PROJECT

Preliminary studies for the decommissioning of the reactor compartments of the former Paldiski military nuclear site and for the establishment of a radioactive waste repository

FINAL SEMINAR

Task 2

Collection and analysis of the available data concerning the reactor compartments and other aspects related to legal and regulatory frameworks

A.N. Abramov, J.M. Simanovsky, T.V. Shidlovskaya
JSC ATOMPROEKT
A.A. Kvar
JSC FCNRS

Republic of Estonia, Tallinn, 14 December 2015

Task 2. Collection of data and overview of national and international requirements

Subtasks for Task 2:

SUBTASK 2.1. COLLECTION AND ANALYSIS OF THE AVAILABLE DATA CONCERNING THE REACTOR COMPARTMENTS AND OTHER RELATED ASPECTS

SUBTASK 2.2. OVERVIEW OF INTERNATIONAL AND NATIONAL RECOMMENDATIONS AND LEGAL ACTS ON THE DECOMMISSIONING OF REACTOR SECTIONS

SUBTASK 2.3. OVERVIEW OF INTERNATIONAL AND NATIONAL RECOMMENDATIONS AND LEGAL ACTS ON THE DISPOSAL OF RADIOACTIVE WASTE

Task 2. Collection of data and overview of national and international requirements

Structure of the Report on Task 2:

CHAPTER 1 COLLECTION AND ANALYSIS OF THE AVAILABLE DATA CONCERNING THE REACTOR COMPARTMENTS AND OTHER RELATED ASPECTS

CHAPTER 2 OVERVIEW OF INTERNATIONAL AND NATIONAL RECOMMENDATIONS AND LEGAL ACTS ON THE DECOMMISSIONING OF REACTOR SECTIONS

CHAPTER 3 OVERVIEW OF INTERNATIONAL AND NATIONAL RECOMMENDATIONS AND LEGAL ACTS ON THE DISPOSAL OF RADIOACTIVE WASTE

4. INPUT DATA FOR THE TASK 4 RELATED TO THE ESTABLISHMENT OF THE DISPOSAL FACILITY

ANNEX 1 ASSESSMENT OF THE LEGISLATION OF THE ESTONIAN REPUBLIC

Subtask 2.1. Collection and analysis of the available data concerning the reactor compartments and other related aspects

There was presented historical background and major data for 346A and 346B reactor compartments:

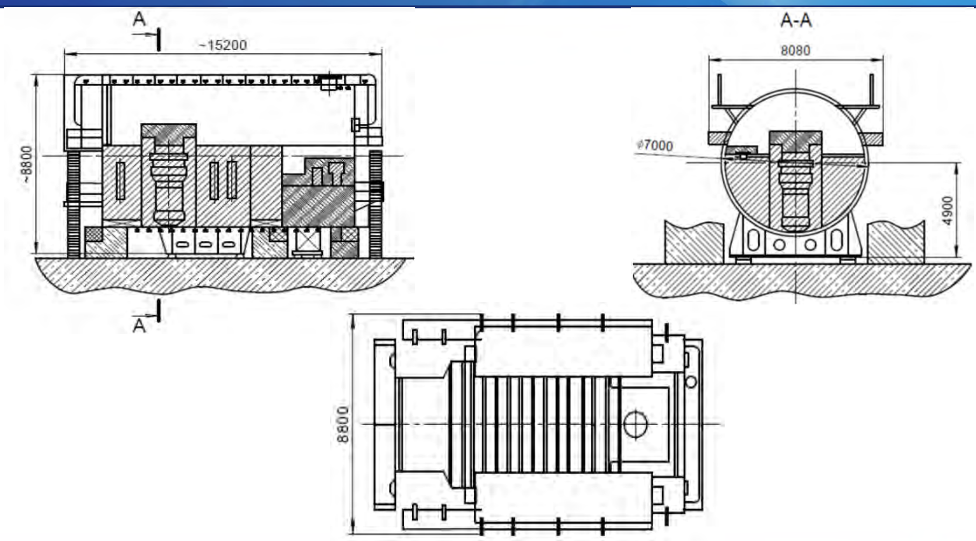
- Key technical specifications of the reactor compartments
- Organization of the reactor compartments decommissioning activities
- Equipment and radiological characteristics of the reactor compartments
- Activities implemented to prepare the reactor compartments for long-term storage
- Radiological situation in the reactor compartments area prior to their emplacement for long-term storage
- Activities implemented at the reactor compartment sarcophagi after 1995
- Indicative analysis of radioactive waste quantities, including operation and decommissioning of a possible NPP in the Republic of Estonia

