TECHNICAL SPECIFICATION

ANALYSIS AND PROPOSALS FOR DEMOLITION AND WASTE MANAGEMENT OF CONTAMINATED STRUCTURES AT IGNALINA NUCLEAR POWER PLANT

2025 m. kovo 24 d. Nr. Spc-12(13.67E)
Vilnius

CHAPTER I. PURPOSE

1. The purpose of the Contract is to define a concept for safe and effective decontamination and demolition of the most contaminated structures at INPP and the subsequent management of the radioactive waste thereby generated, taking account of best international practice.
2. Services purchased are product important to safety. Requirements for the purchase of services important to safety are provided in the Chapter VI.

CHAPTER II. DEFINITIONS AND ABBREVIATIONS

BSR	–	The Lithuanian Nuclear Safety Requirements;
Controlled area	–	an area subject to special rules for the purpose of protection against ionizing radiation or of preventing the spread of radioactive contamination and to which access is controlled;
CCL	–	Conditional Clearance Levels;
EDR	–	Equivalent Dose Rate;
EIA	–	Environmental Impact Assessment;
FDP	–	Final Decommissioning Plan;
SE INPP	–	State enterprise Ignalina Nuclear Power Plant;
INPP site	–	Nuclear site which is enclosed by a physical perimeter fence subject to the requirements of a restricted access area;
LT	–	The Republic of Lithuania;
RW	–	Radioactive waste;
RBMK	–	Russian acronym which means “channel type high power reactor”;
Security area	–	an area that is surrounded by a physical barrier around the perimeter of nuclear facility to which access is controlled, for the purpose of physical protection;
SRW	–	Solid radioactive waste;
TS	–	Technical specification;
VATESI	–	The Lithuanian State Nuclear Power Safety Inspectorate;

VLLW	–	Very Low-Level (radioactive) Waste;
WAC	–	Waste Acceptance Criteria.

CHAPTER III.
GENERAL INFORMATION

3. INPP consists of two power units with RBMK-1500 reactors. The layout of the main structures at the INPP site is shown in Annex 1.

   In fulfilment of the obligation of the Republic of Lithuania according to Protocol No. 4 of its EU Accession Treaty, Unit 1 of the plant was permanently shut down on 31 December 2004, and Unit 2 on 31 December 2009. The plant is currently under decommissioning according to an "immediate dismantling" strategy. The commencement of demolition of its main buildings (Bldgs. 101/1 and 101/2) is dependent principally on progress of reactor core dismantling and residual equipment removal in Block A of the respective units which house the reactors and (now unloaded) spent nuclear fuel pools. The proposed approach to zoning of the INPP site after decommissioning in the FDP is presented in Annex 2 of the technical specification.

4. RBMK channel-type reactors feature a single circuit such that the coolant that passes over the fuel assemblies circulates throughout the plant. This has resulted in widespread contamination of various components during the plant's operational lifetime. Cases of leakage from the main circulation circuit and well as from the spent-fuel storage pools have been recorded, causing the contamination of concrete structures. Other structures in the controlled area are also contaminated, due to the handling of RW (historical and current operations) or the storage of contaminated equipment, and similar reasons. According to the FDP, the dismantling of technological equipment within these contaminated structures will be followed by the removal of engineering and auxiliary systems (residual equipment). Final-state radiological surveys and clearance procedures will then be conducted. The decontamination of structures, partial dismantling, and the management of the resulting radioactive waste will be systematically organized based on the results of these final-state radiological surveys.

5. The decommissioning of INPP represents the first time that operated RBMK reactor buildings will be released from radiation control and demolished. It is currently assumed that it will not be possible to completely reach free release levels of the main reactor buildings; therefore, it is necessary to establish options for dealing with the most important contaminated structures at INPP to the point of demolition, as well as for the management of the resulting radioactive waste. The optioneering will incorporate a thorough evaluation of best practices from international projects to ensure that the chosen methods are effective, safe, and environmentally responsible.

6. The scope of the buildings and structures to be examined under this contract comprises the following (hereinafter, referred to jointly as "the selected structures"):

   6.1. The main INPP Unit buildings – Buildings 101/1, 101/2, (including block A, B, V, D, G and 119, hereinafter, "the Units");

   6.2. The Building 150 liquid waste management complex comprising Buildings 150, 151, 153, 154, 154A and 154B (hereinafter, "the Bldg. 150 complex"),

   6.3. The legacy Solid Radioactive Waste Storages: Buildings 157 and 157/1 (hereinafter, "the Bldg. 157 storages").

   The Bldg. 150 complex is interconnected functional complex for cementation is installed together with liquid waste accumulation tanks and other auxiliary facilities. The building is designed for treatment of liquid RW generated from technological systems of the Units, 130, 156 and 159 by using evaporation and cementation methods.

   Bldg. 157 storages are used for temporary storage of solid radioactive waste generated during the operation of the INPP. Structure is divided into vaults for short-lived and long-lived Very Low Level, Low and Intermediate Level Solid Waste storage.

   It is known that substantial amounts of concrete in these buildings is contaminated (Annex 3 – General view of INPP site) – together, they account for around 90% of structural contamination at the plant.

The analysis performed and provided recommendations will be transferable to other contaminated buildings and structures where necessary.

7. The final report, upon approval, will serve as a strategy for preparing for main buildings demolition and additional infrastructure (if necessary) implementation, as well as a guide for the development of Technological Designs for decommissioning and as documentation required under the Construction Law for demolition.

CHAPTER IV.
INITIAL DATA

8. Descriptions of the relevant buildings and structures, the Units, the Bldg. 150 complex and the Bldg. 157 storages, are provided in the attached documents. Because decommissioning-related works are still being carried out therein (equipment dismantling, RW management, etc.), the final state of these structures is not yet reached. The situation in these structures will change before their demolition.
9. It is assumed that all main technological and support equipment will be removed from the structures first. However, building engineering systems (such as ventilation, lighting, electrical installation, etc.) may remain when planning demolition. Also, underground drainage systems, gutters and similar.
10. SE-INPP will provide information and lessons learned from reaching free release levels in the contaminated former Emergency Core Cooling System building, Bldg. 117/1, which is ready for demolition (together with Bldg. 117/2). Additional lessons learned will be provided from workshop on large concrete blocks cutting from turbine hall foundation, where concrete was cut into 10t blocks, local surface contamination (if present) was removed mechanically using remotely controlled technologies.
11. During 2016-2017, an assessment of concrete radiological contamination was performed for structures in the controlled area, principally the Units.

    Radiological surveys were conducted with the intention preliminarily to evaluate the amount of contaminated concrete. During the assessment of the concrete structures of the INPP controlled area, simple (dosimetric) and complex radiological measurements were performed.

    The total number of 5949 dosimetry measurements includes:

    - 1323 measurements of EDR of gamma radiation in the places of sampling (cores) from concrete structures of premises;
    - 1096 measurements of total surface beta contamination in the places of sampling (cores) from concrete structures of premises;
    - 3530 measurements of EDR gamma radiation from individual samples from concrete structures of premises.

    As part of the assessment, 3689 complex measurements were performed. This number includes:

    - 83 EDR cartograms of gamma radiation from concrete floor structures (2243 separate sections);
    - 76 gamma spectrometric measurements in the premises;
    - 3530 measurements of samples taken from the concrete structures of the premises on a stationary gamma spectrometer.

    The detailed report on the radiological assessment will be provided after signing the contract.
12. In 2018, engineering inventorization of reinforced concrete was performed. The assessment was based on engineering architectural and construction drawings.

    The assessment determined that the total volume of reinforced concrete of the structures examined is 732,257 m^3. Buildings 101/1 and 101/2 account for 611,142 m^3 of this, or 83.46% of the total volume. The remaining structures contain 121,114.78 m^3 of reinforced concrete or 16.54% of the total volume of the NPP.

    After merging inventorization data with radiological assessment results premises were classified accordingly:

Table 1 INPP contaminated premises classification

	Classification		Number of Rooms	Percentage of total rooms	Reinforced concrete, m^3	Percentage of total concrete
	EDR	Contamination				
Class 1	> 0.24 µSv/h	> 4.0 Bq/cm²	2,724	38.05%	568,168.07	77.6%
Class 2	0.21 - 0.24 µSv/h	0.41 - 4.0 Bq/cm²	835	11.66%	46,163.42	6.3%
Class 3	≤ 0.2 µSv/h	≤ 0.4 Bq/cm²	3,600	50.29%	117,925.62	16.1%

Table 2 INPP structures with contaminated concrete distribution

No.	Building, structure		Amount of reinforced concrete in 2018, m^3	Amount of contaminated reinforced concrete, m^3	Purpose
1	Bldg. 101/1	Block A1	131,863	22,405	Unit 1 with main reactor in block A1, chemical water treatment block B1, auxiliary technological systems block V1, turbine hall G1, deaerator D1 and auxiliary block D0.
2		Block B1	16,607	1,656	
3		Block V1	12,432	349	
4		Block G1	86,271	3,678	
5		Block D1	51,242	2,754	
6		Block D0	7,401	180	
7	Bldg. 101/2	Block A2	131,888	19,083	Unit 2 with main reactor in block A2, chemical water treatment block B2, auxiliary technological systems block V2, turbine hall G2, deaerator D2.
8		Block B2	16,665	1,677	
9		Block V2	12,467	334	
10		Block G2	88,465	3,732	
11		Block D2	51,243	3,473	
12	Building 119		4,595	59	Interconnected with 101/1 building, has slight possible contamination, main part of it is used for material Free Release procedure (packages for free release measurement formation)
13	Building 150		28,164	2,356	The Bldg. 150 complex building is designed for treatment of liquid RW generated from technological systems of the Units (and other facilities) using evaporation and cementation methods. The Bldg. 150 complex includes cementation facility (150), liquid waste tanks (151/154, 154A,B) and ventilation stack (153).
14	Structures 151/154, 154A,B		18,137	3,249	
15	Structure 153		627	26	
16	Structures 157, 157/1		9,672	1,690	Building storages are used for temporary storage of solid radioactive waste generated during the operation of the INPP - short-lived and long-lived Very Low Level, Low and Intermediate Level Solid Waste.

The detailed assessment report on the amount of contaminated concrete will be provided after signing the contract (2019-02-08 No. PD-4(19.54)).

All concrete mentioned in the text is reinforced; where appropriate, separate consideration should be given to the cementitious and metallic materials.

13. A large part of the nuclear power plant demolition waste that meets the criteria set out in the Nuclear Safety Requirements BSR-1.9.2-2018 “Establishment and application of clearance levels of radionuclides for the materials and waste generated during the activities with the sources of ionising radiation in the area of nuclear energy” will be released from further radiation control.

Part of the demolition waste from INPP buildings is suitable for burial in the landfill facility for short-lived, very low-level radioactive waste (hereinafter, “the VLLW landfill” or “Facility B19/2”), where declared radionuclide activity values exceed further uncontrolled levels and which meet the Nuclear safety requirements of BSR-3.1.2-2017 “Pre-disposal Management of Radioactive Waste at Nuclear Facilities” criteria for Class A radioactive waste.

However, the disposal capacity of the VLLW landfill is limited to 60,000 m^3 and most of this will be used Class A waste from decommissioning before decontamination and demolition of the Units commences.

Radioactive waste is accepted into the VLLW landfill in compliance with its WAC (to be provided after signing the contract).

14. A small proportion of concrete (e.g. from Building 157 Vaults 1 and 4, and concrete structures under the metal lining of spent nuclear fuel pools in the Units) may be Class B or C. Class B and C waste management instructions will be provided after signing the contract. Near Surface Repository (NSR) for Low and Intermediate Level Short-lived Radioactive Waste will be used B and C class waste disposal. NSR is designed for final disposal of 100,000 m^3 of final packaging of radioactive waste (concrete containers with cemented radioactive waste).

15. Technical drawings with cross-section of buildings will be provided. After doing concrete volume estimation in controlled area it was concluded that the real situation has differences not reflected in the technical drawing documents. The engineering inventory ~~group~~ estimated that the uncertainty in some cases can be up to 20% when evaluating reinforced concrete volume. Main reactor building A1 block has 3D model. Model was prepared for representative and works estimation purposes (is not detailed enough for calculations and modelling purpose). SE-INPP is considering to prepare a detailed 3D model of main buildings in the controlled area. Mentioned data will be provided after signing the contract.

16. INPP operates waste management complexes, the capacity of these facilities is intended only for the management of historical radioactive waste and radioactive waste generated during dismantling of the INPP and has not yet been assessed in terms of the possibilities for managing radioactive waste generated during demolition. Also, the capacity of these disposal facilities is limited:

    16.1. Landfill Facility for Very Low-Level Radioactive Waste (https://www.iae.lt/en/activity/decommissioning-projects/b19-project.-landfill-facility-for-very-low-level-radioactive-waste/362).

    16.2. Near Surface Repository for Low and Intermediate Level Short-lived Radioactive Waste (https://www.iae.lt/en/b25-project.-near-surface-repository-for-low-and-intermediate-level-short-lived-radioactive-waste/470) project is initiated and construction preparation works has started. More detailed and actual information about these facilities will be provided after signing the contract.

17. Annex 4 includes short description of methods and findings from radiological survey. Full reports will be provided after signing the contract.

CHAPTER V.
SCOPE AND REQUIREMENTS

18. The Supplier shall evaluate possible options for decontamination and preparation for demolition of the selected structures, based on international practices. Analysis will include generated waste management, evaluation of possible alternatives for waste processing and waste disposal.

19. Before commencing the Tasks under the Contract, the Supplier must provide, and receive the approval of the Client, for a Quality Assurance & Implementation Plan as described in Chapter VI. Kick-off meeting will be organized after the draft issue of Quality Assurance & Implementation Plan to establish lines of communication, discuss the schedule, and discuss how the objectives will be achieved.

    The tasks to be performed by the Supplier are:

20. **TASK 1 – Status and Gap Analysis**

    Under this task, the Supplier shall establish and provide justified best estimate of the extent of contamination for the selected structures. This shall include the following key activities:

    a) Comprehensive Review of Existing Data.

20.1. The Supplier shall analyse the Client's current measurements and calculations, including the scope, methodology, and patterns of sampling; analysis of samples and methods, assumptions used in extrapolation and interpolation for volumetric calculations.

20.2. Presenting, and based on this analysis, the Supplier shall recommend and justify improvements to reduce uncertainties, such as additional measurements or advanced statistical modelling techniques.

b) Quantitative Analysis of Radioactive Materials.

20.3. On the basis of the Comprehensive Review of Existing Data, incorporating where possible the recommended improvements, the Supplier shall estimate and present with justification a best estimate the quantities of radioactive materials by type and classification within the contaminated structures of the selected buildings setting out the level of uncertainty associated with this best estimate.

c) Gap Analysis and Future Sampling Plan.

20.4. Recognizing that some locations currently cannot be sampled (e.g. under the liners of spent fuel pools in the Units) and that there are other places at risk of further contamination during decommissioning (e.g. buffer storage for dismantled equipment), the Supplier shall prepare a gap analysis to outline additional sampling or modelling required in the final state.

20.5. If a lack of data is identified by the Supplier, which may significantly affect the evaluation relevant to the complexities and costs of planned decontamination, demolition and/or demolition waste management, the need for additional measurements and their detailed specification shall be presented and justified by the Supplier to the Client.

20.5.1. Supplier shall present the findings in additional meeting after finishing the Task 1(a) (with meeting results minuted).

20.5.2. The Client shall assess the need for, and possibility of, performing such additional measurements during execution of the Contract. If, the Client establishes that the additional measurements are not performed during the Contract execution period then the Supplier will be so informed, and the Supplier shall be required to indicate in the Status and Gap Analysis report the impact of the lack of data and how the expected results of the new measurements should be interpreted.

20.5.3. If such measurements will be considered critical to the project deliverables and cannot be executed within the terms of established timelines, an extension of the contract may be initiated, based on the terms outlined in the Contract.

