

Document:	NSRAO2-POR-030	Procurer: REPUBLIC OF SLOVENIA Gregorčičeva ulica 20, 1000 Ljubljana By authorisation of: ARAO, Ljubljana Celovška cesta 182, 1000 Ljubljana
ARAO identification code:	02-08-011-004	
Date:	March 2019	
Revision:	5	
Number of copies:		
Facility:	Vrbina, Krško LILW repository	
Contractor:	ARAO, Ljubljana	
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Document title:		
<h1>Draft Safety Analysis Report for the Vrbina Krško LILW repository</h1> <h2>Chapter 8 Trial Operation</h2>		

DOCUMENT HISTORY

Revision:	Date of (previous) revision:	Brief description of changes relative to the previous version:	Notes:
1	May 2017	amendment of the document following review	
2	January 2017	amendment of the document following review by an approved nuclear and radiation safety expert	
3	November 2018	amendment following review by SNSA	
4	February 2019	amendment following review by SNSA	
5	March 2019	supplementing of application	

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ABBREVIATIONS AND TERMS

ARAO	Agency for Radwaste Management
IAEA	International Atomic Energy Agency
IDZ	Conceptual design
FP	Final package
N/A	Irrelevant/not applicable to the examined area
NSR	Not related to nuclear safety
Krško NPP	Krško nuclear power plant
LILW	Low and intermediate level waste
RW	Radioactive waste
SSC	Structures, systems and components
TO	Technological facility
SNSA	Slovenian Nuclear Safety Administration
OSH	Occupational Health and Safety
ZGO-1	Construction Act, Official Gazette of the RS, No. 102/04 as amended and corrected

8 REPOSITORY TRIAL OPERATION

8.1 GENERAL

Descriptions related to the programme of trial operation are derived from design solutions provided in the Vrbinja LILW repository's conceptual design (IDZ) [1]. Project documents are drawn up in accordance with the Decree on the detailed plan of national importance for the low and intermediate level radioactive waste repository at Vrbinja in the Municipality of Krško [2].

The chapter addressing the repository trial operation is a summary of the LILW repository – trial operation reference document [4].

Removal of the LILW already disposed (retrievability) and having gaps filled with filler grout from the disposal silo is not required and hence is not a subject of tests in the scope of trial operation.

8.2 TRIAL OPERATION PROGRAMME

8.2.1 TRIAL OPERATION PURPOSE

The purpose of trial operation is to carry out tests and verifications of operation of the repository following its construction and to verify and establish the functional conformance of the repository and structures (SSC) with the approved design solutions and specified design criteria and the adequacy of design solutions and operational procedures, involving the foreseen operational personnel that examine the application of such solutions in view of the desired SSC functions. The container, as the final package, will be designed and specified in the phase of the building permit application procedure and appropriately licensed in the trial operation application procedure, at which time the procedures to verify final package adequacy, i.e. its conformance with design and other requirements, will also be specified. The responsibility for the adequacy of concrete containers rests with the repository operator, while the responsibility for the adequacy of the final package and its conformance with acceptance criteria rests with the entity conditioning waste/final package for disposal. Final package compliance with acceptance criteria shall be verified by the repository operator at the time of reception of the final package at the repository.

Containers with LILW are delivered to the repository upon the completion of tests and verifications envisaged for the phase preceding the acceptance of radioactive materials at the repository. Prior to dispatching to the repository, Krško NPP will carry out all tests and verifications to demonstrate the compliance of wastes conditioned for disposal with the acceptance criteria for disposal. The scope of tests and verifications at the Krško NPP will thus be drawn up in accordance with the disposal acceptance criteria.

Furthermore, prior to transport to the repository, the adequacy of the driver, the package and the transport vehicle will be verified.

The package, the vehicle and the driver must meet the requirements of the Transport of Dangerous Goods Act (ZPNB), respectively, the ADR requirements.

The package (disposal container) shall meet the ADR requirements for industrial package type IP-2.

The driver and the transport vehicle shall meet the ADR requirements for transporting class 7 materials (radioactive materials).

Administrative procedures of designing and approval of testing, testing surveillance, and testing procedure reviewing and approval fall in the domain of system management and are described in Chapter 3 of this document.