Subtask 2.1. Collection and analysis of the available data concerning the reactor compartments and other related aspects

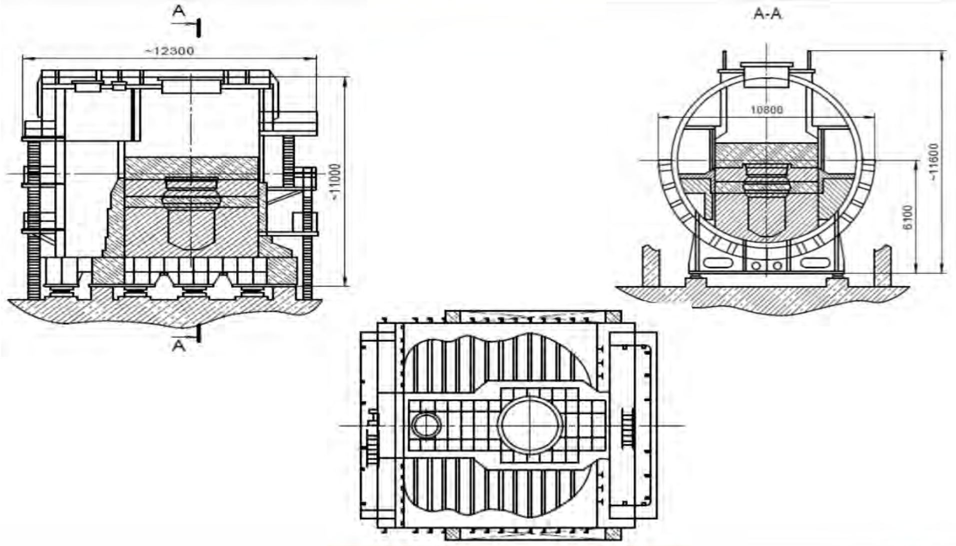
Data collection procedure

- At present the most part of design materials is not available in the archives of Russian enterprises;
- The input data of remained reporting materials, archival data, data of working documents, Technicatome reporting materials (2001) have been used;
- The data on design, weight and size characteristics of the principal equipment of power stands, on the equipment layout inside the reactor compartments (RC), on the design accumulated activity in the equipment are taken from reporting documentation of companies that designed the reactor stands, i.e. JSC Atomproekt, JSC NIKIET, JSC OKBM and CDB ME "Rubin".

Subtask 2.1. Collection and analysis of the available data concerning the reactor compartments and other related aspects
Reactor Compartment of Stand 346A



Subtask 2.1. Collection and analysis of the available data concerning the reactor compartments and other related aspects
Reactor Compartment of Stand 346B



Subtask 2.1. Collection and analysis of the available data concerning the reactor compartments and other related aspects

TECHNICAL PARAMETERS OF THE STANDS

Reactor stand	346A	346B
Reactor type	PWR/VM-A	PWR/VM-4
Thermal power, MW	70	90
External dimensions, meters:		
length	50	50
diameter	7,5	9,5
Stages of operation:		
Commissioning	10.04.1968	10.02.1983
Final shutdown	January1989	December 1989
Total time of operation, hours	20281	5333
Reactor reload	1980	-
Final unloading	July – September 1994	

Subtask 2.1. Stand 346A
Activity after the reactor shutdown for the cooling periods of 26 and 50 years, Bq

Induced radionuclide activity in the principal equipment (Bq)

