



National Framework for Spent Fuel and Spent Fuel Management in Decommissioning Cost Estimation



NATIONAL FRAMEWORK

The policy of the Republic of Bulgaria in the field of SF and RAW management is based on the principle of avoiding the imposing of undue burden on future generations

Strategy for the Management of Spent Nuclear Fuel and Radioactive Waste is basic national document setting out the policy and principles for the safe management of activities related to SF and RAW.

- The SF generated in the country is a material containing useful components. This material should be reprocessed in the country of origin or in third country in an internationally acceptable and mutually beneficial economical, technological, and environmentally friendly manner;
- The SF for which reprocessing has proven cost ineffective shall be classified as radioactive waste pursuant to ASUNE, and may be managed in line with the concept of “deferred decision for subsequent use”, if it is stored in a manner allowing its retrieval.
- In the case of long-term storage under the “deferred decision” option, the spent fuel shall be stored using the “dry storage” technology;
- Deep geological disposal is considered the most suitable option for sustainable guaranteed safety for isolation of high level and long-lived RAW;
- The country’s participation in regional and international projects for deep geological disposal is expedient; however looking for international solutions should not jeopardize the current national program.



SPENT FUEL SOURCES

Unit	Type	Year of commissioning	Current status
1	WWER-440/B-230	1974	Shut down at 31.12.2002 at Decommissioning Phase
2	WWER-440/B-230	1975	Shut down at 31.12.2002 at Decommissioning Phase
3	WWER-440/B-230	1980	Shut down at 31.12.2006 at Decommissioning Phase
4	WWER-440/B-230	1982	Shut down at 31.12.2006 at Decommissioning Phase
5	WWER-1000/B-320	1988	In operation
6	WWER-1000/B-320	1991	In operation



LEGAL FRAMEWORK

The legal framework for SF management refers to international conventions and European directives, namely:

- Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management;
- Council Directive 2011/70/EURATOM establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste,

Bulgarian national acts and regulations:

- Act on the Safe Use of Nuclear Energy (ASUNE);
- Regulation on safe management of RAW;
- Regulation for safety of spent fuel management;
- Regulation on conditions and procedure for transfer of RAW to the State Enterprise “Radioactive waste”;
- Regulation for radiation protection.



SPENT FUEL STRATEGY

Bulgaria has adopted a policy after irradiation of the fuel in the reactor core to send the SF for reprocessing to other countries, with a subsequent return of the HLW.

The transportation of SF from Kozloduy NPP units for technological storage and reprocessing is performed on the basis of long-term commercial contracts notified and approved by the EURATOM Supply Agency (ESA) in 2007.

The end point of the SF management process is the complete reprocessing of the generated SF quantities from WWER-440 and WWER-1000 and final disposal of HLW quantities generated during reprocessing.

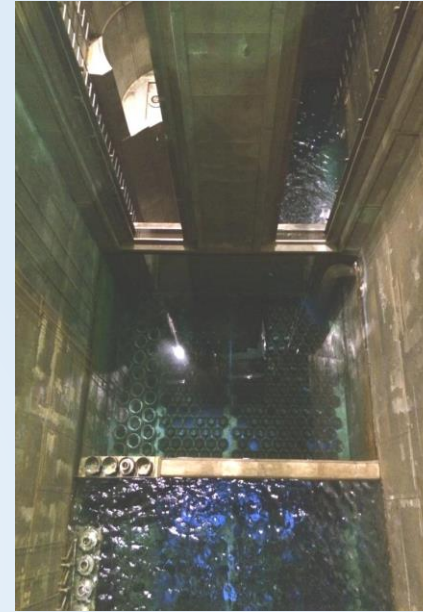
The SF generated from the operation of the KNPP is managed solely by the plant. The costs of Kozloduy NPP for transportation of SF for technological storage and reprocessing are recognized as expenses for the licensed activity, which form the cost of electricity.

