From Dealing with Legacy Waste to Avoiding It – 17432

Oliver Rabe, Jörg Gebauer, Fabienne Anton
TÜV NORD EnSys GmbH & Co. KG

ABSTRACT

When dealing with radioactive waste management and its regulation, there are various national approaches. At the same time there is a growing tendency towards consideration of fundamental principles and standards thus forming the underlying basics in detailing the customized regulatory framework for specific applications.

Dealing with legacy waste poses some particular problems as at the time of its production current safety principles were sometimes not well established. Considering today's standards this frequently requires remedial actions. Usually, this involves considerable effort and cost as well as radiation exposure for the involved personnel. Resolving legacy waste related problems not only benefits from an established regulatory framework but allows conclusions on how deal with legacy waste problems in general. The most important lessons learned from such operations might be how to prevent the production of legacy waste in the first place, thus avoiding further problems.

By reflecting on practical applications from a number of countries the presentation is set to carve out the crucial recommendations from internationally recognized standards that give a substantial dividend in terms of not only time and budget but most of all safety and radiation exposure when properly implemented. The scope of the examples given ranges from dealing with legacy waste to avoiding it and includes recommendations towards essential features of best practice as seen from the perspective of an independent expert organization.

INTRODUCTION

The management of legacy waste is a challenge in many countries. Due to changes in the safety standards like waste acceptance criteria for disposal or interim storage the documentation of important waste properties was not done to an adequate extent during the time of production of what is now legacy waste. Additionally, in former times the conditioning and packaging of radioactive waste used to be practiced without due consideration of the conditions of long term storage. Therefore, these radioactive waste packages are subject to corrosion and deterioration of the waste products.

The situation with regards to the incurrence and the challenges in the management of legacy waste will be presented by giving examples from Germany, Ukraine, and Georgia. The experts of TÜV NORD EnSys were engaged in all of the described examples and in the course further expanded their knowledge concerning waste management and safety of waste handling on an international basis.

GERMANY

West Germany

German nuclear power started during the Atoms for Peace era with research reactors in the 1950s and with the first commercial plant coming online in the 1960s. A closed nuclear fuel cycle was planned, with fuel element production at Hanau; and reprocessing of the spent fuel in the pilot nuclear fuel reprocessing plant at Karlsruhe. The radioactive waste was intended to be stored in a deep geological repository. Between 1965 and 1995 the former salt mine Asse II was used on behalf of the Federal Ministry of Research to test the handling and storage of radioactive waste in a repository.

Fig. 1. Corroded drum with cemented radioactive waste after several years of interim storage.

Even subsequent to the termination of operations at the Asse repository waste was still treated and documented according to the waste acceptance criteria of the Asse. These waste packages were not suitable for a long term interim storage and thus an increasing number of drums with defects were detected in the German interim storage facilities since the 1980s. These drums were subject to corrosion and internal pressure build up with deformations of the lids was not uncommon. Their content was insufficiently documented. From the beginning of the 1990s the waste owners and operators of the interim storage facilities launched inspection programs to improve the characterization and documentation of their waste inventories. The older waste drums were refurbished, and loaded into overpacks and containers. Additionally, the inventories of the waste packages were determined according to the then applicable legal frame work, e. g. the waste acceptance criteria for the projected Konrad repository [4] or the Guidelines for the storage of radioactive waste with negligible heat generation [3].

East Germany

The former German Democratic Republic (GDR) entered nuclear technology with the founding of the Zentralinstitut für Kernforschung (national institute for nuclear research) 1956 in Rossendorf near Dresden. The first NPP in the GDR was of the WWER-70 type with an electrical output of 70 MW which was exported from the Soviet Union. It was built at Rheinsberg and was commissioned in May 1966.

In 1965 the Staatliche Zentrale für Strahlenschutz (State Office for Radiation Protection) of East Germany started with a search for a central storage location for all types of radioactive waste. In 1965 the decision was made to select the salt mine at Morsleben as the site for the repository, the final license was issued 1986. Until then operational waste from the NPPs was stored on site.

Fig. 2. View of NPP Rheinsberg with tents for the remediation of the waste storage installations.

Several installations for the storage and disposal were erected at the site of the NPP Rheinsberg. The so-called "ALfR", for low and intermediate active liquid and solid waste disposal, was foreseen to store waste for an unlimited period. The disposal facility "ALfR-solid" was designed as an underground concrete structure consisting of eight chambers for the deposition of solid mixed waste. Four of the eight chambers were filled with waste. Each of them has a volume of 175 m^3. These vaults also held eight "Hot-cell-drums" containing medium active waste from hot cell operation encapsulated into concrete.

