Lithuania

(based on JC national report and NEWMDB country profiles)

a) National framework for management of spent fuel and radioactive waste

There is only one nuclear power plant (NPP) in Lithuania - Ignalina NPP. The INPP reactors were commissioned in December 1983 and August 1987. After the accident in Chernobyl, the safety systems were re-evaluated and it was decided to decrease the maximum thermal power of the units from 4800 to 4200 MW. Now both units are being prepared for decommissioning. Unit 1 of INPP was shut down on 31 December 2004 and the second unit of INPP was shut down at the end of 2009 according to the obligations of Treaty of Accession of Lithuania to European Union.

It should be noted that according to the Law on Nuclear Energy the spent fuel in Lithuania is radioactive waste. Geological disposal is considered final solution. However, a possibility to ship the fuel abroad for reprocessing has to be analyzed too.

All radioactive waste management facilities in Lithuania are considered nuclear facilities. The operators have to obtain a license in order to operate these nuclear facilities. All these facilities are situated within the territory of INPP, with the only one exception of Maišiagala storage facility, which is about 30 km northwest from Vilnius, the capital of Lithuania.

The management of radioactive waste must ensure that:

1) at all stages of the radioactive waste management, individuals, the society and the environment within Lithuania as well as beyond its borders are adequately protected against radiological, biological, chemical and other hazards that may be associated with radioactive waste by applying the appropriate methods;

2) efforts are made to prevent future generations from any reasonably predictable impact greater than those permitted for the current generation and to avoid any undue burden for future generations;

3) radioactive waste is kept generated to the lowest practical minimum in terms of volume and activity, achieving this through measures during design, operation and decommissioning, including reprocessing and further use of nuclear fuel cycle materials;

4) interdependencies among different steps of the radioactive waste management are taken into account;

5) the safety of radioactive waste management facilities is guaranteed during their operating lifetime and thereafter, applying passive safety measures;

6) radioactive waste management safety measures shall be implemented applying graded approach;

7) radioactive waste generated within the territory of the Republic of Lithuania shall be disposed of in disposal facilities within the Republic of Lithuania or transported for disposal to other country, except for cases indicated in Article 24 (cases related to management of spent sealed sources).

Radioactive waste in the Republic of Lithuania is classified according to the disposal principle and radiological characteristics. According to the Nuclear Safety Requirements BSR-3.1.2-2010 "Regulation on the Pre-disposal Management of Radioactive Waste at the Nuclear Facilities" the following waste categories are distinguished:

- Very Low Level Waste (VLLW). Radioactive waste with radiological characteristic values exceeding clearance levels, however, lower than the characteristics for low level waste. VLLW will be disposed of in licensed landfill facility at the site near Ignalina NPP. License on construction and operation of Landfill facility already provided by VATESI (State Nuclear Power Safety Inspectorate) to Ignalina NPP.

- Low and Intermediate Level Waste (LILW). Radioactive waste with radiological characteristics between those of very low level waste and high level waste. These may be long-lived waste (LILW-LL) or short-lived waste (LILW-SL). LILW-SL will be disposed of in Near Surface Repository (NSR) at the site near Ignalina NPP (NSR Technical Design and Preliminary Safety Analysis Report are prepared and are at review stage in VATESI). LILW-LL will be stored in the storage facilities for LL waste (it is expected that 2 LL waste storage facilities will be used for storage, one of them already exists (LILW-SL temporary storage) and the second is under construction) up to the moment of construction of intermediate or deep geological repository. This repository will be constructed along with deep geological repository for High Level Waste (HLW) or, in Lithuanian case, along with geological repository for SF.

- High Level Waste (HLW). Spent fuel which shall be placed in deep geological repository due to its significant emitting capacity of a heat generated during radioactive decay or due to the contained amount of long-lived radionuclides. According to the draft report on Lithuanian Radioactive Waste Management Programme (national strategy prepared in accordance with Council Directive 2011/70/Euratom), the concept of deep geological repository, Safety Analysis Report with all necessary studies (more important geological study is place selection) will be prepared up to 2038.

b) State legal and regulatory framework

The list of main laws regulating the management of spent nuclear fuel and radioactive waste in Lithuania is provided below:

- Law on the Management of Radioactive Waste (1999, last amended 2014);

- Law on Nuclear Energy (1996, last amended 2014);
- Law on Radiation Protection (1999, last amended 2011);
- Law on the Ratification of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (2003);
- Lithuanian Radioactive Waste Management Programme (2015) (national strategy prepared in accordance with Council Directive 2011/70/Euratom)

The operator of radioactive waste management facilities is fully responsible for the safety of these facilities. INPP is responsible for the safe management of radioactive waste produced during operation or accepted for storage or processing, and produced during decommissioning until this waste is transferred for disposal. INPP is also responsible for construction and operation of disposal facilities for short-lived radioactive waste (Landfill facility for A class wastes (VLLW-SL) and Near Surface Repository for B and C class waste (LLW-SL and ILW-SL)) as well for construction of storage facilities of LL waste and Spent Fuel.