STORAGE FACILITIES

Spent fuel is stored at the KNPP for a certain period of time (at present is at least five years) in the reactor Spent Fuel Pools

Full capacity of Unit 5 pool is 612 fuel assemblies

Full capacity of Unit 6 pool is 611 fuel assemblies



Spent Fuel Storage Facility (SFSF) is of “wet” type and stores the WWER-440 and WWER-1000 reactors’ spent fuel

STORAGE FACILITIES



Dry Spent Fuel Storage Facility (DSFSF) is commissioned in 2011;

DSFSF is a project financed by KIDSF and its value is 72.831 MEUR

A 10-year license for operation issued in 2016 by BNRA;

Cask “dry storage” technology - Constor 440/84;

Design lifetime 50 years;

Currently DSDFS stores spent fuel from WWER-440 reactors

It is planned that all the WWER-440 fuel assemblies left on KNPP site will be stored in the DSFSF

In order to ensure efficient and safe management of SF from WWER-1000, licensing and commissioning of DSFSF's extension up to 2030 is planned





SPENT FUEL IN STORAGE

The total amount of SF generated from the operation of Kozloduy NPP Units 1 to 6 for the period 1979–2018 is about 2310 t HM.

About 1280t HM or about 56% of this quantity was transported for reprocessing and technological storage in that period.

Reactor Type	Assemblies pcs.	HM [t]
Spent Fuel Storage Facility (AFR) - wet storage		
WWER-440	1 772	205
WWER-1000	768	305
Dry Spent Fuel Storage Facility (AFR)		
WWER-440	1 092	126
Spent Fuel Pool Unit 5 (AR) – wet storage		
WWER-1000	338	139
Spent Fuel Pool Unit 6 (AR) – wet storage		
WWER-1000	355	146

The total amount of SF at KNPP site at 31 December 2018

Reactor Type	Assemblies pcs.	HM [t]
WWER-440	2 864	331
WWER-1000	1 461	590
Total	4 325	921



SF MANAGEMENT IN DECOMMISSIONING COST ESTIMATION

File	Task	Resource	Report	Project	View	Format	Tell me what you want to do...	Sign in
1	01							
	01					5802 days	Tue 20/05/03	Fri 25/07/25
77	02					4606 days?	Wed 01/01/03	Fri 07/08/20
78	02.01					2037 days?	Wed 01/01/03	Mon 18/10/10
79	02.0101					6 days	Wed 01/01/03	Wed 08/01/03
80	02.0102					48 days	Mon 13/01/03	Wed 19/03/03
81	02.0103					1695 days	Mon 13/01/03	Tue 07/07/09
82	02.0104					997 days?	Tue 13/09/05	Tue 07/07/09
83	02.0105					2037 days?	Wed 01/01/03	Mon 18/10/10
84	02.0106					479 days?	Tue 02/01/07	Thu 30/10/08
85	02.02					3403 days?	Thu 04/01/07	Fri 03/01/20
91	02.03					1893 days?	Mon 01/01/07	Mon 31/03/14
92	02.0301					16 days?	Mon 01/01/07	Sun 21/01/07
93	02.0302					66 days?	Mon 22/01/07	Mon 23/04/07
94	02.0303					1437 days?	Mon 22/01/07	Tue 24/07/12
95	02.0304					1272 days?	Mon 10/09/07	Tue 24/07/12
96	02.0305					1607 days?	Mon 01/01/07	Mon 25/02/13
97	02.0306					1000 days?	Wed 02/06/10	Mon 31/03/14
98	02.04					1955 days?	Mon 25/02/13	Fri 07/08/20
104	03					5741 days?	Tue 02/01/07	Fri 15/12/28
1302	04					6875 days?	Thu 09/09/04	Mon 30/12/30
2661	05					7319 days	Wed 01/01/03	Tue 31/12/30
2955	06					7319 days?	Wed 01/01/03	Tue 31/12/30
2996	07					7319 days	Wed 01/01/03	Tue 31/12/30
3032	08					7319 days	Wed 01/01/03	Tue 31/12/30
3033	08.01					5232 days	Wed 01/01/03	Fri 30/12/22
3034	08.0101					5232 days	Wed 01/01/03	Fri 30/12/22
3035	08.0102					2880 days	Tue 03/01/12	Fri 30/12/22
3036	08.0102.1					2880 days	Tue 03/01/12	Fri 30/12/22
3037	08.0102.2					2880 days	Tue 03/01/12	Fri 30/12/22
3038	08.0102.3					2880 days	Tue 03/01/12	Fri 30/12/22
3039	08.0102.4					2880 days	Tue 03/01/12	Fri 30/12/22
3040	08.0102.5					2880 days	Tue 03/01/12	Fri 30/12/22
3041	08.0102.6					2880 days	Tue 03/01/12	Fri 30/12/22
3042	08.0103					2880 days	Tue 03/01/12	Fri 30/12/22
3043	08.0104					783 days	Mon 01/01/07	Tue 29/12/09
3044	08.02					6949 days	Mon 31/05/04	Tue 31/12/30
3045	08.0201					2303 days	Mon 31/05/04	Tue 26/03/13
3046	08.0202					4968 days	Mon 02/01/12	Tue 31/12/30
3047	08.03					4183 days	Thu 01/01/15	Tue 31/12/30
3052	09					7319 days	Wed 01/01/03	Tue 31/12/30

