SAFETY REPORT FOR THE CENTRAL INTERIM STORAGE FACILITY FOR RADIOACTIVE WASTE FROM SMALL PRODUCERS

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ABSTRACT

The Central Interim Storage for institutional radioactive waste in Brinje near Ljubljana was put into operation in 1986. In 1999 its operation was transferred to ARAO - the national Slovenian Agency for radwaste management organization. Simultaneously with the transfer of operation ARAO also received a request from the regulatory body to reconstruct the storage and to provide the Safety report (SR) for the facility. ARAO faced two main problems in the course of realization of the regulatory provision: firstly, the extent of the reconstruction works far exceeded the dimensions originally expected and requested by the provision and, secondly, the safety report for the facility still did not exist. Due to these facts the reconstruction was much more demanding and the preparation of the safety report more complicated than expected. In this paper the SR is presented, with emphases on the description of safety analyses for the Central Interim Storage and the consequent operational conditions and limitations, including the dilemmas and comments on different chapters.

1 INTRODUCTION

In 1999 the Agency for Radwaste Management took over the management of the Central Interim Storage (CIS) in Brinje, intended only for radioactive waste from industrial, medical and research applications in Slovenia. With the transfer of the responsibilities for the storage operation, ARAO, the new operator of the facility, received also a request from the competent regulatory body in Slovenia - the Slovenian Nuclear Safety Administration (SNSA) - for refurbishment and reconstruction of the storage and for preparation of the safety report for the storage with the operational conditions and limitations.

In order to fulfill these requirements ARAO first thoroughly reviewed the existing documentation on the facility, the facility itself and the stored inventory. It was found that some installations and systems in the storage facility were out-of-date and had fallen into disuse, the inventory was poorly characterized and arranged, the system of procedures and instructions was limited and not suitable for the extent of public service of radioactive waste management as was prescribed by the Decree on the Mode, Subject and Terms of Performing Public Service of Radioactive Waste Management (Official Gazette of RS, 32/99). Based on the findings of this review, ARAO prepared several basic documents for improvement of the current conditions in the storage facility. In October 2000 the Plan for refurbishment and modernization of the CIS was prepared, providing an integral approach towards remediation and refurbishment of the facility, optimization of the inventory arrangement and modernization of the storage and storing utilization.

In October 2001, project documentation for renewal of electric installations, water supply and sewage system, ventilation system, the improvements of the fire protection and remediation of minor defects discovered in the building were completed according to the Act on Construction. Besides information needed for the construction licence, the documentation included also an implementation plan with details on construction, required material, and costs. A special part of the project documentation involved radiation protection with the ALARA plan and first estimation of doses expected to be received during reconstruction works.

The preparation of the SR took much longer than was foreseen. The difficulties in preparing this document were not only of a technical nature. Most of the problems emerge from the fact that the storage was operating and the waste was stored in the facility,yet the SR - clearly requested by the law – still did not exist. Such a situation was not foreseen by the legislation, which gave room for different interpretations and opinions on how to resolve this unique situation. Unfortunately, it also gave room for different interpretations on the content and the extent of the SR, which placed additional pressure on ARAO.

In July 2003 the safety report was prepared, based on the facility status after the completion of the reconstruction works. It takes into account all improvements and changes introduced by the refurbishment and reconstruction of the facility according to project documentation. Besides the basic characteristics of the location and its surrounding, it also gives the technical description of the facility together with proposed solutions for the renewal of electric installations, renovation of water supply and sewage system, refurbishment of the ventilation system, the improvement of fire protection and remediation of minor defects in the facility. The safety report also incorporates the implementation projects for the inventory rearrangement and the projected waste quantities up to 2013, when the LILW repository should be available. The most important part of the safety report deals with safety analyses of all relevant operational conditions which could influence safety of the storage and its inventory, taking into account also the phase of reconstruction works.

