ГОСУДАРСТВЕННАЯ КОРПОРАЦИЯ ПО АТОМНОЙ ЭНЕРГИИ «РОСАТОМ»

Experience of Leading Institute VNIPIET (JSC Atomproekt) in Establishment and Decommissioning of Nuclear Facilities

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History

1. Leading Institute VNIPIET (original name is “Special-Purposed Design Bureau “Dvigatelstroy”) was founded in October 1933 at the initiative of People's Commissariat for Heavy Industry (the order was signed by Sergo Ordzhonikidze).
   From 1933 to 1945 designed facilities for People's Commissariat for Defence and People's Commissariat for Armament.
2. 04.09.1945 the State Defence Committee decided to transfer GSPI-11 (new name of “Dvigatelstroy”) under the authority of the First Chief Directorate of the Council of Ministers.
   Hereby GSPI-11 was included into a number of companies involved in the Nuclear Project.
3. Within the shortest possible period of time the Institute (being the first in the European continent) designed and constructed the main nuclear weapon facilities.
4. Afterwards the facilities of peaceful nuclear energy usage were established within similar short periods.

History

- The world's first NPP in Obninsk – 1954
- Siberian NPP of 100MW capacity was commissioned in 1958.
- The world's first nuclear-power icebreaker Lenin was constructed in 1954. In operation till 1989.
- The first units of Beloyarsk Nuclear Power Station: AMB-100 (electrical output – 100 MW), Novovoronezh Nuclear Power Station (electrical output – 135 MW) were commissioned in the early 60s.
- The following was design and constructed in the 60s:
  - Training center in Paldiski.
  - NPP with BN-350 fast neutron reactor.
  - Leningrad NPP etc. Nuclear Facilities.

In 1965 VNIPIET was appointed as the leading institute on decontamination and radwaste management for nuclear-powered navigation and Navy based on the Council of Ministers' degree.

Obninsk NPP

Siberian NPP. Short Reference

- **Siberian NPP** is the first industrial nuclear plant in the Soviet Union. Commissioned in 1958 in Seversk town of the Tomsk region.
- Dual purpose: weapon-grade plutonium production and generation of thermal and electric energy.
- Electrical output: 100 MW.

Siberian NPP. Turbine Hall

AMB-100 Unit. Reactor Hall

Nuclear-Powered Icebreaker Lenin

BN-350 Reactor and World's First Power and Desalination Pant (Shevchenko town (Aktau), Kazakhstan)

BN-350 Reactor.
350 MW electrical output

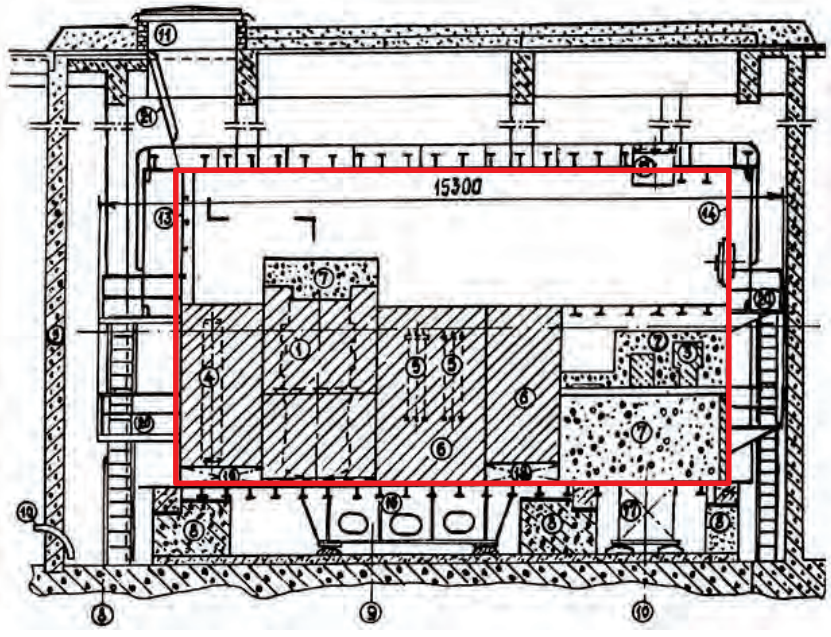
Desalination plant, capacity - 120,000 m^3 of fresh water per day

General view of the former training center of RF Navy in Padiski (Estonia) with bench-scale prototypes of NPS nuclear reactors