The kind of waste which was disposed of in these vaults covered all types of waste which could occur during the operation phase of a nuclear power plant. Taking into account that also research was done in this facility, there was a wide spectrum of raw waste. The chambers contained loose waste as well as some cemented parts like solidified fluids or higher active parts in concrete shielding [2].

After the German reunification the legacy waste was retrieved from these underground chambers. It was then characterized and conditioned. Until 1998 the waste products resulting from this were disposed of in the Morsleben repository Waste packages produced after closing the Morsleben repository are stored in the interim storage facility at the site of the Greifswald NPP Lubmin in northern Germany.

UKRAINE

Ukraine has a history of nuclear power applications that extends over many. Currently there are 15 nuclear reactors in operation at four different sites; 13 units are of the VVER-1000 design and 2 units are of the previous VVER-440 type. These were commissioned during the period from 1981 to 2004.

In the early 1960s, more than 5,000 enterprises, institutions and organizations in Ukraine used radiation sources for production purposes or generated radioactive waste in their technological processes. All industrial radioactive waste including disused radiation sources was delivered to six specialized plants situated in Kiev, Kharkov, Dnepropetrovsk, Donetsk, Lvov and Odessa.

Fig. 3. Service Regions Map [1].

Each of the specialized plants has a number of radioactive waste facilities, including near-surface facilities for solid radioactive waste (concrete-lined rectangular pits or cells which hereafter are called solid RAW storages), shallow well-type facilities for disused radiation sources and tanks for liquid waste. These facilities were designed and commissioned in 1960-1962 and, in respect of the facilities for solid radioactive waste and disused radiation sources, were initially designed for disposal.

There are two types of solid RAW storage facilities with effective disposal capacities of 200 and 400 cubic meters, respectively. They were originally intended for the disposal of radioactive waste of various origins, forms, physical and radiological characteristics, including disused sealed radiation sources within their biological shields. In some cases layer-by-layer waste cementation was used in the process of disposal. When full, the solid RAW storages were capped with concrete slabs and thus sealed. Over the operation period of the facilities there was ingress of precipitation water in some of the facilities, notably, three solid RAW storages at the Kiev plant. This resulted in release of tritium into the ground water beneath the facilities.

Fig. 4. Soviet-design "RADON-type" facility [1].

Recognizing the importance of long-term safety and security, Ukraine intends to retrieve the waste and remove it to a location where safety and security can be more easily ensured.

After detailed analysis of the available information, a comprehensive stock taking and analysis of the radioactive waste inventory of the respective vaults was made. The technology and design of structures, systems and equipment for the remediation of State Corporation "Ukrainian State Association 'RADON'" solid RAW storages was developed. A retrieval concept and the infrastructure needed for the retrieval of radioactive waste for the Dnepropetrovsk site as the first site to be remediated was developed. To date the decision by the Ukrainian operator on the implementation of this concept is still pending.

GEORGIA

Georgia does not have a nuclear power plant. The operation of its only nuclear research reactor IRT-M was terminated in 1988. The reactor is currently being dismantled. The radioactive waste generated in the country to date can be divided on the following four main categories:

- Disused sealed radiation sources that are declared as waste;
- Radioactive waste from the research reactor operation and decommissioning;
- Waste from cleanup of radioactively contaminated areas;
- Other radioactive waste (for example orphan sources from illicit trafficking).

The majority of the radioactive waste in terms of activity in the country is constituted by a large number of disused sealed radioactive sources. Georgia has also encountered some serious problems with orphan radioactive sources found in the country.

Another significant portion of the Georgian radioactive waste is legacy waste generated during decommissioning of the IRT-M research reactor (4 MW pool type reactor). The reactor core has been covered by concrete. All reactor systems inside the reactor building and connecting the reactor building to the cryogenic station have been removed.

Until 1995 the "Saakadze" near surface disposal site was used for the disposal of radioactive waste generated in Georgia since 1963. The solid waste is disposed of in near surface concrete vaults. It is important to note that comprehensive data on the radioactive waste disposed of or stored on the site are not available. It is understood that these include both short and long-lived radionuclides. The disposal site was closed in 1995.