The Law on Nuclear Safety describes licensing procedure and types of licenses as well as permits to be issued, validity of these licenses and permits, the main steps and principals of nuclear safety evaluation and responsibility and fines for not following the law. VATESI is state regulatory and supervisory authority in Lithuania for activities involving nuclear materials and other activities in the area of nuclear energy involving sources of ionizing radiation. VATESI sets safety requirements and regulations, supervises compliance with them, applies enforcement measures in case of incompliance with safety requirements and regulations, issues licenses, permits and temporary permits and assesses safety of nuclear facilities.

The Radiation Protection Centre (RPC) coordinates actions of state and municipal institutions in the manner established by the Government or, upon direction from the Government, by the Minister of Health, in the area of radiation protection, exercises the state regulation and supervision of both radiation protection in respect of exposure of members of the public and the environment, and the practices involving sources of ionizing radiation, except of practices in the area of nuclear energy.

c) Radioactive waste management, decommissioning and spent fuel strategy

Radioactive Waste Management Programme was approved by the Government of Lithuania on 23 December 2015. Its objective is to define radioactive waste management strategy. This strategy is approved to implement the provisions of the Law on the Management of Radioactive Waste of the Republic of Lithuania, which establishes the basic principles of radioactive waste management.

The strategy has few main objectives:

1) Strive to achieve high level of nuclear and radiation safety in the management of spent fuel and radioactive waste;

2) Improve the radioactive waste management infrastructure, which shall be based on modern technologies; strive to minimize activity and volume of radioactive waste;

3) Foreseen all steps on radioactive waste management from generation until disposal;

4) Inform the Lithuanian public to achieve a better understanding of the main radioactive waste management principals and achieve acceptance of waste management projects.

The spent nuclear fuel is stored at INPP by means of two methods. "Wet" storage in spent fuel storage pools near the reactor and "dry" storage in the detached storage facility at NPP site. Wet storage facility was provided in the initial design of NPP. NPP's design was developed in the 70s of the last century in the former Soviet Union. It was intended to store the fuel unloaded from the reactor for several years and then to transfer it for processing. In the beginning of the 90s, when it became finally obvious that the matter of spent fuel processing is not considered any more, a decision was made to build up a dry type interim storage facility for spent nuclear fuel at INPP and store it for 50 years.

Institutional waste producers pay for their waste collection, transport, treatment, and storage and disposal services according to a contract with RATA (State Enterprise Radioactive Waste Management Agency). The fees for the services were approved by the Order of the Minister of Energy. RATA is also an operator of "Radon type" disposal facility for institutional waste which is closed and all waste from this facility will be extracted up to 2023 and will be transferred to the retrieval facilities of INPP and later to the disposal facilities of INPP. All Radioactive waste collected from small producers in Lithuania by RATA as well transferred to INPP periodically (no more than few times per year) for storage, treatment and disposal in accordance to the contract of RATA and INPP.

d) Radioactive waste classification, waste and spent fuel quantities (inventory) (including disused sources that are declared radioactive waste)

Table 1 Radioactive Waste In Storage Facilities (including spent fuel that is considered waste)

Route, Waste Class	Processed (type)/Un processed	Total Current Volume (m^3)	Estimated Disposal Volume (m^3)	Distribution (%)							Planned Disposal Route (if known)
				RO	FFE	RP	NA	DF	DC/ RE	ND	
All Classes	No	9289.1	9289.1	99	0	0	1	0	0	0	
All Classes	Yes	37164.64	31902.2	100	0	0	0	0	0	0	
Group-1	No	7210	7210	100	0	0	0	0	0	0	Landfill
Group-1	Yes	21085	8434	100	0	0	0	0	0	0	Landfill
Group-2	Yes	404	2000	99	0	0	1	0	0	0	NSR
Group-3	Yes	471	1000	100	0	0	0	0	0	0	Temporary storage
VLLW-SL Class A	No	3278,64	3278,64	100							Landfill