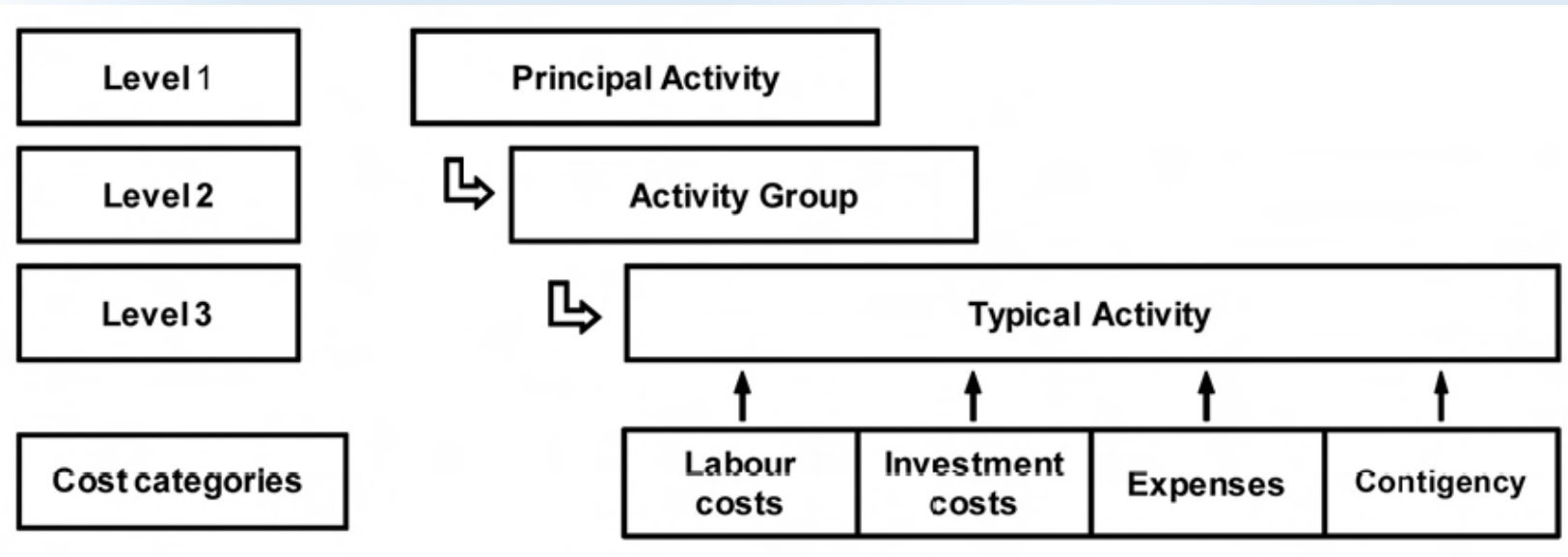
GANI CHAKI



SF MANAGEMENT IN DECOMMISSIONING COST ESTIMATION

COST ESTIMATION

For each Typical Activity are evaluated four cost categories





SF MANAGEMENT IN DECOMMISSIONING COST ESTIMATION

Activity	Status	Labour costs (MEUR)	Invest. costs (MEUR)	Expenses (MEUR)	Conting. (MEUR)	Total (MEUR)
02 Facility shutdown activities						
02.0100 Mode E of operation of Units 1&2						
02.0102 Defueling and transfer of the SNF to Spent Fuel Pools (SFP) 1 and 2	complete	0.100	0.000	0.040	0.000	0.140
02.0103 Safe storage of SNF in SFP 1&2	complete	3.082	0.000	1.233	0.000	4.315
02.0104 Transfer the SNF from SFP 1&2 to Spent Fuel Storage Facility	complete	1.406	0.000	0.563	0.000	1.969
02.0300 Mode E of operation of Units 3&4						
02.0302 Defueling and transfer of the SNF to Spent Fuel Pools (SFP) 3 and 4	complete	0.123	0.000	0.049	0.000	0.173
02.0303 Safe storage of SNF in SFP 3&4	complete	3.456	0.000	1.382	0.000	4.838
02.0304 Transfer the SNF from SFP 3&4 to Spent Fuel Storage Facility	complete	2.176	0.000	0.871	0.000	3.047
08 Fuel and Activated Material						
08.0100 Temporary storage of spent fuel in Spent Fuel Storage Facility						
08.0101 Safe storage of fuel in Spent Fuel Storage Facility	in progress	9.535	0.000	13.072	0.000	22.607
08.0102 Loading the fuel in dedicated casks Constor 440/84	in progress	1.530	0.000	0.000	0.000	1.530
08.0103 Transfer casks from SFSF to DSFSF	in progress	0.085	0.000	0.000	0.000	0.085
08.0104 Transfer of SNF for reprocessing	complete	0.000	0.000	61.375	0.000	61.375
08.0200 Dedicated storage for fuel and activated material						
08.0201 Construction of Dry Spent Fuel Storage Facility	complete	0.000	72.830	0.000	0.000	72.830
