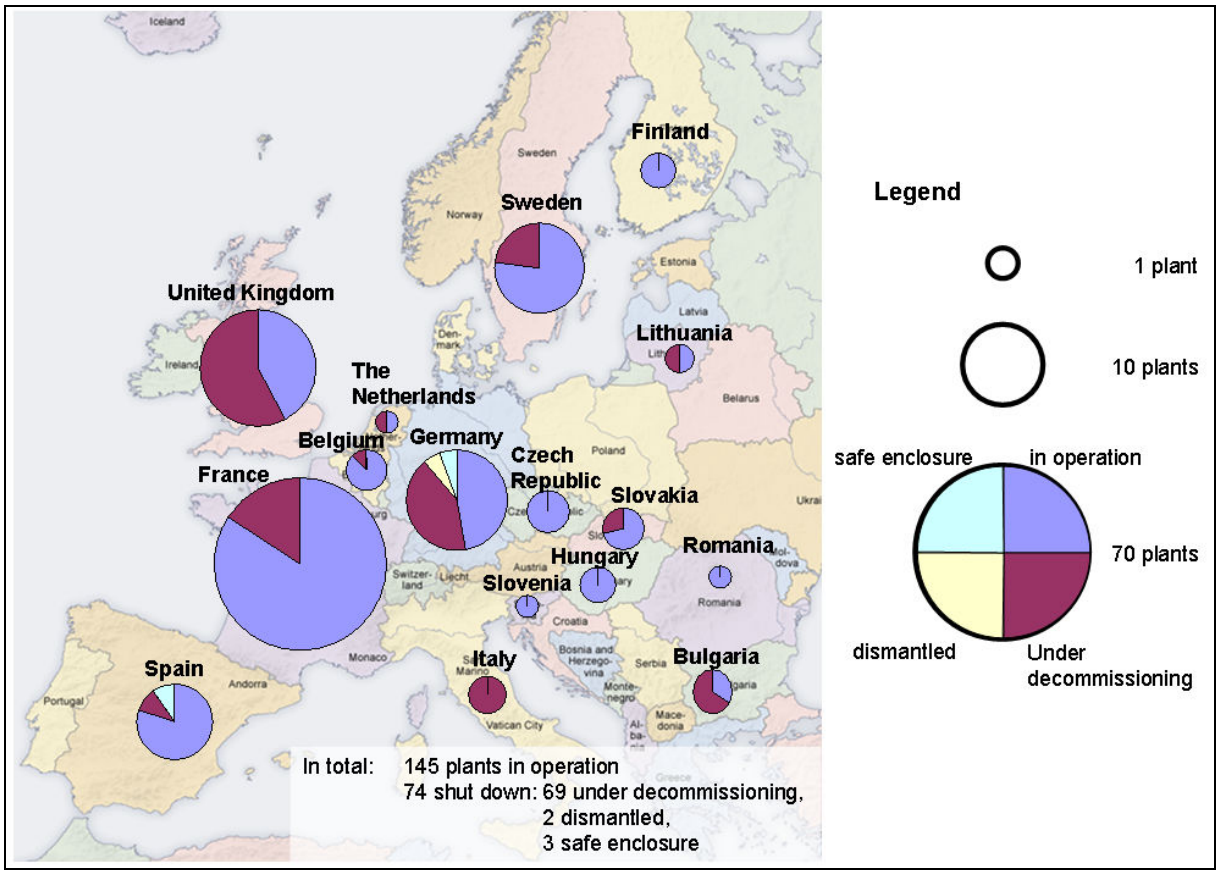

Figure 2.1: Map of nuclear power reactors in the EU (Status 30.06.2007)

	before 1986	1986-2005	2006-2025	later or unknown	Total
Belgium		1	7		8
Czech Republic				6	6
Germany	6	13	17		36
Spain		1	7	2	10
France	6	6		58	70
Italy	1	3			4
Lithuania		1	1		2
Hungary				4	4
The Netherlands		1		1	2
Slovenia				1	1
Slovakia	1		2	4	7
Finland				4	4
Sweden	1	2		10	13
United Kingdom	2	20	22	1	45
Bulgaria		2	2	2	6
Romania					
Total	17	50	58	94	219

Table 2.2: Power reactor closure status and prediction

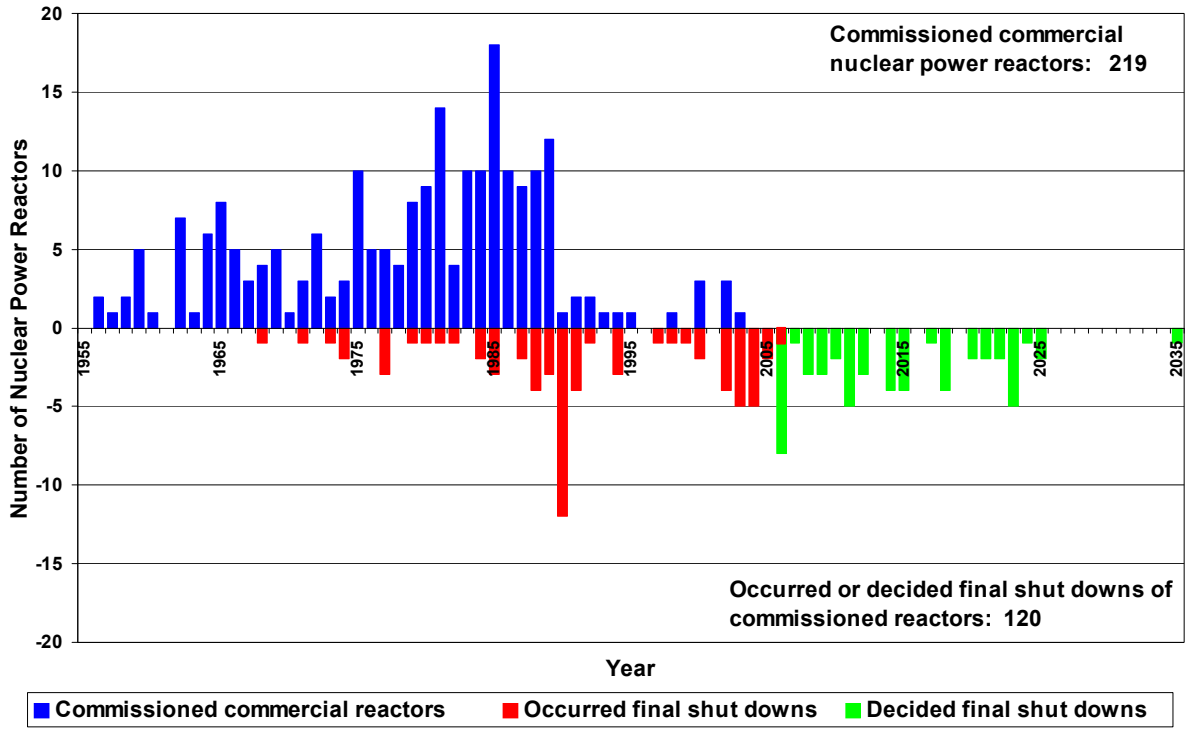

Figure 2.2: Timeline of power reactor commissioning and closure

Table 2.3: Decommissioning strategies within the European Union (Status 30.06.2007)

	Research Reactors			Decommissioning Status				
	Total	Opera-tional	Shut Down	Not specified	Ongoing	Safe enclosure	Modified use	Dis-mantled
Belgium	5	3	2	2				
Czech Republic	4	3	1					1
Denmark	2		2		2			
Germany	46	12	34		8	3		23
Estonia								
Greece	3	2	1	1				
Spain	4		4		1			3
France	30	11	19	1	7	1	1	9
Ireland								
Italy	14	5	9	4				5
Cyprus								
Latvia	2		2	2				
Lithuania								
Luxembourg								
Hungary	3	2	1					1
Malta								
Netherlands	5	3	2					2
Austria	1	1						
Poland	5	1	4	2				2
Portugal	1	1						
Slovenia	1	1						
Slovakia								
Finland	2	1	1					1
Sweden	6		6		2			4
United Kingdom	34	3	31	2	5			24
Bulgaria	1		1	1				
Romania	2	1	1	1				
Total	171	50	121	16	25	4	1	75

Table 2.4: Research reactors in the European Union

	Fuel Fabrication	Fuel Reprocessing	Spent Fuel Storages	Total
Belgium	4	2	3	9
Czech Republic			3	3
Denmark	1			1
Germany	11	13	14	38
Estonia				0
Spain	6		1	7
France	20	12	6	38
Italy	6	2		8
Lithuania			1	1
Hungary			1	1
Netherlands	1			1
Portugal				0
Slovenia				0
Slovakia			1	1
Finland			3	3
Sweden	1	0	1	2
United Kingdom	21	13	7	41
Bulgaria			1	1
Romania	1		1	2
Total	72	42	43	157

Table 2.5: Type of nuclear fuel cycle facilities in the European Union

	Nuclear Cycle Facilities			Decommissioning Status		
	Total	Operational	Shut down	Not specified	Ongoing	Dismantled
Belgium	9	5	4		3	1
Czech Republic	3	3				
Denmark	1		1	1		
Germany	38	12	26		9	17
Estonia						
Greece						
Spain	7	2	5		1	4
France	38	21	17	2	8	7
Ireland						
Italy	8		8		4	4
Cyprus						
Latvia						
Lithuania	1	1				
Luxembourg						
Hungary	1		1	1		
Malta						
Netherlands	1	1				
Austria						
Poland						
Portugal						
Slovenia						
Slovakia	1	1				
Finland	3	3				
Sweden	2	2				
United Kingdom	41	15	26	1	16	9
Bulgaria	1	1				
Romania	2	2				
Total	157	69	88	5	41	42

Table 2.6: Operational and decommissioning status of the nuclear fuel cycle facilities

3. FUNDING STATUS

The following table provides a comparison of estimated liabilities and accumulated provisions and is based primarily on the results of the study on funding methodology (2). In order to provide an indication of fund adequacy, the percentage operational lifetime is also indicated.

For reasons of simplicity and clarity, costs are only provided in Euros and, should be considered indicative only.

The table is not exhaustive and, obtaining accurate detailed information was problematic due to a lack of transparency or in many cases an outright refusal to make such information available. The Commission will correct the data at regular intervals as necessary in future revisions of this working document.

3.1. Decommissioning funds accumulated in relation to expected total costs of future decommissioning of nuclear installations in the European Member States.

Name of nuclear facility	Kind of facility	Total decommissioning costs estimated [€ million]	Provisions accumulated by end 2004 (unless otherwise stated) [€ million]	Percentage of required provisions accumulated [%]	Percentage of operational lifetime expired [%]
BELGIUM					
Doel, Tihange	7 NPPs + spent fuel management	2,300 (discounted) 7,450 (discounted)	1,376 2,540	60% 34%	various
EUROCHEMIC	Reprocessing Plant	203.3 (EUR2004, discounted)			100
BULGARIA					
Kozloduy unit 1	NPP	2,600	280 in decomm. funds + 69 in radioactive waste management funds	14%	~70 (weighted average of the 6 plants)
Kozloduy unit 2	NPP				
Kozloduy unit 3	NPP				
Kozloduy unit 4	NPP				
Kozloduy unit 5	NPP				
Kozloduy unit 6	NPP				
Uranium mine	Uranium mine				
IRT Sofia	RR				
Considerable Community assistance also provided to Bulgaria in support of the decommissioning effort of Kozloduy 1-4 and, to address the consequences of early closure. Approximately €550 million up to 2009.					

CZECH REPUBLIC					
Dukovany 1	NPP	> 580 (price basis 2003) (the 580 do not include any costs for waste management and disposal)	137	24%	48
Dukovany 2					
Dukovany 3					
Dukovany 4					
Temelin 1	NPP	> 480 (price basis 2004) (this sum does not include any costs for waste management and disposal)	28	6%	10
Temelin 2					
LVR-15	Research reactor	4.4 (price basis 2003)	2.5	55%	61.5
ISFSF Dukovany	Interim storage	0.4 (price basis 2004)	0.018	4%	11
Repository Dukovany	Repository (above ground)	23 (price basis 2003)			
SFSF Dukovany	Interim storage	0.4 (price basis 2003)		2%	2
SF storage facility NRI Řež	Interim storage	0.14 (price basis 2003)	0.01	11%	11
RAWRA activities	Waste management	1,490 (own estimate of all activities related to Dukovany and Temelin based upon 40 years lifetime and current contribution of 50 CZK/MWh to Nuclear Account)	211	14%	n.a.
GERMANY					
E.ON Corporate group	Several NPP (41.7% of total German NPP capacity in 2006)	Information on site-specific provisions is not accessible	12,907	Information on site-specific provisions is not accessible.	
RWE corporate group	Several NPP (27.1% of total German NPP capacity in 2006)		9,473		
EnBW corporate group	Several NPP (21.4% of total German NPP capacity in 2006)		3,920		
Stadtwerke München	Share in KKI 2		679		
GKN 1	NPP		Information on site-specific provisions is not accessible.		81.8
GKN 2	NPP				44.1
KKP 1	NPP				72.7
KKP 2	NPP				55.9
KKG	NPP				66.7
KRB-B	NPP				51.4
KRB-C	NPP				48.7
KKI 1	NPP				74.3
KKI 2	NPP				46.9
KWB A	NPP				82.9
KWB B	NPP				69.2
KKE	NPP		1,709		39.5
KWG	NPP		1,401		55.9

Name of nuclear facility	Kind of facility	Total decommissioning costs estimated [Mio. EUR]	Provisions accumulated by 31-12-2004 [Mio. EUR]	Provisions accumulated in relation to expected costs [%]	Years of operation until 31-12-2004 in relation to total expected lifetime [%]
KKU	NPP		Information on site-specific provisions is not accessible.		73.5
KBR	NPP		1,577		51.5
KKB	NPP		1,354		79.4
KKK	NPP		1,806		58.8
KWO	NPP		880		94.6
KKS	NPP		1,204		100
KMK	NPP		Information on site-specific provisions is not accessible.		100
KWW	NPP	(> 700)	Information on site-specific provisions is not accessible.	According to EON provisions should be more or less sufficient	100
KKR	NPP	3,200	No nuclear provisions because liability is with the Federal government and not with EWN GmbH	0%	100
KGR 1	NPP				100
KGR 2	NPP				100
KGR 3	NPP				100
KGR 4	NPP				100
KGR 5	NPP				100
AVR	NPP	ca. 500	Paid out of public budget, therefore 0	0%	100
KKN	NPP	150			100
THTR-300	NPP	(444)	?		100
MZFR	NPP	275	Paid out of public budget, therefore 0	0%	100
KNK-II	NPP	291			100
FRM-II	RR				?
FRJ-1	RR	26			100
FRJ-2	RR	100			?
FRG-1	RR	100			?
FRG-2	RR				100
FR-2	RR	55			100
URENCO	Enrichment	No site-specific data accessible. Only data for the URENCO group as a whole: By the end of 2005, URENCO's provisions in the company's balance sheet for all the URENCO sites in total amount to 129 Mio. Euro for tails disposal, 157 Mio. Euro for dismantling of plant and machinery and 19 Mio. Euro for other, also non-nuclear purposes.			
ANF	Fuel fabrication	Information not accessible			
WAK	Reprocessing, complex site	2,230	Paid out of public budget, therefore 0	0%	100
ITU-JRC	Research facilities	389	Paid out of the EC budget, therefore 0	0%	
Wismut	Uranium mine				100