Trial operation also covers abnormal operating conditions (anomalies) and emergencies as well as implementation of the programme of monitoring in the course of trial operation, which is the same as during regular operation as defined in section 15.2 of this document dealing with monitoring of radioactivity.

It will be possible to remove, from the silo and from the repository, containers with waste placed in the disposal silo in the course of trial operation. Removed containers will be temporarily stored in the technological facility or in the hall above the silo. Gaps between the containers with waste placed in the silo in the course of trial operation will not be filled with filler grout. Test containers will be stored for the purpose of periodical testing of devices and equipment in the Krško NPP and in the repository used for other purposes (weights, shields) or designated as construction waste.

Description of needs for any additional personnel and their cooperation with the operator during trial operation and detailed description of procedures of designing and approval of testing procedures, testing surveillance, and testing procedure reviewing and approval will be defined in detail in the safety analysis report in the phase of application for consents for construction permit.

8.2.2 TRIAL OPERATION MANAGEMENT

Prior to commencing trial operation, documents must be drawn up and preconditions fulfilled as laid down in:

- ZGO-1 [5]; Section four: Acquisition of the operating permit
- ZVISJV [6]; Article 78 and implementation requirements laid down in JV 5 [7] and JV 9 [8] and
- Modification management programme (application as appropriate to new SSC construction).

Trial operation of the repository is carried out in accordance with the Trial Operation Programme (the Programme) and:

- procedures of acceptance and establishment of compliance with acceptance criteria, recording and disposal of LILW drawn up based on the radioactive waste management programme [9];
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- specific documents for the needs of trial operation as drawn up for different SSC and tests in accordance with the provisions in section 8.2.3 of this document and the radioactive waste management programme [9]; and
- general written procedures for the needs of trial operation as laid out in section 8.2.3 of this document.

In the course of trial operation, programme documents and associated implementation procedures will be applied and verified for adequacy and conformity with design solutions, safety requirements and other repository operation conditions in the fields of:

1. operating conditions and limits;
2. SSC performance;
3. management system;
4. design bases;
5. safety analyses;
6. maintenance, surveillance, inspections and testing;
7. programme of monitoring of ageing processes;
8. monitoring of changes in the repository;
9. personnel training;
10. operating experience and operating indicators feedback;
11. radiation protection;
12. operational monitoring;
13. action in the event of accidents; and
14. physical security.

Trial operation involves collaboration of all the services, respectively organisational unit of ARAO.

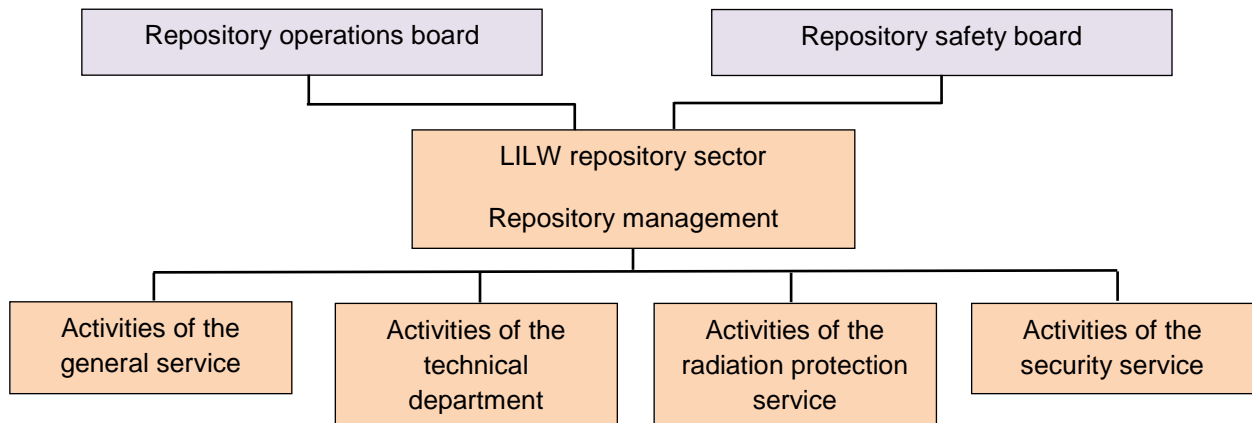


Figure 8-1: Trial operation organisational structure

Trial operation involves, in particular, collaboration of:

- The QA/QC department (ARAO),
- The Radiation protection service (ARAO),
- The Engineering department (ARAO),
- The Designer,
- Selected SSC providers,
- Selected SSC suppliers,
- Authorised testing and verification service providers, and
- The professional surveillance service provider (pursuant to Article 98 of the ZGO-1).