08.0202 Temporary storage of casks with spent fuel in Dry Spent Fuel Storage Facility	in progress	2.209	0.000	0.000	0.000	2.209
09 Miscellaneous Expenditures						
09.0100 Payments to BNRA						
09.0101 Fees for issuing licenses	in progress	0.000	0.000	2.881	0.000	2.881
09.0102 Other payments to BNRA	in progress	0.000	0.000	43.104	0.000	43.104
09.0300 KNPP Investments						
09.0302 KNPP Investments in SFSF and DSFSF	in progress	0.000	18.124	0.000	0.000	18.124



FUNDING SOURCES

- **KNPP own funds**

The costs of Kozloduy NPP for transportation of SF for technological storage and reprocessing are recognized as expenses for the licensed activity, which form the cost of electricity.

- **Radioactive Waste Fund**

The nuclear operator makes annual contributions

- **Nuclear Facilities Decommissioning Fund**

The nuclear operator makes annual contributions

- **Kozloduy International Decommissioning Support Fund**

European Commission, as well as by Austria, Belgium, Denmark, France, Greece, Ireland, the Netherlands, Spain, Switzerland and the United Kingdom.



RISKS AND UNCERTAINTIES

Several major risks concerning the SF management are identified:

- Changed conditions or inability to transport SF from WWER-1000 for storage and reprocessing - this may lead to a lack of long-term SF storage capacity.
- Changed conditions for the delivery of fresh nuclear fuel - this may lead to necessity of changing the SF management plans and to plan additional infrastructure at the NPP site.
- Change in the regulatory and legal framework - initiation of new standards and technical requirements could lead to necessity of changing the facilities and plans for management of SF and RAW.



**THANK YOU
FOR
YOUR ATTENTION**