Name of nuclear facility	Kind of facility	Total decommissioning costs estimated [Mio. EUR]	Provisions accumulated by 31-12-2004 [Mio. EUR]	Provisions accumulated in relation to expected costs [%]	Years of operation until 31-12-2004 in relation to total expected lifetime [%]
SPAIN					
Lobo (La Haba, Badajoz) Mina and Planta Lobo-G	Mine and Mill (no separated costs for m available)	8.4 (2006 estimate)	N/A	-	100
Fábrica de Uranio de Andujar (FUA) (Andujar Uranium Mill-AUM)	Uranium Mill	-	-	-	-
Saelices el Chico (Salamanca) Planta Elefante	Uranium Mill	5.5 (2006 estimate)	-	-	-
Saelices el Chico (Salamanca) – Planta Quercus	Uranium Mill	4.6 (2006 estimate)	-	100	N/A
Saelices el Chico (Salamanca) – La mina	Uranium Mill	58.7 (2006 estimate)	-	100	N/A
JEN 1	Research reactor	In process	-	100	N/A
Vandellos 1	NPP	> 224.3 (stage 3; 2006 estimate)	-	100	60
José Cabrera	NPP	>130.8 (spent fuel + stage 3; 2006 estimate)	-	100	95
LWR in operation (6PWR, 2BWR)	NPP	>1660 (spent fuel + stage 3; 2006 estimate)	Information on site-specific provisions is not accessible.	Information on site-specific provisions is not accessible.	various For planning and cost estimation purposes, all of them have an estimated lifetime of 40 years.
FINLAND					
OL 1+2 (TVO)	NPP	827 (2005 estimate)	827	100	42
Lo 1+2 (FPH)	NPP	618 (2005 estimate)	618	100	50
FiR 1 (VTT)	RR	5.3 (2005 estimate)	5.3	100	88
FRANCE					
EDF	NPPs and waste	52,610 (2006 estimate undiscounted)	26,609 (2006 5% discount)	51%	Various
CEA	Research, fuel cycle and waste	13,600 (2006 estimate undiscounted)	8690 (2006 5% discount)	64%	Various
AREVA	Fuel cycle and waste	8,897 (2006 estimate undiscounted)	4,308 (2006 5% discount)	48%	Various

Name of nuclear facility	Kind of facility	Total decommissioning costs estimated [Mio. EUR]	Provisions accumulated by 31-12-2004 [Mio. EUR]	Provisions accumulated in relation to expected costs [%]	Years of operation until 31-12-2004 in relation to total expected lifetime[%]
HUNGARY					
NPP Paks	NPP	2,446 (2005 estimate)	261	11	64
ISFSF Paks	SF storage site	Together with NPP	Together with NPP	Together with NPP	10
BRR Budapest	RR	4.7 (2005 estimate)	Will not be financed from CNFF	-	<72
TR Budapest	RR	1 (2005 estimate)	Will not be financed from CNFF	-	<61
ITALY					
SOGIN facilities	Diverse	4,029 (EUR 2004) (w/o costs of HLW final disposal and uncertainties)	Ca. 1500	ca. 37%	100
ISPRA – JRC facilities	RR	645	Paid out of the EC budget, therefore 0	0.0%	100
LENA Triga II ENEA, TrigaII, Taprio Palermo University, AGN-201	RR	No decommissioning plan, no cost calculations, no provisions yet. Public budget will be allotted when shut down.			
LITHUANIA					
INPP Unit 1 and 2	NPP	~ EUR 2020 million for immediate dismantling strategy (EUR 2002)	By 2006: EUR 104 million	5% of immediate strategy costs	Unit 1 – 100% Unit 2 – 74%
Considerable Community assistance also provided to Lithuania in support of the decommissioning effort of Units 1 &2 and, to address the consequences of early closure. €1.366 billion up to 2013.					
THE NETHERLANDS					
Dodewaard	NPP	175 (undiscounted) 75 (discounted)	114 (for all remaining decommissioning liabilities)	100% (compared to remaining liabilities	100
Borssele	NPP	700 (undiscounted) 145 (discounted)	163.6	23.4% (undiscounted) 100.0% (discounted)	51
URENCO Almelo	Enrichment facility	No site-specific data accessible. Only data for the URENCO group as a whole: By the end of 2005, URENCO's provisions in the company's balance sheet for all the URENCO sites in total amount to 129 Mio. Euro for tails disposal, 157 Mio. Euro for dismantling of plant and machinery and 19 Mio. Euro for other, also non-nuclear purposes.			
Petten nuclear reactor (HFR) (JRC Site)	RR	69	5 (2003)	7.2%	Not decided yet, maybe 83%
HOR-RID, TU Delft	RR	Not calculated yet	0	0.0%	Not decided yet
COVRA	Waste management & disposal	1,270 (disposal only)	85.3	6.7%	ca. 10% – 20%

Name of nuclear facility	Kind of facility	Total decommissioning costs estimated [Mio. EUR]	Provisions accumulated by 31-12-2004 [Mio. EUR]	Provisions accumulated in relation to expected costs [%]	Years of operation until 31-12-2004 in relation to total expected lifetime[%]
ROMANIA					
Cernavoda 1	NPP	240 (2006 estimate)	0	0	27
Cernavoda 2	NPP	240 (2006 estimate)	0	0	-
Horia Hulubei, Magurele, Bukarest	RR	19	0	0	100
TRIGA, Mioveni, Pitesti	RR	100	0	0	49
CNU Bihor	Uranium mine	N/A	0	0	100
CNU Banat	Uranium mine	N/A	0	0	100
CNU Suceava	Uranium mine	N/A	0	0	N/A
CNU Feldioara	Milling facility for uranium ore	N/A	0	0	N/A
FCN, Mioveni, Pitesti	Fuel fabr. plant	N/A	0	0	N/A
SWEDEN					
B1, B2	NPP	510 (EUR 2004)	510	100%	100
F1, F2, F3	NPP	1,180 (EUR 2004)	1100	93%	53-78
O1, O2, O3	NPP	890 (EUR 2004)	850	97%	53-85
R1, R2, R3, R4	NPP	1,250 (EUR 2004)	1210	96%	58-78
SLOVENIA					
Krško Nuclear Power Plant	NPP	1,149.3 (undiscounted) 338.5 (EUR 2002) (discounted)	115	10.0% (undiscounted) 34.0% (discounted)	52.5
TRIGA Mark II	RR	Not calculated yet	0	0.0%	Not decided yet
Central interim storage of	storage of radioactive	Not calculated yet	0	0.0%	Not decided yet

radioactive waste in Brinje	waste				
Zirovski Vrh Uranium Mine and Milll; Waste Pile Jazbec	Uranium Mine and Mill	Not known	0	0.0%	100
SLOVAKIA					
A1 J. Bohunice	NPP	378 (EUR 2004)	324	6 %	5 years, 25
V1 J. Bohunice	NPP	1,884 (EUR 2004)			28 years 75
V2 J. Bohunice	NPP	1,620 (EUR 2004)			28 years 75
JE Mochovce 1,2	NPP	1,620 (EUR 2004)			5 years 14
Considerable Community assistance also provided to Slovakia in support of the decommissioning effort of Bohunice V1 and, to address the consequences of early closure. €614 million up to 2013.					
UNITED KINGDOM					
British Energy facilities	8 NPP sites (9,892 MWe)	about 129,00 in total	1,137 (NLF) (31 March 2005)	?%	various
All other civilian facilities	Diverse facilities		0 (NDA)	0.0%	various

4. EU MEMBER STATE OVERVIEW

Countries are listed in order of the relative share of nuclear energy production:

Contents:

4.1. FRANCE

4.1.1. Overview

The regulatory situation and organisation of nuclear decommissioning and waste management in France underwent profound change in 2006 with the adoption new legislation on nuclear waste research and management ("*New Waste Law")*[7]. The new law provides for the:

- creation of a national management plan and continued research;
- supervision of the reprocessing - recycling of foreign spent fuel in France;
- evaluation of research work by an independent commission of experts;
- consultation and safety analysis aspects of the process to create a repository in deep geological formations;
- economic development of the territories concerned by sitting of an underground laboratory or repository in deep geological formations;
- missions of the national agency for radioactive materials and waste management (Andra);
- financing of research into radioactive waste management;
- security of financing for decommissioning of basic nuclear installations and management of radioactive waste and spent fuel. These provisions are in particular designed to ensure that the goal of the first article of the bill is reached (*article 1 A*): "*Steps are taken to search for and deploy the resources necessary to ensure that radioactive waste is finally secure, to prevent an undue burden being placed on future generations*".

Given the scale of the sums and the time-frame involved in the cost of decommissioning nuclear installations and managing radioactive waste, it became apparent that creation of a specific legislative system was necessary to secure the funding required. Although measures of this type already existed (in particular with the gathering of dedicated assets by the main operators concerned, and even the creation of dedicated funds with supervisory committees in certain cases), they had no legislative or regulatory basis.

Key articles of the new *Law on the Programme Relative to the Sustainable Management of Radioactive Materials and Wastes* include the legal requirement to elaborate a National Plan for the Management of Radioactive Materials and Wastes and a National Inventory of Radioactive Materials and Wastes. Both have to be updated every three years. The National Radioactive Waste Management Agency ANDRA has to set up an internal restricted fund in order to finance the storage of long lived high and medium level wastes. The fund will be fed by contributions from the nuclear operators under bilateral conventions. The nuclear operators will set up internal restricted funds covered by dedicated assets managed under separate accountability.

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[7] Loi n°2006-739 de programme relative à la gestion durable des matières et des déchets radioactifs, 28 June 06. This law has been completed by two other texts : décret n°2007-243 du 23 février 2007 relatif à la sécurisation du financement des charges nucléaires (JO 25/02/2007) and arrêté du 21 mars 2007 relatif à la sécurisation du financement des charges nucléaires (JO 31/03/2007).

AREVA, EDF and the CEA have set up restricted internal funds for the financing of future backend charges. The CEA was the first to set up a specific fund for its civil activities in 2001, while AREVA was the first to cover provisions by dedicated assets. EDF is expected to have built up earmarked assets by 2010, which is thought to be the earliest time EDF can complete this.

The sums involved are very significant. The French Court of Accounts has calculated liabilities totalling €65 billion (undiscounted) for the three main operators as of the end of 2004.

4.1.2. Decommissioning funding

The New Waste Law stipulates in article 20 that the operators of basic nuclear installations build up provisions "in a prudent manner, for the costs of decommissioning of their installations or for their radioactive waste storage facilities, the final shut down, maintenance and surveillance costs". Moreover, the decree n°2007-243 precises that this assessment of charges needs to be based on a reference strategy, chosen in a prudent manner, and should take into account uncertainties and lessons learnt. In addition the law requires operators to "earmark necessary assets exclusively to cover these provisions". These assets have to be accounted for separately and they have to present a "sufficient degree of security and liquidity in order to serve their objective" (for this purpose, the decree n°2007-243 stipulates constraints for the admissible assets). Their market value has to be at least as high as the provisions to be covered. The assets are protected by law and nobody, besides the state in the execution of its right to enforce the operators' obligations to decommission their facilities and to manage their spent fuel and radioactive waste can claim any right over the assets.[8] This means that it is aimed at protecting the assets in case of insolvency or bankruptcy of an operator while at the same time leaving them with the operator who has a level of freedom to control and access them. The new law stipulates that any operator of a nuclear installation must carry out a prudent assessment of the cost of decommissioning and of managing its spent fuel and radioactive waste. An assessment such as this constitutes the foundation for any secure funding mechanism.

The new law requires that the level of assets must be at least equal to the discounted cost. This applies as soon as a nuclear installation is operated. For current installations, operators have until June 2011 to constitute such a dedicated portfolio covering at least 100% of their provisions. Besides, this legal frame applies to all nuclear operators (not only for power reactors; it includes research reactors and installations for fuel cycle).

Specific requirements are also set for each operator, such as the obligation to assess the financial risks, the obligation to establish an internal oversight for the assessment of nuclear liabilities and for the management of the dedicated assets.The law also requires regular communication commitments from the operators about all previous aspects: report every three years (to be completed by an updating every year)[9], specific report on internal oversight, synthesis of the dedicated assets every three months, and any other information required by the administration. The detailed report every three year, presents an assessment of these costs,

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[8] Art.20 II of the New Waste Law stipulates: « A l'exception de l'Etat dans l'exercice des pouvoirs dont il dispose pour faire respecter par les exploitants leurs obligations de démantèlement de leurs installations et de gestion de leurs combustibles usés et déchets radioactifs, nul ne peut se prévaloir d'un droit sur les actifs mentionnés au premier alinéa du présent II, y compris sur le fondement du livre VI du code de commerce.

[9] Operators submitted this report to the competent administrative authority in the summer of 2007

their anticipated schedule and the amount of the reserve set up in the undertaking's balance sheet in accordance with applicable accounting rules. This report and the other information are submitted to public authorities, through an Administrative Authority (both ministers in charge of Economy and Energy). It will not give a formal approval to the reports by operators: these are still responsible for their dismantling strategies and for the management of their dedicated funds. This Authority may address remarks concerning possible deficiencies, inadequacies, incoherence or lack in information, or prescribe corrective measures.

To ensure that the funding of these future costs is secure, the law creates a "National Financial Evaluation Commission", to evaluate the whole system set up by the law. This Commission will be made up of members of the Parliament, four experts appointed by the Government, and four experts appointed by the Parliament (composition in progress).