Radio nuclide	T = 26 (2015)			T = 50 (2039)		
	Reactor	Shield Tank	Whole reactor plant	Reactor	Shield Tank	Whole reactor plant
^{55}Fe	8,4 E+10	4,7 E+09	8,5 E+10	1,96 E+08	11 E+6	1,99 E+08
^{60}Co	4,5 E+12	5,0 E+10	4,6 E+12	1,93 E+11	2,12 E+09	1,95 E+11
^{59}Ni	1,2 E+12	1,4 E+10	1,2 E+12	1,17 E+12	1,37 E+10	1,19 E+12
^{63}Ni	7,8 E+13	9,2 E+11	7,9 E+13	6,66 E+13	7,81 E+11	6,73 E+13
Total	8,4 E+13	9,9 E+11	8,5 E+13	6,81 E+13	7,99 E+11	6,88 E+13

Corrosion product activity in the primary circuit (Bq)

Equipment	T = 26 (2015)	T = 50 (2039)
Reactor and primary circuit	1,7 E+11	6,79 E+10
Steam Generator	1,5 E+10	5,98 E+09
Pressurizer	7,5 E+09	3,09 E+08
ГЦЭН-146 (reactor coolant pump)	2,3 E+08	9,58 e+07
ВЦЭН- 147 (auxiliary circulating pump)	1,9 E+08	7,66 E+07
ХГЦЭН-601 (reactor coolant pump cooler)	4,3 E+08	1,77 E+08
ХГЦЭН-146М (reactor coolant pump cooler)	2,5 E+08	1,02 E+08
ХВЦЭН-147М (reactor coolant pump cooler)	9,3 E+07	3,83 E+07

Subtask 2.1. Stand 346B
Induced radionuclide activity in the principal equipment after the reactor shutdown for the cooling periods of 26 and 50 years, Bq

Equipment	Radionuclide	T=26 2015)	T=50 (2039)
Reactor	Σ	2,9 E+13	1,5 E+13
	Fe-55	3,6E+11	8,37E+08
	Co-60	5,4E+12	2,3 E+11
	Ni-59	1,5 E+11	1,5 E +11
	Ni-63	1,4 E+13	1,2 E+13
	Nb-94	1,4 E+10	1,4 E+10
	Eu-152	5,1 E+12	1,5 E+12
	Eu-154	3,3 E+12	4,8 E+11
Steam Generator	Σ	1,7 E+9	1,2 E+9
	Fe-55	8,1 E+7	1,9 E+5
	Co-60	3,3 E+8	1,4 E+7
	Ni-59	1,5 E+7	1,5 E+7
	Ni-63	1,3 E+9	1,1 E+9
Filter cooler	Σ	1,2 E+9	7,8 E+8
	Fe-55	4,7 E+7	1,1E+5
	Co-60	1,9 E+8	8,1 E+6
	Ni-59	8,5 E+6	8,5 E+6
	Ni-63	9,2 E+8	7,8 E+8
Pressurizer	Σ	3,6 E+7	1,9 E+7
	Fe-55	9,4 E+6	2,2 E+4
	Co-60	3,5 E+6	1,5 E+5
	Ni-59	2,3 E+5	2,3 E+5
	Ni-63	2,2 E+7	1,9 E+7
Ion exchange filter	Σ	1,2 E+8	7,8 E+7
	Fe-55	4,0 E+6	9,3 E+3
	Co-60	1,8 E+7	7,8 E+5
	Ni-59	8,1 E+5	8,1 E+5
	Ni-63	9,2 E+7	7,8 E+7