2 CENTRAL INTERIM STORAGE IN BRINJE AFTER REMEDIATION

The Central Interim Storage facility in Brinje (Figure 1), placed in the vicinity of the TRIGA research reactor, is the only facility in Slovenia for LIL solid radioactive waste from small producers (medicine, industry and research activities). The facility was constructed in 1984 and put into operation in 1986.

The interim storage facility is a near-surface concrete building covered with soil. The building is subdivided by concrete walls into nine storage sections and an entrance area. One section for radioactive waste is deepened compared to the floor of the other sections, and is intended for more active spent sources. The ventilation system in the facility will be renovated and replaced by new one which will incorporate 3 different filters including the HEPA filter, thus enabling reduction of radon concentration and air contamination with daughter products.

A specially designed water and sewage collecting system retains all liquids within the closed system in the sump; liquids are discharged after the measurements of the radioactive contamination, which has to be below the limitations given in Regulation Z 9. The storage facility is physically protected by an alarm system, which is connected to the 24-hour security service. Fire protection will be assured by smoke detectors which are going to be placed over each section and connected to the fire alarm.

Figure 1 Central Interim Storage for small producers – inside and front side.

The ground plan of the facility remains 10.6 m x 25.70 m with a height of 3.6 m. Currently around 60 m3 of solid waste is held in the storage,giving the equivalent of 280 210-l drums. The total activity of the waste inventory is estimated at 3250 GBq (end of 2002). The major contribution to the total activity comes from the disused teletherapeutic source of Co-60 with present activity around 2200 GBq. While the safety analysis was made for the current volume and activity of stored waste, the capacity of the CIS in the safety report is limited to 330 drums (210-l) of conditioned waste.

3 SAFETY REPORT CONTENT

The first dilemma about the content of the safety report arose from the un-harmonized requirements from the still valid regulations which were developed in the 1980's and in the new Act on Radiation Protection against Ionizing Radiation and Nuclear Safety from October 2002 (Act). According to this Act the storage facility is a nuclear facility, and as such it should have a SR. The safety report is required also for reconstruction in support for obtaining the construction license and has to include general requirements given in Article 71 of that Act. Yet in the requirements of Regulation E2 (Regulation on Compilation and Contents of the Safety Report and Other Documentation Necessary for the Assessment of the Safety of Nuclear Facilities, Off.Gaz. SFRY 68/88) - which prescribes in the Appendices the precise content and the format of the safety report for different nuclear facilities - the storage facility has never been included. The nearest relevant safety report format is provided in Appendix 4 of Regulation E2 for the LILW (low and intermediate level waste) disposal facility. However, it is evident that a storage facility is different from a disposal facility, which is expected to be manifested also in the requirements for the safety report.

Since the legislation did not give any clear answer on the format and the content of the SR, the regulatory body did not provide any instructions or any further prescription for the preparation of the Safety report.

Based on the recommendation from the E2 for the disposal facility, the following chapters of the SR were proposed:

1. The safety approach to the LILW storage,
2. Description and location analysis of the Central interim storage,
3. Technical characteristics of the Central interim storage,
4. Safety analysis of the Central interim storage,
5. Organizational measures for construction and pre-operational testing,
6. Organizational measures for commissioning and normal operation of the Central interim storage,
7. Operational conditions and limitations,
8. Ionizing radiation protection service, its methods and equipment,
9. Radioactive waste management and disposal,
10. Review of the plans, measures and procedures to prevent radiological accidents,
11. Quality assurance program,
12. Review of the measures for physical protection of the LILW storage and stored radioactive waste,
13. Planned measures and necessary equipment for closure of the Central interim storage.

