Gamma Waste Assay System Upgrade

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ABSTRACT

Krško NPP struggles with a lack of storage space in dedicated LILW storage. Beside stored radwaste packages, some dedicated equipment including two waste assay systems used to occupy a lot of space in the storage building.

After a new building for radwaste operations was constructed, the equipment from the storage building was moved out. The two waste assay systems were reconstructed and functionally combined into one system being capable of measurement of all geometry packages from up to date plant operation. A close cooperation with equipment supplier on waste assay system reconstruction resulted in both, space saving as well as cost effective solution.

Operational LILW forms are result of plant waste streams, typical for pressurised water reactors. However, conditioning and treatment is dominantly oriented in as low as reasonably achievable storage volume. This is due to very limited available capacity of onsite interim LILW storage. A lot of attention is put on characterisation of waste packages on hard gamma emitters. Gamma spectrometry measurements have to be adopted to properties of big variety of waste packages. Waste assay system has to be capable of covering measurements of packages with large span of mass, density, homogeneity and activity. Some packaging for higher activity of waste form is manufactured with a thicker wall to provide shielding during the manipulation early in the process.

Single, custom designed waste assay system is in use at the plant, which has the capability of measurements with transmission source suitable for assay of lower activity non-homogeneous packages. On the other hand, there are mathematically modelled geometries developed for higher activity homogeneous and shielded packages.

Radiological properties of the waste are essential part of data package to be reported to the state central database as well as future data package to be handed over at waste transfer for disposal or long-term storage.

The Krško NPP started operation in 1981 with an onsite storage for LILW, designed as a 5-year interim storage.

Operation with practically no free storage capacity in LILW is bottom line non-conservative. There is a very limited capability for managing waste from mitigation of unplanned events. Dose to operating staff is rather high. Waste characterisation is crucial for waste hand over for disposal or long-term storage.

Keywords: *LILW, gamma waste assay, characterisation, waste storage*

1 INTRODUCTION

Responsibilities regarding treatment, conditioning and storage of radioactive waste from operation lies with the NPP operator. Database of stored waste packages is maintained at the plant level and annually reported to the national central database, maintained by Slovenian nuclear safety administration (SNSA). Set of data for particular waste package includes radiological data, obtained from spectrometric measurements of hard gamma emitters using waste assay system. Waste assay system in general has a capability of measuring waste packages - drums of known geometry.

2 EVOLUTION OF WASTE ASSAY AT NEK

Extensive super-compacting campaign was conducted in mid-90's to process over 10.000 drums of compressible waste to reduce volume of stored waste in plant waste storage. At the time, waste assay system was purchased to characterise gamma emitters in waste packages before compacting and store them in overpacks.

Figure 1: NEK Radwaste Storage

The waste assay system was placed in access corridor in radwaste storage and equipped with drum manipulator to facilitate drum positioning between forklift and drum rotating table of waste assay system. It had a capability for characterization of packages up to 250 kg of weight and maximum activity in order of magnitude of 10 GBq. Density of the matrix was also a limiting factor, however less exactly defined. It was related to strength of transmission source, decaying over the time. If isotope, used as a transmission source (Na-22) couldn't be quantified due to high density of the matrix, the measurement was terminated.

Process of exemption or clearance from administrative control neither was not formalised nor the waste assay system had a capability of measurement of very low activities. Capability - size of germanium detector was just not capable to serve for this kind of measurement. Beside this, background at the equipment location was too high. Therefore, no waste packages were released from administrative radiological control, that time or later.

Waste packages from any waste stream at the plant, exceeding above described limiting parameters, were not subject of characterization with waste assay system. For those packages, radiological characterization consisted of dose rate measurements at reference points – at the contact and at one-meter distance. These data were essential for manipulation with packages and related radiation exposures of operating personnel.

New technology of waste boric acid ad spent resin processing replaced cementing technology in late 90's. As a part of licensing process, new waste types were licensed. Properties of In-drum-drying products were significantly different from cementation products. In parallel with deployment of new technology, new waste assay system was provided.

Figure 2: In-Drum-Drying Products

3 WASTE ASSAY FOR IN-DRUM-DRYING PRODUCTS

Significantly higher specific activities and consequently higher contact doses, homogeneous matrix and thick heavy weight packaging impose different approach to design of waste assay system. Main design inputs were development of mathematical geometries instead the use of transmission source and unconditional remote handling during transport from the in-drum-drying system to the waste assay system and this point forward to placing the package into storage cell.