Equipment	Radionuclide	T=26 (2015)	T=50 (2039)
Ion exchange filter	Σ	1,2 E+8	7,8 E+7
	Fe-55	4,0 E+6	9,3 E+3
	Co-60	1,8 E+7	7,8 E+5
	Ni-59	8,1 E+5	8,1 E+5
	Ni-63	9,2 E+7	7,8 E+7
Primary circuit pump	Σ	7,7 E+7	5,2 E+7
	Fe-55	3,2 E+6	7,4 E+3
	Co-60	1,2 E+7	5,2 E+5
	Ni-59	5,5 E+5	5,5 E+5
	Ni-63	6,1 E+7	5,2 E+7
Cooldown pump	Σ	1,2 E+7	8,1 E+6
	Fe-55	1,8 E+6	2,5 E+3
	Co-60	1,7 E+6	7,4 E+4
	Ni-59	9,3 E+4	9,3 E+4
	Ni-63	9,6 E+6	8,1 E+6
Shield tank	Σ	4,1 E+11	3,1 E+11
	Fe-55	4,1 E+10	9,5 E+7
	Co-60	1,2 E+10	5,2 E+8
	Ni-59	4,1 E+9	4,1 E+9
	Ni-63	3,5 E+11	3,0 E+11
	Nb-94	3,3 E+8	3,3 E+8
Concrete blocks of containment (nearest to the reactor)	Σ	2,1 E+6	1,2 E+6
	Fe-55	1,6 E+5	3,7 E+2
	Co-60	4,9 E+5	2,1 E+4
	Ni-59	1,5 E+4	1,5 E+4
	Ni-63	1,4 E+6	1,2 E+6
Whole reactor plant		**2,9 E+13**	**1,5 E+13**

Subtask 2.1. Concrete and Ionizing radiation sources inside reactor compartments

Concrete

During preparation for the long-term safe storage to ensure additional protection for the equipment of the nuclear power unit, concrete was laid inside the reactor compartment:

Stand 346A: ~ 30,75 cubic meters (67650 kg);
Stand 346B: ~ 41,25 cubic meters (90700 kg).

Ionizing radiation sources placed within concrete poured inside Stand 346A

About 100 sources (used for calibrating radiological measurement equipment) were entombed in concrete poured 346A reactor compartment within containers (exact location is not available):

- **neutron sources: Pu-238, Be-7, Cf-252**
- **γ-radiation sources: Co-60**
- **β-radiation sources: Na-22, Cl-36, Sr-90/Y-90, Cs-137, Tl-204**
- **α-radiation sources: Pu-239**

Subtask 2.1. Radioactive waste inside reactor compartments

Waste placed inside reactor compartments before conservation:

Stand 346 A (about 15 tons)

- cut-off pipes, valves, tools, small parts, retrieval equipment, containers, spent fuel cases;
- Spent enclosed sources of ionizing radiation in containers, including: drum transfer cask packaged with gamma radiation sources of cobalt - 60 (05 pcs.) weight - 1,200 kg; paraffin container with neutron radiation sources ($5 \cdot 10^7$ n/s·) in a 05 pcs. weight - 400 kg, etc.

Stand 346 Б (about 10 tons)

- metal waste (tool, retrieval equipment, electrical equipment, etc.)
- Organic waste - air filter weighting ~ 200 kg.

Volumes of unremovable water remained in circuits and equipment of the Stands:

about 1,370 liters within Stand **346A** (about 360 litres of borated water in the primary circuit);
about 2,280 liters within Stand **346B** (about 600 litres of this borated water is in the primary circuit).

Substage 2.1. Required additional surveys

- Reactor compartment power units are radiation-hazardous facilities.
- The comprehensive engineering and radiation survey (CERS) is required to obtain proved data for pre-design and design stages and to justify safety during decommissioning activities
- CERS is a set of measures aimed to obtain the data on the engineering, technical and radiological condition of buildings, structures and equipment, as well as on the radiation situation inside the reactor compartments, on volumetric and surface radioactive contamination of rooms and equipment, quality and volume of radioactive waste
- It is recommended to start with engineering investigations of the main technological building and site structures in 2016-2017 as the current condition of the main technological building is not verified.

Substage 2.1. Preliminary indication of waste volumes of stands 346A and 346B decommissioning various options