However, in the new Act there are some new requirements for the SR which are sometimes in contradiction with requirements in Regulation E2. The new demands for safety report content -such as an obligatory meteorological monitoring program, which should be part of the operational monitoring - were met by including the meteorological program in Chapter 8. According to the Act, a physical protection plan as a separate confidential document should be enclosed with the safety report and approved by the Ministry of Internal Affairs. Approval of the Slovenian radiation protection administration by the Ministry of Health, accompanied by assessment of the authorized organization on the proper use of methods for dose estimations, according to the Act should form part of the safety report, yet the SR format from E2 regulation does not include such a request. At the end, this approval was added as a separate document to the safety

report. There are some chapters which are prescribed in E2 but are not included in the Act - one of such is the plan for closure of the facility and its decommissioning including radioactive waste management. Although no specific demands in the Act the Chapter had been prepared.

Since the format as well as the content of the safety report had not been uniformly prescribed, the expert organization asked to provide expert opinion to the Slovenian nuclear safety administration was left without clear rules or requirements when reviewing the document. There was also a lack of instruction from SNSA and no experience provided from similar facilities. Such a situation encourages free interpretation of the requirements and tempts those who are requested to provide expert opinion to resort to excessive and groundless interference. Due to all these reasons, it took nearly 2 years to conclude the procedure of preparation and confirmation of the Safety report.

4 SAFETY ANALYSES FOR THE CENTRAL INTERIM STORAGE FACILITY

The most important part of the safety report is safety analysis, which was performed for normal and abnormal operational conditions by taking into account thse external and internal events which could influence storage safety. Based on the types of stored radioactive waste, packaging characteristics, construction of the storage facility together with the location properties and anticipated normal and abnormal operational conditions, several potential events were identified. By using elimination criteria, sets of relevant events were defined with relevant scenarios which were then analyzed.

During the normal operational conditions in the storage two different scenarios were analyzed. Assessment of external irradiation due to the storing of radioactive waste was done on the basis of the regular monitoring of the storage and its surrounding. Results of the measurements demonstrate that the dose rate due to gamma radiation from the storage decreases to the natural background within 10 to 20 m from the storage entrance (Figure 2).