Bench-type prototype of nuclear-powered submarine reactors

- The training center with a land-based nuclear reactor prototype of generation I NPS was commissioned in 1968. The nuclear reactor prototype of generation II NPS was commissioned in 1983.
- The reactors were finally shut down in 1989.
- The SNF of both bench-type facilities was transported into the RF in 1994.
- The main activities on reactor compartment mothballing for 50 years were carried out in 1994 – 1995. They comprised the following:
  - Dismantling of adjacent compartments and non-radioactive equipment;
  - Unloading the filtering materials of circuits I – III;
  - Sealing the reactor vessels, internal systems;
  - Air drying in the reactor compartment using moisture absorbers and reactor compartment sealing;
  - Painting the external reactor compartment surfaces with chemical resistant coatings;
  - Construction of reinforced concrete shelters over the reactor compartments

Longitudinal cross section of the reactor compartment of the bench-type facility of generation I NPS



1 - reactor; 3 - RCP;
4 – pressurizer;
5 – coolant purifying filter;
7 – re-poured concrete inside the reactor compartment;
8,17,18,19 – concrete shielding walls;
9 – constructed shelter wall; 10 – penetration in the wall for check measurements; 11 – access hatcher inside the shelter;
12 – reactor compartment body;
13,14 - transverse bulkheads of the reactor compartment;
15 – hatch inside the reactor compartment;
16 – supporting metalwork;
20 - gangway;
21 - ladder.

- reactor compartment border

Parameters of Shelters for Land-Based Prototypes of NPS reactors

Buildup activity (excluding nuclear fuel) ~ $1*10^{15}$ Bq.

Radionuclide composition, % : ^{60}Co - 31; ^{55}Fe – 58, ^{63}Ni -10,3, ^{59}Ni – 1,2.

Dimensions of shelters

Parameter	Shelter for Prototype of Generation I	Shelter for Prototype of Generation II
Length, m	16.9	13.5
Width, m	10.4	12.3
Height, m	12.4	13.0
Wall thickness, m	0.4	0.4

Shielding Cover Construction over the Reactor Compartment in the former training centre in Paldiski (Estonia)

Full scale model of NPS reactor compartment

Reinforced concrete shelter being constructed to store the reactor compartment

USA experience in NPS RC decommissioning

POCATOM

Possible options of reactor compartment (RC) decommissioning and final disposal

POCATOM

1. Disposal of RC as a whole (without dismantling).

1.1 **RC disposal on the installation site**. This disposal option is possible. According to Technicatome (France) experts, the existing RCs may be stored safely for hundreds of years under periodic checks subject to additional reinforcement of protective engineering barriers.

1.2 **RC disposal in a near-surface repository** located on the training center site or near it. At that the newly constructed repository shall provide for disposal of all radwaste (including RCs) accumulated in the main building of the Centre. The newly constructed repository shall be located near the Training Centre (TC) due to the difficulty of RC transportation as its total weight is about 1,000 t.

2. **RC disposal after its dismantling into large fragments**. The RCs shall be dismantled into large fragments, packed into developed casks and transported into a newly built near-surface radwaste repository.

Large-size fragments, including the reactor vessel (RV) and iron-water protection tank may be packed into LLW (Low-level waste) casks. In this case the repository shall provide enough area for the disposal of LLW stored in the main building (LLW volume is about 2,000 m^3).

Possible options of reactor compartment (RC) decommissioning and final disposal

The reactor vessel and iron-water protection tank shall be cut into smaller fragments, packed into ILW and HLW casks and transported into the RW repository.

The HLW repository may be of a geological type subject to suitable natural conditions.

The RC cannot be fragmented into small pieces as the compartments were prepared for long-term mothballing.

According to the analysis, the preferable option is the disposal of the RC as a whole on the installation site or in close proximity to it. It will allow to exclude additional RW generation.

In this case the RW repository shall be constructed for LLW stored in the main building.

Thank you for your attention!