Waste denomination	Stand 346 A		Stand 346 B	
	Mass, kg	Volume, m³	Mass, kg	Volume, m³
Dismantling of RC with large-sized fragmentation				
Long-lived ILW, LLW from dismantling of RC primary circuit equipment	115,000	220	210,000	384
Waste from RC dismantling (removed from under control and non-radioactive)	740,000	370	740,000	370
Radioactive waste from the concrete cutting with RW inside the compartments (categories of ILW compartments with IRS, LLW, VLLW - for the rest of the concrete compartments)	656000	73	906000	55
Waste from sarcophagus dismantling (non-radioactive)	650,000	650	610,000	610
Total RW	**180,000**	**~293**	**300,000**	**439**
Total of non-radioactive waste	**1,390,000**	**1020**	**1,350,000**	**980**
Dismantling of RC with small-size fragmentation				
Long-lived ILW, LLW from dismantling of RC primary circuit equipment	115,000	197	210,000	288
Waste from RC dismantling (removed from under control and non-radioactive)	740,000	370	740,000	370
Radioactive waste separated from the concrete inside the compartments (category of ILW compartments with IRS, LLW, VLLW - for the rest of the concrete compartments)	15,000	17	10,000	17
Concrete (non-radioactive)	50,000	50	80,000	80
Waste from sarcophagus dismantling (non-radioactive)	650,000	650	610,000	610
Total RW	**130,000**	**214**	**220,000**	**305**
Total of non-radioactive waste	**1,440,000**	**1070**	**1,430,000**	**1060**
RC disposal as a whole				
Radioactive waste of category ILW, LLW in RC volume	920,000	~700	1,040,000	900
Waste from sarcophagus dismantling (non-radioactive)	650,000	650	610,000	610
Total RW	**920,000**	**700**	**1,040,000**	**900**
Total of non-radioactive waste	**650,000**	**650**	**610,000**	**610**

PRELIMINARY STUDIES FOR THE DECOMMISSIONING OF THE REACTOR COMPARTMENTS OF THE FORMER PALDISKI MILITARY NUCLEAR SITE AND FOR THE ESTABLISHMENT OF A RADIOACTIVE WASTE REPOSITORY
EKSORTUS FCNRS

Substage 2.1. Indicative analysis of radioactive waste volumes from operation and decommissioning of possible NPP (1000 MW unit)

Summary of the rated annual volume of conditioned (solid) radioactive waste from the power unit with AP-1000 reactor plant under normal operation

Name	Class of radioactive waste	Normal volume, m³	Maximum volume m³
Waste ion-exchange resins	ILW (Intermediate level waste)	7.8	15.6
Birch activated carbon (moist)	ILW (Intermediate level waste)	0.6	1.1
Filter-cartridge	ILW (Intermediate level waste)	0.2	0.4
Compressible paper, clothing, plastic, PVC, PPE, etc.	LLW (Low level waste)	135	206
Non-compressible: metal fragments, glass, wooden fragments	LLW (Low level waste)	6.6	10.6
Waste ion-exchange resins	LLW (Low level waste)	3.9	7.7
Birch activated carbon (moisture-free)	LLW (Low level waste)	0.3	3.3
Different materials	LLW (Low level waste)	1	2
Total, m³/year:		155.4	246.7

The total amount of conditioned radioactive waste generated during decommissioning of AP-1000 power unit

Activity	Volume, m³	Weight, tons
LLW (Low level waste)	2911,937	2316,10
ILW (Intermediate level waste)	3151,707	2540,66
HLRW	13,740	124,00
Total:	6077,384	4980,76

Thus, the total amount of conditioned radioactive waste expected to be generated during operation and decommissioning of a power plant with AP-1000 unit is (at least) - 15,401.5 m³.

The total amount of conditioned radioactive waste expected to be generated during operation and decommissioning of a VVER-1000 unit power plant is (at least) – 7,145 m³.

Subtask 2.2. Overview of international and national recommendations and legal acts on the decommissioning of reactor compartments

- **Overview of the IAEA standards and guidelines for the decommissioning of nuclear and radiation hazardous facilities (NF)**
  - Decommissioning of Facilities, IAEA General Safety Requirements, Part 6 (GSR Part 6), 2014
  - Safety Assessment for the Decommissioning of Facilities Using Radioactive Material, IAEA Safety Guide No. WS-G-5.2
- **Overview of the European Union legal framework with respect to nuclear facilities decommissioning**
  - Council Directive 2011/70/Euratom of 19 July 2011
  - Directive 2014/52/EU of 16 April 2014
  - Council Directive 2013/59/Euratom of 5 December 2013
  - Commission Recommendation of 24 October 2006 (2006/851/Euratom)
- **Overview of Russian recommendations and legal acts on nuclear facilities decommissioning**
- **Overview of the legal framework of the Republic of Estonia with regard to nuclear facilities decommissioning**
  - Radiation Act enforced in 1 May 2004
  - Environmental Supervision Act, enforced in 06 June 2001
  - Emergency Act, enforced in 15 June 2009
  - Environmental Impact Assessment and Environmental Management System Act
  - And other documents concerning reactor compartments decommissioning (all in all 32 documents)