LLW-SL Class B	Yes	14417	14417	100	0	0	0	0	0	0	NSR for bitumen compound
ILW-SL Class C	Yes	820.64	6084.2	100	0	0	0	0	0	0	NSR

NEWMDB waste origin type codes:
RO – reactor operations
FFE – fuel fabrication & enrichment
RP – fuel reprocessing
NA – nuclear applications
DF - defence
DC/RE - decommissioning & remediation
ND - Not Determined

Note: Spent fuel is not included in this table. Information about SF is presented below (see Table 3). Group 1, 2 and 3 is operational waste in temporary storage facility, it will be retrieved, sorted, prepared for disposal. At present time it is temporary solution for such type of waste. Approximately relation of 1-3 groups such: Group 1 - **VLLW-SL (Class A),** Group 2 - **LILW-SL (Class B and C),** Group 3 - **LILW-LL (Class D and E).**

Table 2. Disposed Radioactive Waste (as disposed volume)

Waste Class	Processed (not)	Total Volume (m^3)	Distribution (%)							Disposal Route Used
			RO	FFE	RP	NA	DF	DC/RE	ND	
All Classes	No	120	0	0	0	100	0	0	0	
Group-1 Solid	No	110	0	0	0	100	0	0	0	Landfill
Group-2 Solid	No	10	0	0	0	100	0	0	0	NSR
LLW-SL Class B	Yes	14417	100							NSR for bitumen compound

Note: At present time all disposed waste in Lithuania is placed in the temporary disposal facility (Radon type) at Maišiagala location. But it was decided that up to 2021 all waste from this disposal facility will be removed and later retrieved and disposed of in the INPP facilities. Bitumen compound with radioactive salts in storage facility (at the end of 2015 it is stored 14417 m^3) it is planned to transfer to repository in siitu, but it is not final justification of safety of such solution exist at present time, but project are under initiation.

Table 3. Spent Fuel in Storage Facilities (MTHM)

Type	Current Amount (NPP)	Current Amount (Research Reactors)
Total Spent Fuel Storage	2415.952	0
Wet storage (AR)	1742.16	0
Wet storage (AFR)	0	0
Dry storage (AR)	673.792	0
Dry storage (AFR)		0

Total spent fuel held in storage for other countries (amounts also included above)	0	0

Note: The number of RBMK-1500 SF assemblies (~7 m long) is presented in the table above (each SFA consist of two SF bundles (~3.5 m long each), the SF bundles are stored in containers in the dry storage facility). There are 6016 SFA in dry storage facility and 15555 SFA in wet storage facility (21571 pcs. in total) (about 112 kg of HM each).

Table 4. Spent Fuel Sent for Reprocessing (within the country or sent to another country) (MTHM)

Type	Current Amount (NPP)	Current Amount (Research Reactors)
Total amount Spent Fuel sent to Reprocessing (in your country)	0	0
Total amount Spent Fuel sent to Reprocessing (in another country)	0	0
Total amount of Spent Fuel received from another country for reprocessing and recycling	0	0
Total amount of Spent Fuel (MTHM) or radioactive waste (cubic metres) returned to country of origin for storage/disposal	0	0

Table 5. Example of a translation matrix (from NEWMDB) that can be used for transition from a national classification system to IAEA classification

National Waste Classification Name	LILW-SL	LILW-LL	HLW
VLLW (A)	100	0	0
LLW-SL (B)	100	0	0
ILW-SL (C)	100	0	0
LLW-LL (D)	0	100	0
ILW-LL (E)	0	100	0
Group-1	100	0	0
Group-2	100	0	0
Group-3	0	100	0

Table 6. Waste Management Facilities

Type	Planned	Construct.	Commiss.	In Operation	Shutdown	Decomm.	Other	Total
Spent Fuel Storage	0	1	0	1	0	0	0	**2**
Spent Fuel Reprocessing and Recycling	0	0	0	0	0	0	0	**0**
Spent Fuel Conditioning	0	0	0	0	0	0	0	**0**
Spent Fuel Disposal	1	0	0	0	0	0	0	**1**
Waste processing	3	2	0	4	0	0	0	**9**
Waste storage*		2		10	2			**14**
Waste disposal	3							**3**

*Note: All waste storage facilities are at INPP site, only one institutional waste storage facility at Maišiagala location is in Lithuania, in addition, some small storage facilities exist to collect and temporarily store the institutional waste; therefore, the number of waste storage facilities depends on definitions of these facilities.

