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

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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 346B

### Technical Parameters of the Stands

<table>
<thead>
<tr>
<th>Reactor stand</th>
<th>346A</th>
<th>346B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactor type</td>
<td>PWR/VM-A</td>
<td>PWR/VM-4</td>
</tr>
<tr>
<td>Thermal power, MW</td>
<td>70</td>
<td>90</td>
</tr>
<tr>
<td>External dimensions, meters:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>length</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>diameter</td>
<td>7,5</td>
<td>9,5</td>
</tr>
<tr>
<td>Stages of operation:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commissioning</td>
<td>10.04.1968</td>
<td>10.02.1983</td>
</tr>
<tr>
<td>Final shutdown</td>
<td>January 1989</td>
<td>December 1989</td>
</tr>
<tr>
<td>Total time of operation, hours</td>
<td>20281</td>
<td>5333</td>
</tr>
<tr>
<td>Reactor reload</td>
<td>1980</td>
<td>-</td>
</tr>
<tr>
<td>Final unloading</td>
<td>July – September 1994</td>
<td></td>
</tr>
</tbody>
</table>
### Subtask 2.1. Stand 346A
Activity after the reactor shutdown for the cooling periods of 26 and 50 years, Bq

<table>
<thead>
<tr>
<th>Radioisotope</th>
<th>Equipment</th>
<th>T = 26 (2015)</th>
<th>T = 50 (2039)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reactor</td>
<td>Whole reactor plant</td>
<td>Reactor</td>
</tr>
<tr>
<td><strong>Fe</strong></td>
<td>6.4 E+10</td>
<td>4.7 E+09</td>
<td>1.96 E+08</td>
</tr>
<tr>
<td><strong>Co</strong></td>
<td>4.5 E+12</td>
<td>5.0 E+10</td>
<td>1.93 E+11</td>
</tr>
<tr>
<td><strong>Ni</strong></td>
<td>1.2 E+12</td>
<td>1.4 E+10</td>
<td>1.17 E+12</td>
</tr>
<tr>
<td><strong>Cu</strong></td>
<td>7.8 E+13</td>
<td>9.2 E+11</td>
<td>6.66 E+13</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>8.4 E+13</td>
<td>9.9 E+11</td>
<td>8.61 E+13</td>
</tr>
</tbody>
</table>

### 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

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Radionuclide</th>
<th>T=26 (2015)</th>
<th>T=50 (2039)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactor</td>
<td><strong>Fe</strong></td>
<td>1.2 E+8</td>
<td>7.8 E+7</td>
</tr>
<tr>
<td></td>
<td><strong>Co</strong></td>
<td>1.2 E+8</td>
<td>7.8 E+7</td>
</tr>
<tr>
<td></td>
<td><strong>Ni</strong></td>
<td>1.2 E+8</td>
<td>7.8 E+7</td>
</tr>
<tr>
<td></td>
<td><strong>Cu</strong></td>
<td>1.2 E+8</td>
<td>7.8 E+7</td>
</tr>
<tr>
<td>Steam Generator</td>
<td><strong>Fe</strong></td>
<td>1.2 E+8</td>
<td>7.8 E+7</td>
</tr>
<tr>
<td>Filter cooler</td>
<td><strong>Fe</strong></td>
<td>1.2 E+8</td>
<td>7.8 E+7</td>
</tr>
<tr>
<td>Pressurizer</td>
<td><strong>Fe</strong></td>
<td>1.2 E+8</td>
<td>7.8 E+7</td>
</tr>
<tr>
<td>Ion exchange filter</td>
<td><strong>Fe</strong></td>
<td>1.2 E+8</td>
<td>7.8 E+7</td>
</tr>
</tbody>
</table>

**Notes:**
- For the cooling periods of 26 and 50 years, Bq.
- Induced radionuclide activity in the principal equipment (Bq).
- Corrosion product activity in the primary circuit (Bq).