20.5.4. Where additional measurements are performed, their performance and costs shall be the responsibility of the Client.

20.6. As the outcome of Task 1, the Supplier shall prepare the Status and Gap Analysis Report that presents and justifies the findings, recommended improvements, and identified gaps. A draft report will be submitted for SE-INPP's review and approval to ensure any deficiencies are corrected prior to final submission. This report will serve as the foundation for the optioneering in Task 2. Proposed template for the report is presented in the Annex 6, possible variations can be suggested by the Supplier prior to submission of the draft report.

21. **Task 2 – Optioneering**

Under this task, the Supplier shall evaluate decontamination and demolition options for the selected structures based on best international practice and the outcomes from Task 1.

a) International experience:

21.1. The Supplier shall summarize relevant techniques and technologies for decontamination and demolition, based on international experience in the following cases:

Case A: Techniques that allow buildings or parts thereof to be released from radiological regulatory control for conventional demolition.

Case B: Techniques that allow demolition in a reduced contaminated state under conditional clearance[1].

Case C: Options where contamination is retained (without additional removal) if removal would compromise structural integrity, detailing the regulatory frameworks and additional measures needed.

21.1.1. Relevant international practises are considered examples of structures with different depth and level of contamination (more importantly structures with contaminated load-bearing elements) and with use-cases of optimal waste management (of contaminated concrete).

21.1.2. Proposed international experiences shall be justified and presented by the Supplier.

21.1.3. When considering CCL option, Supplier shall provide good practice analysis (international experience for application, regulatory and legal basis), evaluate under which conditions hydrogeological model (and other models) would be necessary.

21.1.4. For each case, the Supplier shall Evaluate each technology or technique in terms of:

- Proven effectiveness in similar situations, highlighting any limitations or drawbacks.
- Requirement for personnel intervention and protective measures, or feasibility of remote operations.
- Waste streams generated and their management.

21.2. Supplier shall present review on existing literature and scientific research for new findings on methods, techniques or technologies that could be applied for these cases.

b) Optioneering for the selected structures:

21.3. Based on the outcomes of Task 1, and the international experience presented from Task 2(a) The Supplier shall evaluate options for the relevant techniques and technologies for decontamination and demolition and RW management in Case A, Case B, and/or Case C, as applicable, for the selected structures and/or parts thereof.

The Supplier may, for this purpose, by presenting due justification:

- Group buildings or areas therein as appropriate, such as by contamination characteristics and/or structural similarities.
- Use a compatibility matrix to present commonalities of options, allowing evaluation of overlapping elements such as shared waste treatment methods.

21.4. The Supplier shall evaluate decontamination and release of underground structures of the selected structures that are potentially contaminated, those located deeper than 0.5m underground (according to the construction technical regulation, the building is considered demolished if all its structures are dismantled, except for those remaining deeper than 0.5 m below the ground surface). In this case, there must not be any structures contaminated with radioactive materials deeper than 0.5 m below the ground surface. Or the level of residual contamination must not exceed the CCL (if considered and applied).

21.5. For consideration of relevant techniques and technologies for decontamination and demolition and RW management the Supplier shall include:

21.5.1. decontamination measures and tools in the decontamination options, for removal of surface and deep contamination areas, decontamination of key contaminated structures without weakening main bearing structures/maintaining structural stability;

21.5.2. reuse of waste generated for backfilling the voids in the remaining underground structures of selected structures (or other application) under CCL, including possible impact on the groundwater;

21.5.3. localization solutions (to ensure emission limitation and control) not limited to existing systems, based on good practice analysis;

21.5.4. the need for and use of current ventilation systems and potential to optimize them;

21.5.5. the complexity of exposure risk control, possible radioactive release to the environment, other safety assurance issues identified by the Supplier;

[1] Use of Conditional clearance levels are defined in NUCLEAR SAFETY REQUIREMENTS BSR-1.9.2-2018 (http://www.vatesi.lt/fileadmin/documents/Teisine_informacija/Teises_aktai_anglu_kalba/Orders_of_VATESI/BSR-1.9.2-2018_Establishment_and_Application_of_Clearance_Levels_of_Radionuclides_for_the_Materials_and_Waste.pdf)

21.5.6. the need and solutions for temporary storage. Consider the forecast of the amount of waste that will be generated, the final disposal option of the waste and other possible alternatives;

21.5.7. options for waste treatment (separation of concrete from steel, crushing of concrete, cutting of concrete into blocks, separating crushed concrete fractions and other) evaluate the measuring, means and methods for sorting/characterization;

21.5.8. Optimizing waste management and maximising free release (current estimate by INPP is that 95% of concrete could be free released);

21.5.9. the need for new waste treatment facilities (in-situ/next to other waste management complexes/combined solution), their installation and operating costs evaluation guidelines (direct waste processing hours/m^3, total processing volumes/streams) from similar projects, taking into account possible waste flow and waste generation locations;

21.5.10. When evaluating possible options, integrity of the process, optimal use of existing or new infrastructure, avoiding potential bottlenecks must be taken into account.

c) Option Comparison and Ranking:

21.6. The Supplier shall evaluate each option using a set of criteria that include:

- Timescale of implementation relative to other options.
- Cost relative to other options.
- Projected personnel dose accumulation relative to other options.
- Relative waste generated by type and class (including any proposed packaging).
- Relative maturity of the technology in similar applications.
- Any additional criteria recommended by the consultant and submitted for SE-INPP comments.

21.7. Criteria weighting will be proposed by Supplier and submitted for SE-INPP for comments. If needed, separate workshop will be organized for this reason.

21.8. Ranking will be done by Supplier representatives and submitted for SE-INPP for comments.

21.9. Supplier will apply an agreed weighting to each criterion to rank options:

21.9.1. Explain any assumptions and provide reasoning. In particular, for Case B options, the conditions for discontinuing further removal of contamination shall be presented and explained.

21.9.2. Identify the key risks and assumptions for each option evaluated (include risk description, impact assessment, probability assessment and risk mitigation measures). Use these factors in decision-making to guide the selection of the optimal decontamination, demolition and waste management strategy. Include mitigation measures for assumptions that could significantly impact the decision.

21.9.3. When evaluating timeline and costs, provide comparative financial and time efficiency indicators such as total decommissioning decontamination costs (Eur)/ decontamination decommissioned area (m^2), total time for decontamination decommissioning (h) / decontamination deactivated area (m^2), radioactivity levels before and after decontamination deactivation (radioactivity level reduction), demolition costs (Eur) / waste generated during demolition (m3), total amount of waste generated during demolition (m^3) / total demolition time (h)), RW management costs (Eur) / volume of treated RW (m^3) including landfill costs, reclamation costs (EUR) / demolition site area (m^2).

22. Selection and Recommendation of Preferred Solution:

22.1. Rank the options and recommend a solution for each building as a whole, clearly detailing the decision-making process.

22.2. For selected Case A and B options, aggregate estimated values (timescale, cost, dose, waste generation) to complete the recommended decontamination.

22.3. For selected Case C options, estimate additional timescale, cost, and personnel dose impacts beyond standard demolition, and specify any legal framework adjustments needed.

23. Optioneering draft report detailing option evaluations, recommended of the proposed solution descriptions and justifications, will be submitted for SE-INPP's review.

24. When evaluating decommissioning timeline and preparing decontamination, demolition and waste management planning, Supplier will take into account:
    24.1. The start of demolition for the Units is dependent upon the progress and outcomes of the reactor core dismantling and second-phase equipment removal in Blocks A1 and A2. The Bldg. 150 complex and the Bldg. 157 storages, and other buildings listed in Annex 1, may be demolished earlier and are therefore not on the critical path of INPP decommissioning;
    24.2. Preparation activities for decontamination, demolition and waste management, including necessary infrastructure establishment should be finished until the end of reactor core dismantling.
25. Evaluating solutions, Supplier will evaluate:
    25.1. Nuclear and radiation safety requirements according to BSR requirements and IAEA safety standards recommendations.
    25.2. The minimal impact, most rational solution (e.g. burying in a deep geological repository would have the minimal impact, but is irrational), that includes – determine, describe and evaluate the possible direct and indirect effects of biological, chemical and physical factors caused by selected technologies on public health and employees, direct and indirect possible effects on environmental elements (water, air) and the interaction between these environmental elements and public health[2];
    25.3. According to the results of the environmental impact assessment, after determining the most optimal and minimal environmental impact technological solution, Supplier must provide measures that must be taken in order to avoid a possible significant negative impact on the environment and public health and employees, reduce it, or, if possible, compensate for it.
    25.4. The feasibility of the proposed decision schedule, the impact of other related NPP projects (actual information about ongoing projects, their status and progress will be provided after signing the contract) and compatibility with the INPP final decommissioning plan.
26. Not in scope of this Contract:
    26.1. Related documents modification (like modification of FDP, safety analysis, technical design documents).
    26.2. Design documents for technical solutions or calculations on structural integrity of the buildings, this will be done in the later stages when preparing technical demolition project.
    26.3. Hydrogeological model preparation, calculation of Conditional clearance levels.
    26.4. If additional measurements need is identified, Supplier will not be responsible for executing the measurements.
    26.5. 101/1 and 101/2 ventilation stacks – these are part of the structure, but decontamination and dismantling/demolition of these stacks will be organised as a separate project.

CHAPTER VI.
GENERAL REQUIREMENTS

27. Requirements for the purchase of services important to safety:
    27.1. The Supplier must prepare a Quality Assurance Plan in accordance with requirements established by the Client. The Supplier must submit the prepared Quality Assurance Plan to the Client no later than 30 calendar days after the contract enters into force. The Client, having evaluated the Quality Assurance Plan submitted by Supplier, approves it or submits comments within 10 calendar days. In all cases, it must be ensured that the term of coordination of the Quality Assurance Plan does not exceed 60 calendar days. The quality assurance plan form is available at: https://www.iae.lt/teisine-informacija/vidiniai-teises-aktai/103 .
    27.2. The Supplier must ensure access for authorized employees of the Client and/or authorized employees of VATESI to participate results verification/acceptance, to perform independent

[2] Results of the EIA of the decommissioning, demolition and waste disposal of structures contaminated with radionuclides within the scope of the total EIA of INPP decommissioning process will only be preliminary, if they are prepared accordingly, the results of the EIA carried out before the services provided in the scope of this TS can be used for comparison purposes.

inspections of the activities of the Supplier (subcontractors at all levels) (audits, inspections, etc.). Non-conformities identified during these inspections must be removed in time, within the terms of the Contract. The Supplier must provide opportunities for authorized employees of the Client and/or authorized VATESI employees to verify whether the requirements of procurement documents, contract, quality assurance plan, management system documents are fulfilled, i.e. must provide relevant documents upon request audits (surveys) typically are performed once per three years after signing the contract. From existing practice, the audit takes approximately 3 working days; the number of participants is typically 3 (including VATESI delegated person, whose participation is optional).

27.3. Quality Assurance Plan shall include project implementation plan. It will include clearly defined milestones with planned tasks dates, responsible persons and deliverables. Together with timescale and scheduling, implementation plan shall include proposed analysis and optioneering methods and principles.

28. The purchased services are intangible (intellectual) and not related to the creation of a tangible object, the provision of which is not expected to have a significant negative impact on the environment, it does not create a source of pollution and does not generate waste (Paragraph 4.4.3 of the Procedure for the Application of Environmental Protection Criteria in Green Procurement, approved by Order No. D1-508 of the Minister of the Environment of the Republic of Lithuania, 2011-06-28), therefore additional environmental requirements for the purchased object are not established.

29. The Supplier will describe the methods used in implementation of the Contract. Including, but not limited to (if applied in the implementation): statistical (or other) methods for data collection, analysis, and addressing uncertainties; organizational and process evaluation techniques relevant for this case; technological evaluation of decontamination, demolition, and waste management technologies with benchmarks (if available); environmental and health impact assessment methodologies, including mitigation measures; economic and financial analysis of cost estimations and long-term financial impacts (cost estimation based on ISDC structure where applicable); qualitative and/or quantitative tools supporting decision-making; sustainability and innovation considerations/methods and other.

30. All documents prepared by the Supplier shall be in the Lithuanian or English language.

31. The Supplier must identify any information that was not provided by the Client during the tender or, as set out herein, upon entry to force of the Contract but is or will be needed to fulfil the Contract. In accordance with the conditions provided in the Contract, the Supplier must submit requests to the Client to provide such information, with justification why such information is necessary.

32. Based on reasonable requests, Client must provide the necessary information within 10 working days (only if information is available). Information (documents, drawings, etc.) will be provided in electronic (non-editable) files in their original form and language (mostly Lithuanian or Russian). If the requested information is not readily available, the deadlines for its provision will have to be agreed between the parties on a case-by-case basis.

33. If the requested information is unavailable to the Client, the Supplier shall be so informed and shall justify the assumptions used to compensate the lack of information.

34. Representatives of the Supplier entering/leaving the INPP security area must follow the valid rules and procedures of SE-INPP. Visits to the INPP security area must be planned in advance, by providing necessary documents at last 10 working days before the visit allowing SE-INPP to organise all necessary permits.

35. Service providers and visitors in the INPP controlled area, they shall follow the following documents:

35.1. Nuclear safety requirements BSR-1.9.3-2016 "Radiation safety at nuclear facilities";

35.2. INPP radiation safety instructions, DVSed-0512-2 (https://www.iae.lt/teisine-informacija/vidiniai-teises-aktai/103);

35.3. Instructions for ensuring radiation safety when working in a controlled area, DVSed-0512-7 (https://www.iae.lt/teisine-informacija/vidiniai-teises-aktai/103);

36. The Supplier (and subcontractors of all levels) shall not conduct activities in an ionizing radiation environment at INPP;

37. Radioactively contaminated equipment and tools shall not be returned to the Supplier and shall not be compensated or otherwise remunerated.
38. Electronic files of documents provided by Supplier must be submitted in non-editable format (e.g. *.pdf) and editable format (Word, Excel, etc.). Agreed and approved documents are submitted for signing with a qualified electronic signature.
39. Client is not responsible for organizing accommodation and travel of Supplier employees and related costs.
40. It is recommended for Supplier to plan at least 3 visits to INPP (e.g. kick-off meeting, visit to main reactor buildings and radioactive waste management complexes with SE-INPP personnel guidance, Task 1(a) evaluation meeting, meetings to present the draft and/or final results – planning up to 3-4 working days for each visit).

CHAPTER VII.
STANDARDS AND REGULATION DOCUMENTS

41. The Supplier must take appropriate account of the following standards and legal acts. Evaluated and proposed solutions must take into account restrictions and requirements from existing legislation, for specific cases legal framework adjustments could be suggested as an outcome (as mentioned in Case C evaluation).