Subtask 2.3. Overview of international and national recommendations and legal acts on the final disposal of radioactive waste

- **Overview of the standards and IAEA recommendations concerning predisposal management and disposal of radioactive waste**
  - Predisposal Management of Radioactive Waste, IAEA General Safety Requirements Part 5, 2010
  - Predisposal Management of Low and Intermediate Level Radioactive Waste, IAEA Safety Guide No. WS-G-2.5, 2005
  - Predisposal Management of High Level Radioactive Waste, IAEA Safety Guide No.WS-G-2.6, 2003
  - Disposal of Radioactive Waste, IAEA Specific Safety Requirements No.SSR-5, 2011
  - Near Surface Disposal Facilities for Radioactive Waste, Specific Safety Guide No.SSG-29, 2014
  - Geological Disposal Facilities for Radioactive Waste. Specific Safety Guide No. SSG-14
- **Overview of the standards and IAEA recommendations regarding the RW classification and transportation**
  - Standards Classification of Radioactive Waste for protecting people and the environment, IAEA General Safety Guide No. GSG-1, 2009
  - Regulations for the Safe Transport of Radioactive Material, IAEA Specific Safety Requirements No.SSR-6, 2012
- **Overview of the legislative framework of the European Union with respect to the radioactive waste management and transportation**
  - Council Directive 2011/70/EURATOM of 19 July 2011
  - Council Directive 2013/59/EURATOM of 5 December 2013
  - Council Directive 2006/117/EURATOM of 20 November 2006

Subtasks 2.2, 2.3 Analysis of Estonian legislative framework and regulations ANNEX 1 Assessment of the Legislation of the Estonian Republic

32 documents

Regulation # 163;	Radiation Act;
Regulation # 193;	Environmental Monitoring Act;
Regulation # 41;	Environmental Supervision Act;
Regulation # 86;	Emergency Act;
Regulation # 93;	Environmental Impact Assessment and Environmental Management System Act;
Regulation # 113;	
Regulation # 8;	General Part of the Environmental Code Act;
Regulation # 10;	Building Code;
Regulation # 45;	Planning Act;
Regulation # 243;	Occupational Health and Safety Act;
Regulation # 244;	Road Transport Act;
Regulation # 110;	Industrial Emissions Act;
Regulation # 50;	Chemicals Act;
Regulation # 57;	Ambient Air Protection Act;
Regulation # 92;	Waste Act;
Regulation # 15;	Fire Safety Act.
Regulation # 5;	

Assessment areas

Radioactive Waste Management
Transportation
Decommissioning
Disposal

Activities are not covered or covered partly	*Recommendation EU document*	*Recommendation IAEA document*

Subtasks 2.2, 2.3 Analysis of Estonian legislative framework and regulations

Analysis of 32 documents of the legislative framework and regulatory acts of the Republic of Estonia has been performed for the purpose of distribution of the requirements in the field of:

- **RW handling;**
- **RCs decommissioning;**
- **RW transportation;**
- **RW disposal.**

The analysis has revealed the following:

- **There are no special regulatory acts that regulate the process of decommissioning and disposal of the radiation hazardous facilities in the Republic of Estonia;**
- **decommissioning is defined as part of operations for RW handling, it is covered by the requirements for RW handling**
- **recommendations on amendments to documents regarding decommissioning and disposal have been given**

Subtasks 2.2, 2.3 Analysis of Estonian legislative framework and regulations

- **The need for introducing amendments into the legislative and regulatory framework of the Republic of Estonia is stipulated by work plans for RW handling in the Republic of Estonia; updating the regulatory framework of the EU and the IAEA (the EU Directives 2013/59/EURATOM, 2011/70/EURATOM).**