NPP decommissioning cost estimates have been subject of a detailed study and cost breakdown. The assessment assumes a generic treatment for all reactor types and while the benchmark value of 15% of construction cost is believed to still be valid, such a methodology is not considered best practice.

4.1.3. Decommissioning strategy

Until the end of the 1990s the reference strategy for the decommissioning of commercial nuclear facilities in France consisted of deferred dismantling activities (30 to 50 years) after discharging of fuel from nuclear reactors or respective operations like the evacuation of nuclear materials from other facilities. Only few and small-scale facilities like a number of small research reactors and laboratory scale facilities have been entirely dismantled so far (see table 2.4).

In 2003 the French regulations were modified significantly as to allow for the immediate or slightly deferred dismantling of the facilities.[10] The amendment of the rule was felt necessary also to take into account difficulties that had been encountered to apply existing regulations to non-reactor facilities. EDF had decided on its end already in 2001 to decommission its first generation reactors without an additional deactivation phase.

The French nuclear safety authorities are clearly in favour of immediate dismantling under the condition that a full scale dismantling strategy is available prior to the start of the operations. The strategy is elaborated by the operator but has to be authorised by the safety authorities not only from their technical point of view but also on the level of their financial feasibility.[11] The position of the safety authorities was instrumental in the shift from deferred to immediate dismantling as the reference strategy.

Dismantling operations can take more than a decade in case of more complex nuclear facilities, often after several decades of operation. The safety authorities consider that the risk of the loss of memory on the conception and the operation is "very significant"[12]. This is one of the key reasons why the immediate dismantling approach has been adopted in France.

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10 ASN, DGSNR, « Procédures réglementaires relatives au démantèlement des installations nucléaires de base », Révision de la note SIN/PARIS 16310/90 du 9 novembre 1990, DGSNR/SD3/N°/0095/2003, Fontenay aux Roses, letter dated 17 February 2003, Note n° SD3-DEM-01, Indice 1 du 3 February 2003 (see Annex 8)

11 However, in practice human resources to do so remain limited within the Safety Authorities.

12 Autorité de sûreté, DGSNR, « Rapport Annuel 2005 », p.414

The safety authorities specifically request in most of the cases the development of means to preserve the memory of the past presence of a nuclear facility on a given site and to restrict the scope of its use.

4.1.4. Radioactive waste management

The French nuclear industry is based upon a closed fuel cycle. The original UP1 plant at Marcoule initially only processed military though later extended to cover civil fuel. The second plant UP2-400 was financed for half of the cost by the military budget of the CEA and for half by the civil budget. The plant also processed civil and military fuels.

In view of the then expected large-scale introduction of fast breeder reactors, the French industry invested in two commercial reprocessing plants, UP2-800 and UP3, each with 1000 t/a capacity at La Hague (with a limit of 1700 t/a for both). Most of the investment cost of the UP3 plant was covered under cost-plus-fee contracts by foreign reprocessing clients.

The choice of the reprocessing option had considerable impact on the definition of the current waste management scheme in France The management policy for radioactive material and waste is defined by the 28th June 2006 Act.

Besides, there are some disposal facilities in operation or under monitoring:

For low and medium level short-lived waste, the « Centre de Stockage de la Manche » (CSM) opened in 1969 and operated until 1994 (it is now under an active monitoring); it contains 527,000 m^3 of radioactive waste. Today, such waste is stored in the Centre de Stockage de l'Aube (CSA), in operation since 1992, with a capacity of 1,000,000 m^3.

For very low level waste, the « Centre de Stockage de déchets à Très Faible Activité » (CSTFA) is in operation since January 2003, and has a capacity of 650,000 m^3.

4.2. LITHUANIA

4.2.1. Overview

Lithuania has two nuclear reactors of the RBMK-1500 series located at the Ignalina Nuclear Power Plant, close to the town of Visaginas. These reactors have generated up to 70- 80% of the country's electricity production, and have enabled in the past a limited amount of electricity to be exported to neighbouring countries. In line with its Accession Treaty obligations, Unit 1 was permanently shutdown on December 31, 2004. Ignalina Units 1 & 2 are Soviet design reactors, on which the Commission's position has remained consistent and in line with the G7 multilateral programme of action adopted at the Munich G7 summit in 1992; these reactors should be closed. During the accession negotiations, the Lithuanian Government took a commitment to close Unit 1 in 2004, and Unit 2 in 2009. Community assistance totals €319 million for the period 2004-2006 resulting in a total Community contribution of €529 million since 1999 and, a further €837 million has been earmarked for the period 2007-2013.

The Ignalina reactors are foreseen for immediate dismantling with completion by 2030. Estimation of the cost of decommissioning ranges from €987 million to €1,300 million purely in terms of technical costs. A national fund has also been created which has accumulated just over €100 million however, a significant proportion has been disbursed, in some cases on non-decommissioning projects.

4.2.2. *Decommissioning funding*

According to the cost estimates, made initially in 2001, pure technical costs of decommissioning range from €987 million to €1,300 million. The agreed final decommissioning plan notes the sensitivity of the liability assessment to manpower costs and estimates an increase to ~€2 billion should the average wage rise from €6/hour to €40/hour. There are presently three different sources available for funding of INPP Decommissioning: direct Community assistance; the Ignalina International Decommissioning Support Fund (IIDSF) to which the Community is the largest contributor (~95%); and a State INPP Decommissioning Fund. The main source of the State INPP Decommissioning Fund is deductions from the revenue received from the INPP sale of electricity (now 6% after the excise tax).

By 2013 the total support to Lithuania will reach approximately €1.4 billion via either direct Community contributions or the IIDSF however, this assistance is not just foreseen for decommissioning of the reactors but equally important are issues related to security of supply (replacement capacity) and the maintenance of an adequate safety culture through the maintenance of morale and retraining at the plant. It is also to be noted that significant proportion of the State INPP Decommissioning Fund has been used for non-nuclear projects relating to replacement capacity.

Aware of the significant variations in decommissioning estimate, in 2006 the Commission requested the Lithuanian government to provide a detailed project pipeline for all projects foreseen for assistance in order to gain confidence that adequate funding would be available for safe decommissioning.

The license holder has full responsibility for dismantling and waste management and contributes to the budget relative to its economic strength, its annual contribution amounting to 6% of the plant's annual revenue from the sold electricity.

4.2.3. *Decommissioning strategy*

The immediate decommissioning strategy is planned to reach the "brown field", with possible re-use of the site as an industrial facility or for new energy production. The decommissioning project is expected to be completed by 2030.

The Preliminary Decommissioning Plan, adopted in 1999, included analysis of potential future at that time decommissioning strategies, which were three: immediate, deferred dismantling and entombment. In order to choose the best strategy the Ministry of Economy asked the INPP to prepare an analysis of technical and financial considerations having influence for the selection of a strategy. After extensive discussions, in 2002, the Government of Lithuania, basing its opinion on the need to prevent the country from cumbersome long-term social, economical, financial and environmental consequences and having in mind to use INPP staff in decommissioning activities selected an option of immediate dismantling. This is a continuous process starting after final shutdown and finishing with the interim/final disposal of all radioactive waste and territory restoration. Different factors have influenced the selection of strategy, in particular the development of the state energy policy, social aspects and nuclear safety aspects, technical characteristics of the power plant, financing, radioactive waste storage and international experience in the field of decommissioning of nuclear power plants.

A Final Decommissioning Plan was subsequently drafted and agreed based solely upon the selected strategy of immediate dismantling.

Dismantling requires appropriate radioactive waste management facilities (landfill near surface repository, waste management facility and free release measurement facility), dismantling of non-contaminated or slightly contaminated plant will begin in 2008.

4.2.4. *Radioactive waste management*

At present, only operational waste facilities are available in Lithuania. Nevertheless, it is expected that a landfill facility for short-lived very low level radioactive waste will become available by 2009. A dry storage facility for spent fuel as well as a near surface repository for low and medium level short lived radioactive waste will become available by 2012. A decision on high level and long lived waste repository is expected to be taken till 2030.

4.3. SLOVAKIA

4.3.1. Overview

Slovakia operates six VVER 440 nuclear reactors, four at Bohunice and two at Mochovce. These generate approximately 50% of the country's electricity supply. Bohunice Units 1 & 2 are first generation Soviet design reactors, on which the Commission's position has remained consistent and in line with the G7 multilateral programme of action adopted at the Munich G7 summit in 1992; these first generation reactors should be closed. During the accession negotiations, the Slovak Government took a commitment to close Unit 1 in 2006, and Unit 2 in 2008. The Treaty of Accession includes a specific protocol which describes this commitment and offers substantial Community assistance. Protocol 9 has resulted in a commitment for €100 million over the period 2004-6 and, the provision of a further €423 million over the period 2007-2013 has been agreed upon.

The privatisation of Slovenske Elektrarne (SE) which is now owned 66% by ENEL has led to a major reorganisation of operating and shutdown facilities. A new government owned group now assumes responsibility for Bohunice A1, V1 and most waste management facilities.

In addition to the two operational VVER 440 reactors at Mochovce, there are also two partially completed VVER 440 reactors and for which a decision on completion is expected in 2007.

Prior to specific legislation in 1996, there was no requirement to create a dedicated fund with costs being borne directly from the treasury account. A national fund has steadily built up since the mid-nineties. The separation of operational reactors from those shutdown or waste management facilities has led to a concern over the distribution of the previously established national decommissioning fund.

4.3.2. *Decommissioning funding*

Prior to 1996, decommissioning and costs were provided primarily from the federal budget. A first law was then approved which saw the creation of a state fund with various sources but in particular through contributions from operating facilities. This legislation was replaced by a new law in 2006 with funding resourced through a 5.95% levy on electricity price and a charge of €9450/MW_e. Financial resources of the previous Fund were transferred to the new Nuclear Fund and its individual sub-accounts and analytical accounts in shares corresponding with the shares of generated electricity in the individual NPPs in relation to the overall electricity generated in all NPPs during 1978 – 2005. The breakdown by sub-account gives cause for concern as it appears to leave the ongoing A1 decommissioning project without any specifically earmarked source of funding:

1.) Decommissioning of nuclear facilities located at the Bohunice power plants site providing a separate independent account for each plant:

- A1: € 0

- V1: € 216 million

- V2: € 180 million

2.) Decommissioning of the Mochovce NPP:

- EMO: € 61 million

3.) Decommissioning of nuclear facilities that started their operations following the date when National nuclear fund law came into force:

- Beginning with € 0

4.) Treatment of nuclear materials and nuclear waste of unknown origin: € 0

5.) Searching the localities, geological survey, preparation, designs, constructions, operation and for closing-up the deep repositories of RAW and spent nuclear fuel: € 0

6.) Institutional control of (deep) repositories: € 0

7.) Storage of spent fuel in independent nuclear facilities: € 0

8.) Nuclear fund administration: € 0,8 million

In recognition of the financial burden that Slovakia's early closure commitment for the V1 reactors creates, the European Community has foreseen considerable financial assistance in a specific protocol to the Treaty of Accession. This Community assistance will amount to a total of approximately €600 million up to the end of 2013. EU assistance is not just foreseen for decommissioning of the reactors but equally important are issues related to security of supply. The amounts fixed for this assistance are not based on a specific proportion of the estimated costs, but recognise the extraordinary burden placed on Slovakia by the shutdown commitment, and are to some extent an expression of solidarity between the Union and Slovakia. While the Community assistance is significant, the specific nature regarding its intended use needs to be noted in that while not intended solely for nuclear decommissioning but cannot be used for the decommissioning of other facilities.

The national fund is State held segregated fund with strict controls on use. Fund management and use is controlled by a supervisory board made up of representatives from several ministries.

The total cost of decommissioning and waste management, including disposal, is estimated at €3.6 Billion. The present level of the national fund is of €324 million$_{2004}$.

4.3.3. Decommissioning strategy

The strategy for Bohunice V1 nuclear power plant was re-assessed in 2005 and decision has been taken in early 2007 to change from deferred to immediate decommissioning. According to the latest estimates, the decommissioning of Bohunice V1 will cost approximately €500

million with this figure rising to €1315.9 million in total, when pre-decommissioning projects, safe shutdown, dismantling and the back-end of the nuclear cycle are taken into account.

The A1 plant was shut down in 1977 soon after operation started in 1973 following an INES 4 accident. The facility has been under decommissioning since 1979 with a chosen strategy of immediate dismantling. The decommissioning process is split into two phases: the main goal of the first phase, to be finished in 2007, is to achieve radiation safety, i.e. defueling and treatment of liquid radioactive waste. The second phase is expected to start in 2008 and will be finished by 2033. The cost of decommissioning was estimated at €290M (price level 2001).

4.3.4. Radioactive waste management

The near surface National Radwaste Repository for low and intermediate level waste is operational since 1999. The waste which is not acceptable for the National Repository Mochovce shall be stored at the sites of the power plants. A project for the enlargement of this repository or alternative construction of a VLLW is being financed primarily through Community financial assistance.

Options to construct a deep geological repository are being assessed with a view to have an operational facility by 2038.

4.4. BELGIUM

4.4.1. Overview

Belgium has two sites with operating nuclear power plants at Doel and Tihange, operated by Electrabel. In addition to the seven NPPs there is an LEU and MOX fabrication plant. The only NPP which is shut down in Belgium is BR-3, a prototype reactor subject of a decommissioning pilot project within the European Commission's research programme.

Other decommissioning projects include several old SCK-CEN waste facilities and the Eurochemic reprocessing plant.

A subsidiary of Electrabel, SYNATOM is responsible for establishing and managing the provisions for the decommissioning of the operational power plants including spent fuel. This fund is overseen by a Surveillance committee and the State holds a "golden share" which gives it the power to veto decisions. The use made of provisions is fairly flexible with up to 75% being available for loan to the operators. There is also currently a proposal to use part of the funds for power sector investments which are unrelated to nuclear decommissioning.

The State is responsible for ensuring that adequate financial resources are set aside for the nuclear liabilities programme such as Eurochemic, via a levy on electricity sales which are held in a fund managed by the national waste agency ONDRAF/NIRAS.

4.4.2. Decommissioning funding

For all nuclear power plants, the obligation to constitute adequate reserves for future liabilities stems from the generally applicable accounting regulation. As a rule, the net present value has to be available at any time during the operation of the nuclear power plants.