Figure 3: Waste Assay for In-Drum-Drying Products

The new waste assay system served well for all in-drum-drying products as designed, however occupied a lot of space in radwaste storage. Especially due to massive manipulator for remote handling over the whole corridor and equipment.

3.1 Space Limitations in the Radwaste Storage

Krško NPP radwaste storage high occupancy is a long-term issue. In accordance to spatial plan LILW from NEK are not allowed to be stored anywhere else than in dedicated radwaste storage. Therefore, to assure maximum storage space, all the other equipment had to be moved out of the storage. That includes super-compactor as well as both waste assay systems.

Waste manipulation building (WMB) construction, which was grounded in the spatial plan, has been launched a decade ago. Construction was completed in 2018.

Figure 4: Waste Manipulation Building

Unfortunately, WMB was not constructed in full size as allowed in spatial plan and as NEK ambitiously proposed, but in partial size due to lack of agreement between the two owners. A part of the building not being constructed was supposed to be dedicated to waste manipulation and conditioning of packages to be handed over for disposal, for example equipped with a 40-t overhead crane, appropriate radiological shields etc to facilitate a part of post operational or predisposal waste management and waste hand over in accordance to high working and radiological standards. Additional studies are undertaken at the moment to overcome the gap. Packages currently stored in radwaste storage for up to 40 years, meet waste acceptance criteria for storage, however significant part of the inventory is not ready neither for transport nor for disposal as it is.

3.2 Spare Parts Obsolescence

The old waste assay system was to great extent worn out, spare parts were obsolete and therefore maintenance of the system was improvised in some cases. Finally, the manufacturer announced end of providing support for maintenance of dedicated system software.

Waste assay system for in-drum-drying products was in much better shape, however over the time similar scenario could be expected in term of system maintenance.

3.3 Creative Solutions

Beside issues described above, there was actually no enough space in new WMB for two sets of waste assay system, together with massive drum manipulators. To keep the ability of measuring all waste types currently coming out of radwaste operation, together with all limitations, creative solution was needed. Therefore, upgrade of the waste assay system for in-drum-drying to be capable of measuring of all types of waste was the outcome of the internal problem-solving analysis.

Result of extensive work with the contractor is an upgraded waste assay system, positioned on dedicated location in WMB.