Table 7. Summary of Major Sources of Waste

Type	Planned	Construct	Commiss.	In Operation	Shutdown	Decomm.	Other	Total
Research reactors	0	0	0	0	0	0	0	0
Nuclear Power reactors	1	0	0	0	0	2	0	3
Spent Fuel Reprocessing and Recycling	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0

e) Trends and future prospects (volumes of generated waste and spent fuel, waste and spent fuel management facilities)

At present time there are 2 SF storage facilities at INPP, 1 is in operation from 2000, the second SF storage facility is at cold trials stage. Start of operation of the second SF storage facility is planned for 2017. All fuel from wet storage (in SF pools of both INPP Units and from reactor of Unit 2) will be transferred to SF storage facility until 2022. The operation period of SF storage facility is limited by the operational period of SF storage containers to 50 years, because the operation period of SF storage facilities is much longer than operation period of the containers (the first one is open type facility, operation period of the second SF storage facility is 100 years, i.e. up to 2117). According to the national strategy, the site should be selected and preparation works for the start of deep geological disposal facility

construction should be performed up to 2038. Additional actions with SF in the first SF storage facility should be started in 2050. In the same manner a justification for additional period for the storage facility should be prepared or repackaging and preparation for final disposal should be performed. The same procedure should start for SF in the second SF storage facility until 2067. According to this limitation it is planned to start disposal of SF in 2060-2070.

The liquid waste is reprocessed at INPP by two ways: bituminization and cementation. Bituminized waste is stored in bitumen compound storage facility, which was planned as a final disposal place for this waste (project B20, see figure below). Cemented waste is stored in temporary storage facility in drums and in FRAMATOME concrete containers (8 drums in one container). Later the containers will be transferred to NSR where they will be backfilled by cement compound and then disposed of in the NSR vaults. The NSR at present time is at the stage of review of Technical Design and PSAR by VATESI (State Nuclear Power Safety Inspectorate) Start of operation of NSR is planned for 2021.

There are two main steams of solid radioactive waste: from operation and from decommission. Operational waste is collected in operational waste storage facilities.

Decommissioning waste at present time is Class 0 waste (uncontrolled level waste) transferred from INPP by Free Release Measurement Facilities (FRMF) (project B10, see figure below). It is not planned to construct additional facilities for free release.

Class A waste is characterized and collected in the temporary storage facility for Class A waste (Buffer Storage Facility for Short-Lived Very Low Level Waste (project B19-1, see figure below)). The start of operation of Landfill facility where Class A waste will be disposed of is planned in 2017-18. It is planned that Class A waste from 15 companies about 4000 m^3 each will be disposed of from 2017-18 up to 2038.

Class B and C waste after formation of packages in Solid Waste Management and Storage Facilities (SWMSF) (project B2 and B3/4, see figure below) will be disposed in Near Surface Repository (NSR). Start of operation of SWMSF - 2018 and NSR - 2021. All Class B and C waste will be disposed of in NSR until 2038.

Class D and F waste are divided to two steams: graphite waste from dismantling of the reactors and other waste. Graphite waste from the reactors dismantling will be stored in containers in Temporary storage facility (existing facility is used for storage of cemented waste). Operation period of this facility is up to 2066. Other Class D and F waste will be sorted by waste types and stored in drums (4 drums in a container) or in container without drums in the Solid Waste Treatment and Storage Facilities (SWMSF) (project B3/4, see figure below). Operational period of SWMSF is 50 years, up to 2068. All Class D and E waste should be disposed of in Deep Geological Disposal Facility.

Class F waste (Spent Sealed Sources) should be separated from other waste. Separation will be carried out in the Solid Waste Management and Storage Facilities (SWMSF) (projects B2 and B3/4, see figure below) and then it should be stored in drums within storage container (4 drums in a container) or SSS

should be placed in special container within the storage container of SWMSF (project B3/4). All Class F waste should be disposed of in Deep Geological Disposal Facility.

Main streams of radioactive waste during decommissioning of INPP are presented on figure below.