The trial operation organisational structure also involves the Slovenian Nuclear Safety Administration.

Transfer of responsibilities between the phase of construction and the phase of trial operation is carried out in accordance with the relevant provisions of the ZGO-1. The repository management and services are responsible for the repository trial and regular operation. By acquiring the operating permit for the repository, the responsibilities on the part of ARAO as the customer on behalf of the investor, i.e. the Republic of Slovenia, are transferred to the repository operator. ARAO becomes the repository operator at the time of undertaking the public service of disposal; for this purpose, it also requires a licence for radiation practice of disposal of LILW.

All persons actively participating in the trial operation activities at the repository site must have completed special training arranged by ARAO. The training required for the LILW repository employees is defined in more detail in the reference document for training [10]. An indicative complement of required personnel is 12 persons.

8.2.2.1 Trial operation time schedule:

The two-year trial operation will start at the end of construction and acquisition of the decision on trial operation. The first part of trial operation will contain in particular cold operational tests (commissioning); for this purpose, 10 containers will be constructed for licensing and for tests and verifications required for this purpose.

The larger part of the tests and verifications is envisaged to be completed in the first half of the first year of trial operation. In the second half of the first year of trial operation, conditions will be fulfilled for the takeover of radioactive waste. Thus in the first year 5 containers containing LILW will be disposed of and in the second year, 10 casks. At the end of the second year, a permit to use will be obtained; this permit is the basis for the issuing of the operating licence.

Table 8-1: Trial operation time schedule

Trial operation activities	First year	Second year
Preoperational testing	X	
Number of test containers (cold operational tests)	10	
Operational tests and verifications	X	X
Number of containers containing LILW disposed of	5	10

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8.2.2.2 Radiation protection

Radiation protection is organised by the radiation protection service at ARAO and engages subcontractors as necessary.

8.2.2.3 Occupational health and safety

Occupational health and safety (OSH) activities are organised, provided and implemented by the OSH service at ARAO. The OSH activities are also implemented by the OSH coordinator appointed by ARAO pursuant to the Decree on the Implementation of Safety and Health Requirements at Temporary and Mobile Construction Sites.

8.2.2.4 Security

Security of the repository is provided and organised by ARAO and implemented by ARAO with its subcontractors. Access levels are proposed by responsible officers of involved entities and approved by the repository manager. Persons participating in the repository trial operation will have passed security screening.

8.2.2.5 Actions in emergencies

Instructions on actions in emergencies are provided by ARAO. The applicability and effectiveness of the instructions are verified in the course of trial operation.

8.2.2.6 Consideration of human factors

In planning trial operation, ARAO considers factors that have impacts on the working environment, task-discharging efficiency and job satisfaction, in particular:

- Suitability and sufficiency of human and other resources;
- Suitable working hours, including breaks for meals;
- Suitability of the working environment and means of work; and
- Sufficiency and transparency of communications.

To minimise the extent of human errors, clear rules of work and conduct are followed, in line with the rules for work and conduct in nuclear facilities (working according to procedures, self-checking, three-way communication, independent audits-surveillance, personal accountability). In planning trial operation, an appropriate management system must also be set up, with due consideration to safety culture.

8.2.2.7 Non-compliance management and corrective measures

Rectifying non-compliances established by tests is verified by means of reviews of corrective measures. For those SSC for which non-compliance has been established by tests and verifications, modification of design solution is implemented. Implemented modification of the design solution must be appropriately verified and validated.

8.2.3 IMPLEMENTATION OF THE PROGRAMME

8.2.3.1 Trial operation scope of execution

Trial operation covers nuclear safety related equipment (systems and devices). In the scope of trial operation, further indirect objects of conformity assessment include support systems,

devices and facilities into which systems and devices are integrated and written procedures for use and operation of nuclear safety-related equipment [11].