Since 2003, the existence of a supervising committee charged with the control of the mechanisms for the decommissioning provisions for nuclear power plants including spent fuel

management is required by law. The supervising committee is composed of high level people in the administrations and banking world. The National Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF) is specifically responsible for collecting information related to the decommissioning programmes, approving these programmes, and eventually executing the programme at the request of the operator, or in case of its failure. Decommissioning provisions and costs are regularly revised, i.e. every three years for the decommissioning of nuclear power plants including spent fuel management and every five years for other facilities.

In practice, provisions are created by trimestrial endowments of the electricity producers during 40 years of operation of the nuclear power plants. Effectively, the trimestrial endowment of the nuclear power plants is the interest on the gathered provisions at a rate of 5% given that the net present value of decommissioning is already constituted. In total, the estimated cost of decommissioning (1999) is €2280.8 million. The reserves are managed by Synatom, the nuclear provision company, and up to 75% can be re-borrowed to the nuclear operators.

The first of the seven pressurized water reactor units is expected to be closed in early 2015 and the last in 2025. No shutdown date has been set for the fuel fabrication site at Dessel.

From the financial point of view, all nuclear fuel remains always the property of Synatom, being effectively loaned to the nuclear power plant for the production of electricity. The costs related to the nuclear fuel cycle are paid to Synatom from the revenue generated through electricity sales with a portion of this payment being set aside for the constitution of the provisions for the future management of spent fuel. The provisions for the management of spent fuel are managed by Synatom in the same way as the decommissioning provisions of the nuclear power plants. The cost estimate for the provisions of spent fuel management is based on the most expensive scenario for the back-end of the nuclear fuel cycle, which is reprocessing. The costs are furthermore increased with an uncertainty margin of 15%. For this purpose, €2540 million was in total constituted by the end of 2004.

The state finances the decommissioning of older R&D-facilities, the so-called “nuclear liability programme”. The facilities were operated in the first development phase of nuclear energy and their prime objective was not commercial operation. Until 2002, the state and the electricity producers financed jointly these projects on the basis of annual endowments. From 2003 onwards, the dismantling of the EUROCHEMIC pilot reprocessing plant and the former waste management site of SCK•CEN is financed by a levy on the electricity consumption.

The other SCK•CEN facilities which existed before 1989 are still financed by the state. In practical terms, it is for ONDRAF to manage these projects, executed by BELGOPROCESS in the first two, and by SCK•CEN for the latter facilities.

The cost of spent fuel management for the BR3 reactor is included in the decommissioning costs of the reactor and is the responsibility of the Belgian Government. The spent fuel of the BR2-reactor irradiated before 1989 belongs to the “nuclear liability programmes” and is the responsibility of the Belgian Government; while the spent fuel irradiated since 1989 is the responsibility of SCK•CEN.

4.4.3. Decommissioning strategy

Immediate decommissioning with green field end status was estimated to be the most expensive dismantling strategy and therefore chosen as a reference scenario for nuclear power plants in order to make sure that adequate financial resources will be available independent

from the future strategy choice of the operator. Consequently, immediate decommissioning has been selected for all on-going decommissioning projects.

4.4.4. Radioactive waste management

ONDRAF is responsible for the management of all radioactive waste in Belgium and, all radioactive waste has to be transferred from the producer or owner to ONDRAF. Upon transfer, the producer or owner pays to ONDRAF the amount which covers the future management costs. These provisions are managed by ONDRAF. The decommissioning waste management cost is included in the decommissioning cost estimate of the facility.

In 2000 a detailed assessment concluded that following decommissioning, about 319600 tons of material is expected to be unconditionally released, while 15500 tons (about 5% of the total) of radioactive waste will have to be disposed, 98% of which is expected to be low level and the rest as medium and high level radioactive waste. BELGOPROCESS, a subsidiary of ONDRAF, is responsible for the processing, conditioning and storage of all radioactive waste before a final repository becomes available.

Belgium is in the process of selecting a site for a low level waste repository, where most of the decommissioning waste can be deposited (status 2006). In the meantime the Belgian Government has decided to site the low level waste repository at Dessel. Furthermore, an extensive R&D programme is aimed at assessing the possibilities for a geological repository for medium, high level and long-lived waste. This programme is expected to result in a site selection, between 2010 and 2020, followed by a preliminary safety report to be submitted to the safety authorities by around 2025. Currently, a first authorisation will be requested for the construction of a disposal facility limited to non heating waste.

4.5. SWEDEN

4.5.1. Overview

Sweden's nuclear facilities are made up of 13 power reactors, 5 research reactors, a spent fuel store, a repository for short-lived waste, a fuel fabrication plant and several other related facilities. Three power reactors and both research reactors have already been shutdown. The two Barseback reactors which were closed down in 1999 and 2005 as part of Sweden's nuclear phase out policy.

The funds are set up as external segregated funds with considerable oversight especially with respect to fund investment[13]. Power reactor decommissioning costs must be accrued during the first 25 years of operation and are backed up by two guarantees relating to early closure and unforeseen waste management costs.

4.5.2. *Decommissioning funding*

The legal framework on decommissioning imposes the licence holder to pay a fee per delivered kWh of electricity to the Nuclear Waste Fund. The size of the fee is based on a 25-year earning period per reactor[14]. In practice, the fee, transferred quarterly, has in recent years been set at between 0.01 and 0.02 SEK/kWh.

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[13] A reformed legal framework will take effect as at January 1, 2008. The reformed system will be in full practice as at January 1, 2010, when the "Studsvik Act" will be fully incorporated.

[14] See note 14

The purpose of the Fund is to cover all expenses incurred for the safe handling and disposal of spent nuclear fuel, as well as dismantling nuclear facilities and disposing of the decommissioning waste. The Fund must also finance research and development carried out by the Swedish Nuclear Fuel and Waste Management Company (SKB) as well as the governmental costs.

Updated cost calculations, including decommissioning costs are to be carried out jointly by the operators and submitted to the Swedish Nuclear Power Inspectorate (SKI) for approval on an annual basis. Based on a proposal from SKI the Government decides on the fees. The withdrawals from the Fund are subject to decisions on disbursements by SKI after normal regulatory review.

The management of the Nuclear Waste Fund is the responsibility of a separate government agency, the Board of the Nuclear Waste Fund. The Fund is in principle administered as a number of individual funds corresponding to operators required to pay fees, but the funds are managed together.

The total cost estimates for managing all nuclear waste and for dismantling nuclear power plants in the future are approximately SEK 50 Billion (1997 price level). At the end of 2004, SEK 31.68 billion had been collected in the fund.

In addition to the fees paid to the Nuclear Waste Fund, the nuclear power utilities must provide two forms of guarantees. Guarantee I should cover the shortfall should a reactor be finally closed down before it has reached its earning period of 25 years. Guarantee II should cover contingencies if expenses for future nuclear waste management become higher than expected, if these expenses have to be met earlier than expected, or if the actual amount in the Fund is lower than was estimated. The sizes of these guarantees are €150 million and €1.5 billion, respectively.

The financing of the historical liabilities, e.g. older experimental facilities previously owned by the state, in particular the facilities at Studsvik, the Ågesta reactor and the uranium mine in Ranstad, are dealt with separately. The basic requirement imposes for all four nuclear power utilities equally to pay a fee to a dedicated fund proportional to the generated kWh of electricity until the Fund is built-up. The fee is reassessed each year and is currently SEK 0.0015 per kWh. The Board of the Nuclear Waste Fund administers this fund together with the Nuclear Waste Fund. By 2030, approximately €125M will have been collected.

4.5.3. *Decommissioning strategy*

The operator decides the decommissioning strategy but it is subject to the regulatory authorities' approval. No binding time limits for decommissioning is set in the current Swedish legislation and operating licenses for nuclear facilities. Storage facilities for decommissioning waste must however be available before dismantling of the facilities can take place. The standpoint of the regulating authorities (the SKI and the SSI) from a safety and a radiation protection view is that a decommissioned power reactor should be dismantled, demolished and the site cleared for unrestricted use in a timeframe of about 5 – 15 years, provided that storage facilities for the waste are available.

4.5.4. Radioactive waste management

The Swedish policy is that radioactive waste that has arisen in Sweden should be managed and disposed of in Sweden. There is so far no repository licensed for decommissioning waste. Shallow land burials are licensed only for short-lived very low level waste. There are plans to

re-license the repository for short-lived low and intermediate level operational waste to allow for disposal also of short-lived decommissioning waste in an extension to the existing facility. There is no disposal facility licensed for long-lived low and intermediate level radioactive waste. According to current plans, a repository for long-lived low and intermediate level waste will be sited in about 2035.

4.6. BULGARIA

4.6.1. Overview

Bulgaria did not respond very positively to the requests for information made in the course of the Commission studies.

Bulgaria has four VVER 440 and two VVER 1000 nuclear reactors at the Kozloduy plant. A decision was taken in 2006 to construct two new reactors on Belene site. Spent fuel is currently shipped back to the Russian federation and there are plans to construct a national repository for low and intermediate level waste.

Kozloduy Units 1 - 4 are first generation Soviet design reactors, on which the Commission's position has remained consistent and in line with the G7 multilateral programme of action adopted at the Munich G7 summit in 1992; these first generation reactors of Soviet design should be closed. The first two reactors were closed in 2002 and Units 3 and 4 in 2006 in line with Bulgaria's commitment under the Treaty of Accession. In order to help alleviate the consequences of early closure of these 4 units considerable Community assistance is being made available which will see a total of €550 million provided to Bulgaria by 2009.

Segregated external funds were created in 1999 to cover decommissioning and waste liabilities. The main source of funding is from a levy of the electricity price which, following a revision of the decommissioning estimate was decreased in the beginning of 2007 from 15% to 7.5%.

4.6.2. Decommissioning strategy

The basic document of the decommissioning of Kozloduy Unit 1 – 4 was developed under Phare programme, and completed in November 2001 representing a "Deferred Dismantling" concept. The concept was revised and the approach of the Updated Decommissioning Strategy for units 1-4, approved in June 2006, is immediate staged dismantling, the so called "Continuous Dismantling".

4.6.3. Radioactive waste management

The Bulgarian policy of Management of RAW includes:

Procurement of equipment for treatment of specific RAW - spent ion exchange resins, solidified phase from evaporator concentrate tanks etc.

Optimization of waste conditioning and packaging;

Preparation of facilities for temporary storage of dismantling equipment and other RAW generated during decommissioning;

Treatment and removal of RAW from operation of units;

Commissioning of national disposal facility.

4.7. SLOVENIA

4.7.1. Overview

The nuclear power plant at Krško represents the major nuclear liability on the territory of Slovenia. The plant is co-owned by Slovenian and the Croat states, which share equally the plant's benefits and liabilities. The nuclear power plant has an operational licence until 2023, with investigations are foreseen on a possible life-time extension of 20 years.

Croatia has joint responsibility with Slovenia for the decommissioning and waste management liabilities relating to the Krsko NPP. In 2003, the governments of Slovenia and Croatia concluded an agreement on decommissioning of the Krsko NPP. In this agreement, both countries agreed on:

- assuring funds for decommissioning financing in equal shares,
- developing a new decommissioning plan, which was finally completed in 2005 determining the decommissioning strategy based on scenario analysis, costs and timetable for decommissioning, and
- requiring each country to establish its own fund for the management and collection of financial resources for its share of decommissioning.

For its part, Slovenia has been contributing to a dedicated external fund since 1996 which currently (as of 31 December 2007) stands at approximately €145 million being based upon a total liabilities estimate of €1200 million (undiscounted).

Croatia has adopted implementing legislation related to the provision of funds for covering Croatia's liabilities concerning the decommissioning of the Krško Nuclear Power Plant, including the disposal of radioactive waste and spent nuclear fuel.

In addition, Slovenia has a research reactor, a waste storage and Uranium mine.

4.7.2. *Decommissioning funding*

A dedicated agreement, concluded between the two states in 2003, sets out the basic principles for the decommissioning funding and waste management aspects: both countries have the obligation to grant half of the funds for the financing of all activities related to decommissioning and radioactive waste disposal.

The financial resources for the decommissioning and disposal of all radioactive waste must be available before the end of the nuclear power plant's operation. An external fund, a legal entity managed by a dedicated agency, was established in Slovenia to gather these resources and to ensure their availability when needed. The operator contributes monthly to the Fund a levy on the produced electricity (0.3 eurocent per kWh). The levy is periodically reassessed. Both the decommissioning plan and the spent nuclear fuel and radioactive waste management plan shall be updated and revised every 5 years.

The total cost of decommissioning is estimated at €1.2 billion. The Slovenian fund amounted to €145 Million at the end of 2007.

4.7.3. *Decommissioning strategy*

Immediate decommissioning is the preferred strategy in order to exploit to the maximum the experience of the personnel, economical factors and political aspects. The dismantling of the plant is expected to be finalised by 2037 with "green field" as the end point.

4.7.4. Radioactive waste management

It is assumed that all low and interim level radioactive waste will be disposed of in a near-surface repository, expected to become available before the start of decommissioning activities. The site selection, a responsibility of the Agency for Radioactive Waste Management to be determined by 2008, is in its final stage. The site is expected to be brought into operation by 2013.

In the long term, a decision will be made either to construct a final repository (operation expected to start in 2030) or to export spent fuel.

4.8. GERMANY

4.8.1. Overview

Germany has a significant nuclear industry consisting of:

- 34 commercial nuclear power plants of which are 17 in operation, 2 in safe enclosure and 15 in the process of decommissioning
- 6 prototype reactors (demonstration plants) of which 4 are in the process of decommissioning and 2 are already fully dismantled
- 46 research reactors of which are 12 in operation, 3 in safe enclosure, 8 in the process of decommissioning and 23 already fully dismantled
- 38 other nuclear facilities of which are 12 in operation, 9 in the process of decommissioning and 17 already fully dismantled.

According to the German Atomic Energy Act (AtG), statutory ordinances promulgated on the basis of the AtG, as well as general administrative provisions, and following the 'Polluter Pays Principle', the licensees are responsible for any decommissioning activities, are free to decide on the decommissioning strategy they would like to follow, and have to bear the respective costs. On the corporate group level, the corporate groups to which the private operators belong set up provisions according to international accounting standards (US-GAAP, IAS/IFRS). There are no restrictions with regard to the investment of these internal funds.

Germany has considerable experience of nuclear decommissioning, its operators have built up considerable funds for the financing of such operations and, have demonstrated a preference for immediate decommissioning strategy.