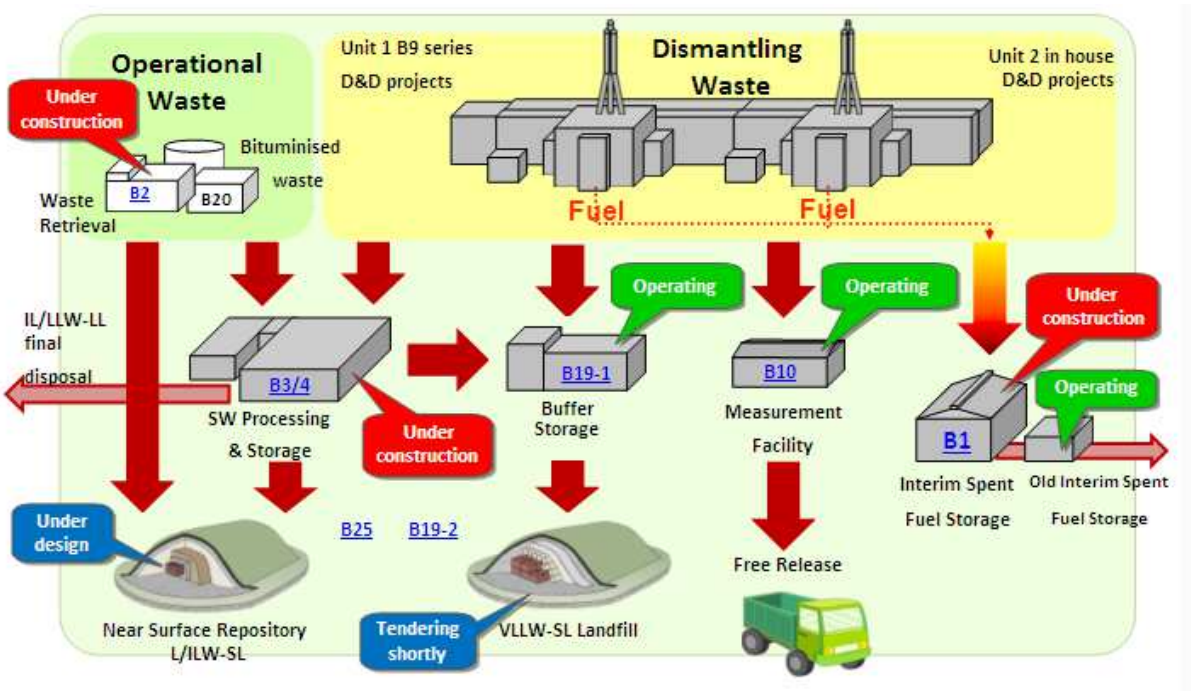

Figure 1. Waste routes scheme during decommissioning of INPP

Table 8. Future Prospects

Type	Current amount	Estimated Current amount when prepared for disposal	Current Disposal Capacity	Total forecast for 2030	Disposal Capacity in 2030	Total forecast for 2050	Disposal Capacity in 2050*
Spent Fuel Storage	2415.952			0	0	2415.952	0
Wet storage (AR)	1742.16			0	0	0	0
Wet storage (AFR)	0						
Dry storage (AR)	673.792			2415.952	0	2415.952	0
Dry storage (AFR)							
Total amount of Spent fuel sent to Reprocessing and Recycling							
Total amount of Spent fuel disposed							
Waste in storage	46453.74 m^3	22547.3 m^3	16500 m^3	10000 m^3	176500 m^3	10000 m^3 **	176500 m^3
Disposed Waste	0	14.417 m^3	16500 m^3	100000 m^3	176500 m^3	150000 m^3 ***	176500 m^3

*Deep geological disposal concept, place selection should be prepared by 2038. Construction of deep geological disposal should be in progress in 2050.

** LL waste in storage facilities for future disposal in deep geological repository.

*** Amount of waste in disposal facilities with packages (60000 m^3 of VLLW with packages or about 40000 m^3 of waste without packages (mass of VLLW approximately 60000 t) and 90000 m^3 – volume of packages with LILW-SL waste (volume of waste about 35000 m^3 or about 45000 t.))

Sources of data, assumptions (especially for future waste forecasts) and references

In the future it is possible that additional radioactive waste (not evaluated in the tables above) is to be generated in case of implementation of New NPP project (Visaginas NPP). At present time the decision should be made on a governmental level.

List of references

1. Lithuanian National Report Under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. Fourth Lithuanian National Report on Compliance with Obligations under the Joint Convention, Vilnius, 2014.

2. Evaluations of Total Amount of Radioactive Waste at INPP and Possibility of Its Disposal and Storage in Existing Disposal And Storage Facilities and in those under Construction (internal document of INPP (in Russian)), 2015-03-06, № At-754(3.166), Visaginas.

3. Radioactive Waste Management Programme. Lithuanian Government approval. 2015 -12 - 23 d. Nr. 1427, Vilnius