The list of nuclear safety-related SSC, summarised from the document "Projektne osnove za odlagališče NSRAO Vrbina, Krško – faza presoje vplivov na okolje", Doc. No. 02-08-011-001/NSRAO2-POR-013-01, Revision 1, ARAO, August 2016, [12] is presented in section 8.3. Devices to be tested and verified in the course of trial operation are tagged in the list. This is accompanied by an outline description of testing and testing objectives. All the tests and verifications will be completed prior to the acceptance of any radioactive materials at the repository. Following acceptance of radioactive materials, only the tests and verifications of the operational surveillance system and monitoring of radioactivity in the working environment will be repeated.

In the course of trial operation, no filling of gaps between containers in the silo will take place at the repository. The test of filling gaps with filler grout will be performed by the contractor at another location while taking into account the circumstances of filling gaps in the silo, thereby validating the feasibility and efficiency of the procedure. Gap-filling equipment performance will also be tested. Gap-filling itself is to be tested at a test field to provide bases for the definition of the main parameters of the method and rate of gap-filling. Filling grout is not nuclear safety related, so minor pouring anomalies will not have any significant impact on nuclear safety.

8.2.3.2 Acceptance criteria for tests

Acceptance criteria for tests and verifications are laid out in written procedures for testing and verification execution and are based on:

- operating conditions and limits;
- design bases;
- SSC functionality analysis; and
- applicable technical regulations, standards and guidelines.

Testing criteria will be addressed in special written procedures.

8.2.3.3 Management of design

Any modifications of design solutions which result from findings in the scope of trial operation are managed and implemented in accordance with the programme of design management [11].

8.2.3.4 Trial operation documents

Testing, verification and trial operation procedures are carried out in accordance with written documents addressing individual SSC and testing and verification procedures or groups thereof.

Trial operation documents lay down:

- requirements relating to the subject of the testing;
- purpose and objectives;
- limitations and (pre)conditions;
- procedures (by work steps) and methods;
- equipment;
- requirements concerning personnel;
- safety requirements and emergency actions;
- acceptance criteria;
- data collection;
- recording; and
- validation of trial operation activities.

Trial operation documents are drawn up in accordance with the trial operation programme and are made in the form of:

- preoperational test procedure or
- trial operation procedure.

8.2.3.5 SSC labelling

In the course of trial operation, labels assigned in the design and construction phases will be applied for SSC. Labels for any temporary equipment will ensure differentiation from those of permanent equipment.

8.2.3.6 Control, testing and operational status

The SSC or their accompanying documents must be fitted with a marking related to the control or testing procedure status (status indicator), which indicates that the procedure has been carried out and ensures that any product not having passed the control or testing procedure will not be applied or installed, i.e. not be involved in operation.

8.2.3.7 Provisional modifications

Provisional modifications in the course of trial operation will be managed according to the modification management programme.

8.2.3.8 SSC maintenance

In terms of content, the programmes of SSC maintenance, testing and inspection will be set up, verified and applied in the phase of trial operation. Experience so gathered will be applied in the phase of operation [11].

8.2.3.9 SSC ageing management

In terms of contents, the SSC ageing management programme, in particular the programme of geodetic and technical monitoring of civil engineering SSCs including the container will be set up, verified and applied in the phase of trial operation. Experience so gathered will be applied in the phase of operation [11].

8.2.3.10 Handling and storage

Handling and storage of all SSC and other vital equipment that might, in the course of trial operation, get damaged and be rendered unfit for use if handled or stored in an improper way, will be prescribed.

8.2.3.11 Management of measuring and testing equipment

Measuring and testing tools and devices that may affect quality will be managed, periodically calibrated and maintained within their intended accuracy ranges.

In selecting measurement and testing equipment, requirements defined for the planned measurements are considered. The requirements concern, in particular, data on type, accuracy, allowable errors and measurement range.

8.2.3.12 Operational monitoring

In terms of content, the operational monitoring programme will be finalised for the purposes of trial operation, during which it will be verified and applied. Experience so gathered will be applied in the phase of operation [13], [14].