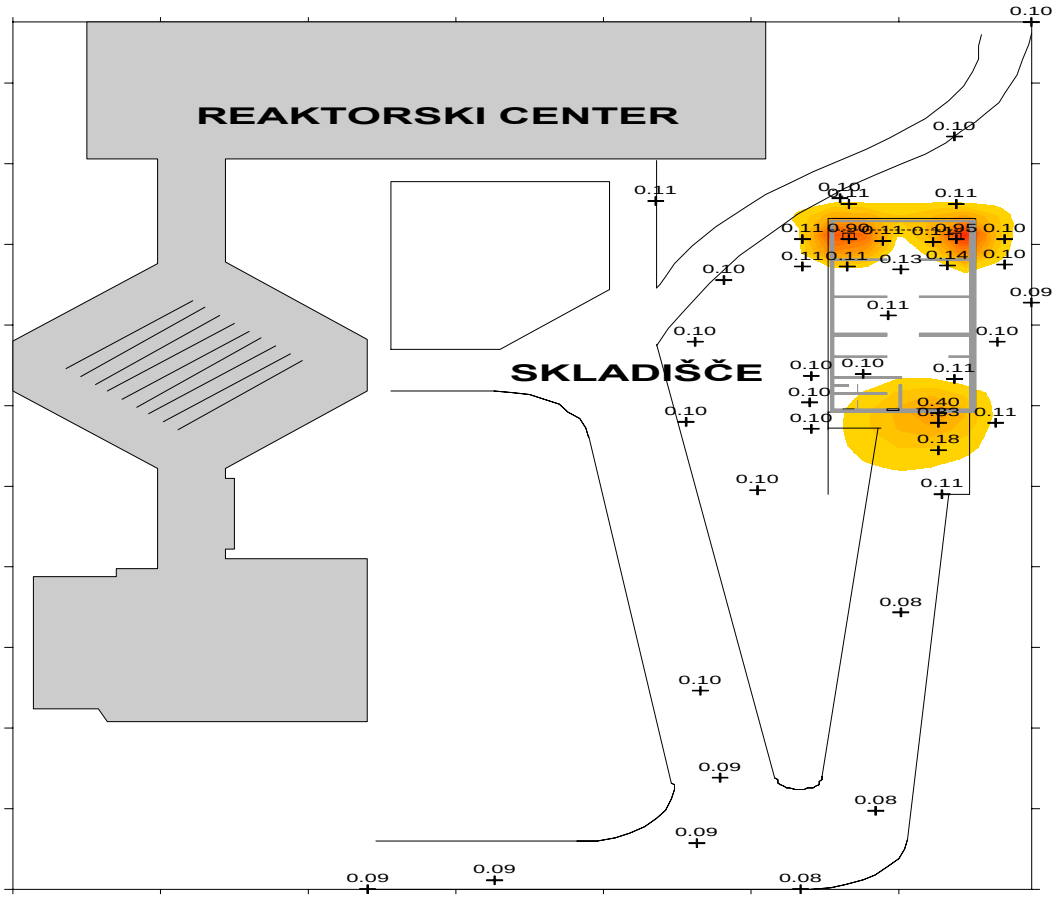

Figure 2 Gamma dose rate (micro Sv/h) in the storage and its surroundings (measurements 2000)

Analyses of atmospheric gas release due to emission of radon and its daughter radioisotopes from the storage are based on the conservative Gauss model of gas release. The results of the calculations show that the radon concentration is approximately 3 - 5 Bq/m3 at a distance of 50 m from the storage entrance, i.e. at the reactor centre fence, which is negligible even when compared with the natural radiation of soil.

For the abnormal operational conditions eleven different potential scenarios were screened (Table 1). Based on the elimination criteria, which are defined by waste characteristics, location, facility characteristics and operation (procedures and instructions), only two different scenarios were relevant and selected for further analyses.

Table 1 Scenarios for abnormal operational conditions for the Central interim storage facility

Potential scenarios	**Elimination criteria**	**Relevant scenarios**
Spilling of the liquid in the storage	• Waste characteristics • Facility (technical system)	
Drop and crush of a waste package during the manipulation		Dissipation of the waste
Direct irradiation with radioactive waste		
Direct contact with radioactive waste		
Explosion in the storage	• Administrative procedure	
Explosion in nearby facility	• Location (distance) • Facility (construction) • Administrative procedure for nearby facilities	
Fire		Fire
Flooding (groundwater level rise, rainwater, ..)	• Location (measurements) • Facility (technical systems)	
Earthquake	• Location (measurements) • Facility (construction)	
Airplane crash	• Location(as regards to other facilities)	
Terrorist attack	• Administrative procedure (physical protection)	

Dissipation of the waste includes three different possible scenarios: drop and crush of a waste package during the manipulation, direct irradiation with radioactive waste and direct contact with radioactive waste. All three scenarios, which are relevant also for the storage facility, result in the same consequences: irradiation of the workers. The estimations of doses are given in Table 2.

Table 2 Calculated doses for dissipation of waste

Scenario	**Effective dose due to external radiation**	**Effective dose due to inhalation**	**Effective dose due to ingestion**
Drop of sealed source	**1 mSv**	**/**	**/**
Direct contact with radioactive bulky waste	**0.25 mSv body** **0.2 mSv skin**	**0.48 mSv**	**0.17 mSv**
Drop of the drum	**0.5 mSv**	**0.06 mSv**	**0.003 mSv**

According to the study on fire safety in the storage facility, minor confined fire may possibly occur in the area intended for workers and in the control area where also combustible waste (or the packaging) is placed. Analyses of the fire in the typical drum in the control area - prepared by using the IAEA procedure for assessing radionuclide concentrations in air in case of fire - show that the maximum equivalent dose to the security personnel due to the fire would be 265 micro Sv. The dose contribution to the nearby living resident would be 3 micro Sv. Additionally, several administrative measures have been undertaken for fire safety assurance together with regular physical inspections every two hours.