Table 3 Standards and legal acts

No.	Title of legal act
	Laws of the Republic of Lithuania
1.	Law of the Republic of Lithuania on Radioactive Waste Management
2.	Law of the Republic of Lithuania on Radiation Protection
3.	Law of the Republic of Lithuania on Nuclear Safety
4.	Law of the Republic of Lithuania on Nuclear Energy
5.	Law of the Republic of Lithuania on Construction
6.	Law on Environmental Protection of the Republic of Lithuania
7.	Law on Safety and Health of Employees of the Republic of Lithuania
8.	Law on Environmental Impact Assessment of the Proposed Economic Activity of the Republic of Lithuania
9.	Law on Waste Management of the Republic of Lithuania
	International law
10.	Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, 1997, entered into force on 14 June 2004, Ratified.
	Nuclear safety requirements
11.	Nuclear Safety Requirements BSR-3.1.2-2017 “Pre-disposal Management of Radioactive Waste at Nuclear Facilities”
12.	Nuclear Safety Requirements BSR-3.2.2-2016 “Radioactive Waste Disposal Facility”
13.	Nuclear Safety Requirements BSR-1.9.3-2016 “Radiation Protection at Nuclear Facilities”
14.	Nuclear Safety Requirements BSR-1.9.2-2018 “Establishment and application of clearance levels of radionuclides for the materials and waste generated during the activities with the sources of ionising radiation in the area of nuclear energy”
15.	Nuclear Safety Requirements BSR-1.5.1-2019 “Decommissioning of Nuclear Facilities”
16.	Nuclear Safety Guidelines BST-1.5.1-2020 “The Evaluation of Compliance with Free Release Criteria of Buildings, Engineering Structures and Site of Nuclear Facilities”
17.	Nuclear Safety Requirements BSR-1.9.1-2017 “Standards of Release of Radionuclides from Nuclear Facilities and Requirements for the plan on Release of Radionuclides”
18.	Nuclear Safety Requirements BSR-3.2.1-2015 “Radioactive Waste Acceptance Criteria for Near Surface Disposal Facilities”
19.	Nuclear Safety Requirements BSR-1.8.9-2020 “Buildings and structures of nuclear facility”
	Other LT law and regulatory documents
20.	HN 73:2018 Basic Radiation Safety Norms
21.	Lithuanian Standard LST EN ISO 9001:2015 “Quality Management Systems. Requirements”

No.	Title of legal act
	International recommended documents
22.	IAEA Safety standards series, Nr. RS-G-1.7. Application of the concepts of exclusion, exemption and clearance
23.	IAEA Safety standards series, Nr. GSG-18. Application of the concepts of clearance
24.	The Safety Case and Safety Assessment for the Disposal of Radioactive Waste. Specific Safety Guide No. SSG-23. IAEA, Vienna, 2012
25.	Near Surface Disposal Facilities for Radioactive Waste. Guide No. SSG-29. IAEA, Vienna, 2014
26.	Disposal of Radioactive Waste. Specific Safety Requirements No. SSR-5, IAEA, Vienna, 2011
27.	IAEA Safety Report Series, Nr. 44. Derivation of activity concentration values for exclusion, exemption and clearance
28.	The Safety Case and Safety Assessment for the Predisposal Management of Radioactive Waste. General Safety Guide No. GSG-3. IAEA, Vienna, 2013
29.	Fundamental Safety Principles. Safety Fundamentals No. SF-1 IAEA, Vienna, 2006
30.	Predisposal Management of Radioactive Waste. General Safety Requirements No. GSR Part 5. IAEA, Vienna, 2009
31.	IAEA GSR Part 3 “Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards”, 2014
32.	IAEA GSR Part 6 “Decommissioning of Facilities”, 2014
33.	IAEA Safety Report 67 “Monitoring for Compliance with Exemption and Clearance Levels”, 2012
34.	IAEA Technical Report “Dismantling of Contaminated Stacks at Nuclear Facilities”, 2005
35.	Decontamination Methodologies and Approaches, No. NW-T-1.38, IAEA, Vienna, 2023
36.	Decontamination and Dismantling of Radioactive Concrete Structures, OECD/NEA, 2011
37.	EU Waste Management Protocol version 2024 https://op.europa.eu/en/publicatio n-detail/-/publication/d63d5a8f- 64e8-11ef-a8ba-01aa75ed71a1
	INPP documents
38.	Description of the Procedure for the Assessment of Suppliers and Sub-Suppliers of a Product Important for the Safety of the State Enterprise Ignalina Nuclear Power Plant and for the Control of Their Activities, DVSta-1708-4 (https://www.iae.lt/en/legal-information/internal-rules-and-regulations/387).
39.	SE-INPP final decommissioning plan (approved by the order of the Minister of Economy of the Republic of Lithuania 2020 08 11 order No.1-248)
40.	INPP experimental radiological survey of controlled zone concrete structures (PD-5), ArchPD-2345-76240v1, 2017-08-12 (171 pages)
41.	INPP contaminated concrete evaluation report (PD-4), ArchPD-2345-77040v1, 2019-02-08 (48 pages)
42.	INPP radiation safety instructions, DVSed-0512-2 (https://www.iae.lt/teisine-informacija/vidiniai-teises-aktai/103)
43.	Instructions for ensuring radiation safety when working in a controlled area, DVSed-0512-7 (https://www.iae.lt/teisine-informacija/vidiniai-teises-aktai/103)
	Most of the legal acts are available here: https://vatesi.lrv.lt/en/legal-information/list-of-legal-acts/

CHAPTER VIII.
CONTRACT MANAGEMENT

42. Contract progress and status meetings shall normally be held at least every 2 weeks (using teleconference, preferably Microsoft Teams platform. Each meeting with be minuted). The frequency of meetings can be adjusted (for individual project milestones/stages or the time of specific meetings) after notifying the Client in advance and receiving approval by e-mail of contact person provided in the Contract or otherwise agreed in writing with SE-INPP.
43. Supplier shall provide monthly report based on project execution plan, including descriptions of available risks and challenges.

CHAPTER IX.
SERVICES TIMELINE

44. Contract term – 18 months from the effective Contract date.
45. The services are divided into the following main stages:
    45.1. Preparation of Quality assurance plan and Project implementation plan.
    45.2. Task 1: Status and Gap Analysis of nuclear power plant contaminated structures and available data on structures contamination, used methods, need for additional modelling and other.
    45.3. Task 2: Optioneering analysis with proposed recommended and alternative solutions, according to the requirements of the technical specification.
46. Tasks timelines and results are presented in the table below:

Table 4 Tasks timeline

#	Task	Timeline	Result
1.	Preparation of Quality Assurance Plan (QAP) and Project implementation plan (as part of QAP) Project implementation plan can be corrected according to results and recommendations of each stage (or if additional measurements are identified) after approved by INPP.	60 calendar days after the effective date of the Contract	Prepared and approved QAP
2.	Draft Status and Gap-analysis	5 months after the effective date of the Contract	Draft report on analysis, presentation.
3.	Status and Gap-analysis final report	9 months after the effective date of the Contract	Report on analysis, presentation, acceptance of transfer.
4.	Draft Optioneering report	14 months after the effective date of the Contract	Draft report version, presentation.
5.	Final Optioneering report	18 months after the effective date of the Contract	Final report version, presentation, acceptance of transfer

Proposed report contents of each stage is provided in the Annex 6.

The project implementation plan can be adjusted, considering the results of each stage (or if the need for additional measurements is identified) and recommendations, after informing and agreeing with the INPP.

ANNEX

Annex 1. INPP site structures

Annex 2. Forecasted condition of the INPP site after completion of Decommissioning

Annex 3. INPP radioactive waste management

Annex 4. Information about radiological experiments done in INPP structures

Annex 5. Radionuclides examples

Annex 6. Reports contents examples.

Separately attached documents:

Object description – the Units

Object description – Bldg. 150 complex for processing liquid radioactive waste

Object description – Bldg. 157 storages of radioactive waste

Annex 1 – INPP site structures

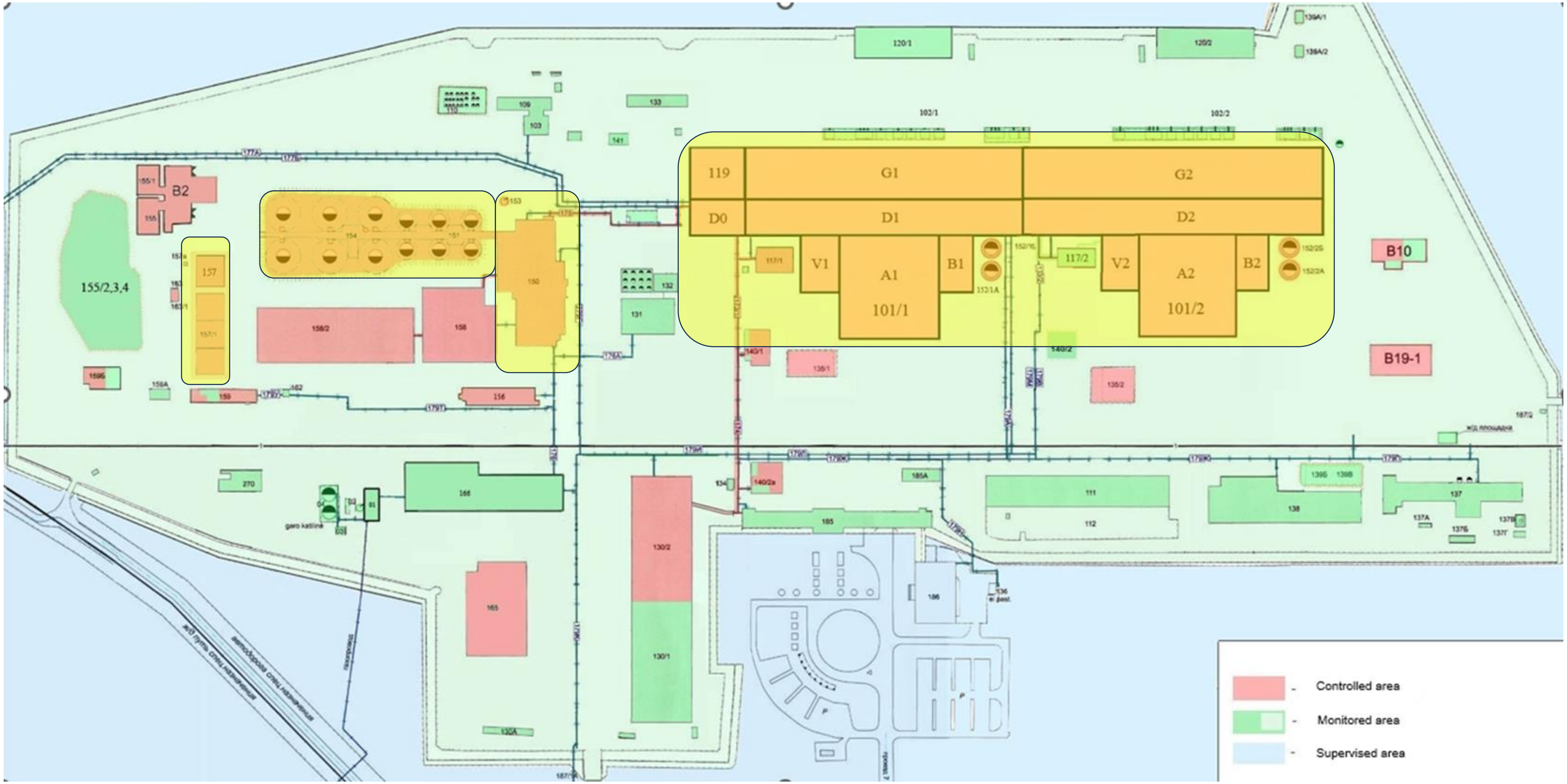


Figure 1. INPP site. There are technological, production, administrative buildings, radioactive waste management, temporary storage complexes and other structures at the NPP site. Structures that are considered the most polluted in the zone under the control of the NPP (marked yellow):

- The Units - 101/1 and 101/2 the main Units buildings consist of separate blocks (the most contaminated blocks are reactor bld. A1 and A2).
- The Bldg. 150 complex – Liquid radioactive waste treatment complex (Building 150 is connected to buildings 151/154 (Sewage (Drainage) Storage Tanks and Sewage Storage and Treated Water Tanks. Next to Building 150 is a ventilation stack (Structure 153).

- the Bldg. 157 storages - 157 and 157/1 are solid radioactive waste storage facility with removal modules (IM-3 and IM-2).

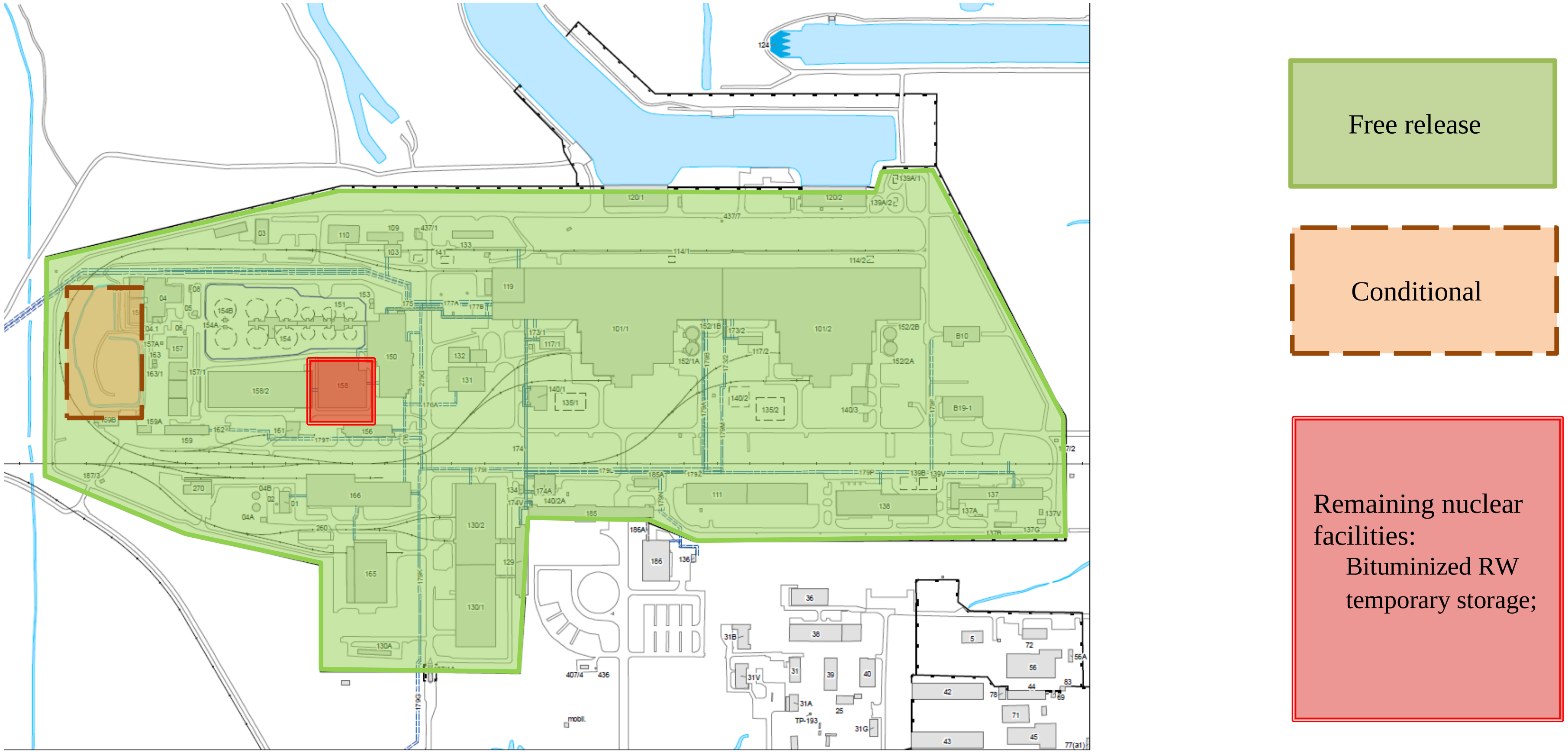
Structure	Marking	Comments
Main buildings of Unit 1 consisting of:	**101/1**	
– Reactor block with Ventilation Stack	A1	Contaminated structure
– Spec. Chemical Water Treatment Block	B1	
– Auxiliary Technological Systems Block	V1	
– Turbine Hall	G1	
– Deaerator	D1	
– Auxiliary Block	D0	
– Cogeneration Facility	119	
Reactor Emergency Cooling System Tank Building	**117/1**	Final radiological survey is being done, will be demolished in 2025
Technical Water Supply Pumping Station	**120/1**	Final radiological survey is being done
Gas holding underground Chamber	**135/1**	
Low Salinity Water Storage Tanks	**152/1a** **152/1b**	
Main buildings of Unit 2 consisting of:	**101/2**	
• Reactor block with Ventilation Stack	A2	Contaminated structure
• Spec. Chemical Water Treatment Block	B2	
• Auxiliary Technological Systems Block	V2	
• Turbine Hall	G2	
• Deaerator	D2	
Reactor Emergency Cooling System Tank Building	**117/2**	Released, ready for demolition
Passage from Building 101/2 to Building 117/2	**173/2**	Released, ready for demolition
Technical Water Supply Pumping Station	**120/2**	Final radiological survey are being done
Gas holding underground Chamber	**135/2**	
Low Salinity Water Storage Tanks	**152/2a** **152/2b**	
Liquid radioactive waste treatment facility	**150**	This structure is assumed to be highly contaminated
Building 150 Ventilation Stack	**153**	
Communications Overpass Between Building 101/1 and Building 150	**175**	