4.8.2. Decommissioning funding

The way funds are set aside for financing decommissioning activities differs between purely publicly-owned nuclear installations, nuclear installations with mixed ownership, and nuclear installations belonging to private companies (nuclear power plants, fuel cycle facilities, etc.):

- In general, decommissioning of publicly owned nuclear facilities is financed from the current budget. There are no provisions made for future payments. For most projects, the Federal Government covers the bulk of the costs. For some projects, part of the costs is covered by the State Governments ("Länder"). Furthermore, there are the ITU European Commission JRC research facilities in Karlsruhe, financed from the current budget of the European Union.

- For facilities with mixed ownership, special arrangements are required to clarify the proportion of the costs to be borne by the public and that by the private organisations.

- The private owners of nuclear facilities build up internal non-segregated funds according to German commercial law based on their liabilities according to the Atomic Energy Act. On the corporate group level, international accounting standards are applied (IAS/IFRS; US-GAAP).

The obligation to set up provisions (internal, unrestricted decommissioning funds) starts with the beginning of operation, but not the complete amount is required at this time. According to German tax law, decommissioning provisions for nuclear reactors in German tax balance sheets have to be set up as follows:

- Provisions for spent fuel management are allocated according to their burn-up over the period they are used in the reactor (about 4-5 years). Discounting takes place in a layered procedure over five years, which probably means that the time the spent fuel is placed in the spent fuel storage bay will be added to the burn-up period (i.e. over 9 - 10 years in total).

- Provisions for the management of the core are allocated over the first 19 years of operation (the change in German tax law in 1999/2000/2002 did not affect the length of this allocation period).

- As long as the final shut down of a nuclear facility is not exactly determined, provisions for dismantling, decontamination and demolition have to be accumulated in equal instalments over the first 25 years of operation (19 years before 1999).

- Since 1999, provisions for additional costs of manufacturing Mixed Oxide Fuel (MOX) are no longer permitted, as well as any additional costs with regard to the management of remaining fissile materials in case they are not used for MOX production.

- Provisions for management of radioactive waste from operation are made according to the waste generated.

- Claims of future interest on advance payments for a final disposal site have to be balanced with the liability which says that operators have to contribute to financing costs of a final disposal site.

- Since 1999, provisions for nuclear decommissioning have to be discounted by a nominal discount rate of 5.5%. However, the discounting period is limited to the period during which the provisions are accumulated. In contrast to IAS/IFRS, the discounting period does not cover the whole time between generation of the kWh which causes the liability and start of the respective decommissioning activity.

- For changes in the size of decommissioning provisions caused by the new German tax law in 1999, a ten years transition period has been granted.

The net provisions given in 2005 commercial balance sheets total about €30 billion and this provides for a recognised major source of internal finance. The cost estimates on which the provisions are regularly checked by state ministries (in particular tax authority) however, there are only limited possibilities to confirm the technical basis on which assessments are made. Investments are made such there will be sufficient fund liquidity when needed however, there is no direct link made between provisions and liabilities.

4.8.3. Decommissioning strategy

Germany has considerable experience in dismantling of nuclear power plants and other nuclear installations. Operators are responsible for the choice of the decommissioning strategy taking radiation protection, employment/knowledge and financial aspects into account. In the past, after having removed all spent fuel, for several nuclear facilities the 'safe enclosure' option was chosen, while for other plants, direct dismantling was preferred. From the perspective of the Federal Ministry for Environment as the supervising authority, the main factors influencing strategy selection provide arguments in favour of an immediate dismantling strategy.

4.8.4. Radioactive waste management

The German policy is aiming at minimising (radioactive) waste and at recycling and reuse of materials. In this context, the release of materials, buildings and sites from nuclear regulatory control is of high importance. The German Radiation Protection Ordinance, as amended on August 01, 2001, includes a comprehensive and consistent set of quantitative and radionuclide specific data for the release of materials, buildings and sites from nuclear regulatory control. This is a profound basis for terminating such controls. In practice, the implementation of such an approach requires a great number of measurements, in particular by the operator, in order to demonstrate compliance with legal requirements.

As there is no repository (neither for radioactive wastes nor for spent fuel and heat generating waste) available in Germany, clearance also helps to avoid the use of valuable space for interim storage for material not requiring treatment as radioactive waste. Although the costs for performing clearance are not negligible – the costs for decontamination and preparation of the material as well as for performing the clearance and control measurements etc. – the costs for treating this material as radioactive waste and bringing it to final disposal would be considerably higher.

Since July 1, 2005, the Atomic Energy Act forbids transport of spent fuel elements from power reactors to reprocessing (this does not affect spent fuel from research reactors). Prior to this date, reprocessing was an option used by many NPPs in Germany. Furthermore, the shipment of spent fuel to the existing centralized interim storage facilities is also no longer legally viable. Therefore, interim storage facilities for spent fuel have been constructed during the last few years at the NPP sites in Germany.

4.9. CZECH REPUBLIC

4.9.1. Overview

The Czech Republic operates six pressurized water reactor units, four VVER-440/213 reactor units at Dukovany and two VVER-1000/320 reactors at Temelín. Taking into account

anticipated lifetime extensions, the expected shutdown dates for these units are between 2025-2028 and 2042-2043 respectively. There are also three operating research reactors, two interim storage facilities for dry spent-fuel storage for the commercial NPPs and one storage facility for the research reactors spent fuel, and three LLW/ILW repositories in use.

In addition to the remedial efforts for the environmental legacies from closed and operating uranium mining sites, the decommissioning of the commercial NPPs sites will constitute the bulk of decommissioning effort and expense. Separate funds are set up for decommissioning and waste management. The former being an internally managed block account and the latter an external fund managed by the Ministry of Finance.

4.9.2. Decommissioning funding

All private utilities are obliged to collect financial means for decommissioning purposes. The license holder bears full responsibility for the costs of decommissioning and management of waste arising. The license holder is therefore obliged to create reserves for the preparation and actual decommissioning of its nuclear installation(s). This obligation is not applied to organisational units of the state, state-subsidised organisations, public universities and their organisational bodies as well as organisations established by territorial self-governing units.

The amount of these reserves shall be established based on the decommissioning strategy approved by the State Office for Nuclear Safety, and gathered in a dedicated and "blocked" bank account. While this bank account is maintained by the licensee, payments can be effectuated solely for decommissioning purposes, subject to the approval of the Radioactive Waste Repository Authority. The latter monitors the account and verifies the decommissioning cost estimate on the basis of both publicly available information and expert estimates. The decommissioning plan and the relevant cost estimate of nuclear installation or workplace shall be updated at least every 5 years.

As of 31.12.2005 decommissioning cost estimates cover the technical decommissioning amounted to €580 million for NPPs Dukovany 1-4, and €480 million for Temelin 1-2. Liabilities resulting from spent-fuel management (e.g., costs for on-site interim storage) and all costs related to final nuclear waste disposal are not covered by these estimates. Estimated decommissioning costs are based on undiscounted decommissioning cost estimates which must be updated every five years.

The cost for the disposal of all spent fuel and high level waste is borne by the waste producers via their contributions to the so-called Nuclear Account, a dedicated external fund held at the Czech National Bank and managed by the Ministry of Finance.

The contribution of nuclear power plants to the Nuclear Account is based on their electricity production at the rate of 1.8 €/MWe. Small producers pay when their waste is accepted for disposal. The Radioactive Waste Repository Authority monitors the adequacy of the reserve and approves any withdrawal. The total cost of waste disposal is estimated at €1570 million (2003). At present, €193 million (2004) is available.

4.9.3. Decommissioning strategy

The adopted decommissioning strategy for both nuclear power plant sites involves a 35-50 year safe enclosure period following spent fuel removal and facility preparation (deferred decommissioning). The installation is then decommissioned over a ten year period and a green field state is not a requirement. The timescale for research reactor decommissioning is more rapid but subject to optimisation for economic reasons.

4.9.4. Radioactive waste management

The waste resulting from the decommissioning process will be processed by standard technologies, which are presently available and which are/will be used in the Dukovany nuclear power plant and the Temelin nuclear power plant.

Radioactive waste repositories are available for the nuclear power plants' operational waste and for the decommissioning waste (in Dukovany). The total disposal capacity of the repository is 55 000 m^3. It is expected that 4764 m^3 of radioactive waste will be produced by the Dukovany nuclear power plant and 10686 m^3 by the Temelin nuclear power plant.

The decommissioning waste that does not meet the waste acceptance criteria is planned to be disposed of in a deep geological repository. The same applies for decommissioning waste from other nuclear installations or workplaces. Investigations are on-going to select an appropriate site for a deep geological repository, expected to become operational by 2065.

4.10. FINLAND

4.10.1. Overview

Finland has four existing reactors, two boiling water reactors at Olkiluoto, operated by TVO and two pressurised water reactors at Loviisa, operated by Fortum Power and Heat. In May 2002, the Finnish parliament voted in favour of building a fifth nuclear power plant to be constructed at Olkiluoto site. The chosen reactor type is the European Pressurised Water reactor, expected to become operational in 2009 with a design operating lifetime of around 60 years.

4.10.2. Decommissioning funding

According to the Nuclear Energy Act the licence holder has an obligation to take responsibility for all nuclear waste management measures and their appropriate preparation (including decommissioning costs), and shall cover all the related expenses. This is done by gathering adequate funds for future investments in the Finnish State Nuclear Waste Management Fund, which is independent of the State budget but controlled by the Ministry of Trade and Industry. The Fund collects, holds and invests in a secure way the accumulated financial resources.

The Fund's capital consists of the contributions determined by the Ministry of Trade and Industry and paid mainly by the two nuclear power companies. The contributors are entitled to borrow money from the Fund against securities. These loans may not exceed 75% of the confirmed fund holding of the loan-taker at a time. Furthermore, the state has a right to borrow the sum not borrowed by the contributors. The remaining funds are invested.

Dismantling costs must be financed during the first 25 years of plant operation. In 2004 the State Nuclear Waste Management Fund amounted to about €1365.9 million, adequate to cover all future nuclear liabilities, including the disposal of the current amount of waste. However, the collection of assets will continue in order to cover the liabilities related to additional accumulation of spent fuel. At each moment, the amount of liabilities which is not yet covered by the fund has to be covered by securities supplied by the licensees.

Fortum and TVO are obliged to update their decommissioning plans every five years in order to ensure that decommissioning can be appropriately performed when needed and that the decommissioning cost estimates are realistic. The last updates were published at the end of

2003. In addition, the licensees have to draw up annually a provisional cost assessment for the liabilities until the end of the current year to be reviewed by the Ministry. The sum corresponding to those costs shall be evaluated in nominal terms following the current cost level, without discounting.

On top of the assessed liability, gathering contingencies of at least 10% is legally required. In practice, Fortum and TVO use 10% and 15% contingencies, respectively. On top of the legally required contingencies, the operators add to all cost estimates for unspecified costs and contingencies typically additional 10-20%.

4.10.3. Decommissioning strategy

Immediate dismantling has been selected for the Loviisa nuclear power plant, while a 30 year safe storage period is envisaged for the Olkiluoto nuclear power plant.

4.10.4. Radioactive waste management

The existing repositories for operational low and intermediate level waste, located in the crystalline bedrock at the sites of the nuclear power plants, will be extended to accommodate the waste from decommissioning.

It is expected that the Olkiluoto nuclear power plant will produce 10830 tons or 26600 m^3 of radioactive waste, with that for the Loviisa nuclear power plant being 9720 tons or 16000 m^3.

Studies are ongoing on the technical feasibility of disposing of the decommissioning wastes from the TRIGA Mark II research reactor in one of the repositories at the sites of the nuclear power plants.

The construction of a final repository is also subject to in-depth analysis.

4.11. SPAIN

4.11.1. Overview

Spain has 8 operating power reactors, two shutdown commercial reactors (one in safe enclosure), a fuel fabrication plant, a research reactor under dismantling, an intermediate storage facility for SNF and several uranium mines none of them being operational. The Spanish Radioactive Waste Management Organisation (ENRESA), a state company set up in 1984, is responsible for spent fuel, radioactive waste management and decommissioning activities.

4.11.2. Decommissioning funding

A royal decree on the ordering of fuel cycle activities requires the conclusion of contracts between ENRESA and the companies owning nuclear power plants and other facilities used for the manufacturing of concentrates of uranium and nuclear fuels. The major objective of these contracts is to establish the necessary means with regards to the collection of the financial resources for decommissioning during the operating life time of the installations.

The royal decree was revised in 2003 with the objective to apply the polluter pays principle in a more direct manner. Whereas prior to its introduction a general fee was applied to all electricity producers, since 2004 a more complex system is applied where nuclear utilities bear the bulk of the expenses.

These amounts are allocated to the build up a fund, managed by ENRESA. According to the corresponding royal decrees, the revenues transferred to the fund arise from:

a) The amounts collected via the supply and access tariffs proportional to electricity sales. The applied percentages are set, since 2008 by a Ministerial Order establishing the electricity tariff for each year.

b) Billing to the licensees of the nuclear power plants a certain amount, which results from multiplying the gross kilowatt-hours generated by each plant in each calendar month by a unit value specific to each plant, to be revised annually and established by a royal decree.

c) The amounts collected for the management of radioactive wastes arising from the manufacturing of fuel assemblies and for the dismantling of the facilities at which such fuel assemblies are manufactured. A mechanism is established for annual contributions to be made throughout the operating lifetime of the fuel assembly manufacturing facilities, such that these revenues plus the corresponding financial yields cover the costs foreseen for these activities in the so-called General Radioactive Waste Plan (GRWP).

d) Billing to the operators of radioactive facilities generating radioactive wastes and involved in medicine, industry, agriculture and research, via tariffs approved by the Ministry of Industry, Tourism and Trade.

e) Any other revenue collection method not contemplated in the previous paragraphs.

The financial management of the fund by ENRESA, currently in force, is governed by the principles of security, profitability and liquidity. The total amount shall cover the costs related to the activities contemplated in the GRWP. For nuclear power plants, a 40 years service lifetime is assumed in the calculation. The average value of the yearly incomes estimated to finance the future costs of decommissioning and end fuel cycle burdens represents around €4.5/MWh of nuclear origin (2007 value). Every six months ENRESA has to produce a report on the state of the fund.