- **Amendments made to the legislative and regulatory framework of the Republic of Estonia shall be sufficient for:**
  - **development of the design documentation for decommissioning the reactor compartments in Paldiski and RC dismantling;**
  - **development of the design documentation for construction and operation of the RW repository;**
  - **handling of generated RW ;**
  - **obtaining licenses for the right to carry out the activities.**

Subtasks 2.2, 2.3 Analysis of Estonian legislative framework and regulations

Proposals concerning introducing the amendments to the Radiation Act, Regulation No 10 and the Waste Management Act with respect to decommissioning:

- identification of specific requirements to the license owner who practices radioactive waste disposal activities;
- provision of financial resources to cover the costs related to safe decommissioning, including waste management;
- special attention shall be paid to the possibility of environmental pollution due to the formation and release of dust and aerosols of radioactive liquids, as well as vast quantities of the waste to be generated during decommissioning.
- due to fact that during decommissioning large quantities of metal waste are to be generated, that are to be exempted from regulatory control, Regulation No. 10 and the Waste Management Act shall be amended.

Subtasks 2.2, 2.3 Analysis of Estonian legislative framework and regulations

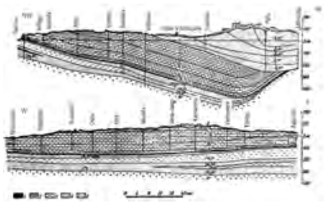
The main proposals for introducing amendments to the Radiation Act with respect to RW disposal and Regulation No. 8 with respect to RW disposal:

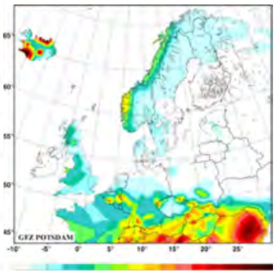
- definition of the regulator's role in the planning, designing, building and operational stages of the radioactive waste management site, including disposal facilities of all types
- definition of legal, technical and financial responsibilities for organisations involved in radioactive waste management activities in the course of radioactive waste disposal;
- incorporation of options for waste disposal planning and implementation into the national policy;
- division of the activities at different stages of the disposal facility operation: pre-operational, operational and post-operational periods;
- identification of specific requirements to the license owner who practices radioactive waste disposal activities;
- guidelines and details pertaining to studies and identification of site characteristics during the building period and following its shutdown;
- etc.
- review of the classification of the radioactive waste taking into account the classification proposed by IAEA;
- development of the waste acceptance criteria for radioactive waste as part of the design process of the disposal facility;
- any other issues concerning waste acceptance for disposal and safety assessment of RW disposal

Task 2.
4. Input data for the Task 4 related to the establishment of the disposal facility

Reviewed issues

- Regional Geology
- Tectonic and seismicity
- Stratigraphy
- Geophysical Investigations
- Geology and disposal
- Site Geology
- Regional and Site Hydrogeology
- Groundwater
- Monitoring data
- Potential sites for the RW disposal





The most promising area with regard to the safety of the proposed Repository construction site needs to be selected based on comparing the following alternative characteristics:

- geological and hydrogeological conditions that will ensure reliability of natural barriers;
- minimum required land allocation that will determine a potential sanitary protection area;
- remoteness from surface water courses and water intake structures;
- minimum population density and the degree of remoteness from big cities;
- any protected areas, such as national parks;
- any natural resources.

When selecting the repository construction site, it is reasonable to consider the areas with the outcrops of the Cambrian sediments, such as Narva, Viivikonna, Jõhvi, Võhma and Võru.

Task 2.
4. Additional recommendations for a disposal site

Description of the selection criteria

Technical/safety criteria

Geotechnical stability;
Seismicity, tectonic activity, and dynamic soil liquefaction;
Hydrogeological properties;
Mineral resources;
Human activities;
Transport conditions.

Social and economic criteria

Economic environment;
Public acceptance.