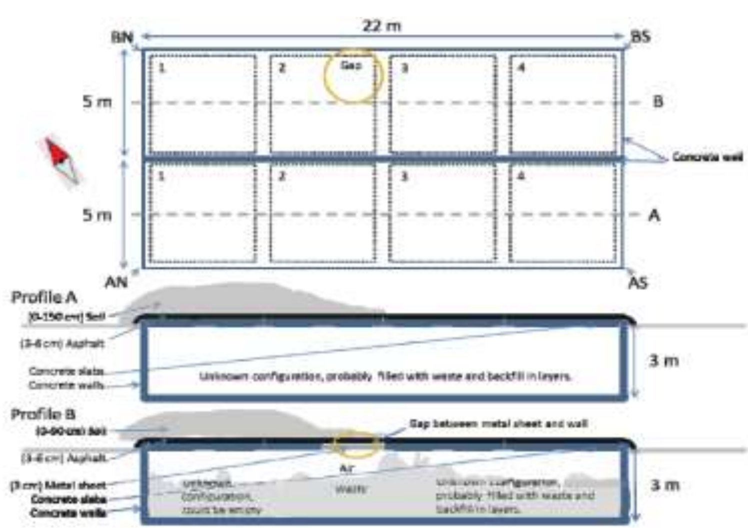

Fig. 5. Saakadze repository, "RADON type" disposal facility.

Fig. 6. Surface area of the two vaults, in the foreground the surface of the asphalt layer can be seen and in the background the partly soil covered end of the vaults (width ca. 10 m, length 22 m) [5].

According to the safety assessment the release of activity from the Saakadze disposal facility via the groundwater pathway for its normal evolution scenario is likely to cause only very minor dose rates, which are by 2-3 orders of magnitude below the internationally accepted regulatory limits. Therefore it was recommended to retain the legacy waste in the vaults and to take the following actions [5]:

- Uphold institutional control for 300 years after closure
- Backfilling of voids inside the vaults
- Construction of an appropriate cover for the facility
-

The interim storage facility (Centralized Storage Facility - CSF) of the Institute of Physics is a two-floor building (one – above ground, another – underground) with eight modules. The storage is designed to accept only solid or solidified radioactive waste.

Fig. 7. Interim storage facility in Georgia near Tbilisi.

The interim storage facility for storage of high active disused sealed radioactive sources originally designed with the support of the USA, also hosts the waste stemming from decommissioning of the IRT-M research reactor and other disused sealed radioactive sources. Some contaminated small pipes and tubes were collected and cemented in 200 l drums.

Fig. 8: Disused sealed radioactive sources in the interim storage.

Documentation on the design, inventory, and the site of the CSF is available.

A safety assessment report for the CSF was prepared and submitted to the Georgian regulatory body. As a conclusion the safety assessment report states that the estimated values for radiation exposure caused by the CSF are well within the limit of 1 mSv/y for members of the general public. For the workers of the CSF the limit of 20 mSv per year for Group A and 5 mSv per year for Group B workers are not exceeded either. Moreover, the associated radiological risks meet the regulatory criteria. Further on, it is recommended that the risk of accident initiating events be reduced through the implementation of some simple measures and a number of recommendations is made. Most of the recommendations from the safety assessment report were immediately implemented.

CONCLUSION

Legacy waste has been produced in the past when no suitable repository was available and no valid waste acceptance requirements were to be regarded during treatment and storage of radioactive waste. In order to avoid the production of future legacy waste it is important to have a strong regulatory regime concerning waste management. The regulations have to cover a set of requirements concerning the documentation of the waste, the quality control of handling and treatment of waste, waste acceptance requirements for the disposal and the interim storage and requirements for the inspection of waste packages during a period of prolonged interim storage.

REFERENCES

1. Nataliya Rybalka
   State Nuclear Regulatory Committee of Ukraine
   Safety and Security of Radioactive Sources Management System
   IAEA International Workshop on Sustainable Management of Disused Sealed Radioactive Sources
   Lisbon, Portugal, 11-15 October 2010
2. F. Krause, M. Schönherr
   EMPTYING, DISMANTLING AND DEMOLITION OF RADIOACTIVE WASTE DISPOSAL "ALFR" ON SITE OF NPP RHEINSBERG
   WM'00 Conference, February 27 – March 2, 2000, Tucson, AZ
   http://www.wmsym.org/archives/2000/pdf/50/50-2.pdf
3. German Nuclear Waste Management Commission
   Guidelines for the storage of radioactive waste with negligible heat generation (revised version of 10.06.2013).
4. Dr. Peter Brennecke, Bundesamt für Strahlenschutz
   Requirements on Radioactive Waste for Disposal (Waste Acceptance Requirements as of December 2014) - Konrad Repository
5. Bernt Haverkamp, Heinz Kroeger
   Safety Assessment for the Radon-Type Surface Disposal Facility at Saakadze, Georgia
   WM2015 Conference, March 15 – 19, 2015, Phoenix, Arizona, USA