The GRWP includes activities regarding the management of radioactive waste, spent fuel as well as dismantling and decommissioning of both nuclear facilities and as a result of the uranium mining and milling activities performed prior to 1984. The GRWP is revised every four years or upon request of the Ministry of Industry, Tourism and Trade. Besides, during the first six months of every year, ENRESA draws up an updated economic-financial study of the costs of the activities contemplated in the GRWP. Furthermore each year a technical-economic assessment is submitted to justify the suitability of the annual budget for the next financial year and to provide forecasts for the next three years, with respect to the provisions of the updated economic-financial study of the costs.

Total decommissioning and waste management costs are estimated at €14 billion (2007 value), including disposal. The dismantling of nuclear power plants is estimated at €2.5 billion (20007 value). The total amount of money collected in the fund as of 31st December, 2007 was €2.13 billion.

4.11.3. Decommissioning strategy

The selected strategy for NPPs is of immediate dismantling except for the Vandellós I nuclear power plant, which is already decommissioned to stage 2 in the beginning of 2003 and due to remain in safe enclosure for 25 years. The immediate decommissioning strategy is to be

initiated three years after definitive shutdown and following removal of the spent fuel. The end-point of decommissioning is the free release of the site, e.g. “green field”.

CIEMAT nuclear facilities are under decommissioning.

4.11.4. Radioactive waste management

The handling, storage and disposal of radioactive waste are responsibility of ENRESA, the Spanish radioactive waste management agency. The radioactive waste management services rendered by ENRESA to the operators of nuclear and radioactive facilities are governed by contracts based on corresponding type-contracts. Once the radioactive waste is removed from the facilities ENRESA becomes the owner and is legally responsible.

In accordance with the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management the seven nuclear power plant sites in Spain are also radioactive waste management facilities. To assure the temporary storage of spent fuel until definitive solutions become available the following strategies are applied in Spain. Firstly, re-racking can take maximum advantage of the existing space in the pools. Secondly, if necessary, the spent fuel storage capacity can be extended by dry storage technologies. This strategy was applied in the case of the Trillo plant, and provisionally in José Cabrera NPP until a Centralised Interim Storage Facility is in operation.

The Second Spanish National Report for the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management presents the waste conditioning and storage facilities at the various sites.

The nuclear power plant management facilities consist of treatment plants for liquid wastes, based on desiccation or immobilisation in cement, and other installations for the conditioning of solid wastes by compacting or immobilisation in cement. The temporary storage facilities at the different plants are used as an intermediate step prior to the transport of the wastes to the El Cabril low and intermediate level waste disposal centre.

The plant Vandellós I has an installation prepared in the reactor building pit for the temporary storage of low and intermediate level wastes generated during the dismantling process as a specific intermediate solution for the inventory of wastes that cannot be managed at the El Cabril facility.

The Juzbado fuel manufacturing facility has installations similar to those of the nuclear power plants, consisting of a treatment plant for liquid wastes, based on desiccation and immobilisation in cement, and other installations for the pre-conditioning of solid wastes by pre-compacting or their final conditioning by immobilisation in cement. As in the case of the nuclear power plants, the temporary storage facility is used as an intermediate step prior to the transport of the wastes to the El Cabril low and intermediate level waste disposal centre.

The CIEMAT processing and temporary storage installations IR-17 is authorised as a 2nd category radioactive facility and consists of three buildings: the conditioning sheds building (CIEMAT Building 33), the package store (Building 40) and the packaging and components manufacturing workshop (Building 41).

In accordance with its operating permit, the IR-17 facility may be used for the conditioning of low and intermediate level solid wastes produced by CIEMAT or managed by ENRESA. The permit also establishes that the materials that may be handled or stored are solid wastes belonging to IAEA categories 1 and 2 and encapsulated sources of categories 1, 2 and 3

(whose surface dose rate does not exceed 1Sv/h for maximum energies of 1.33 MeV) and 4. The facility may also receive and store sources of Ra-226 taken over by the Directorate General of Energy Policy and Mines of the MITYC.

The facility is also equipped with the systems required for the disassembly of radioactive lightning rod for subsequent conditioning. The CIEMAT also treats and conditions the secondary wastes arising from research activities carried out at the centre, relating mainly to radioactive waste characterisation methodology developments.

The disposal facility El Cabril can store low and intermediate-level waste. Recently, a disposal facility for very low-level waste has been added, reducing the storage costs. The El Cabril centre has solid and liquid waste treatment and conditioning systems, including an incinerator and a compactor. These systems are used to suitably treat and condition all the wastes from the minor producers, as well as those generated at the facility itself, prior to their being introduced in the cells. It also possesses the systems required for the final conditioning of wastes from nuclear facilities, prior to their disposal in the cells. There are two sets of installations used for the temporary storage of solid waste and installations for definitive disposal."

The future construction of a centralised interim storage facility for SF/HLW is envisaged and scheduled for 2012.

4.12. UNITED KINGDOM

4.12.1. Overview

In the United Kingdom there are three main nuclear operators, British Energy (BE), British Nuclear Fuel (BNFL), and the UK Atomic Energy Authority (UKAEA). BE is a private company while BNFL and UKAEA belong to the public sector. The UK's decommissioning plans are advanced and probably better documented than elsewhere in Europe, mainly because UK was a pioneer in nuclear power and already has many retired nuclear facilities that need to be decommissioned. The UK government's Nuclear Decommissioning Authority (NDA) was set up in 2005 to take over the sites previously owned by BNFL and the UKAEA and is expected to manage the decommissioning of British Energy's sites.

The total cost of decommissioning Britain's civil nuclear facilities is currently estimated to be in excess of €100 billion, although it is widely expected that this figure will rise. The cost estimates are dominated by two sites, Dounreay and Sellafield, which account for about 75 per cent of the total liability.

Due to its operational independence, the NDA is considered a useful model for other countries for managing decommissioning once the facilities have been closed. However, the funding mechanisms that resulted in identifiable funds representing only 1 percent of current liabilities needs to be carefully addressed in order to avoid possible repetitions. In addition, the funding arrangements for NDA give cause for concern in that the government share (currently 50%) is based upon a short term commitment period which can be argued as inappropriate for long term decommissioning planning.

4.12.2. Decommissioning funding

The NDA has contributed to transparency by publishing a vast amount of useful and accessible material on its decommissioning plans and the estimated costs through the

'Lifecycle Baselines' it drafts for each of its main facilities. A similar remark cannot be made for the government underwritten BE fund.

There have been a number of major changes in the way decommissioning provisions for the civil nuclear power plants have been collected. Provisions were initially set up as internal unsegregated provisions however these were not passed on to successor companies. A consumer subsidy was introduced in the 1990s – Fossil Fuel Levy (FFL) – in order to finance inter-alia, decommissioning costs. The absence of any segregated fund, and the creation of NDA has seen the main part of this subsidy used by the government for purposes other than nuclear decommissioning.

BE operates the AGR reactors and Sizewell B. Approximately €350 million of the FFL was passed on to BE and placed in a segregated fund which did not address stage 1 decommissioning. This and the very long deferral periods mean BE was required to only provide relatively small discounted contributions. Subsequently, under the EC approved restructuring package, the former fund was subsumed within the new Nuclear Liabilities Fund (NLF). BE makes periodic contributions into the NFL, aimed at covering all stages of decommissioning and uncontracted liabilities. While BE is making an effort to cover the decommissioning costs of its power stations, there can be no guarantee the assets in the segregated fund will be sufficient. Therefore, the fund is underwritten by the UK Government to ensure safety and environmental protection. Nevertheless, the Government can initiate at specific intervals, the first of which is 2015, a 'Fund Review' if it believes the assets of the Fund will outstrip the liabilities by 125%. If the Review confirms that position, the Government has a right to extract the excess funds from the NLF.

BE's nuclear liabilities are estimated in the companies accounts for the year ending 31st March 2003 at €1.5 billion for decommissioning, €5 billion for Contracted Spent Fuel Liabilities and €1.5 billion for uncontracted Spent Fuel Liabilities. BE is also responsible for future (post Jan 2005) spent fuel liabilities. Under the EC approved restructuring plan, BE contributes to the NLF in the following ways: a fixed contributions of €35 million per annum; €412 million of new bonds; €225,000 per tonne/uranium of fuel loaded into Sizewell B reactor; and 65 % of BE's free cash flow. The value of the segregated fund as set out in 2004 annual accounts was €660 million.

4.12.3. Decommissioning strategy

By international standards, UK timescales for decommissioning are long: completion of final clearance for nuclear power plants is not expected until up to 130 years after plant closure. NDA had expressed an aspiration to speed up the decommissioning of Magnox stations, subject to a business case but work on this has had to be postponed because of the pressing need to prioritise funding on dealing with high hazard facilities first. While the NDA has a supervisory role over plans to decommission British Energy's plants, it is not clear whether it is able to require British Energy to reduce the timescales for its plants, which on current plans assume site clearance is not complete until nearly 100 years after plant closure.

4.12.4. Radioactive waste management

During October 2006 the UK Government accepted, as recommended by the independent Committee on Radioactive Waste Management (CoRWM), that geological disposal coupled with safe and secure interim storage is the way forward for the long-term management of the UK's higher activity radioactive wastes. The UK Government also confirmed it is supportive of exploring an approach based on voluntarism and partnership with local communities.

The Nuclear Decommissioning Authority (NDA) was given responsibility for the delivery and implementation of geological disposal. There is now a single point of responsibility and accountability, providing the UK with a strategic view across the radioactive waste management chain.

As part of the Government's Managing Radioactive Waste Safely (MRWS) Programme, Government launched a consultation on 25 June 2007 outlining an implementation framework for geological disposal. The consultation closed on 2 November 2007 and the UK Government expects to make a policy statement during the first half of 2008.

In conjunction with this the UK Government issued a policy statement in early 2007 on the management of low level radioactive waste. The NDA was given responsibility for developing a UK wide nuclear industry LLW management strategy, as well as supporting the UK Government in developing a UK non nuclear LLW strategy. The policy review which preceded this statement was the subject of two national stakeholder workshops in 2005 and a full public consultation exercise during the course of 2006. Currently the Low Level Waste Repository near Drigg in West Cumbria remains the primary site for the disposal of LLW in the UK.

4.13. ROMANIA

4.13.1. Overview

Romania operates a PHWR plant in Cernavoda site, with one unit in operation since 1996 and a second unit in commercial operation since September 2007. Romania has also 1 operational TRIGA research reactor in Pitesti and 1 shutdown VVR-S research reactor in Bucharest.

A national agency - ANDRAD - was established in 2004 entrusted to coordinate the safe management of spent nuclear fuel and radioactive waste at national level, including the final disposal. The ANDRAD's role and responsibilities were reinforced through the Government Ordinance 11/2003 modified and up-dated by the Law 26/2007 stating that ANDRAD is responsible for disposal of radioactive waste and the coordination of the safe management of spent nuclear fuel and radioactive waste at national level. ANDRAD elaborates in collaboration with waste producers the National Strategy on medium and long term for spent fuel and radioactive waste management. The holder of a nuclear license is responsible for the decommissioning of the nuclear installations and for the management of radioactive waste till disposal. By law, the nuclear license holder can transfer the responsibility of the decommissioning, after final shutdown of a nuclear installation, to ANDRAD.

According to the nuclear Law 111/1996 modified and republished, the nuclear license holder is responsible to prepare a decommissioning program and send it for approval to CNCAN (the Romanian Nuclear Regulatory Body). By Law 26/2007, ANDRAD issues its opinion on the decommissioning plans and cost estimations issued by the nuclear license holder.

Safety provisions for the decommissioning of nuclear installations, except the decommissioning of NPP, are set in the "Norms on the Decommissioning of Nuclear Facilities". The decommissioning of NPP is subject of a case by case approach following any specific application of the nuclear license holder.

4.13.2. Decommissioning funding

By nuclear law provisions, the nuclear license holder pays the contribution to the decommissioning fund and has to ensure that appropriate material and financial arrangements are in place for decommissioning, by the time they are needed.

The GO 11/2003, modified and republished in 2007, stipulates the creation of the financial resources for radioactive waste management and decommissioning of the nuclear installations and establishes obligation for each radioactive waste producer to make annual contributions to those funds. The amounts of the annual contributions are proposed by the Ministry of Economy and Finances and approved by a Governmental Decision. The Government decision shall be reviewed at least once in 5 years.

ANDRAD will monitor the adequacy of the financial resources for decommissioning. The agency is responsible for the management of the national created funds for radioactive waste and spent fuel management and decommissioning of the nuclear power units.

In 2007, was issued the Governmental Decision no. 1080/2007 regarding the set up and management of finance resources necessary for the safe management of radioactive waste and decommissioning of nuclear and radiological installations. The Governmental Decision stipulates the creation of two segregated funds with the following destinations: one for spent fuel and radioactive waste disposal and the second one for the decommissioning of the nuclear units. Both funds will be administrated by ANDRAD. Currently, a proposal for a Government decision is prepared for establishing the amount and the provisions for the management and use of both funds that will make it similar to existing ones in other EU member states. The amount of the contribution shall be revised at maximum 5 years.

Preliminary estimations indicate that liabilities of Cernavoda NPP are at level of 3,900 M€ that include costs for a LILW near surface repository and a geological repository and 320 M€ for each nuclear power unit. The payment for the decommissioning of the research reactors will be done by the Government.

4.13.3. Decommissioning strategy

Currently, Cernavoda NPP has considered the deferred decommissioning strategy.

4.13.4. Radioactive waste management

The current National strategy on radioactive waste management was issued in 2004 and it would be revised at least once in five years. By Law 57/2006, that strategy is a component of the National Nuclear Strategy which is approved by Governmental decision.

According to the current national strategy on radioactive waste management, a disposal facility for LLW with certain limited quantities of long lived radio nuclides generated by the operation and decommissioning of the NPP should be commissioned in 2014. A sitting process has been developed since ‘90s and a selected site located in the exclusion zone of Cernavoda NPP has been under detailed characterization and confirmation stage within last years. Also, according to the strategy, the LLW radioactive wastes from decommissioning of the VVR-S research reactor are planned for disposal in Baita Bihor repository dedicated for institutional wastes. Storage facilities for spent fuel and different categories of radioactive wastes are available on Cernavoda NPP site and the research reactors’ sites.

Preliminary R&D studies were done in order to identify potential host rocks and sites for an underground repository. In 2007, ANDRAD has started coordinating a review of the past work in order to define the sitting program, which is in an early stage now.