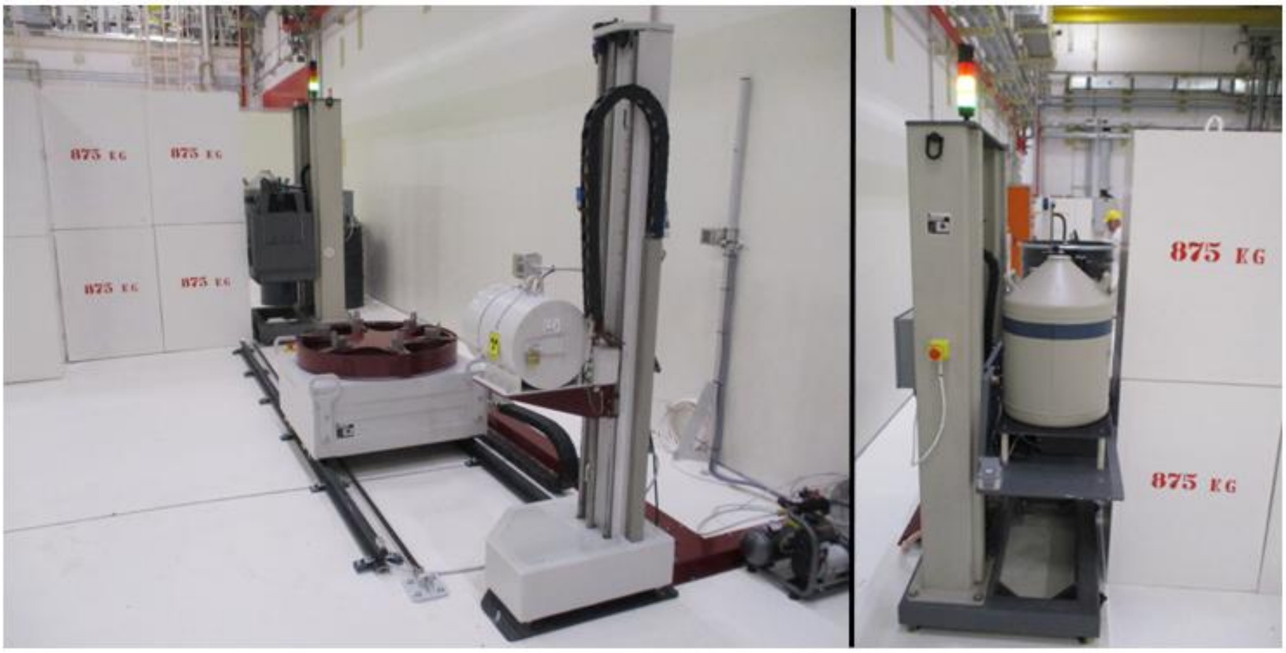

Figure 5: Upgraded Waste Assay System

3.4 Performance of an Upgraded Waste Assay System

The system accommodates the variety of waste packages resulting from current radwaste operation. Transmission source or mathematical modelled geometries are used depending on the type of waste. Rotating table with integrated scale is movable on rails to adjust the drum – detector distance. Dose rates at reference points are measured and recorded. Waste packages are labelled with readable label and bar code. Completely new software was developed that supports also an auto data collection. After particular waste package is processed, waste data file is stored and transferred to a plant radwaste database.

Equipment location is in a bigger room, dedicated also for other plant needs. Around the waste assay system removable concrete shield is placed to minimise interferences with other activities in the room.

Waste assay system has two operator’s consoles, one locally and the other ALARA enhanced remote system and video control system in dedicated control desk in a separate room. Video system with fixed and movable cameras support remote operation. Instead of dedicated massive manipulator, bridge overhead crane with corresponding gripper is used for drum manipulation.

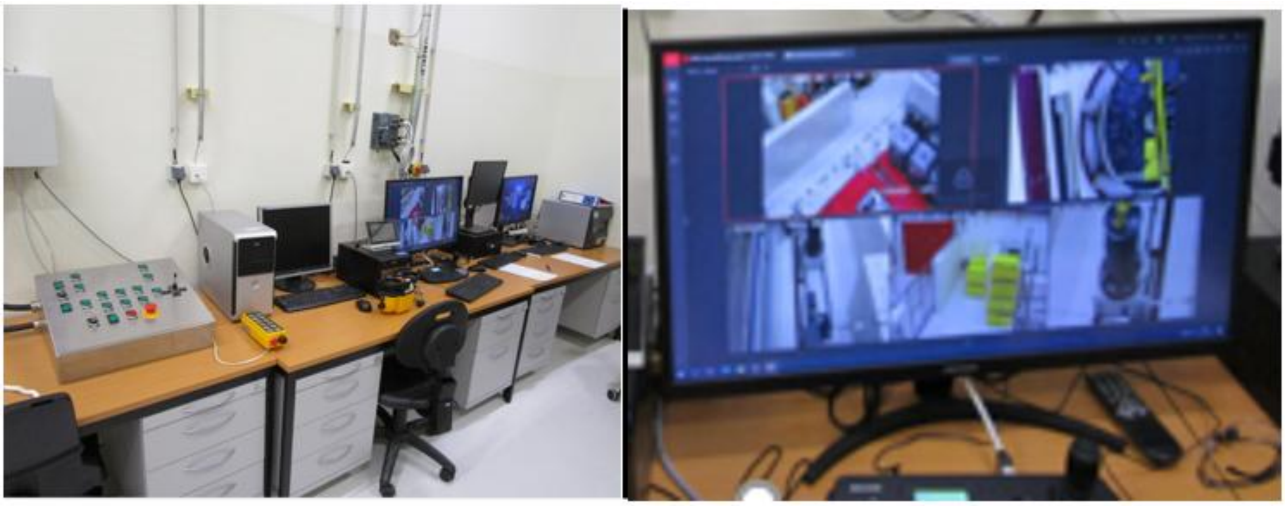

Figure 2: Remote System and Video Control

4 CONCLUSION

Moving treatment and measuring equipment from the site radwaste storage into new building was a necessity to release additional space in the storage to overcome storage capacity issues until the take over the waste from NPP for post operational phase of radwaste management. Waste assay system upgrade to accommodate all current waste types with one set of equipment without massive dedicated drum manipulator is innovative and also cost-effective solution. ALARA enhanced approach with remote system and video control in dedicated control desk in a separate room corresponds to highest industry standards as well as operational safety standards and praxis.

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