Exclusion criteria for the territories

legal and environmental restriction	excluded due to technical and safety reasons
Protected territories, nature protection reservations, territories of European ecological network Natura 2000 and cultural heritage territories; Urban and recreation territories; Mining territories; Waterworks and inland water bodies; Air grounds, oil and gas pipelines protection zones; Military grounds and other military facilities; National border zone.	Highly compressible soils and physically or chemically unstable rocks; Seismic territories, presence of active tectonic faults and high liquefaction of the soil; Presence of mineral resources; Unstable slopes; Active erosion areas; Flooded areas.

Task 2.
4. Additional recommendations for a disposal site
Main technical characteristics of disposal facility

RW description	RW weight, kg	Specific activity, Bq/kg	RW category based on GSG-1	Radionuclides determining rating as RW	Disposal method
Stand 346A					
VM-A reactor (with internals and control rods)	30 000	2.3 E+09	ILW (long-lived)	Co-60, Ni-59, Ni-63 (97.8%)	Intermediate depth disposal at a depth from several tens to several hundreds of meters
IWS tank	52 000	1.6E+7	ILW (long-lived)	Co-60, Ni-59, Ni-63	
Total:	82 000				
Stand 346B					
VM-4 reactor (with internals and control rods)	50 400	3.0E+08	ILW (long-lived)	Co-60, Ni-59, Ni-63 Nb-94 Eu-152 Eu-154	Intermediate depth disposal at a depth from several tens to several hundreds of meters
SG - primary circuit pump assembly	71 000	2.1E+04	LLW (short-lived)	Co-60,	Near-surface disposal
Heat exchanger of the primary circuit cooling system filter	2 780	2.8E+05	ILW (long-lived)	Co-60, Ni-63	Intermediate depth disposal at a depth from several tens to several hundreds of meters
Primary circuit cooling system filter	1 980	3.9E+04	LLW (short-lived)	Co-60	Near-surface disposal
Shield tank	66 180	4.6E+06	ILW (long-lived)	Co-60, Ni-63 Nb-94	Intermediate depth disposal at a depth from several tens to several hundreds of meters
Total:	192 340				
346A and 346B total:	**274 340**				

Task 2. Collection of data and overview of national and international requirements

- **The procedure of collection and assessment of the input data:- available documents; - the expertise by experts; - technical visits, seminars and technical meetings.**
- **The current status of the facility – safe storage with the minimum period up to the year of 2045.The further decision could take into account approaches of immediate decommissioning (50 years after shut-down) and deferred decommissioning (prolongation of the safe storage). It is recommended to coordinate further decision with the general designer of the facility.**
- **Additional data / uncertainties - for taking future decisions for subsequent works at pre-design and design stages, environment impact assessment procedure etc. - need of the comprehensive engineering and radiation survey of the reactor compartment building, adjacent areas, premises etc. It is recommended to start engineering and radiation survey of the site structures in 2016-2017 to verify the current status.**
- **The indicative analysis of quantity of the decommissioning wastes, currently stored waste and waste to be generated by 2039 gives the assessed volume of the waste to be disposed – about 2500-3000 cubic meters.**
- **The analysis of amount of radioactive wastes generation from the possible single-unit NPP (1,000 MW): Conditioned radioactive waste from operation and decommissioning of a power plant with AP-1000 unit is expected (at least) 15 401,5 m^3. Conditioned radioactive waste from operation and decommissioning of a VVER-1000 unit is expected (at least) 7 145 m^3.**
- **The review of international and state recommendations and regulatory documents on the decommissioning / disposal has demonstrated a necessity of amendments into the legislative and regulatory framework.**
- **According to the Minister of the Environment Regulation No. 8 "Radioactive waste classification, recording, handling and transfer of radioactive waste acceptance criteria", wastes from the decommissioning of the reactor compartments are classified as low and medium active short-term and long-term waste.**
- **The current report and its results are the preliminary studies for the decommissioning of the reactor compartments and for the establishment of a radioactive waste repository.**
- **In order to maintain safety of the reactor compartments, it is necessary to provide continuous control and monitoring of the state of reactor compartment, building, adjacent area as well as maintenance and repair of the building and premises.**

THANK YOU!