Sewage (Drainage) Storage Tanks	**151**	This structure is assumed to be highly contaminated
Sewage Storage and Treated Water Tanks	**154** **154 a,b**	This structure is assumed to be highly contaminated
Low Activity Solid Radioactive Waste Storage Facility	**155** **155/1**	
Short-lived and long-lived Very Low Level, Low and Intermediate Level Solid Waste Storage Facility with a removal module (IM-3)	**157**	This structure is assumed to be highly contaminated
Ventilation Chamber of the short-lived and long-lived Very Low Level, Low and Intermediate Level Solid Radioactive Waste Storage Facility	**157a**	This structure is assumed to be highly contaminated
Short-lived and long-lived Very Low Level, Low and Intermediate Level Radioactive Waste Storage Facility with a removal module (IM-2)	**157/1**	This structure is assumed to be highly contaminated
Equipment Installed within the Scope of the Project B2-1 (removal module, sorting module, auxiliary equipment, territory)	**B2**	
Special Vehicle Garage and Wash	**159**	
Industrial Waste Management Complex	**159b**	
Industrial Waste Repository (“waste ground”)	**155/2, 3, 4**	
Material Radioactivity (Release Levels) Measurement Device	**B10**	
Backup Diesel Power Plant	**111**	
Diesel Fuel Tanks	**112**	Released, ready for demolition.
Repair Workshop	**130/2**	
Sanitary Building	**140/1** **140/2a**	
Passageways	**174, 173/1, 174a**	
Special Laundry Building	**156**	
Fresh Nuclear Fuel Warehouse (room 01 only)	**165**	
Administrative Building	**185**	
INPP Security Building	**185a**	
Vehicle Checkpoint in the Protected Area	**187/1a** **187/2**	
Checkpoint in the Protected Area	**187/3**	

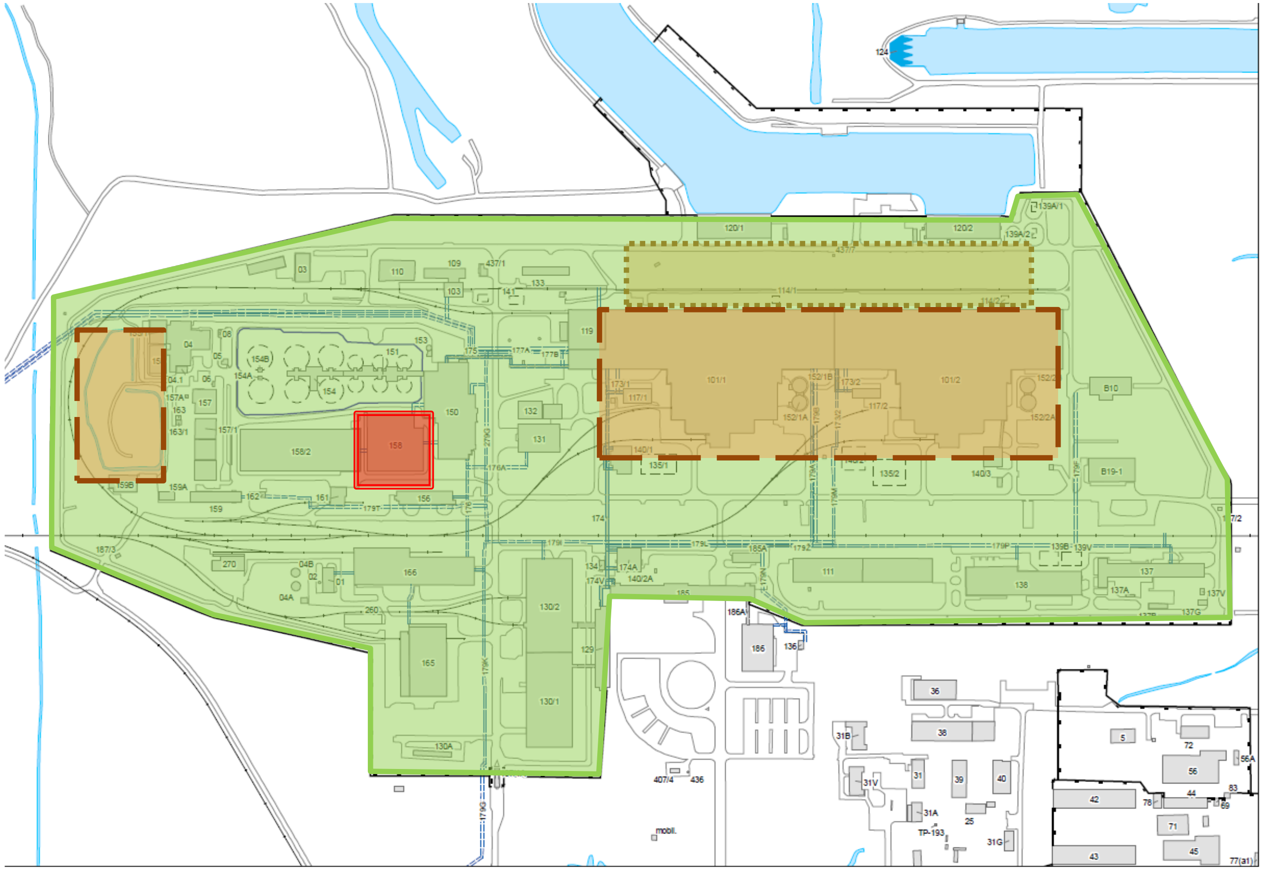
Proposed condition of INPP site, after finishing the decommissioning

The INPP FDP defines the desired state of the NPP site. In the scheme objects that remain nuclear facilities are marked. The scheme is preliminary and subject to change.

Proposed condition of the Ignalina NPP site after the completion of decommissioning:



Proposed condition of the Ignalina NPP site if, in the territory of the units, conditional release is granted.



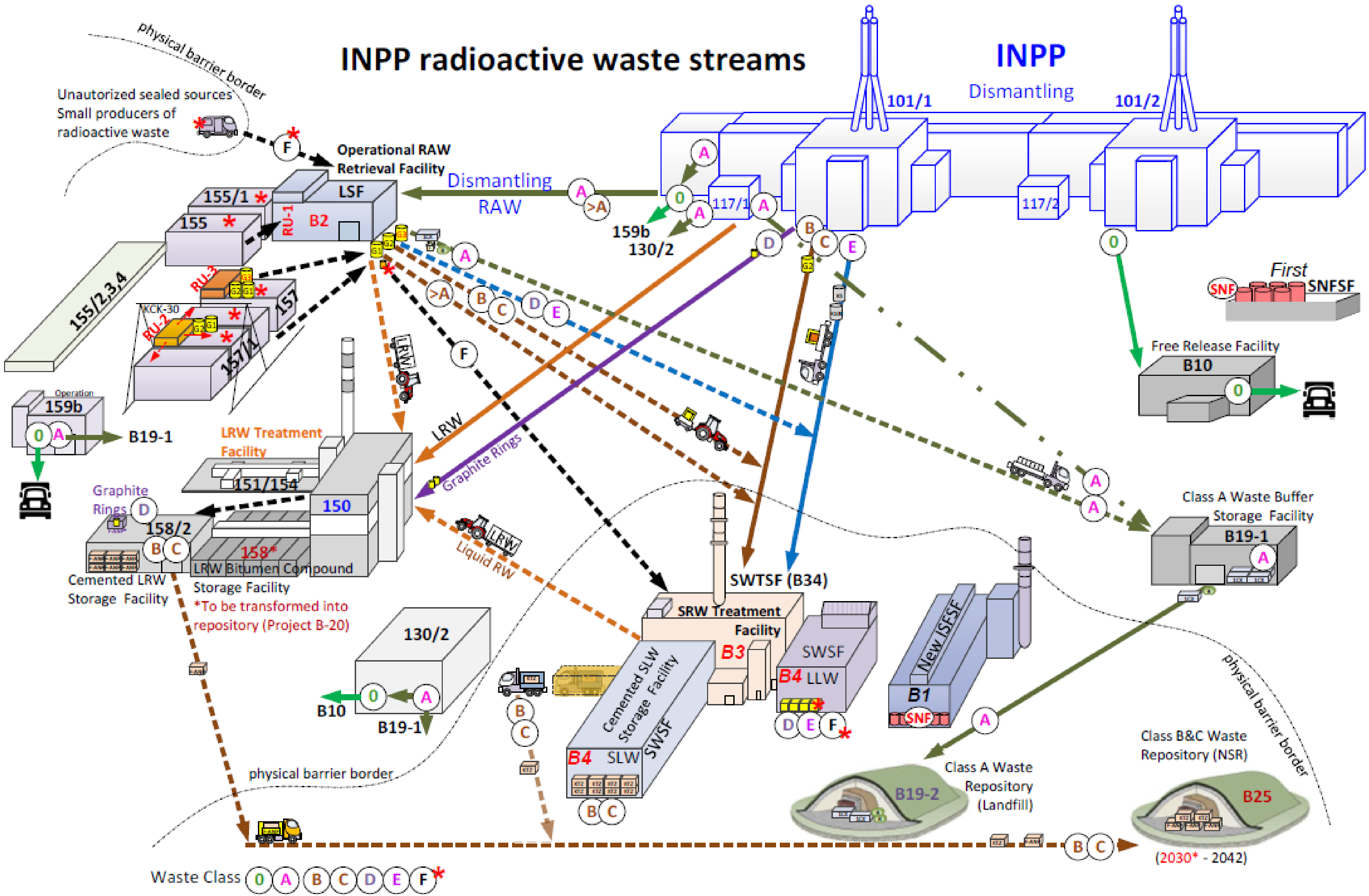
Conditional release

Conditional release - circulation pipelines

Remaining nuclear facilities:

;

Bituminized RW temporary storage;


INPP radioactive waste streams
INPP
Dismantling
101/1
101/2
physical barrier border
Unautorized sealed sources
Small producers of
radioactive waste
Operational RAW
Retrieval Facility
LSF
B2
RU-1
155/1
155
155/2,3,4
RU-3
157
KCK-30
RU-2
157/1
Dismantling
RAW
159b
130/2
117/1
117/2
First
SNFSF
SNF
Free Release Facility
B10
159b
B19-1
LRW
LRW Treatment
Facility
151/154
150
Graphite Rings
Graphite
Rings
158/2
158*
LRW Bitumen Compound
Storage Facility
*To be transformed into
repository (Project B-20)
Cemented LRW
Storage Facility
Liquid RW
SWTSF (B34)
SRW Treatment
Facility
B3
SWSF
B4 LLW
Cemented SLW
Storage Facility
SWSF
B4 SLW
New ISFSF
B1
SNF
Class A Waste Buffer
Storage Facility
B19-1
130/2
B10
B19-1
Class A Waste
Repository
(Landfill)
B19-2
Class B&C Waste
Repository (NSR)
B25
(2030* - 2042)
physical barrier border
Waste Class 0 A B C D E F*

INPP has been performing radiological survey and engineering inventory since 2006. To assess the amount of contaminated concrete, a database of all rooms of the INPP controlled area was created in 2015. The measurements were carried out when no data was available on the radiological parameters of the room (EDR of gamma radiation and surface contamination), as part of the historical assessment.

Class 3*: EDR of gamma radiation in the room does not exceed 0.2 μSv/h, and contamination – 0.4 Bq/cm².*

Class 2*: EDR of gamma radiation in the room is from 0.21 μSv/h to 0.24 μSv/h, and contamination – from 0.41 Bq/cm² to 0.41 Bq/cm².*

Class 1*: EDR of gamma radiation in the room exceed 0.24 μSv/h, and contamination – 4.0 Bq/cm².*

All rooms were divided into 3 groups according to the type of concrete contamination based on several criteria: class of the rooms for the probability of radioactive contamination, the presence of contaminated equipment systems in the room, operational history including emergency situations (database analysis of unusual events).

Rooms with low probability of contamination (Class 3 and group 0) meet the following conditions: during the INPP operation, the rooms were classified as class 3 regarding radiation safety, according to the radiological surveys of the equipment they were assigned to the 3rd class of contamination, after the dismantling of the equipment, the function of the room did not change and there were no emergencies or emergency situations with the formation of radioactive contamination

Rooms with high probability of contamination are categorized as class 1-2 according to radiological investigations of equipment. They are divided into 2 groups:

- ***Group 2*** *– the rooms with predominant secondary contamination of concrete constructions.*

They are divided into rooms where dismantling of equipment has been performed (2-1) and other rooms (2-2):

- ***Group 1*** *– the rooms with predominant primary contamination of concrete constructions are divided into 4 subgroups:*
- *contaminated in the process of production activity and where equipment dismantling works have been performed (1-1);*
- *contaminated in the process of production activity (1-2);*
- *where metal cladding was used and were fulfilling protective functions of concrete structures (1-3);*
- *contaminated in emergency situations (1-4).*

The radiological measurements were performed according to the Programme of Experimental Radiological Investigations of Concrete in Controlled Area Buildings. The radiological measurements were carried out from January 2016 to July 2017. During the radiological measurements, 83 rooms of INPP controlled area of all groups and subgroups were examined. 5,949 dosimetric measurements were performed, as well as 3,689 measurements within the framework of the main investigations, including 83 gamma radiation EDR maps, 76 measurements of the total gamma spectrum in the room and 3,530 measurements of the samples taken from concrete structures on the fixed gamma spectrometer. The following measurement and sampling strategy was used in the survey:

- *For rooms with low probability of contamination coring is carried out to confirm the absence of radioactive contamination. The number of samples shall not be less than two per room, and the depth of sampling shall not be less than 50 mm. In case of detection in the selected core activity of gamma radiation nuclides above the levels specified in the normative documents (for free release), subsequent investigations are carried out according to the algorithm of rooms with predominant secondary contamination.*

For this type of room, the method of measuring gamma spectrum in the room is used. Gamma-spectrometer is placed in the center of the room (or part of the room). Further, the obtained spectrum is analyzed (compared with benchmark).