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### Notes:
- For the decommissioning of the reactor compartments of the former Polish military nuclear site and for the establishment of a radioactive waste repository.
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 (5·10^7 n/s) in a 05 pcs. weight - 400 kg, etc.
Stand 346 B (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

<table>
<thead>
<tr>
<th>Waste denomination</th>
<th>Stand 346 A</th>
<th>Stand 346 B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mass, kg</td>
<td>Volume, m³</td>
</tr>
<tr>
<td>Dismantling of RC with large-sized fragmentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-lived ILW, LLW from dismantling of RC primary circuit equipment</td>
<td>115,000</td>
<td>220</td>
</tr>
<tr>
<td>Waste from RC dismantling (removed from under control and non-radioactive)</td>
<td>740,000</td>
<td>370</td>
</tr>
<tr>
<td>Radioactive waste from the concrete cutting with RW inside the compartments (categories of LW compartments with IRS, LLW, VLLW - for the rest of the concrete compartments)</td>
<td>650,000</td>
<td>370</td>
</tr>
<tr>
<td>Waste from sarcophagus dismantling (non-radioactive)</td>
<td>650,000</td>
<td>370</td>
</tr>
<tr>
<td>Total RW</td>
<td>1,800,000</td>
<td>370</td>
</tr>
<tr>
<td>Total of non-radioactive waste</td>
<td>1,390,000</td>
<td>1020</td>
</tr>
<tr>
<td>Dismantling of RC with small-size fragmentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-lived ILW, LLW from dismantling of RC primary circuit equipment</td>
<td>115,000</td>
<td>197</td>
</tr>
<tr>
<td>Waste from RC dismantling (removed from under control and non-radioactive)</td>
<td>740,000</td>
<td>370</td>
</tr>
<tr>
<td>Radioactive waste separated from the concrete inside the compartments (category of ILW compartments with IRS, LLW, VLLW - for the rest of the concrete compartments)</td>
<td>15,000</td>
<td>17</td>
</tr>
<tr>
<td>Concrete (non-radioactive)</td>
<td>50,000</td>
<td>50</td>
</tr>
<tr>
<td>Waste from sarcophagus dismantling (non-radioactive)</td>
<td>650,000</td>
<td>370</td>
</tr>
<tr>
<td>Total RW</td>
<td>130,000</td>
<td>214</td>
</tr>
<tr>
<td>Total of non-radioactive waste</td>
<td>1,440,000</td>
<td>1070</td>
</tr>
<tr>
<td>RC disposal as a whole</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radioactive waste of category ILW, LLW in RC volume</td>
<td>920,000</td>
<td>700</td>
</tr>
<tr>
<td>Waste from sarcophagus dismantling (non-radioactive)</td>
<td>650,000</td>
<td>650</td>
</tr>
<tr>
<td>Total RW</td>
<td>920,000</td>
<td>700</td>
</tr>
<tr>
<td>Total of non-radioactive waste</td>
<td>650,000</td>
<td>650</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Name</th>
<th>Class of radioactive waste</th>
<th>Normal volume, m$^3$</th>
<th>Maximum volume, m$^3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste ion-exchange resins</td>
<td>ILW (intermediate level waste)</td>
<td>7.8</td>
<td>15.6</td>
</tr>
<tr>
<td>Birch activated carbon (moist)</td>
<td>ILW (intermediate level waste)</td>
<td>0.6</td>
<td>1.1</td>
</tr>
<tr>
<td>Filter-cartridge</td>
<td>ILW (intermediate level waste)</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Compressible paper, clothing, plastic, PVC, PPE, etc.</td>
<td>LLW (Low level waste)</td>
<td>135</td>
<td>206</td>
</tr>
<tr>
<td>Non-compressible: metal fragments, glass, wooden fragments</td>
<td>LLW (Low level waste)</td>
<td>6.6</td>
<td>10.6</td>
</tr>
<tr>
<td>Waste ion-exchange resins</td>
<td>LLW (Low level waste)</td>
<td>3.9</td>
<td>7.7</td>
</tr>
<tr>
<td>Birch activated carbon (moisture-free)</td>
<td>LLW (Low level waste)</td>
<td>0.3</td>
<td>3.3</td>
</tr>
<tr>
<td>Different materials</td>
<td>LLW (Low level waste)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Total, m$^3$/year:</td>
<td></td>
<td>155.4</td>
<td>246.7</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Activity</th>
<th>Volume, m$^3$</th>
<th>Weight, tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLW (Low level waste)</td>
<td>2911,937</td>
<td>2316,10</td>
</tr>
<tr>
<td>ILW (Intermediate level waste)</td>
<td>3151,707</td>
<td>2540,66</td>
</tr>
<tr>
<td>HLRW</td>
<td>13,740</td>
<td>124,00</td>
</tr>
<tr>
<td>Total</td>
<td>6077,384</td>
<td>4980,76</td>
</tr>
</tbody>
</table>

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 m$^3$.

