Dismantling of Highly Contaminated Process Installations of the German Reprocessing Facility (WAK) - Status of New Remote Handling Technology – 13287

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ABSTRACT

Decommissioning and dismantling of the former German Pilot Reprocessing Plant Karlsruhe (WAK) including the Vitrification Facility (VEK) is being executed in different Project steps related to the reprocessing, HLLW storage and vitrification complexes /1/. While inside the reprocessing building the total inventory of process equipment has already been dismantled and disposed of, the HLLW storage and vitrification complex has been placed out of operation since vitrification and tank rinsing procedures where finalized in year 2010.

This paper describes the progress made in dismantling of the shielded boxes of the highly contaminated laboratory as a precondition to get access to the hot cells of the HLLW storage. The major challenges of the dismantling of this laboratory were the high dose rates up to 700 mSv/h and the locking technology for the removal of the hot cell installations. In parallel extensive prototype testing of different carrier systems and power manipulators to be applied to dismantle the HLLW-tanks and other hot cell equipment is ongoing. First experiences with the new manipulator carrier system and a new master slave manipulator with force reflection will be reported.

INTRODUCTION

Key milestone of the WAK decommissioning Project, which is in progress since year 1990 when reprocessing was abandoned in Germany, was the vitrification of app. 60 m³ of highly radioactive liquid waste (HLLW) with a total radioactive inventory of app. 7E+17 Bq. Since the end of 2010 when the VEK-plant was shutdown after 1,5 years of operation and producing 140 glass canisters all main process and media supply systems were placed out of operation. Ventilation and power supply systems are still in operation under conditions needed for future safe remote and manual dismantling /2/.

From the time on the project efforts in the frame of the total D&D-Project have been focused on the dismantling of the ILLW and HLLW tanks and other highly contaminated process equipments, e.g. wet off-gas scrubber, transfer tanks, laboratory equipment.

D&D of the WAK-site including VEK is been carried out in 6 different Project phases being executed as far as technically practicable and economically justifiable. The 5^{th} Project step comprises the HLLW waste storage complex including the VEK-plant /1/.

As a prerequisite for the remote controlled dismantling of the hot cell equipment inside the storage building LAVA (plant for storage and evaporation of high level liquid waste) manual dismantling and removal of installations in the crane hall mainly the laboratory installations were necessary. The licenses according to German Atomic Law for tank dismantling as well as remote dismantling of hot cell equipment were granted already in year 2011. Decommissioning and dismantling started without any further delay /2/.

BOUNDARY CONDITIONS

Remote dismantling of the LAVA hot cell equipment needs the manual removing of the HA laboratory equipment as a precondition. New installations in the crane hall such as crane systems, modification of ventilation system, lock systems for transfer of waste containers and drums are designed. A horizontal cut view of the shielded boxes of the high active laboratory (HA laboratory) is shown in Figure 1. The front side boxes of the high active laboratory (HA laboratory) is shown in Figure 2.

From Figure 1 it can be seen that the HA laboratory includes of separate sampling box where the pneumatic sampling transfer system from VEK is connected. An operation room in front of the analytical boxes and the maintenance area on the back side of the shielded boxes are accessible.

Main boundary conditions for removal of the shielded boxes and equipment of the HA laboratory were

- A maximum dose rate of 700 mSv/h has to be considered.
- The installations of the HA boxes should be dismantled with the existing handling equipment (hand manipulators).
- It cannot be excluded that small volumes of HLLW/ILLW liquids are still being left inside the boxes.
- Parallel running dismantling activities are promoted to realize a short Project schedule as far as safety is not attached.

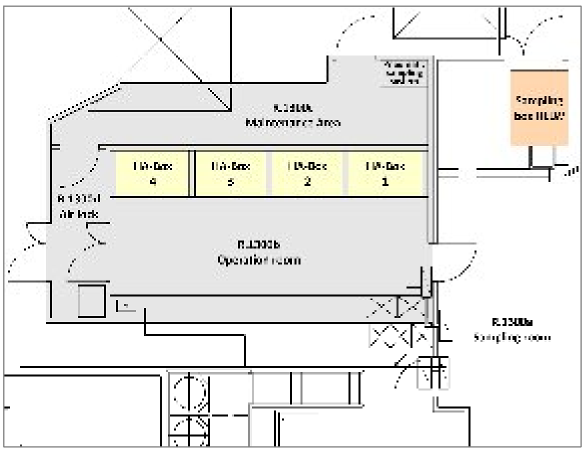

Fig. 1. Arrangement of the shielded boxes of the high active laboratory (HA laboratory)


Fig. 2. Front side of the shielded boxes with hand operated manipulators

REMOVAL OF THE HA LABORATORY INSTALLATIONS

The actual dismantling of the HA laboratory installations requires radiological measurements in advanced to the manual dismantling steps to coordinate the sequences of the working program and to decide on protective measures for the staff. The inventory of the analytical boxes were decontaminated and cleaned as fare as visible.

Equipment and installations were cut into pieces inside the boxes and removed via the existing maintenance room as well as with the help of an additional airlock system outside the laboratory. The total procedure was carried out remotely using the manual manipulators at the boxes and the crane-system of the maintenance area to keep the total personnel dose as low as possible and to avoid any spread of airborne contamination. A specific challenge was the removal of the pneumatic sampling system with shielding and high alpha contamination, which was cut using a hydraulic shear followed by wrapping the piping in a plastic foil and locked out in a waste container. An essential factor was that the divided pieces were compressed with the consequence that liquid contaminations could not leak from the cut pipings. In parallel the installations of the analytical boxes were cut into pieces using an adapted angle grinder and the waste was locked out via the existing maintenance opening.