- For rooms with predominant secondary contamination (group 2) measurements and core sampling are carried out according to the algorithm:

- *concrete structures are verified for primary contamination by moving EDR of gamma radiation. In case of uniform EDR of gamma radiation distribution (absence of hot spots), cores are taken at the rate of 1 sample per 10 m^2 for the floor and 1 sample per 20 m^2 for the walls, with a sampling depth of at least 50 mm. In case of detection in the selected core activity of gamma radiation nuclides above the levels specified in the normative documents (for free release), the sampling depth is increased;*
- *in case of presence of structures with increased EDR of gamma radiation (more than 5 excess over background), further actions in this site are performed according to the algorithm as for the most contaminated rooms;*
- *if the EDR of gamma radiation from concrete structures in the room does not exceed the value of 0.5 μSv/hour, the gamma spectrum is taken using portable spectrometer. Device is placed in the center of the room (or part of the room, if necessary);*
- *if EDR of gamma radiation from concrete structures in the room does not exceed 8 μSv/hour, direct measurements of beta contamination are performed by placing the detector close to the concrete surface.*

For the most contaminated rooms (group 1) measurements and sampling of cores are carried out according to the algorithm:

- *locations with increased EDR of gamma radiation from concrete structures in the room are determined. At these locations, cores are taken to the maximum depth (depending on the thickness of the slab and the layer on the concrete). The condition allowing to reduce the depth of sampling is the establishment activity of gamma radiation nuclides above the levels specified in the normative documents (for free release), of the samples taken from concrete.*
- *the following sampling sites are determined on a radius (with a maximum step of 500 mm). The EDR of gamma radiation is measured at these points. Based on the results of gamma spectrometric measurements of the samples cores taken from concrete, the required sampling depth is determined;*
- *in case of significant reduction EDR of gamma radiation from concrete structures (at distance from contamination centers), cores are taken to determine the level of secondary contamination of concrete constructions. Cores shall be taken at the rate of 1 sample per 10 m^2 and the depth of sampling shall not be less than 50 mm. In case of detection in the selected core activity of gamma radiation nuclides above the levels specified in the normative documents (for free release), the sampling depth is increased;*
- *if there is special sewage drain, embedded or penetrations in the floor of the room, cores are taken in the immediate vicinity to the maximum depth (depending on the thickness of the floor).*
- *The condition allowing to reduce the depth of sampling is the establishment of the activity of gamma-emitting nuclides less than the levels specified in the normative documents (for free release) in samples cores already taken from concrete;*
- *Cores are also taken from vertical structures to determine the level of secondary contamination in them. Cores are taken at the rate of 1 sample per 20 m^2 and the depth of sampling is not less than 50 mm. In case of detection in the selected core activity of gamma radiation nuclides above the levels specified in the normative documents (for free release), the sampling depth is increased;*

The most contaminated were the rooms with primary contamination and those involved in emergency situations. According to the results of the performed investigations the average share of concrete to be removed:

- *For rooms with low probability of contamination (group 0) – 1.29 %.*
- *For rooms with predominant secondary contamination of concrete structures (group 2) – 3.39 %.*
- *For rooms with predominant primary contamination of concrete structures (group 1):*

Subgroup 1-1*. Rooms contaminated during the production activities, where the main equipment of Units G, V, D and auxiliary equipment of Units A and B were located. The average percentage of contaminated concrete – 5.42 %.*

Subgroup 1-2*. Rooms contaminated during the production activities, where the main technological equipment or related water treatment equipment of Units A, B, building 150, etc. were located. The average percentage of contaminated concrete – 23.3 %.*

Subgroup 1-3*. Rooms contaminated during the production activities, where the main technological equipment of blocks A, B, buildings 150, etc. was located. The rooms have metal cladding that performs the protective function for concrete constructions. The average percentage of contaminated concrete – 17.7 %.*

Subgroup 1-4*. Rooms involved in emergency situations related to the spread of radioactive contamination. The average percentage of contaminated concrete – 28.8 %.*

In 2017, Engineering inventory of the reinforced concrete constructions of the rooms in the INPP controlled area was completed sequentially for all buildings/structures. At the same time, the data from the architectural and construction drawings were used as a basis. As the walls, floor and ceiling of the room also relate to several adjacent rooms, it was assumed that half of the volume of the reinforced concrete constructions included in the calculation of the volume of the reinforced concrete constructions. If the wall, floor, or ceiling is the outer boundary of the room, the whole volume of the reinforced concrete constructions refers to that room.

The data was entered in the column “Amount of reinforced concrete”. Based on the data obtained, the amounts of contaminated concrete were calculated.

No	Building, structure	Amount of reinforced concrete in 2018, m^3	Amount of contaminated reinforced concrete, m^3	Percentage of contaminated reinforced concrete in the building, %	Percentage of the total amount of reinforced concrete, %
1	Block A1	131,863.130	22,405.444	16.991	31.238
2	Block B1	16,607.400	1,655.661	9.969	2.308
3	Block V1	12,432.356	348.728	2.805	0.486
4	Block G1	86,271.048	3,678.115	4.263	5.128
5	Block D1	51,242.416	2,753.830	5.374	3.839
6	Block D0	7,401.300	180.196	2.435	0.251
7	Block A2	131,888.480	19,082.631	14.469	26.606
8	Block B2	16,665.200	1,676.678	10.061	2.338
9	Block V2	12,467.300	333.752	2.677	0.465
10	Block G2	88,465.398	3,731.854	4.218	5.203
11	Block D2	51,243.000	3,472.709	6.777	4.842
12	Building 119	4,595.300	59.279	1.290	0.083
13	Building 117/1	2,807.000	69.263	2.468	0.097
14	Building 117/2	1,807.300	51.922	2.873	0.072
15	Building 129 (demolished)	1,104.600	1.120	0.101	0.002
16	Building 130/2	15,991.100	1,092.941	6.835	1.524
17	Structure 135/1,2	3,136.600	730.828	23.300	1.019
18	Building 140/1	1,295.800	24.708	1.907	0.034

19	Building 140/2A	2,442.900	40.794	1.670	0.057
20	Building 150	28,163.789	2,356.042	8.366	3.285
21	Structures 151/154, 154A, B	18,137.400	3,248.809	17.912	4.530
22	Structures 152/1A, B, 152/2A, B	2,466.000	355.201	14.404	0.495
23	Structure 153	627.000	26.426	4.215	0.037
24	Structures 155/1, 155/1	1,290.100	222.509	17.247	0.310
25	Structure 156	3,306.200	84.609	2.559	0.118
26	Structures 157, 157/1	9,671.900	1,689.590	17.469	2.356
27	Structure 158	9,556.800	1,496.225	15.656	2.086
28	Building 158/2	15,203.800	729.874	4.801	1.018
29	Buildings 159, 159B	1,248.300	34.175	2.738	0.048
30	Building 165	977.800	33.147	3.390	0.046
31	Structures 173/1,2, 174, 174A, B, V	924.000	11.920	1.290	0.017
32	Structure 175	956.400	44.992	4.704	0.063
In total:		**732,257.117**	**71,723.971**	**9.795**	**100.000**

Code	**NV-G1-3**		**NV-A1-1**
Date	2007-05-31		2018-01-01
Nuclide/ key nuclide	**Co-60**	**Cs-137**	**Co-60**
^{14}C	8,77E-04	-	9,80E-03
^{36}Cl	-	-	1,00E-03
^{54}Mn	1,70E-01	-	1,80E-04
^{55}Fe	4,20E+00	-	5,50E+00
^{59}Ni	2,25E-03	-	3,10E-03
^{60}Co	1,00	-	1,00
^{63}Ni	2,70E-01	-	3,60E-01
^{65}Zn	1,56E-04	-	5,70E-09
^{90}Sr	1,70E-03	-	3,50E-02
^{93}Zr	3,60E-05	-	2,60E-02
^{93m}Nb	2,95E-01	-	6,40E-01
^{94}Nb	2,30E-02	-	2,50E-02
^{99}Tc	1,97E-05	-	8,00E-05
^{110m}Ag	1,00E-03	-	1,10E-08
^{129}I	-	4,73E-07	1,20E-06
^{134}Cs	-	9,00E-02	1,90E-03
^{135}Cs	-	-	1,90E-06
^{137}Cs	-	1,00	4,30E-01
^{234}U	4,38E-07	-	5,60E-07
^{235}U	8,73E-09	-	1,40E-08
^{238}U	1,37E-07	-	1,60E-07
^{237}Np	2,78E-08	-	2,50E-08
^{238}Pu	1,45E-04	-	1,10E-04
^{239}Pu	6,96E-05	-	7,10E-05
^{240}Pu	1,18E-04	-	9,10E-05
^{241}Pu	8,56E-03	-	8,30E-03
^{241}Am	1,97E-04	-	5,10E-04
^{244}Cm	9,82E-05	-	1,40E-04
^{152}Eu	-	-	2,70E-02
^{154}Eu	-	-	1,90E-02

Status and Gap Analysis

(proposed report contents)

1. Executive Summary
- Overview of activities.
- Summary of key findings.
- Importance of addressing identified gaps.

2. Introduction
- Purpose and scope of the analysis.
- Background on INPP's contaminated structures and radioactive waste management.
- Relation of the analysis to overall decommissioning process.

3. Current Status Overview

3.1. INPP structures selected and contaminated concrete estimations

3.2. Existing decommissioning plans

4. Status and Gaps Analysis

4.1. Comprehensive Review of Existing Data.

4.2. Quantitative Analysis of Radioactive Materials.

4.3. Gap analysis and Future sampling plan

5. Impact of Gaps on Project Objectives

6. Additional measurements needs

7. Recommendations to Address Gaps

7.1. Summary of identified gaps

7.2. Recommended improvements

8. Conclusion
- Summary of the critical gaps.
- Importance of addressing these gaps for project success and regulatory compliance.
- Next steps for closing the gaps as part of the analysis.

Optioneering Report

(proposed report contents)

1. **Executive Summary**
2. **Introduction**
3. **Considerations for options selection, assumptions**
4. **International good practice analysis**
5. **Development of comprehensive set of options, determination of the available and feasible options**
   - **5.1. Concrete treatment decontamination**
   - **5.2. Demolition of structures**
   - **5.3. Waste processing**
   - **5.4. Waste management**
6. **Elimination of non-viable options**
7. **Development of compatibility matrix**
8. **Ranking of viable solutions**
9. **Decision-making and selection process**
10. **Selection of recommended solution**
    - **10.1. Schedule**
    - **10.2. Budget estimation**
    - **10.3. Evaluation of risks and uncertainties**
    - **10.4. Safety assurance process**
11. **Conclusions and recommendations**

Annex – Support Modelling, Calculations and Analyses

Description of Building 101/1 (including Bldg. 119)

Building 101/1 is located about 400 m from the shore of Lake Drūkšiai. The Ignalina NPP site is located on the south shore of the Lake, 6 km from the city of Visaginas (Fig. 1).

Figure 1. Layout of the structures of the INPP

Main block building consisting of:

Block A1 is located in the central part of the main block, in axes 18/19-33/34, between D-ŠČ (Д-Щ) levels. Block A1 is multi-storey building with basements at alt. -12.00 m and -7.20 m, between axes 18/19-33/34 and D-X levels. The dimensions of the building are 90×84 m, with a protruding part in axes 24-28, and levels X-ŠČ (X-Щ), with the dimensions 24×18 m, brick outbuilding in axes 23-24, and levels X-Š, with the dimensions 6×10 m.