4.14. HUNGARY

4.14.1. Overview

Hungary has four operational pressurised water reactor units in the Paks nuclear power plant along with an associated interim spent fuel store. The plant's design lifetime was 30 years. The national parliament approved in November 2005 a resolution on the preliminary approval in principle to initiate activities of preparing for the establishment of a radioactive waste repository for low and medium level radioactive waste at Bátaapáti, and was informed about the extention the operational life time of Paks nuclear power plant by 20 years. There are also two research reactors in Budapest.

The nuclear installations are all state owned and provide regular payments to a single segregated central fund managed by the Hungarian Atomic Energy Authority. The funding for the two research reactors will be paid into the fund by the government when required.

4.14.2. Decommissioning funding

The Central Nuclear Financial Fund (CNFF), a separate Treasury account made up of the contributions of the nuclear power plant operator, the waste producers and the State central budget, is liable for the costs arising after the shut-down of the plant, including decommissioning of nuclear facilities, interim storage and final disposal of spent fuel and final disposal of radioactive waste. CNFF is managed by the Hungarian Atomic Energy Authority (HAEA). The state is responsible for preserving the value of CNFF by making annual contributions with a sum that is calculated on the average assets of the Fund in the previous year using the average base interest rate of the central bank in the previous year.

The nuclear power plant at Paks is obliged to make annual contributions to the fund covering the total cost of waste and spent fuel management and decommissioning until the end of its operation. The payment is determined annually by the Public Agency for Radioactive Waste Management (PURAM) in discussion with the HAEA, the Hungarian Energy Office as well as a special committee of the CNFF, and approved by the Minister disposing over the Fund. Finally, as the research and training reactors are state-owned, the cost of their decommissioning will be paid into the CNFF by the state when the time comes.

In total, the decommissioning cost of the Paks nuclear power plant was estimated at €1.35 billion (2005). As for the management of radioactive waste, including the construction of a final repository, the cost is estimated at €1.09 billion (2005). At the end of 2004, CNFF had HUF 65.12 billion, i.e. €261 million.

4.14.3. Decommissioning strategy

PURAM is responsible for the decommissioning and waste management activities, including the preparation of the long term plans and related financial requirements. The plans, after supervision by the HAEA and the Hungarian Energy Office, are approved by the Minister supervising the HAEA.

The selected strategy is deferred dismantling with a safe enclosure period of 70 years. As a conservative assumption for cost estimation, the preliminary decommissioning plan –

actualised in 2002 – has been worked out for the "green field" option as the end point of decommissioning, while the "brown field" option might be later selected when a final choice is made on the end-status of the site. The decommissioning plan is up-dated every 5 years.

4.14.4. Radioactive waste management

Non-nuclear power plant waste arisings are disposed of in the existing radioactive waste treatment and disposal facility, operational since 1976. An interim spent fuel storage is also available for nuclear power plant waste.

On top of these, a project is on-going to construct a low and intermediate level waste repository at Bátaapáti for the operational and decommissioning waste of the nuclear power plant. A referendum held in July 2005 demonstrated the existence of a very high level of public acceptance at local level for this project. Its opening is expected for 2008.

Finally, a site for an underground repository is being assessed for the final disposal of high activity wastes and spent fuel.

4.15. NETHERLANDS

4.15.1. Overview

The Netherlands has one operational power reactor (Borssele) which has recently been subject to a lifetime extension to 2033. A second power reactor was shutdown in 1997 and is currently in safe enclosure. A URENCO enrichment facility is in operation at Almelo and the country contains several operational research reactors and waste storages.

The legal obligations regarding the setting up of decommissioning funds are in the process of change which should require operators to establish segregated funds for new constructions from commissioning. There are currently no specific obligations for private operators which has resulted in the creation of several internal non-segregated systems. With one exception no funds have been established for the countries research reactors.

4.15.2. Decommissioning funding

A specific legal requirement that ensures adequate decommissioning funds are available does not exist though there is a general understanding that the 'Polluter Pays Principle' applies. Consequently, and according to the accounting standards used in their balance sheets, the operators of NPPs and the URENCO plant have made financial provisions based upon levy on the electricity price for decommissioning (internal non-segregated funds). Provisions for the Dodewaard NPP are understood to equal the estimated value of remaining liabilities. Provisions set up for the Borssele NPP equal estimated discounted costs even though the strategy was changed recently to immediate decommissioning (due to the accompanying lifetime extension). There has been some discussion and proposals about changing the current decommissioning financing system but there is no decision with regard to existing plants. However, for new nuclear facilities to be built new conditions have been already set which will require segregated funds with discounted provisions from commissioning.

The decommissioning funds are held as internal provisions with no external control on use. Funding for waste management and final disposal are not covered by these provisions but instead the operators pay volumetric fees to Central Organisation for Radioactive Waste.

4.15.3. Decommissioning strategy

The strategy for the Borssele NPP was changed in 2005 to immediate decommissioning whereas, the shutdown Dodewaard plant remains in its safe enclosure period of 40 years. With the exception of the JRC site, information on strategy details for other nuclear installations is quite limited

4.15.4. Radioactive waste management

The Nuclear Energy Act stipulates that a licensee can dispose of waste only if disposal is specifically approved in a license, or by handing it over to the authorised waste management organisation. As such, the Central Organisation for Radioactive Waste, COVRA, is the only organisation authorised by the Government of the Netherlands. COVRA N.V. is a State owned company and is responsible for the treatment and storage of all kinds of radioactive waste (LLW, ILW, HLW, spent fuel). This comprises also the waste associated with dismantling of a nuclear facility. Storage takes place in a single location in the south-west of the country, for a period of at least 100 years. A centralised storage facility for HLW and SF, the HABOG facility (part of COVRA site), is available at Borssele.

The government policy on spent fuel management is that the decision on whether or not to reprocess spent fuel is in the first place a matter of the operators of the NPPs. The operators have decided in favour of reprocessing their spent fuel for economic reasons. This decision was endorsed by the government. The operator of the Borssele NPP has recently extended the contract with the reprocessing facility at la Hague, France. Similarly, the spent fuel from the NPP Dodewaard was shipped to reprocessing in the UK.

4.16. AUSTRIA

4.16.1. Overview

In 1978, the Austrian electorate decided in a referendum not to start the operation of the completed nuclear power plant in Zwentendorf. Subsequently, Austria's statute as a nuclear free country was enforced in the regulatory framework. At this time, Austria did have three research reactors: the ASTRA research reactor in Seibersdorf, a TRIGA Mark II research reactor in Vienna and a low power research reactor in Graz. By now, two of these three research reactors have been fully decommissioned. The only operational research reactor in Austria is the TRIGA reactor at the Atominstitut (Atomic Institute) in Vienna.

4.16.2. Decommissioning funding

The final shutdown of the TRIGA II reactor, operated by the Technical University of Vienna, is expected in 2016. The decommissioning costs will be paid by the Austrian state; the Federal Ministry of Finance has assumed liability for financing the decommissioning. It is envisaged to send back the spent fuel elements of this reactor to the United States for disposal in a final repository.

The decommissioning cost of the Graz research reactor is guaranteed jointly by the owners, i.e. a private research association, the federal government and the Province of Styria. Decommissioning activities are expected to be finalised by 2006.

Since the beginning of 2003, all holders of radioactive waste and orphan sources for disposal are obliged to make contributions to a fund for final disposal. Users have to pay this fee to NES. NES regularly transfers the collected fees to the Federal Ministry of Agriculture,

Forestry, Environment and Water Management, where this fund has been separately set up for the exclusive purpose of the later final disposal of the conditioned radioactive waste.

4.16.3. Radioactive waste management

The decommissioning of the ASTRA research reactor at the Austrian Research Centre Seibersdorf was completed in 2006. The decommissioning work could be performed in a very short time by the local experts. Only 80 tons of low and intermediate level radioactive waste resulted from decommissioning and has been treated, conditioned and interim stored at the Austrian waste management facility of NES (Nuclear Engineering Seibersdorf GmbH). The spent fuel has been shipped back to the United States in 2001.

The decommissioning of the 10 kW Siemens ARGONAUT reactor was completed in 2006, too. Due to the special use of the system (the reactor was driven at ultra low power levels < 1 W for training purposes), the radioactive inventory of the reactor was very low. Only 150 grams of radioactive waste rose from the decommissioning work. The fuel has been returned to the United States.

Regarding a facility for final disposal of radioactive waste in Austria, comprehensive studies have shown that the construction and operation of such a facility required a minimum amount of radioactive waste; otherwise the economic implications would be unacceptably high. It is not expected that this minimum amount is produced in countries without nuclear power plants. Austria is convinced that states operating nuclear power plants shall cooperate closely with non-nuclear-power countries to develop solutions to their problem of final disposal of radioactive waste – being in Austria's view a common European responsibility.

4.17. ITALY

4.17.1. Overview

In 1990 the governmental body - "Interministerial Committee for the Economical Planning" (CIPE) - in charge of the strategic decisions on nuclear power plants decided on the definitive closure of all nuclear plants. At the same time Italy's largest power company ENEL, was requested to commence planning for a deferred decommissioning strategy leading to the eventual unconditional release of the site. The decision was taken in 1999 to change the strategy to immediate dismantling with decommissioning activities completed - subject to the availability of a repository - by 2020.

In the context of privatisation and liberalisation, between 1999 and 2003, the liabilities of former ENEL, FN and ENEA facilities were transferred to the company SOGIN which in turn has been transferred 100% to the Italian Ministry of Treasury. While total decommissioning liability is estimated at approximately € 4 billion (2004 estimate) ENEL, thinking to the deferred strategy, has accumulated, during the plants opearation, provisions of €800 million prior to the re-organisation. Thus, considerable decommissioning costs are to be borne by the current generation through a levy on the price of electricity.

The only operating nuclear facilities today in Italy are research and waste management facilities – JRC facilities at Ispra are covered in a separate section. One pilot fuel fabrication facility has been already completely dismantled.

The decommissioning cost of the research reactors will be part of the normal public budget, based on the planning performed when the reactors are close to the shut down.

4.17.2. Decommissioning funding

During the operational period of the nuclear power plants, the nuclear operators had no legal obligation to accumulate assets for the decommissioning of their nuclear installations. ENEL nevertheless decided to gather funds during nuclear power plant operation. However, the early closure in (1978-1987) prevented the full collection of the necessary amount. ENEA has not accumulated any fund for the decommissioning of its nuclear fuel facilities.

A specific state-owned company, Sogin was created in 1999 in order to manage decommissioning planning and activities separately from the nuclear operators. At the same time, ENEL's nuclear assets and liabilities were transferred to Sogin. In 2003 FN and ENEA's liabilities were also transferred to Sogin.

The total decommissioning cost for all the nuclear facilities amounts to €4,029 million (estimate was made in 2004). The total liability does not include final disposal of high level waste and spent fuel, which are still uncertain as well as the date of the actual availability of a final disposal site.

The shortfall in gathered assets and the total necessary amount for safe decommissioning of nuclear liabilities is to be made by various economic conditions such as decommissioning strategy and management costs. A ministerial decree in January 2000 established an instrument for financing the cost of decommissioning by introducing a levy on the price of electricity paid from final users. The decree concerns those nuclear installations only, which were in one way or another involved in the production of electricity (for example: nuclear power plants, fuel fabrication facilities and reprocessing facilities). The levy is fixed by the National Authority for the Electricity and Gas on the basis of Sogin's program of activities, to be presented by every year. Between 2000 and 2004, €700 million was added to the decommissioning fund. The levy is transferred to a national fund for later transfer to Sogin in order to finance decommissioning costs. This national fund is maintained as an external segregated state fund. As with all such funds, the state can, for exceptional reason, use for public interest the available money while as well the total amount of the decommissioning fund and decommissioning activities are not modified.

Information on the Sogin fund utilization is well documented in its annual report covering annual contributions from the state fund.

4.17.3. Decommissioning strategy

In 1999, the original deferred decommissioning strategy was revised and a decision to move to immediate decommissioning made on basis of several considerations. Three main objectives were also set, namely to treat and condition all liquid and solid radioactive waste currently in on-site storage within a period of 10 years; also within 10 years, to select and construct a national repository for low and intermediate level wastes which can also be used as temporary storage for high level long lived wastes, in particular spent fuel and wastes resulting from reprocessing; and finally to start immediately the nuclear power plants' decommissioning and complete it by 2020. This deadline was postponed to 2024 with a new ministerial decree in 2004, allowing also the reprocessing strategy for spent fuel management. This solution was then adopted by Sogin in 2005. As a matter of fact, shipments of spent fuel to reprocessing abroad have started in 2007 and all Italian nuclear installations will have to be decommissioned by 2024 (Garigliano NPP by 2022, Caorso NPP by 2020, Latina NPP by 2024, Trino NPP by 2013, the EUREX and the ITREC pilot reprocessing facilities by 2024, the Casaccia pilot MOX fuel fabrication facility by 2020 and finally the FN fuel fabrication facility by 2009).

4.17.4. Radioactive waste management

In the absence of a national repository, most of the radioactive waste, including spent fuel, is at present stored in temporary facilities on the sites where they have been generated. A process for choosing the site for the national repository is on-going.

The present inventory of Italian radioactive waste can be summarised as follows (not including waste from ISPRA-JRC):

- Low and Intermediate Level Wastes:

- about 25,000 m^3, stored at the sites of origin, and mainly not conditioned;
- about 500 ton/year, annual generation;
- A total of about 50.000 to 60,000 m^3, including waste generated from dismantling, will be shipped to the national repository.

- High level wastes:

- about 9,000 m^3 produced by dismantling;
- about 200 m^3 vitrified wastes back from the reprocessing of spent fuel;
- about 2 dry storage casks.

Until now, there is neither any site for final waste disposal nor a centralised interim storage facility for spent fuel and high level waste. The Ministry of economic development recently started a road map in order to define in 2008 the procedure for the definition of a suitable site for final disposal of low and intermediate wastes, to temporarily host high level waste as well. The availability of the repository is scheduled for 2020.

At present, the inventory of spent fuel in Italian nuclear installations, can be summarised as follows:

- about 230 ton (including MOX) from NPPs; shipments to reprocessing have started
- about 4 ton U-Puand U-Th from ENEA installations of various origins; it will be reprocessed, with exception of 1,6 ton of U-Th fuel coming from Elk River (USA) plant.
- Italian liabilities include also nuclear material now abroad such ad uranium and plutonium recovered from past reprocessing activities and from the participation to "Superphenix" (Creys-Malville).

4.18. LATVIA

4.18.1. Overview

There are only two Research Reactors in Salaspils Latvia, both of which were permanently shutdown in the late 1990s. The State Agency for management of hazardous waste (BAPA) is responsible for the facility and is performing minor decommissioning activities, which are subject to full financing from the state.