Monitoring of radioactivity in the environment is defined in more detail in section 15.2 of this document and covers continual and periodic measurements of:

- radioactivity in the ambient air;
 - external gamma radiation;
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- contents of radionuclides in (surface and underground) waters;
- radioactivity of the ground and precipitation;
- radioactivity of animal fodder, drinking water, foodstuffs, etc.

8.2.3.13 General written procedures of trial operation

All the activities of trial operation will be executed in accordance with general written procedures, which will have been drawn up prior to the commencement of trial operation. They will regulate, in particular:

- organisation of trial operation;
 - competencies and training of the personnel involved in trial operation;
 - administration of personnel access;
 - drawing up instructions for use and operation of components;
 - the radiation protection programme;
 - acceptance of components into trial operation; and
 - labelling of document and SSC statuses [15].
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8.3 DEFINITION OF EQUIPMENT TO BE TESTED

Table 8-2: Definition of equipment to be tested

SSC designation	Description of safety-related SSC	Scope of testing (devices to be tested are shaded)
O1	Final package (disposal container)	<ul style="list-style-type: none"> • Testing of the disposal container is carried out according to a special programme and is not covered by trial operation. • Testing of the adequacy of the container for the purposes of internal transport (e.g. gripping lugs) is carried out in the scope of testing disposal-transport devices. See O11.
O3	Silo	<ul style="list-style-type: none"> • Testing of (installed) gravity draining installations and the accumulation pool will be carried out in the scope of testing the drainage system. See O4.
O4	Drainage system (including the control pool and collection tank)	<ul style="list-style-type: none"> • Testing the performance of the silo drainage system covers testing of collection and sampling of drainage waters, performance of the collection pool with appurtenant equipment for indication of drainage waters in the pool and for pumping drainage waters, and testing of the pressure pipeline and appurtenant fittings up to the control pool or the overflow sewage shaft. • Testing of the performance of drainage systems in a technological facility covers the testing of the performance of gravity drainages and level indicators in the floor drain sump and in the collection tank and pumping of liquids from the floor drain sump and the collection tank. • Testing of the control pool covers the testing of gravity drainage inflows, of level indicators in the control pool, and of the pressure pipeline and appurtenant fittings up to the overflow sewage shaft.
O5	Barrier between silo and aquifer	<ul style="list-style-type: none"> • N/A
O8	Flood protection – embankment	<ul style="list-style-type: none"> • N/A
O9	Canopy (hall)	<ul style="list-style-type: none"> • NA – NSR
O10	Disposal/transport equipment	<ul style="list-style-type: none"> • Testing of the lift capacity. • Testing of the performance of the lift with container gripper and systems for the following: positioning of the vehicle with the container at its arrival, recognition and recording of the container, positioning of the container at its insertion in the silo, monitoring of disposal (video cameras and lighting), remote control of disposal, and recording of disposed container.
O12	Fire protection system	<ul style="list-style-type: none"> • Testing and verification of the fire alarm system. • Testing and verification of the firefighting water-supply system.

SSC designation	Description of safety-related SSC	Scope of testing (devices to be tested are shaded)
O13	Physical security systems	<ul style="list-style-type: none"> Testing and verification of technical security systems.
O16	Radiation protection system	See T7.
T1	Building / building structure	<ul style="list-style-type: none"> N/A
T2	Flood protection	See O8.
T5	Sewerage systems	<ul style="list-style-type: none"> Testing and verification in the scope of drainage system testing. See O4.
T6	Physical security systems	See O13.
T7	Radiation protection system	<ul style="list-style-type: none"> Testing the performance of radiation monitors, sampling of releases and exhausts, and systems for cases of detection of excess measured values.
T9	Fire protection system	See O12.
F1	Outer perimeter fence	<ul style="list-style-type: none"> Testing of sensors in the scope of testing of the technical security system. See O13.

Following their installation, all the mechanical and electrical systems will be tested in accordance with specified requirements laid out in the technical documents to demonstrate their fulfilment of desired functions.

SR SSC will undergo additional testing of functionality in the trial operation phase.

8.4 REFERENCES

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