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
- Overview of the European Union legal framework with respect to nuclear facilities decommissioning
  - Directive 2014/52/EU of 16 April 2014
- 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
  - Disposal of Radioactive Waste, IAEA Specific Safety Requirements No.SSR-5, 2011

• Overview of the standards and IAEA recommendations regarding the RW classification and transportation
  - 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

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; Regulation # 193; Regulation # 41;
- Regulation # 86; Regulation # 93; Regulation # 113;
- Regulation # 8; Regulation # 11; Regulation # 45;
- Regulation # 243; Regulation # 244; Regulation # 110;
- Regulation # 50; Regulation # 57; Regulation # 92;
- Regulation # 15; Regulation # 5;

- Radiation Act;
- Environmental Monitoring Act;
- Environmental Supervision Act;
- Emergency Act;
- Environmental Impact Assessment and Environmental Management System Act;
- General Part of the Environmental Code Act;
- Planning Act;
- Occupational Health and Safety Act;
- Road Transport Act;
- Industrial Emissions Act;
- Chemicals Act;
- Ambient Air Protection Act;
- Waste Act;
- Fire Safety Act.

Activities are not covered or covered partly

Recommendation EU document | Recommendation IAEA document

Assessment areas

Radioactive Waste Management
Transportation
Decommissioning
Disposal
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.

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.

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:

- geographical 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.

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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.

<table>
<thead>
<tr>
<th>Exclusion criteria for the territories</th>
<th>legal and environmental restriction</th>
<th>excluded due to technical and safety reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td></td>
<td>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.</td>
</tr>
</tbody>
</table>
Task 2.

4. Additional recommendations for a disposal site

Main technical characteristics of disposal facility

<table>
<thead>
<tr>
<th>RW description</th>
<th>RW weight, kg</th>
<th>Specific activity, Bq/kg</th>
<th>RW category based on GSST</th>
<th>Radionuclides determining rating as RW</th>
<th>Disposal method</th>
</tr>
</thead>
<tbody>
<tr>
<td>VM-A reactor (with internals and</td>
<td>30000</td>
<td>2.3E+09</td>
<td>LLW (long-lived)</td>
<td>Co-60, Ni-59, Ni-63 (97.8%)</td>
<td>Intermediate depth disposal at a depth from several tens to several hundreds of meters</td>
</tr>
<tr>
<td>control rods)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IWS tank</td>
<td>52000</td>
<td>1.6E+07</td>
<td>LLW (long-lived)</td>
<td>Co-60, Ni-59, Ni-63</td>
<td>Intermediate depth disposal at a depth from several tens to several hundreds of meters</td>
</tr>
<tr>
<td>Total</td>
<td>82000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VM-4 reactor (with internals and</td>
<td>50400</td>
<td>3.0E+08</td>
<td>LLW (long-lived)</td>
<td>Co-60, Ni-59, Ni-63, Nb-94, Eu-152, Eu-154</td>
<td>Intermediate depth disposal at a depth from several tens to several hundreds of meters</td>
</tr>
<tr>
<td>control rods)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SG - primary circuit pump assembly</td>
<td>71000</td>
<td>2.1E+04</td>
<td>LLW (short-lived)</td>
<td>Co-60, Ni-63</td>
<td>Near-surface disposal</td>
</tr>
<tr>
<td>Heat exchanger of the primary circuit</td>
<td>2780</td>
<td>2.8E+05</td>
<td>LLW (long-lived)</td>
<td>Co-60, Ni-63</td>
<td>Intermediate depth disposal at a depth from several tens to several hundreds of meters</td>
</tr>
<tr>
<td>cooling system filter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary circuit cooling system filter</td>
<td>1980</td>
<td>3.9E+04</td>
<td>LLW (short-lived)</td>
<td>Co-60</td>
<td>Near-surface disposal</td>
</tr>
<tr>
<td>Shield tank</td>
<td>66180</td>
<td>4.6E+06</td>
<td>LLW (long-lived)</td>
<td>Co-60, Ni-63, Nb-94</td>
<td>Intermediate depth disposal at a depth from several tens to several hundreds of meters</td>
</tr>
<tr>
<td>Total</td>
<td>192340</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>346A and 346B total:</td>
<td>274340</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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 m³. Conditioned radioactive waste from operation and decommissioning of a VVER-1000 unit is expected (at least) 7 145 m³.
- 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!