4.18.2. Decommissioning funding

A decommissioning cost estimate was provided with the initial decommissioning plan, and approved together with the decommissioning concept. The state is liable for the decommissioning costs, which are planned in the multi-annual state investment programme. The financial commitment is made in the annual state budget.

The completion of the decommissioning activities is foreseen by 2010. According to the revised decommissioning concept, the site will be subsequently available for nuclear use or for other applications involving radioactive material.

4.18.3. Radioactive waste management

BAPA also manages a near surface radioactive waste repository at Baldone. It is planned to modernise and extend the radioactive waste repository in order to ensure the disposal of all radioactive waste arising from the decommissioning of the Salaspils research reactors.

In total, it is expected that 1467 tons of radioactive waste will have to be disposed of.

4.19. ESTONIA

4.19.1. Overview

Estonia inherited a number of installations from Russia related to the nuclear industry, amongst them Paldiski, a former Soviet nuclear submarine training centre, the only site under decommissioning.

4.19.2. Decommissioning funding

The decommissioning project is financed by the state and its implementation was entrusted to the Estonian Radioactive Waste Management Agency. To that end, EEK52 million (approximately €3.3 million) was budgeted during the financial years 2000-2004.

4.19.3. Radioactive waste management

The disposal of radioactive waste is a major concern in Estonia given that some sites store considerable amounts of radioactive waste, in particular the Sillamäe Metal and Chemical Production Plant. The site, the largest phosphate-uranium operation in the former Soviet Union, stores 8 million metric tons of hazardous waste (6.3 million metric tons of uranium processing residues and 150,000 m^3 of uranium mill tailings).

The targeted projects needed to address these historical liabilities are not foreseen as yet in terms of financial or technical planning.

The management of radioactive waste being the major concern, the final goal of decommissioning is to remove all radioactive material from the Paldiski site and its release for unrestricted use. Firstly, the operational waste, the contaminated components, building materials, etc. are disposed of in an interim waste storage facility. By end 2006 most of the site will be ready for release, except the main building where the reactor compartments and the interim radioactive waste storage are located.

The total capacity of the interim radioactive waste storage is 1200 m^3

The complete free release of the site could be only envisaged if a final radioactive waste repository was constructed in Estonia. The preparations for the selection of the site for the final repository are ongoing.

4.20. JOINT RESEARCH CENTRE

4.20.1. General introduction

Under the Euratom Treaty, the JRC has to manage its nuclear heritage and in particular decommission installations that have been shut down. A budget heading has been created for this purpose by joint agreement between the European Parliament and the Council. In 1999, the Commission decided to launch without further delay a programme for decommissioning its obsolete nuclear installations, called the D&WM programme (decommissioning and waste management). In this the Commission followed the new doctrine adopted by most of the EU Member States, preferring to start the decommissioning immediately rather than implement a "deferred" decommissioning which would take advantage of the diminishing radioactivity of the installations.

4.20.2. Decommissioning funding

The JRC facilities were built and put into operation in the early 1960s or 1970s. In those days, decommissioning costs were usually not integrated in the total cost of research facilities. Only in the case of the Petten High Flux Reactor, are provisions put aside from an operational budget (currently trough a supplementary programme, i.e. outside of JRC budget) to contribute to the decommissioning cost.

At the end of 2002, the JRC carried out an analysis of its "historical" and "future" liabilities. The total amount was put at €$_{2003}$941 million In accordance with a request from the Court of Auditors, the programme was examined by a Consortium of outside companies with experience in the field. The Consortium estimated the cost at €$_{2003}$1069 million, which was 13.6% above the JRC's previous figure. The cost of the additional "green field" option of returning the land to its original state was estimated at €$_{2003}$76 million.

In view of the fact that the land on which the Euratom installations are located belongs to third parties, to be on the safe side the Commission chooses the "green field" option. The total cost of €$_{2003}$1145 million is split among the four sites as follows:

- 56.3% for Ispra (€645 million);
- 34.0% for Karlsruhe (€389 million);
- 6.0% for Petten (€69 million);
- 3.7% for Geel (€42 million).

Decommissioning funds are managed by the JRC on the basis of a multi-annual schedule approved by the budgetary Authority with audits by the internal services of the Commission and by the Court of Auditors in order to ensure the appropriate use of the funds.

4.21. POLAND

Poland has no nuclear electrical generation capacity and there is no specific regulation with regards to the decommissioning of nuclear facilities.

Poland does have nuclear research facilities though only one research reactor is still operational. The state has general responsibility for making available adequate financial resources for its decommissioning. The operator is responsible for preparing the decommissioning plan and for the implementation of the project, subject to the authorisation of the National Atomic Energy Agency.

Poland has a final repository for low and short-lived intermediate level radioactive waste, though the site is also available for the temporary storage of long-lived radioactive waste. Spent fuel is foreseen to be returned to the Russian Federation however, no formal arrangements have been made to this effect and all fuel is currently stored on-site.

The decommissioning project of the nuclear research reactor at the Institute of Atomic Energy Otwock-Swierk is expected to produce 109 m^3 of radioactive waste.

4.22. GREECE

In Greece, in possession of only the 5 MW pool type research reactor "Demokritos" and two other zero-power research reactors, there are no national regulations or guidelines with regards to decommissioning. The Greek Atomic Energy Commission will develop the policy and regulations in due course, whereas the operator will be responsible for the implementation of the decommissioning project.

4.23. MALTA

Malta has reported to have no relevant activities or installations to be covered in the present communication. Nevertheless, it is foreseen to set up a centralised storage facility for long lived radioactive waste.

4.24. CYPRUS

Cyprus has reported to have no relevant activities or installations to be covered in the present communication.

4.25. DENMARK

After 40 years of nuclear research, Denmark in 2000 decided to close down all nuclear facilities except the Waste Management at Risø National Laboratory namely the research reactors DR 1, DR 2, and DR 3 and the Hot Cells. In 2003 the Danish Parliament decided that the research facilities should be decommissioned to a status of "green field" during a period of maximum 20 years.

Ultimo 2005 the reactor DR 1 was decommissioned and the building was released free without restrictions (green field). Ultimo 2007 the reactor DR 2 was decommissioned and radioactivity measurements are going on. During 2008-2011 the Hot Cells will undergo decommissioning, and during the period 2011-2018 the reactor DR 3 is planned to undergo decommissioning. Finally the Waste Treatment Plant should be decommissioned when a Danish final repository has been established.

4.26. IRELAND

Ireland has reported to have no relevant activities or installations to be covered in the present communication.

4.27. LUXEMBOURG

Luxembourg has reported to have no relevant activities or installations to be covered in the present communication.

4.28. PORTUGAL

Portugal has reported to have no relevant activities or installations to be covered in the present communication.

5. COMPARISON OF FUNDING PRACTICE WITH COMMISSION RECOMMENDATION[15]

The following table is essentially based upon the results of one of the Commission's studies and a detailed questionnaire provided to Member State representatives.

The updated table integrates feedback from the MS provided via the Council's Atomic Question Group and the Commission's Decommissioning Funding Group.

[15] OJ L 330 (28.11.2006)

		AT	BE	CZ	DK	DE	EE	ES*	FI	FR*	HU*	IT*	LV	LT	NL*	PL	SE	SI	SK	GB	BG*	RO*
	Decommissioning - General																					
1	All nuclear installations are planned to be decommissioned after its permanent shutdown.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2	The management of waste is properly addressed.	Yes	Yes	Yes	n.a	Yes	n.a.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	n.a.	n.a.	N/A	Yes	Yes	n.a.	Yes	Yes
3	Decommissioning activities are carried out without undue risk to public and worker health and safety.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4	The polluter pays principle is fully applied throughout the decommissioning of nuclear installations.	Yes State	Yes	Yes	n.a.	Yes	N/A	Yes	Yes	Yes	Yes	Yes		Yes + EC	Yes	Yes state	Yes	Yes Slo/Cro	Yes + EC	Not clear	Yes	Yes
5	Ensuring the availability of adequate financial resources for safe decommissioning by the time the respective nuclear installation is permanently shut down is a primary concern of operators.	Yes State	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	N/A		Yes	Yes	Yes State	Yes	Yes	Yes	Yes	Yes	Yes
6	The financial resources available are aimed at covering all aspects of decommissioning activities, notably as from the technical decommissioning of the installation to the waste management.	Yes State	Yes	Yes	n.a.	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes State	Not defined	Yes	Yes	Not clear	Yes	Yes
	National instances and their powers																					
7	The state has at its disposal a dedicated national body capable of providing an expert judgment concerning nuclear safety and decommissioning cost matters.	N/A	Yes	Yes RAWRA	n.a.	N/A	N/A	Yes ENRESA	Yes	Yes	Yes	Yes	N/A	Yes	Yes	N/A	Yes	Yes	Yes	NDA+ BE (NLF)	Yes-nuclear safety No-decom.	Yes
8	The national body is independent as regards the contributors to the fund		Yes	Yes				Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes	Yes	Yes	N/A	Yes
9	The national body reviews annually the gathered financial resources		No (3y)	Yes				Yes	Yes	Yes	Yes	Yes		Yes	No		Yes	Yes	Yes ½ a	No (3y)		Yes
10	The national body reviews at least every 5 years the decommissioning cost estimates.		Yes	Yes				No (1y)	Yes	Yes	Yes	Yes		No (3y)	Yes		No (1y)	Yes	No (2y)	Yes		Yes
11	The national body is fully involved in the elaboration of solutions for cases arising for historical reasons		n.a.	Yes				Yes	n.a.	Yes	Yes Gov	Yes	Yes Gov	Yes	No		N/A	Yes	Not specified	Yes		N/A
12	For cases arising for historical reasons, the budgetary planning is subjected to the review of the national body.		Yes	Yes				Yes	n.a.	Yes	Yes Gov	Yes	Yes Gov	Yes	No		N/A	Yes	Yes	Yes		Yes
	Establishment of decommissioning funds																					
13	New nuclear installations are required to constitute ring-fenced external decommissioning funds.	N/A	No	Yes	n.a.	N/A	N/A	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Yes	Not defined	Yes	N/A
14	Nuclear installations are required to constitute adequate decommissioning funds on the basis of the revenues obtained from their nuclear activities during the designed lifetime.		Yes	Yes				Yes	Yes	Yes (available at start of operation)	Now Yes			Yes	Yes		Yes	Yes	Yes	Not clear	Yes	
15	A ring-fenced external fund is required for all nuclear installations.		No	No				No (CIEMAT)	Yes	N/A	No			N/A	N/A		No	No	No	No	No	

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		AT	BE	CZ	DK	DE	EE	ES*	FI	FR*	HU*	IT*	LV	LT	NL*	PL	SE	SI	SK	GB	BG*	RO*
	Cost calculations																					
16	Any shortfall between cost estimates and gathered resources is addressed in a timely manner.	N/A	Yes	Yes	n.a.	N/A	N/A	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	N/A	Yes	Yes	Yes	In process	Yes	Yes
17	On the basis of separate cost calculations, the technical decommissioning of the installation and the waste management are addressed separately.		Yes	Yes				Yes	No	Yes	Yes	Yes		Yes	Not clear		Yes	Yes	Yes	In process	Yes	Yes
18	It is assumed for the cost calculations that the more expensive alternative will be chosen when the decommissioning and waste management strategy will be decided upon.		No	No				No	No	No	No	No		No	No		No	No	No	No	No	No
19	All cost estimates are site-specific.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes (exept NPPs)	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	No	Yes	Yes
20	All cost estimates are the best available estimate of the occurring expenses.	N/A	Yes	Yes	n.a.	N/A	N/A	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Not defined
21	If during implementation the decommissioning project proves to be more expensive than the approved cost estimates, the operator is required to cover the additional expenses.		Yes	Yes		Yes		No	Yes 10-20% Contingency	Yes	Yes	N/A		No	Yes		Yes	Yes	Not clear	No	Not clear	
22	The latter point is given particular attention if the operator changes during or beyond the lifetime of the nuclear installation.		Yes	Yes		N/A		Yes	N/A	N/A	Yes			N/A	Yes		Not specified	N/A	Yes	Yes	Yes	Yes
23	In the case of nuclear installations whose main purpose is other than the sale of products or services, decommissioning is properly planned and budgeted so as to allow an adequate funding to be available for the safe and timely decommissioning of such installations.		Yes	No		Yes		No (CIEMAT)	Yes	Yes	Yes				Yes		Yes		Yes	Yes Gov	Yes	Not defined
	Transparency																					
24	Cases arising for historical reasons are elaborated in a transparent manner.	N/A	Yes	Yes	n.a.	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	N/A	Yes	Yes	Yes	Yes	Yes	Yes
25	Financial resources are managed in a transparent way.		Yes	Yes		n.a.		Yes	Yes	Yes	Yes	Yes	Yes	Yes			Yes	Yes	Yes	In process	Yes	Yes
26	All commercially non-sensitive information is publicly available.		Yes	Yes				Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
27	In case the decommissioning fund is internally managed the gathered resources are identifiable and traceable at any moment.		Yes Differences	N/A				N/A	N/A	Yes	N/A	N/A		No	Yes		N/A	N/A	N/A	In process	N/A	N/A
	Management of decommissioning funds																					
28	Financial resources are used only for the purpose for which they have been established.	N/A	Yes	Yes	n.a.	Yes	N/A	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	No	Yes	Yes	Yes	Yes
29	In the investment of the assets a low and secured risk profile is sought, ensuring that a positive return is achieved during any period of time.		n.a.	n.a.		N/A		Yes	Yes	Yes	N/A	N/A	N/A	No	Not clear		Yes	No	N/A	N/A	N/A	N/A
30	In case of external decommissioning funds, the value of the investments is guaranteed by the state		n.a.	Yes				Yes	Yes	N/A	Yes	Yes	Yes	Yes	N/A		No	Yes	Not specified	Not clear		N/A
31	In case the decommissioning fund is internally managed, a segregated decommissioning fund is established within the accounts of the operator.		Yes	N/A		Yes		N/A	N/A	Yes	No	N/A	N/A	No	Yes		No	N/A	N/A	No		Not defined
32	In case an internally managed decommissioning fund underperforms, the operator is fully responsible to ensure that adequate funds are available when needed.		Yes			Yes		N/A	N/A	Yes	Yes		Yes Gov	No	Yes		N/A			No		N/A

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