ROSATOM

НИКИЭТ им.Н.А.Доллежаля

State Atomic Energy Corporation "Rosatom" (ROSATOM)

Project: Paldiski Site

Reactor Compartments

Decommissioning Problems and Solutions

Estonia, November 2014
V.A. Mazokin
N.I. Gontsaryuk

Works on tasks 2 & 3 be carried out by JCS NIKIET:

ROSATOM

- 1. Analysis and updating the data for the existing waste and for the waste to be generated under dismantling activities;
- 2. Characterization of the waste to be generated during decommissioning activities;
- 3. Development of the concept for the decommissioning of the reactor compartments basing on the analysis results

- 1. JCS *N.A. Dollezhal Research and Development Institute of Power Engineering*:
- General designer of the A-type reactors for the Paldiski Navy nuclear site.
- 2. Nominated by the Russian Government as the primary developer of nuclear, radiological and safety-related technologies and procedures for the decommissioning of nuclear powered submarines (NPS), nuclear powered surface vessels (NPSV) and military nuclear facilities and sites.

3. JCS NIKIET has developed and issued the general documentation for NPSs and NPSVs decommissioning and for the remediation of military nuclear facilities and sites:

- Concepts;
- Guidelines;
- Design, engineering and process documents.

3.1 Concepts:

- Concept for the complex decommissioning of NPSs and NPSVs, 2001;
- Concept of the Environmental Remediation for the Coastal Technical Maintenance Bases of the Russian Pacific Region, 2002;
- Concept of the Environmental Remediation for the Coastal Technical Maintenance Bases of the Russian Northern Region, 2002.

3.2 Guiding documents:

- pertaining to solid radwaste emplacement in reactor compartments of decommissioned NS units in floating storage;
- pertaining to the preparation of the reactor compartments for long-term storage at coastal pads on long-term storage sites (RW LTSS);
- pertaining to the acceptance criteria for radioactive waste subject to disposal at the Saida Bay North-Western Regional Conditioning and Long-Term Storage Centre, 2011;
- General Provisions for the preparation for and maintenance of reactor compartments of dismantled nuclear submarines at the Saida LTSS, 2007.

3.3 Design, engineering and process documents:

- **Defuelling of A-type reactor installations;**
- **The procedure of solid radioactive waste conditioning and handover to the Saida Regional Centre;**
- **Transportation and process plans for radwaste management in Russian regions;**
- **The process of operation of the Saida Long-Term Storage Site for one compartment reactor units, 2006;**
- **The process of operation of the Ustrichny Cape Long-Term Storage Site for hazardous radiological units, 2007.**

Fundamental principles for development of concepts for dismantling and remediation of military nuclear facilities and sites in the Russian Federation

1. Unconditional maintenance and promotion of nuclear, radiological and environmental safety, human life and health protection;
2. Compliance with the Russian legal framework, Agreements with and recommendations of the international organizations;
3. Optimal use of the existing infrastructure;
4. Implementation of safety arrangements and measures ensuring the priority of SNF retrieval and removal from the site;
5. Management of reactor compartment radioactive equipment, radioactive and toxic wastes;
6. Secondary use of non-radioactive reactor compartment equipment and dismantling products;
7. Transparency and availability to the public of information on solutions, technologies and expert opinions;
8. Adherence to nuclear technology non-proliferation principles

Concept Implementation Results

1. Over 190 of decommissioned NPSs have been dismantled (defuelling, interim floating storage of reactor compartment units and formation of single-compartment reactor units for long-term onshore storage at coastal pads);

1.1 Over 75 dismantled NPSs units have been placed for storage at coastal pads on long-term storage sites (LTSS);

1.2 Three-compartment units from two damaged NPSs with spent nuclear fuel (SNF) prepared for long-term storage including monitoring have been placed in a coastal shelter in Primorsky Kray region.

2. All SNF unloaded from NPSs reactors have been removed from the corresponding regions for reprocessing.

3. SNF has been finally removed from storage facilities located on military nuclear sites in the Pacific Region.

Proposals for the development of the Concept of the decommissioning of the reactor compartments of the former Paldiski military nuclear site

The Concept will contain the following sections:

1. Terms, definitions and abbreviations.
2. Foreword.
3. Problem description and the Concept objective, tasks and purpose.
4. Scope of the Concept.
5. Legal framework (considering contemporary requirements and decisions by international organisations) of the Concept.
6. Main principles of the Concept.
7. Principal solutions with regard to the Concept implementation.
8. Current status of the reactor compartments of the former Paldiski military nuclear site:

- reactor compartment equipment;
- existing radioactive waste in the reactor compartment;
- radiological situation at the moment and estimated in the course of the reactor dismantling.

9. Key Concept implementation directions:

- radioactive equipment and radwaste management;
- toxic waste management;
- non-radioactive equipment and dismantling product management;
- radiation protection;

10. References.

Thank you for your attention