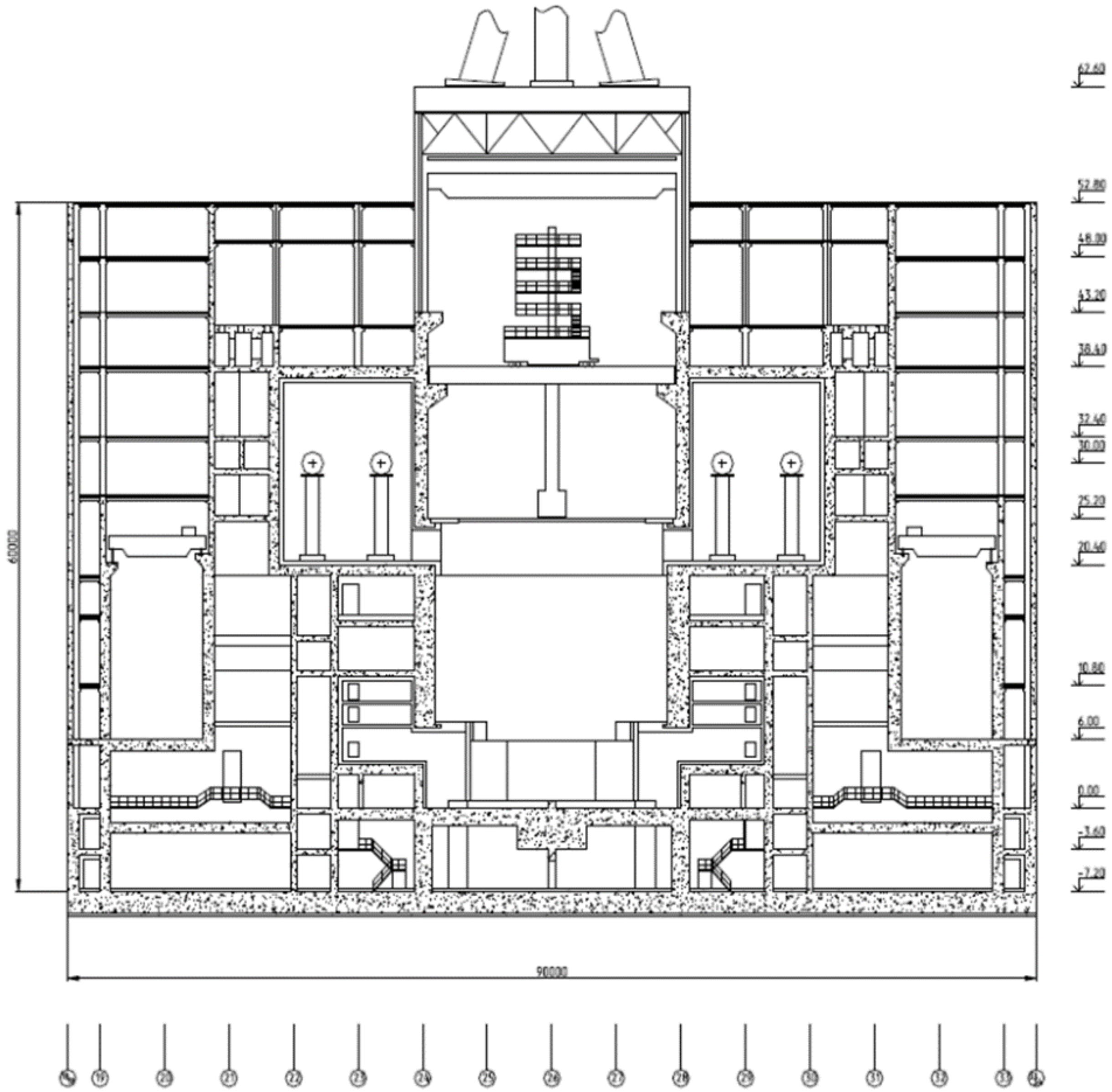


Figure 2. Cross-section A-A of Block A1

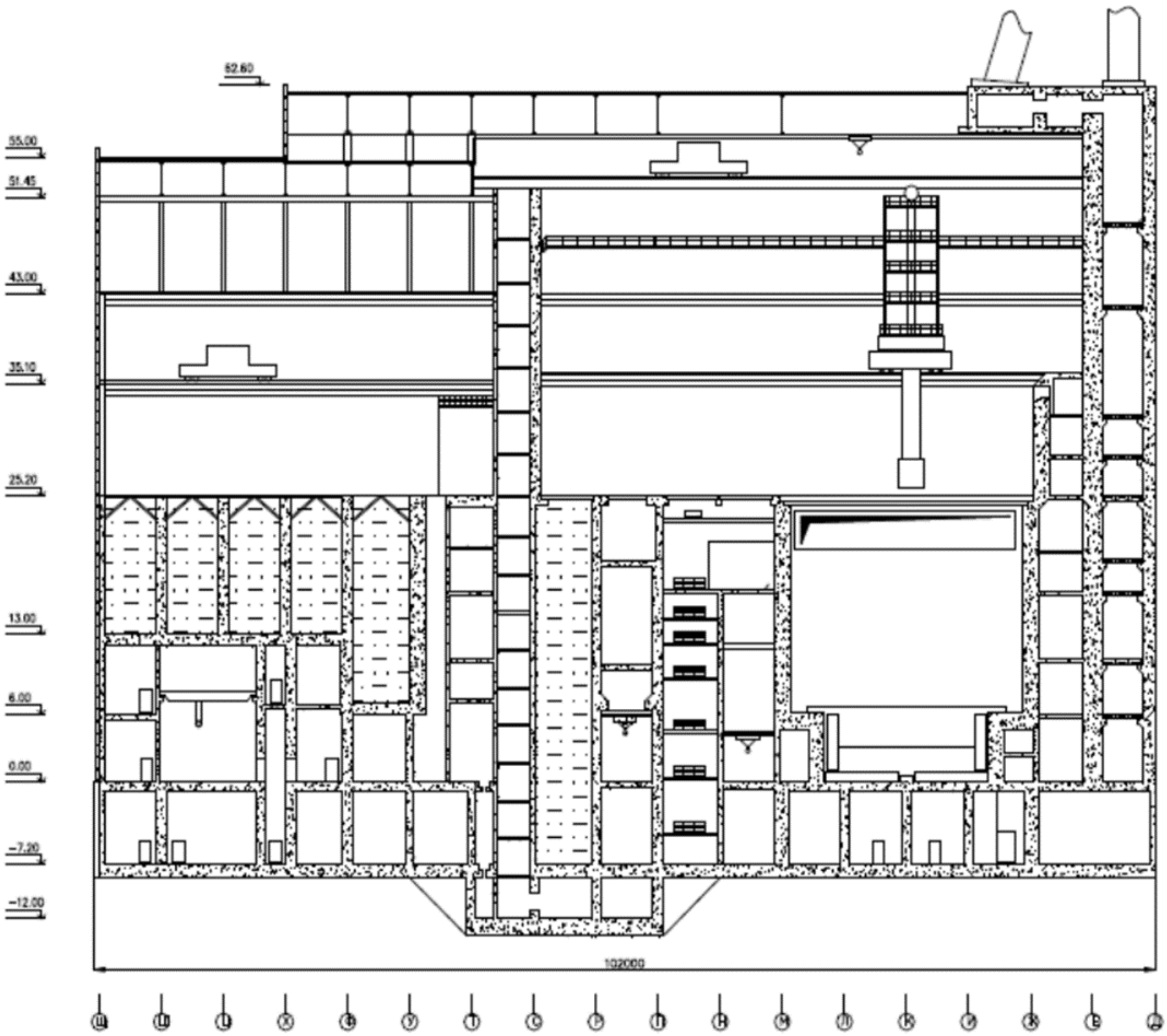


Figure 3. Cross-section B-B of Block A1

The top of the building is at +62.6 m (Fig. 2,3). Structures of the building are monolithic and built-up structures. The foundations are monolithic concrete slab with thickness 1500 mm. The foundation slab material is heavy hydrotechnical concrete of strength class M300. The slab is at depth of 9.00 m, and in axes 24-28, between P-T levels -13.80 m in depth. Hydro-isolation under the slab – reinforced of glass-fiber and layer of rubber-bitumen. Structures of the underground part are monolithic structures. The columns of the overground part are monolithic: reinforced concrete and metal. Load-bearing walls – monolithic structures. Slab – monolithic structures. Dividing walls – reinforced concrete and brick (constructed from bricks). The external walls are constructed from claydite concrete slabs and bricks. Coating is built-up monolithic reinforced concrete structure on girder and metal trusses. The ventilation stack on the roof built from 3 separate pipes with diameter Ø4.8 m. The foundation of ventilation stack starts from alt. +62.60 m. One ventilation stack is vertical at alt. +159.00 m, the other two are leaning at alt. +122.00 m and at alt. +152.40 m. The roof is flat with internal drainage, made of ruberoid, covered with insulation boards with an additional layer of Wolfin material.

Block B1 is located on the righthand side of the Block B1, in axes 33/34-39/40, between D-T levels. Block B1 is a multi-storey building with a basement at alt. -7,20 m, between axes 33/34-38/39 and levels D-T. The dimensions of the building are 30x66 m, with a standout part in axes 38/39-39/40, and levels D-I, brick staircase and elevator shaft are equipped, with the dimensions 6x18 m. The top of the building is at +35,00 m. The building was assembled monolithic reinforced concrete. The description of the building of the construction structures and roof is similar to Block A1, only there are no metal columns, trusses and monolithic layer.

Block V1 is located on the lefthand side of the Block A1, in axes 14/15-18/19, between D-T levels. Block V1 is multi-storey building with a basement at alt. -7,20 m, between axes 15/16-18/19 and levels D-T; The dimensions of the building are 18×66 m with standout part in axes 14/15-15/16, and levels D-I, brick staircase and elevator shaft are equipped, with the dimensions 6×18 m. The top of the building is at +35,00 m. The description of the building is similar to Block B1.

Block G1 is located on the north side of the main block, in axes 1-51, between A-B levels. Block G1 is single-span multi-storey building with the basement at alt. -6,40 m; The dimensions of the building – 300x51 m, height of level A is +32.80 m, height of level B is +34.0 m (Fig. 4).

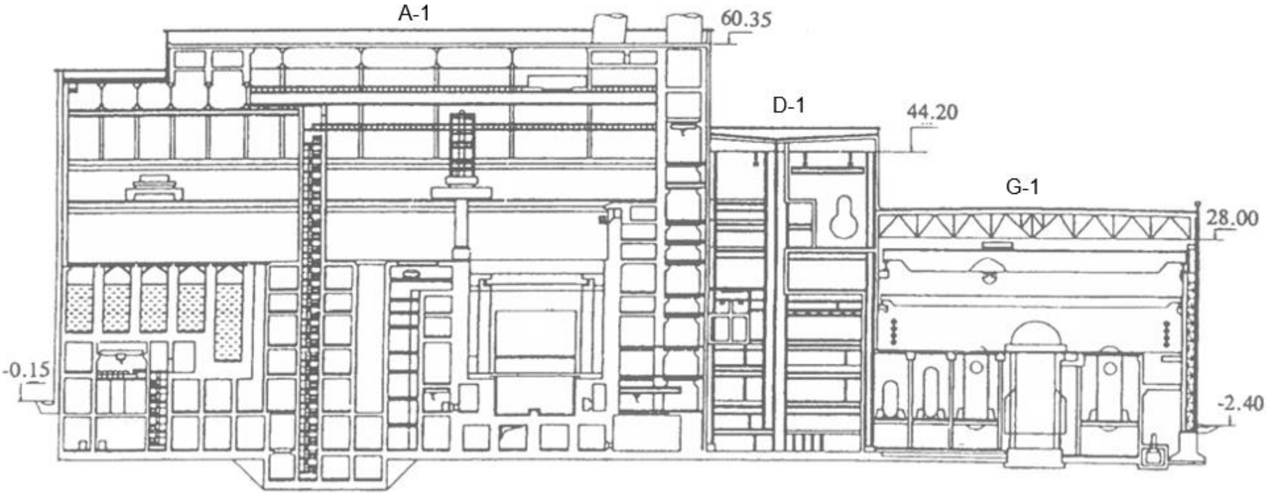


Figure 4. Cross-section B-B

The foundations are reinforced-concrete slab with reinforced-concrete supporting columns and built-up monolithic support. Load-bearing walls and slabs are monolithic. The frame is a metal L-shaped frame with metal braces consisting of columns and trusses supporting the columns in A level and Block D structures in B level. Maintenance platforms are metal. Dividing walls – reinforced concrete and brick. The external walls are constructed from claydite concrete slabs. Coating is constructed of profiled steel. The roof is single-slope with internal water drainage covered with Alkorplan material on top of stone wool slab PAROC.

Block D1 is located between Block G1 in level B and Block A1, B1 and V1 in level G. Block D1 is multi-storey building with a basement at alt. 7,20 m; The dimensions of the building – 300x25,5 m; between axes 1-51and levels B-G, height – 46,4 m (Fig. 4). The foundations are monolithic slab. The reinforced concrete structures of the underground part are monolithic structures. Frame – metal columns, beams and girders. The walls and ceilings of the deaerator rooms are monolithic structures. Slabs are monolithic structures. Dividing walls – reinforced concrete and brick. The external walls are constructed from claydite concrete slabs. Coating is constructed of profiled steel. The roof of Block G1 construction is similar to the roof construction of Block A1.

Block D0 is located on the west side of the main block, in axes 1-9; between B-G levels. Block D0 is **a** multi-storey building with the basement at alt. -7,20 m; The dimensions of the building – 48x25,5 m; heigh – 34,6 m. The description of Block D0 is similar to Block D1.

Building 119 is located on the west side of Building 101/1, in axes 1-9, between A-B levels, next to Block G1 in axis 1, next to Block D0 level B. Building 119 is a one-storey, without basement building, length is 51 m between A-B levels, total length between axes 1-9 is 48 m. Floor alt. -2.40 m, Roof alt. level A +32.80 m, level B +34.0 m. Reinforced-concrete plates and monolithic foundations of supporting metal columns of the frame alt. -9,50 m. The slab of the building and supporting elements of the column's foundations are made of hydrotechnical M300 concrete. Reinforced concrete slab and load of sand and granite rubble ensure reliability against flotation caused by groundwater pressure from alt. -8.50 m to alt. -2.70 m. The foundations of framework columns are made of separate supports which are in level A and axis 9 considering at the interval 12 m. The building frame is made of metal. Spaces between columns and trusses are 18 m. Vertical connectors are equipped between the columns. External walls were constructed of claydite concrete slabs which are 12 m long and 300 mm thick. Coating is constructed of profiled steel. The roof has complex layers: insulation consists of semi-rigid 50 mm thick mineral wool panels, protective levelling layer of 50-80 mm thick cement sand, a waterproofing roofing material of 4 layers of Ruberoid on bituminous mastic. During operation, a damp-proof layer of “Wolfin” material was additionally laid on the ruberoid coating.

General data	**Block A1**	**Block B1**	**Block V1**	**Block G1**	**Block D1**	**Block D0**	**Building 119**	**Building 101/1**
Build up area (m^2)								38875
Main area (m^2)	53596	12027	7132	31594	66174	7244	4865	182734
Volume (m^3)	749810	66888	41815	555348	324577	40689	86522	1865649
Out of total:								
Underground part (m^3)								292888
Above-ground part (m^3)								1572761

Description of Building 101/2

There are no essential differences between structural part of Buildings 101/1 and 101/2.

General data	**Block A2**	**Block B2**	**Block V2**	**Block G2**	**Block D2**	**Building 101/2**
Build up area (m^2)						35087
Main area (m^2)	51126	11820	7116	32228	63616	116732
Volume (m^3)	749810	66888	41815	555878	324047	1738438
Out of total:						
Underground part (m^3)						275836
Above-ground part (m^3)						1462602

Liquid Radioactive Waste Management Complex

The Building 150 liquid waste management complex comprising Buildings 150, 151, 153, 154, 154A and 154B. INPP liquid RW management interconnected functional complex for cementation is installed together with liquid waste tanks and other auxiliary facilities.

Building 150. Liquid Radioactive Waste Management Facility

Building 150 (Liquid Radioactive Waste Management Facility) is located inside the protected zone of the INPP site. The building is designed for treatment of liquid radioactive waste generated from technological systems of Buildings 101/1, 101/2 (Unit 1, 2), 130, 156 and 159 by using evaporation and cementation methods. The dimensions of the building between axes 1÷22 and level A÷H are 126.0 m x 66.5 m. The height of the building is different: between axes 3÷13 and level A÷Б – H=12 m, between axes 1÷10 and level B÷M and between axes 8÷21 and level M÷H – H=16.8 m, between 10÷22 axes and B÷M level – H=36 m. The building in axes 3÷13/A÷B – one-storey, in axes 1÷10/B÷M, 8÷20/M÷H – three-storey, in axes 10÷22/B÷M – seven-storey. There are basements under the building: in axes 1÷3/B÷M at the level -3.00, in axes 11÷19/M÷H at the level -4.80, in axes 3÷4/B÷K at the level -6.00.

The foundation slab of the building is made from monolithic reinforced concrete. The foundation for the external walls of the building is made from reinforced concrete foundation beams. The building columns, ceilings and roof beams, beams and slabs are made of reinforced concrete. In axes 10÷22/B÷M are 600 mm thick reinforced concrete slab made of M300 waterproof concrete. In axes 11÷20/M÷N there is a 700 mm thick reinforced concrete slab made of concrete M200 waterproof concrete. In axes 1÷4/B÷M there is a 500 mm thick reinforced concrete slab M200 made of waterproof concrete. The basement walls are 500 and 600 mm thick and made of M200 waterproof concrete.

A concrete foundation with a 3% slope has been installed around the outer walls of the entire perimeter of the building. The external walls of the building are equipped of 300 mm thick claydite concrete with dimensions of 1.2 mx6.0 m, attached to a reinforced concrete frame. The frame of the building is produced of reinforced concrete structures. The column network is as follows: in axes 1÷22/B÷H – 3×6, 6×6, 6×9, in axes ÷19/M÷H – 6×9, in axes 4÷13/A÷B – 6×18. The strength and stability of the frame in the longitudinal direction is ensured by vertical metal frames installed along the columns between axes 6÷7 and 16÷17, and in the transverse direction by columns and crossbars formed by frames, connected to monolithic wall arrays. Column foundations are made of reinforced concrete M200 waterproof concrete.

Up to altitude +10.80 internal walls of monolithic concrete 600 mm thick, ceilings of reinforced concrete 700 mm thick are made of heavy M200 type concrete and heavy hydrotechnical concrete γ = 2.4 t/m^3 M300 waterproof concrete B6 type. Monolithic structures are reinforced with mesh reinforcement and separate rods. For reinforcement bars class AI, AII and AIII are used, diameter from 8 to 40 mm. Reinforced concrete partition and ribbed slab plates are assembled above +10.80 altitude. The ceiling is constructed with reinforced concrete ribbed slab plates. The walls of the stairway are made from bricks of 250 mm thickness.

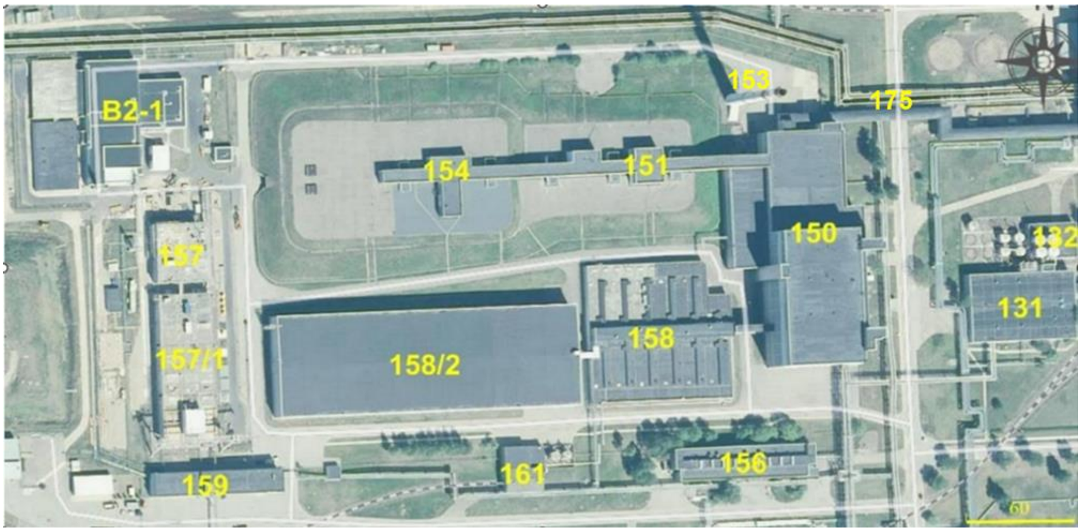


Figure 1. Location of Building 150 on the INPP territory

On the northern side, Building 150 (Fig. 1) has a passageway connecting by communication overpass to Building 101/1. On the western side, Buildings 150 and 158 are connected by a gallery; Building 150 is connected to Buildings 151/154 (Sewage (Drainage) Storage Tanks and Sewage Storage and Treated Water Tanks). Next to Building 150 there is a ventilation stack (Structure 153), and a passageway (Building 175) that connects Building 150 with the power units.