5 OPERATIONAL CONDITIONS AND LIMITATIONS

Based on the safety analyses of normal and abnormal operational conditions the radiological influence of the storage facility for workers, population and the environment was calculated or measured, and is given in Table 3.

Table 3 Radiological influence of the storage facility

Group	**Equivalent dose (m Sv/year)**
Workers - Regular radiological monitoring	0.25 (individual dose for 50 hourse)
Workers - Acceptance of radioactive waste	2.5 (individual dose at acceptance rate of 50 packages per year)
Workers – Inhalation of radon	0.6 (individual dose for 200 hours per year)
Security personnel	0.001 (inhalation due to gas release) 0.007 (external irradiation due to the storage)
Farmer	0.00005 (only inhalation due to gas release)

It could be seen that the calculated and measured values are far below legislative limitations given for workers or for the population.

Based on the assessment of equivalent doses from radiological impact of the storage facility, the following operational limitations are accepted:

- the annual individual effective dose to a member of the critical group should not exceed 0.1 mSv;
- the annual individual effective dose for a worker in normal and abnormal operational conditions should not exceed 10 mSv.

Due to the storage characteristics, the load of the ground floor should be administratively controlled and must not exceed the maximum load. One section has to remain empty to allow sufficient space in case of emergency. The storage facility has to be ventilated before entering , in order to achieve equilibrium concentration of radon and daughter products.

6 ORGANIZATIONAL MEASURES

The safety of the storage is assured by isolation of radioactive waste and radiation from the environment and from people. This is achieved by physical and administrative barriers. Since the physical barriers are already set, the basic safety approach that ARAO applied for the storage was to implement new administrative measures through working procedures and instructions. By taking into account the characteristics of the waste and storage including the new technical systems, and by respecting the administrative procedures, the operation of the storage is organized without radiological burdens on the workers, population and the environment above legislative limitations under both normal and abnormal operational conditions.

Operation of the storage facility is provided by ARAO through its present organizational structure according to the requirements of Slovenian legislation and recommendations from international organizations. The section for facility operations is responsible for undisturbed storage operation, for record keeping and for safe handling of waste. For radiation protection a special service is organized which provides radiation survey, monitoring and protection. Other sections in ARAO assure assistance in preparing plans, documents and their implementation.

Organizational measures are set through a special QA programme which had been prepared according to ARAO's Quality Assurance Manual for the public service of radioactive waste management. The procedures and instructions can be grouped in the following broader areas:

- Waste acceptance requirements,
- Acceptance and transport of radioactive waste,
- Emergency planning,
- Radiation protection,
- QA of public service,
- Operating the Central Interim Storage for small producers,
- Occupational safety and fire protection.

7 CONCLUSIONS

The preparation of the safety report for the Central Interim Storage facility was very demanding from several different points of view. The main problem arose due to the fact that the storage was operating and the waste had been stored for 15 years, while the safety report still did not exist. Additionally, the format and the content of the safety report for storage facility was not prescribed, thus giving room for different interpretations and opinions. All this resulted in the fact that ARAO needed nearly 2 years to conclude the safety report and to obtain expert opinion.

Safety analysis proves that the facility together with the stored waste poses no threat to the environment. The safety report states that there are none of the normal and abnormal operational conditions expected, which would radiologically affect the staff, local population and the environment. That applies for the phase during which reconstruction works are under way and for the commissioning phase, which is foreseen to last for maximum 24 months.

After the conclusion of the refurbishment and renovation activities, and after collection of all results of the testing of the new components and systems, the new revision of the safety report will be prepared on the updated situation. Two new instructions on filter replacement and on sump emptying are under preparation and will be grouped in the QA programme. Based on the result of the measurements during the commissioning period, the final revision of the safety report will be prepared, which will include all the changes to the facility and also some improvement of safety analyses in accordance with the new situation to obtain the operational license.

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