In this phase of dismantling an adapted locking concept was implemented, because the dose rates in the boxes were between 200 mSv/h and 700 mSv/h which made any manual loading of the waste in the drums with personnel access impossible.

For the remote controlled loading in the maintenance area, the room was equipped with cameras and an electric driven crane trolley as well as the installation of a new locking adapter. The locking adapter used for the waste drums can be seen from Figure 3. This adapter was installed on top of the waste drum and fixed by three pneumatic sliders.

Fig. 3. Locking adapter with waste drum

The docking port was adjusted to the existing flange of the maintenance opening at the back side of the shielded boxes. Specific seals prevented any leakage of airborne contaminations resulting from particles or aerosols. After filling of the waste drum, the locking adapter was removed without personnel access and the drum lid was attached. This procedure can be seen from the photo taking during hot operation (see Figure 4)

Fig. 4. Remote controlled filling of waste drums via locking adapter

Subsequently the waste drums were locked out through the connected air lock behind the maintenance room. Following the remote procedures and decontamination processes inside the boxes self were removed manually. For this purpose, the shielding was removed and the metallic boxes were loaded in total with a crane through openings of the laboratory containment, into container and shipped to the waste treatment facilities of the HDB (main department of waste decontamination and treatment).

After the loading and evacuation of the boxes, the next step was concerned with the deconstruction of the drain line under the former HA boxes. Since the dose rate of this drain line was up to 180 mSv/h, the dismantling was carried out by standard tools with adapted extensions.

In order to make sure that no contamination leaks during the cutting of the drain line, this drain line was drilled and foamed with plastic. Afterwards the drain line was cut and disposed in the provided drums.

The following conventional removal of the containment was only influenced by the elaborate decontamination. The objective of the decontamination was to get the waste material in the procedure for conventional disposal.

The deconstruction of the sampling box could not be carried out manually because the detected dose rates were too high. So the deconstruction going to be carried out in line with the remote controlled dismantling of the cells.

During the deconstruction in the year 2012, 58 t of steel, 19 t of lead, 2 t of stained glass windows and 5 t of equipment of the boxes were removed. The resulting group equivalent dose was 15.6 mSv. During the dismantling of the hot cell equipment and removal of the waste 4 operators were on duty. The dismantling of the containment was carried out by 8 operators. The planed duration of the dismantling was 32 weeks. The actual duration was 34 weeks from February the 6th till September the 28th. Figure 5 shows the crane hall before and after the deconstruction of the high active laboratory.

Fig. 5. HLLW storage building crane hall before and after dismantling of the HA laboratory

TESTING OF THE NEW REMOTE HANDLING TECHNOLOGY

Power manipulator with telescope bar and telescope as carrier system

The subsequent dismantling activities in the hot cells of the HLLW storage building will be carried out to large extend using new remote handling equipment (see Figure 6). The WAK chose the new state of the art electrically powered manipulator system TELBOT TB 1000 (manufactured by the Germany Company HWM). This manipulator has a max. horizontal range of 2.7 m by 100 kg payload. To approve the dismantling sequence and to train the operational staff a 1 : 1 mock-up of the hot cell with this process and remote handling equipment was installed.

Fig. 6. Telescope and power manipulator during functional testing

The planned testing program comprises the execution of the complete dismantling procedure including the interface management, cable handling, testing of tools, evaluation of camera-technique and processing training of the operational staff. The test facility is actually in an advanced stage of installation, the remote handling equipment has been installed and functionally tested. Main challenge of the test program will be the removal of the highly contaminated transfer tank

This tank is complicated to achieve and needs a special load bar for attaching the vessel. On the other hand the special characteristics of the off gas scrubber has to be investigated. Because of its size this scrubber needs to be cut inside the cell. The metallic inventory of the scrubber has to be removed separately.

In finally result of the test program will be reported in a manual, describing the whole procedure step by step. The test tools will be adapted according to the technical requirements and the experiences made by the personnel.

First results of inactive HLLW tank dismantling

The testing program of the HLLW tank dummy is underway since August 2012. The tank Mock-up is manufactured of stainless steel with a wall thickness of 12 mm. The stainless steel liner cooling pipes have a diameter of 50 mm. The manipulator is attached to an electric hydraulic powered dredger of the 8 tons class as carrier system (see Figure 7).

The first step of remote dismantling was the cutting of the tank mantle with a high speed diamond grinder and a steel punching shear.


Fig. 7. Electrical master slave manipulator during simulated HLLW tank dismantling

After opening the tank the cooling pipes were cut with a hydraulic shear and an adapted hydraulic grab was used to collect the dismantled parts.

The first test experiences proof that the applied tools are highly available and sufficiently qualified for the use under hot conditions.

CONCLUSIONS

The removal of the HA-laboratory was a major milestone for the remote controlled dismantling of HLLW storage facilities. This safe operation was a credit of the extensive planning and the determined dismantling activities. A hands-on dismantling of a hot cell with installations requires radiological measurements in advanced to the manual dismantling steps in order to coordinate the sequences of the working program and to decide on protective measures for the staff.

The testing of new remote handling equipment is ongoing. The first experiences confirm the chosen dismantling concept and the efficiency of the equipment used.

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