Figure 2. General view of Building 150

Building 150 (Fig. 2) is a rectangular multistorey building with the following dimensions: length – 126 m; width – 66.5 m, height from -6.0 m to +40.0 m. The total area of the building – 23209.09 m^2, the volume – 168365 m^3. The rooms of the building are arranged at ±0.00, +6.00, +10.80, +15.60, +20.40, +25.20, +30.00 levels. The relative height of the top of the building is +40.00.

Building 150 has the main equipment (Fig. 3) for the liquid radioactive waste treatment: two evaporators, two condensate cleaning systems, two sets of bituminisation equipment (out of service since 2015), cementation equipment, etc. Technological equipment is located in sealed rooms, pipelines – in pipeline corridors. The floors of hermetic rooms and pipe corridors are laid out with corrosion-resistant steel.

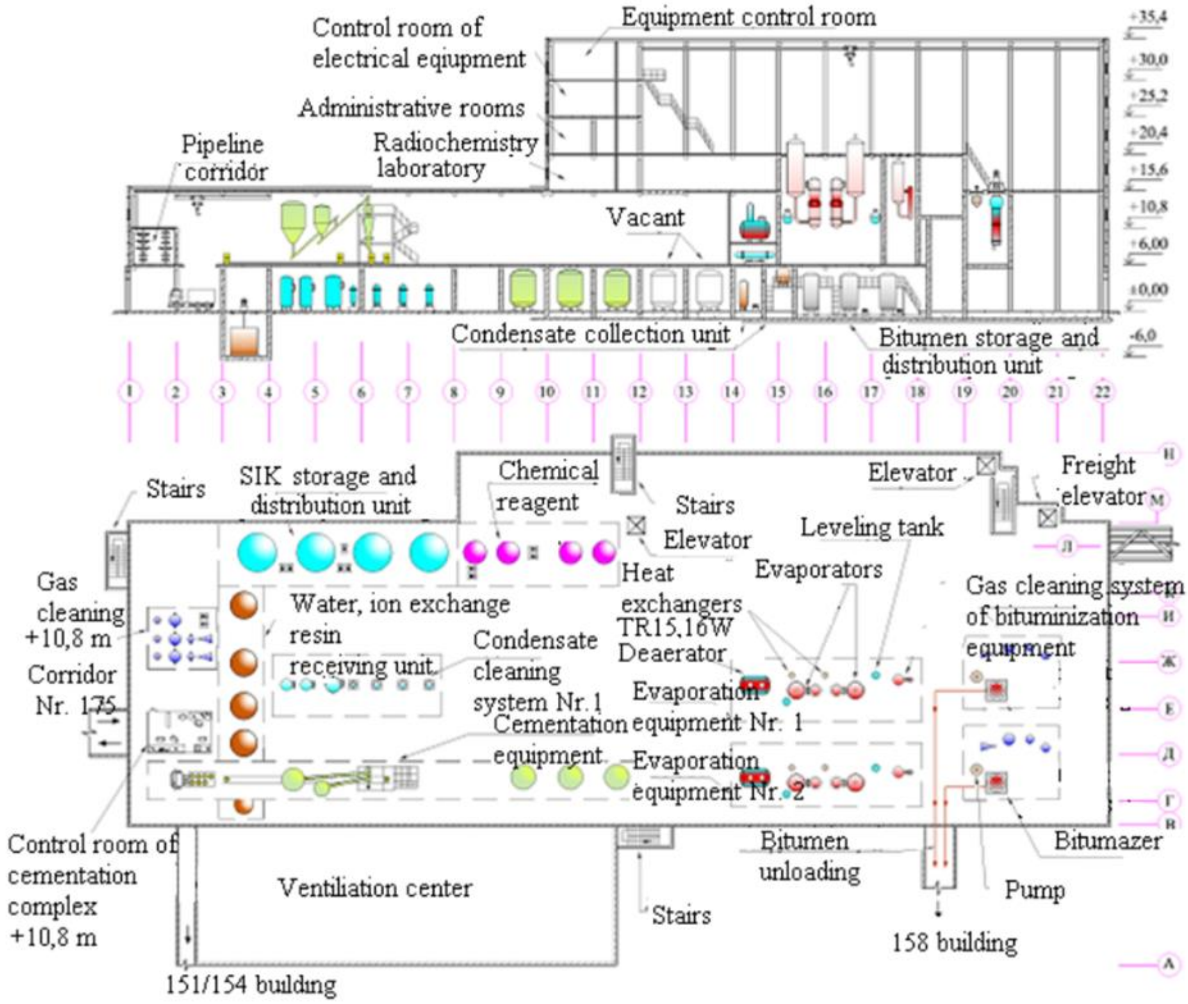


Figure 3. Layout of main installations (Building 150)

The Cementation Facility is located in axis A-E/1-6 of Building 150 in the following rooms: No 104, 105, 125, 126, 127 – at the level 0.00, No 231 – at the level +6.00 and No 324 – at the level +10.64.

Structure 153. Ventilation Stack of Building 150

The reinforced concrete ventilation stack was constructed using reinforced concrete M300 with class A-III Ø12-Ø16 mm reinforcement. The thickness of the reinforced concrete chimney walls varies from 300 mm at the bottom to 160 mm at alt. +70.00 m, with a widening of up to 250 mm at the top. The internal diameter of the stack is 6.75 m at alt.0.00 m and 4.18 m at alt.+75.00 m. There is an opening of 2.40x3.75 m for the flue gas release in the reinforced concrete pipe at the alt. -0.02. The inner surface of the stack is coated with 0.2 mm thick epoxy carbon coating with enamel paint from alt.0.00 m to alt.+75.00 m to protect against chemical impact.

Structure 151/154 (154 A,B). Sewage and Treated Water Tanks

Within the controlled zone of the INPP, all water discharged from various technological tanks and pipelines, wastewater (floor drainages, sanitary buildings, and special laundry wastewater, etc.) is collected into tanks equipped for this particular purpose and located in Structure 151/154.

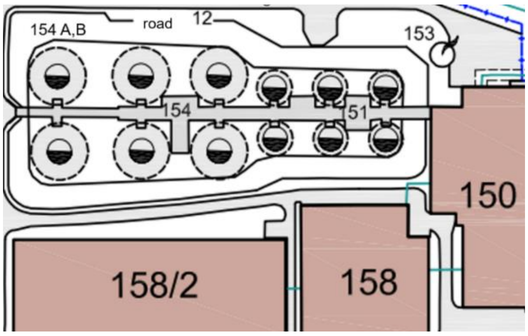


Figure 4. Location of Structures 151/154 and 153 on the INPP territory

Structure 151/154 consists of tanks (4 tanks of 5000 m^3 and 6 tanks of 1500 m^3) connected to each other by a corridor. Structure 151/154 is connected to other two 5000 m^3 tanks (Structure 154A, B) on the west side. The complex configuration of Structures 151/154 and 154 A, B with dimensions of 180x80 has a common embankment. Structure 151/154 connects with Building 150 on the east side. The connecting structure is a 4-storey building with rooms at alt.-1,20, +1,80, +5,40, +9,60. The part of the building up to +9,60 is underground and above +9,60 is above-ground.

The foundations of the connecting structure are made from reinforced concrete slabs of 1000 mm and 600 mm thick M200 concrete on 100 mm thick M150 B4 concrete. A 200 mm thick drainage system of sand and gravel mix is installed under the foundation. The system is waterproof. Foundations under the columns are made of reinforced concrete M200. The structural frame of the connecting structure consists of reinforced concrete columns of 400x400 mm cross-section, made of M300 concrete. The grid of the columns is 6x6 m and 6x9 m.

The walls of the connecting structure and staircases from level -1,20 to level +9,60 is made of reinforced concrete M200 with thicknesses of 400 mm, 500 mm and 600 mm, and from level +9,60 of 300 mm thick claydite concrete. The walls are waterproof in contact with the ground is covered from rubber bitumen mastic up to the -0,50 level and bitumen from the -0,50 level to the +9,60 level. Ceilings are made of reinforced concrete M300 140 and 100 mm thick and plain clay bricks M75 120 mm thick on M50 cement grout with reinforcement. The roof of the building is a flat combined roof, unventilated, with internal drainage, except for the rooms (No. 301, 302, 307, 308, 314÷317), which have external drainage above. The waterproofing of the roof is made up of 4 layers of bituminous mastic and gravel.

In Structure 154, the four 5000 m^3 Ø31,6 m cylindrical monolithic reinforced concrete tanks are coated of hydraulic concrete with a 4 mm thick stainless steel inner coating. Inside there is a Ø2000 mm central column. A 200 mm thick sand and gravel drainage channel was formed under the tanks, on which a dry two-layer waterproofing was laid, and a 100 mm thick monolithic reinforced concrete manhole was installed. Perforated stainless steel pipes Ø159x6 mm were installed to drain the drainage water. The tanks have a waterproof leakage tray with two layers of rubber-bituminous mastic on cold bituminous base, with a 20 mm thick layer of cement grout M50. The bottom of the tank is 200 mm thick, and the concrete walls are 400 mm thick.

In Structure 151, the six 1500 m^3 Ø19,3 m long cylindrical monolithic reinforced concrete tanks are coated of hydraulic concrete with a 4 mm thick stainless steel (walls and floor) and 3 mm thickness (ceiling) inner coating, with a Ø1000 mm central column. A 200 mm thick sand and gravel drainage channel was formed under the tanks, on which a dry two-layer waterproofing was laid, and a 100 mm thick monolithic reinforced concrete manhole was installed. Perforated stainless steel pipes Ø76x4,5 mm were installed to drain the drainage water. The tanks have a waterproof leakage tray with two layers of rubber-bituminous mastic on cold bituminous base, with a 20 mm thick layer of cement grout M50. The bottom of the tank is 200 mm thick, and the concrete walls are 400 mm thick.

All the tanks are covered with soil, and then a concrete levelling layer with an asphalt overlay is laid in horizontal sections. The retaining walls at the base of the slopes are made of reinforced concrete blocks 300 mm thick, which is M300 concrete.

Solid Radioactive Waste Storage Facilities (Buildings 157, 157/1)

Buildings 157, 157/1 are located on the northwest side of the INPP site, at 500-600 m to the west of Unit 1. Lake Drūkšiai is located about 750 m to the north.

Solid radioactive waste generated during the operation of the INPP was placed into temporary storage facilities built for that purpose and located on the INPP site (Buildings 157, 157/1) (Fig. 1). Spent sealed sources (SSS) were also placed into the same facilities.

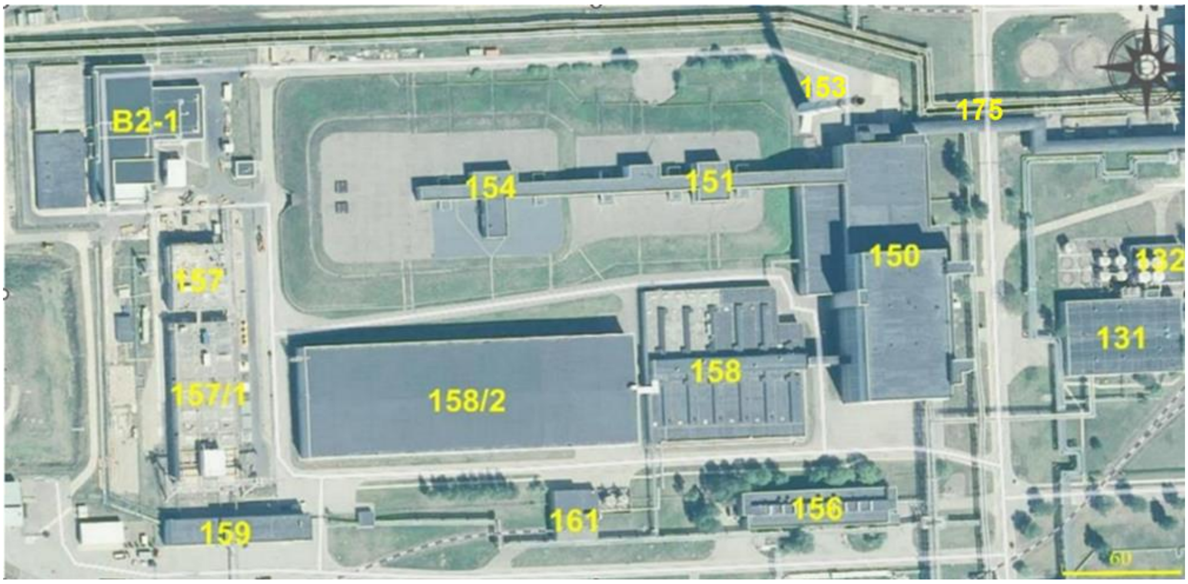
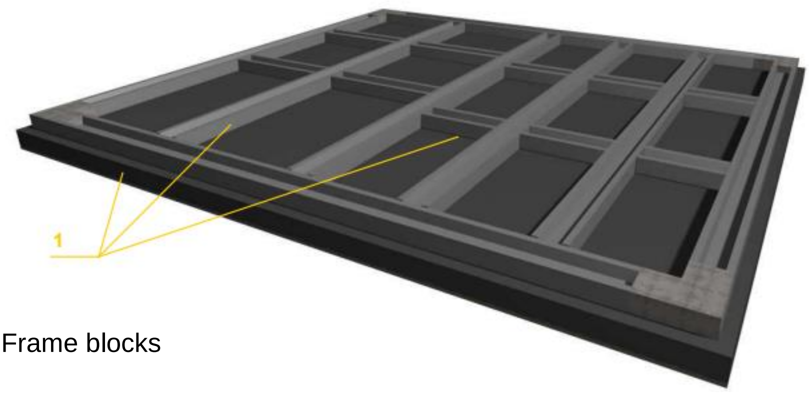


Figure 1. Location of Buildings 157, 157/1 on the INPP territory

Building 157

Building 157 is a one-storey cast-in-situ reinforced-concrete surface construction. The walls of Building 157 are precast reinforced concrete, consisting of two layers: an external layer – vertical reinforced concrete slabs 900×120×30 cm, an internal layer – reinforced concrete blocks 600×220×30cm. For the purpose of storage of different levels of waste, the building is subdivided into 15 vaults.

The foundation base is made of M200 cast-in-situ reinforced-concrete placed on M100 concrete which is covered with a rubberized-bitumen damp isolating layer and M100 concrete protective layer (Fig. 2). Reinforcement of the base is made of two horizontal layers in the form of carbon-steel rod stacks, reinforcing blocks and frame blocks.



1 – Frame blocks

Figure 2. Building No 157 foundation

The bottom reinforcing layer consists of ∅32AIII and ∅16AIII carbon-steel rods grid. The rods are located at a distance of 200 mm from each other. Additional reinforcing with rods ∅25AIII, mm

L=5000 mm was made in the central part of the foundation, in between the grid. The upper reinforcing layer consists of Ø32III and Ø16III carbon-steel rod grid. The rods are located at a distance of 200 mm from each other. Upper and bottom reinforcing grids are joined by fixing blocks which consist of Ø12AI rods and one carbon steel Ø12AI rod. Frame blocks are reinforced with carbon-steel rods Ø25AIII, Ø16AIII and Ø10AIII. Three types of frame blocks were used: AK-1, AK-2 and AK-3. They differ in length only - L=3550 mm for AK-1 (124 units were used), L=2350 mm for AK-2 (20 units) and L=750 mm for AK-3 (6 units). Frame blocks were used for reinforcing panels.

The building is constructed of external and internal (dividing) walls. External walls (supporting structure) consist of M200 reinforced-concrete panels, mainly of SP-1 type; width – 1180, thickness – 300 and height – 8950 mm. Other types of reinforced panels were also used such as SP-1, SP-1-1, SP-1-3, etc. They differ in width only. Spaces between the panels are filled up with concrete-sand mixture under pressure. The reinforcement of SP-1 is made of two grids names C-1 and with a concrete cover of 50 mm, The dimension of C-1 is 1160×8930 mm. Between those grids several Ø8AI rods are fixed. The reinforcement of C-1 in the longitudinal (height) direction is made of Ø20AUI bars (L=8930 mm) spaced 200 mm. In the bottom of C-1 additional Ø20AIII bars (L-2700 mm) are placed. Thus, in the lower part the longitudinal bars are spaced 100 mm in the transverse direction the longitudinal bars are fixed by Ø8AI bars spaced 200 mm. Two additional upper and lower transverse bars are from Ø12AIII.

External walls from the inside are covered with concrete M100 blocks of two types with different thickness: δ=300 mm (FS - 3) and δ=400 mm (FS - 4, were used for high-level waste vaults). These blocks are intended for biological shielding enhancement. Dimensions of FS – 3 blocks - 2400×600 mm, FS - 4 - 1200×300 mm.

From the outside of the building along the walls of high-level waste vaults (vaults No 1 and 4) reinforced-concrete panel SP-1 was erected. Thus, total wall thickness is 600 mm or 1000 mm (high-level waste vaults). Dividing walls are constructed of SP-1 reinforced-concrete panels. Some dividing walls are covered with FS-3 and FS-4 blocks. Concrete blocks of different size cover the spaces between the walls and dividing walls or between dividing walls.

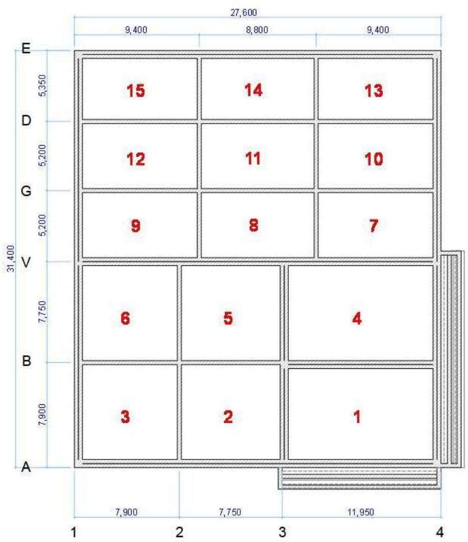


Figure 3. Scheme of Building 157
(Reference numbers of vaults are marked in red)

Cast-in-situ roof slab is constructed of 500 mm M200 reinforced concrete. The thickness of the cast-in-situ roof slab of the high-level waste vaults is 1200 mm. They are mainly reinforced with Ø12AIII and Ø16AIII carbon steel rods placed crosswise to Ø8 mm rods at 200 mm distance. Rubberized-bitumen insulation seals the space between the roof and plate.

The roof of the low- and intermediate-level waste vaults has a 4×5,5 m hatch for waste loading (Fig. 3). Hatches are covered with four M200 reinforced concrete blocks of P-I and/or P-2 type. P-1 concrete block dimensions are 4480×1730 mm, and P-2 concrete block dimensions are 4480×1500 mm (considering 250 mm spacing across). Concrete block thickness is 500 mm. For double reinforcement Ø16AII and Ø12AII carbon steel rods placed at 200 mm distance were used.

For loading of high-level vaults there are six hatches of 1,004 m diameter in the roof for each vault (Fig. 4). The hatches are covered with concrete plugs. The additional 600 mm biological shielding and new plugs were constructed for the HLW sections. Heavy concrete B25, ρ=2400kg/m^3 and ρ=3600 kg/m^3. The reinforcement is mainly from carbon-steel rods Ø 25 and Ø 12 mm.

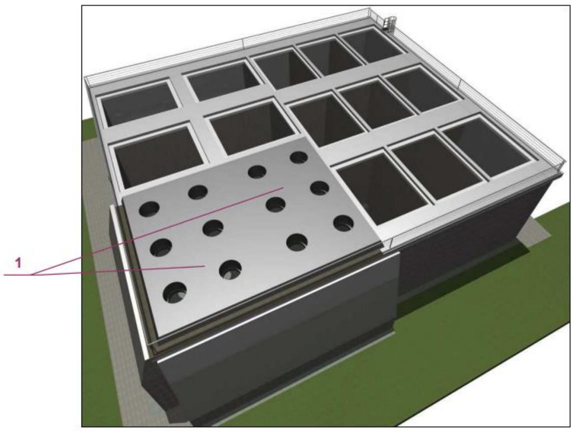


Figure 4. Construction of cast-in-situ roof slab of building No 157
1 – high-level waste vaults

A metal roof enclosure of 850 mm height, made of Ø26 mm rods is installed along the roof perimeter.

Table 1 Constructional characteristics of building No 157

Dimensions	Length, m	31,4
	Width, m	27,6
	Height, (without asphalt layer and obstructions for sealing of vaults, No 1 and 4), m	9,70÷10,70
Foundation	Concrete layer M100, mm	150
	Threefold damp-proof course of rubberized asphalt, mm	~5÷10
	Concrete layer M100, mm	30
	Cast-in-situ reinforced-concrete M200, mm	800
Walls (except walls of vaults No 1 and 4)	Concrete blocks FS – 3 M100, mm	300
	Reinforced-concrete M200, mm	300
Walls of the vaults, level A. axis 3-4 level A-V, axis 4	Concrete blocks FS – 4 M200, mm	400
	Reinforced-concrete M200, mm	300
	Reinforced-concrete M200, mm	300
Dividing walls	Reinforced-concrete M200, mm	300
Dividing walls of vaults level B, axis 3-4	Concrete blocks FS – 4 M100, mm	400
	Reinforced-concrete M200, mm	300
Dividing walls of vaults level B, axis 1-3; level V, axis 1-4; level A-V, axis 3	Concrete blocks FS – 3 M100, mm	300
	Reinforced-concrete M200, mm	300
Roof	Concrete blocks FS – 3 M100, mm	500
	Asphalt layer, mm	30÷110
Roof with high-level waste (vaults No 1 and 4)	Reinforced-concrete plate M200, mm	700
	Reinforced-concrete B25, mm	600
	Concrete M100, mm	30÷100
	Five layers of rubberized asphalt (for sealing)	
	Asphalt layer (for sealing), mm	30

Building 157/1

Building 157/1 is a one-storey a cast-in-situ reinforced-concrete surface construction. The building consists of three separate parts, and it is divided into 29 vaults for the purpose of low- and intermediate-level waste storage (Fig. 5).

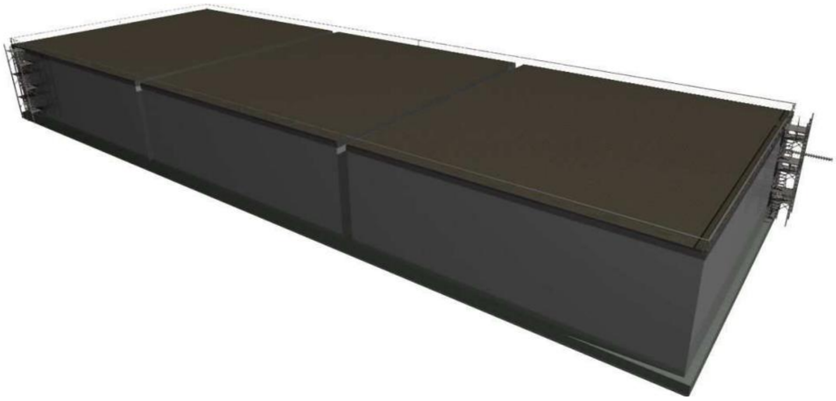


Figure 5. General view of Building 157/1

The slab consists of three separate cast-in-situ reinforced M300 concrete slabs placed at a distance of 50 mm from each other. The slab rests on sand-free 150 mm M150 concrete with the dimensions 28.6x82 m in plane. The reinforcement is made up of two horizontal layers with several rows of steel rods, fixing blocks and frame blocks. The lower grid consists of several rows of Ø32 carbon-steel rods spaced 200 mm. The upper grid consists of several rows of Ø25 and Ø16 carbon-steel rods spaced 200 mm. Fixing blocks of carbon-steel rods connect the lower and upper grids. The building is designed of external and internal (dividing) walls. External walls (load bearing structure) consist of M300 reinforced-concrete panels.

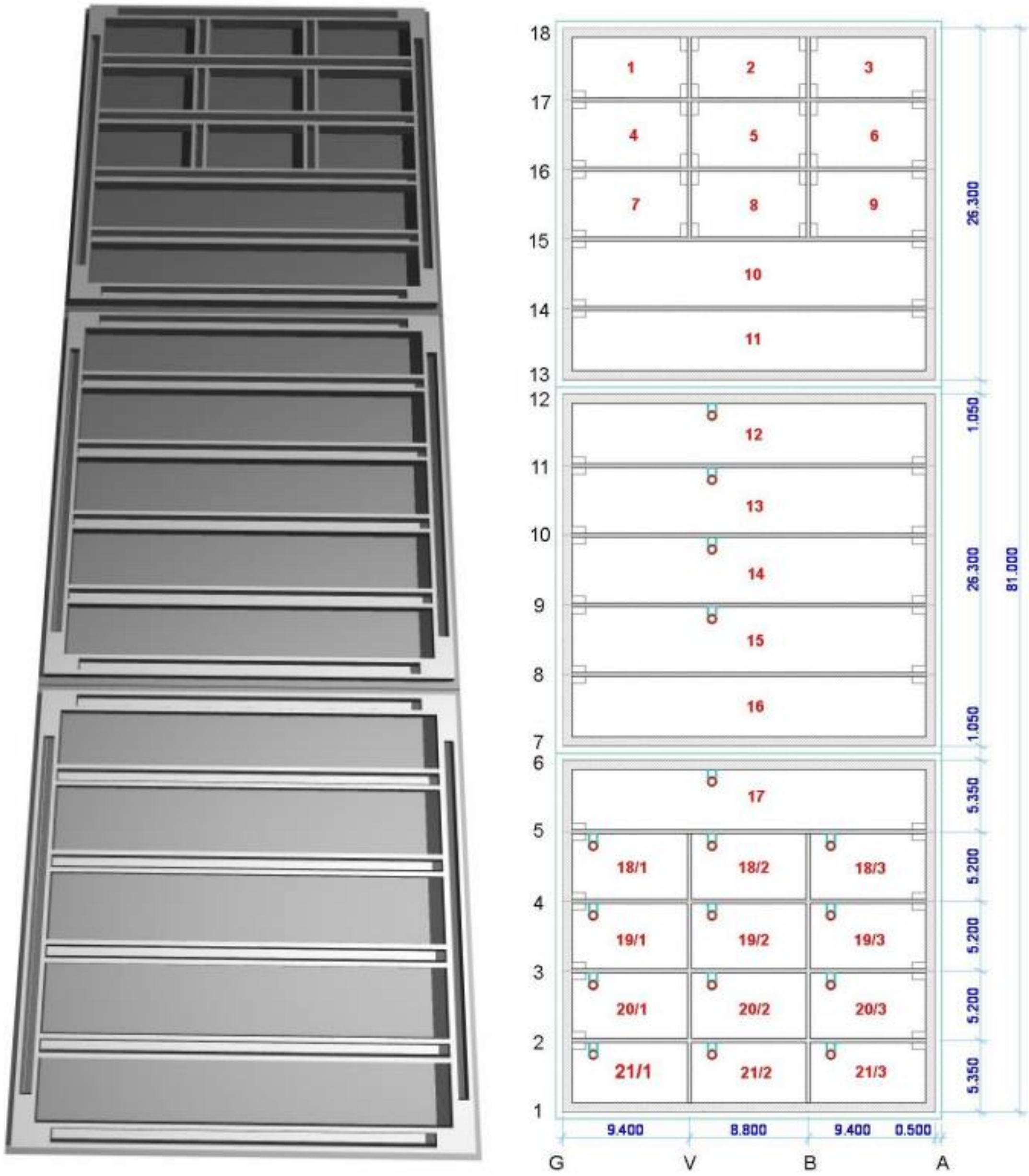


Figure 6. Foundation construction and scheme of Building 157/1
(Reference numbers of vaults are marked in red)

Cast-in-situ walls are designed of M300 concrete of 80 mm thickness and M300 reinforced concrete reinforcing filling material. Reinforcing of this filling material consists of Ø8 mm carbon-steel rods placed horizontally with 400 mm spacing, and Ø20 mm carbon-steel rods placed vertically with 200 mm spacing. Blocks are reinforced with carbon-steel profiles of 2L (No 12) and L (50×5 mm) type. Total thickness of external walls is 700 mm.

Dividing walls are constructed of M200 reinforced-concrete panels of SP-1 type. M100 concrete blocks of different size (of FBS type) were used for covering of hatches between dividing walls and external walls. Small spaces between the panels are filled up with M200 concrete. For the purpose of high-level combustible waste storage in 1994 in vaults 18÷21 (along axis B, V and I÷5 levels) a supplementary dividing wall was erected. Th supplementary dividing wall was made of M300 cast-in-situ reinforced concrete of 300 mm thickness. Reinforcing is of Ø25, Ø12 and Ø8 mm carbon-steel rods were used for reinforcement.

Cast-in-situ roof slab (Fig. 7) is 500 mm thick, made of M300 reinforce-concrete. Spatial carcass from frame blocks and carbon steel rods, mainly of Ø16, Ø12 and Ø8 mm reinforces the roof slab. The frame blocks are of different design; mainly 2L (No 27, No 20 and No 12) and L (63×5 mm) type carbon-steel profiles.

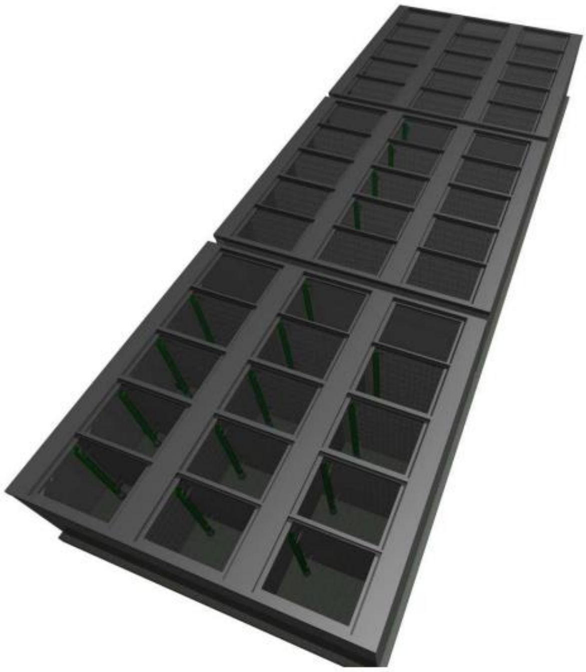


Figure 7. Cast-in-situ plate of building 157/1 roof

For the purpose of waste loading the roof has 4×5,5 m hatches. Four dismountable panels of P-1И type made of M200 reinforced concrete covers each hatch. Complementary M 200 concrete layer forms roof slope. Rubberized-bitumen insulation seals the space between the roof and dismountable cover.

Metal roof enclosure of 850 mm height, made of Ø25 mm rods is installed along the roof perimeter. In places of metal passage roof enclosure height is 150 mm. Detailed structural characteristics of Building 157/1 are provided in Table 4.

Table 2 Structural characteristics of building No 157/1

Dimensions	Length (axis 14÷6, 74÷12, 13÷18), m	82,00
	Width (axis A, B, V, G), m	28,60
	Height (without asphalt layer), m	9,70
Foundation	Concrete layer M50, mm	~30
	Concrete layer Ml50, mm	150
	Cast-in-situ reinforced-concrete layer M300, mm	800
Walls	Reinforced-concrete M300, mm	700
Dividing walls	Reinforced-concrete of M200 type or reinforced cast-in-situ concrete M300, mm	300
Roof	Reinforced-concrete panels M300, mm	500
	Concrete layer M200, mm	~100