

Dismantling of HLLW Process Installations of the German Reprocessing Facility (WAK) – Progress and first Experiences in Hot Application of Remote Techniques-17083

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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. 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 was finalized in year 2010 and is now under deconstruction.

This paper describes the progress and experiences made in dismantling of the process cells of the HLLW storage building. The major challenges of the dismantling are the high dose rates up to 70 Sv/h and the locking technology for the removal of the hot cell installations. As well as the adaption and extensive prototype testing of the remote handling equipment which was applied to dismantle the hot cell equipment prior to the start of the dismantling.

INTRODUCTION

The technical overall concept for D & D of the German Pilot Reprocessing Facility Karlsruhe (WAK) also comprises the remote dismantling of highly contaminated process equipment of the HLLW storage and treatment facility (LAVA) [1]. Since the end of reprocessing operation in 1990, approximately 60m³ of HLLW were stored in the two storage tanks of the LAVA building, and were vitrified in the Vitrification Plant Karlsruhe (VEK) in years 2009/10. Since the end of vitrification operation and transport of the HLW glass canisters to the Interim Storage Facility North (ZLN), the process and infrastructural installations of the LAVA building, which are not further needed for operational or safety reasons, were subsequently taken out of operation and consequently the preconditions for the dismantling of the installations were fulfilled.

The D & D activities of the WAK site are in general divided into six program phases which can be treated independent from each other to a large extend. The fifth program step therefrom comprises the dismantling of all HLLW facilities including the VEK. One section of this fifth step covers the remote dismantling of the process inventory of three highly contaminated hot cells (cells L3, L4, L5) of the LAVA building.

As a precondition for the execution of any remote controlled dismantling work inside LAVA cells L3, L4 and L5, extensive manual removals of minor contaminated equipment as well as the installation of new auxiliary mechanical components were necessary.

The Atomic licence for this dismantling activities was granted by the Federal States Authority in December 2011. The realization of this project phase started immediately afterwards.

SPECIFIC BOUNDARY CONDITIONS

In advance to any vertical remote dismantling work from top of the cells, the shielded boxes of the High Active Laboratory which were located on the upper ceiling of the cells as well as other less contaminated process and ventilation equipment had to be removed manually [2]. Thus the new free space combined with free room capacity in the crane hall of the LAVA building, provide the main preconditions for new installations like cranes, locking systems, ventilation systems and cctv necessary for the subsequent remote dismantling application. The initial and the target status of this area of the HLLW storage building LAVA is shown in Fig. 1.

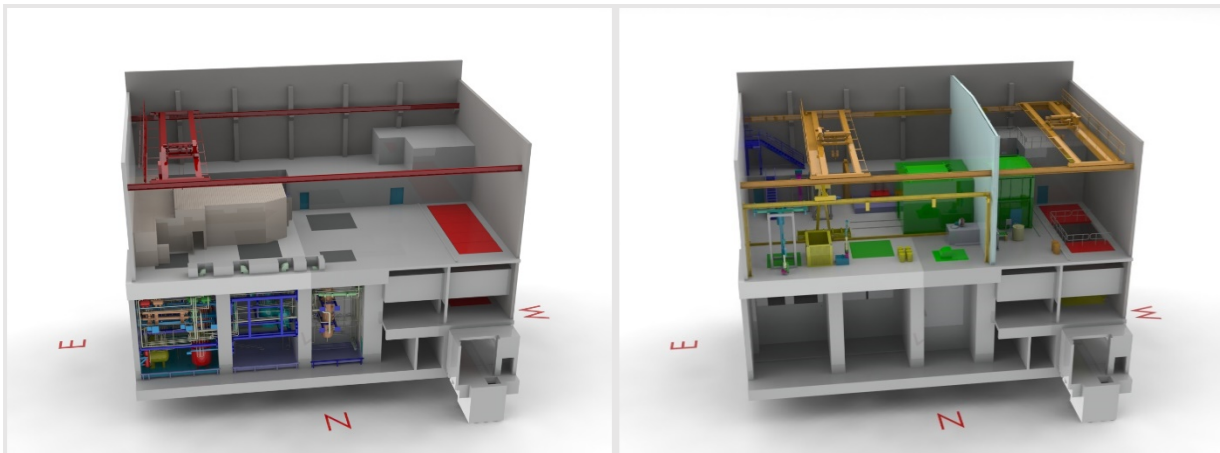


Fig. 1: Crane hall and Process Cells before and after dismantling

The installation of a central control room equipped with Video and actual new developed master control technique completed the technical preconditions for an effective start-up of the remote dismantling program step.

The vessel ventilation system is one of those important process-systems which still need to remain in operation after HLLW Vitrification was finalized. The vessel ventilation system was modified and simplified in a way that the blowers of the original VEK melter off-gas system are now in use to keep all process equipment of LAVA and VEK buildings in under pressure to prevent further contamination of cells. For safety reasons the dismantling concept assures the required reduced pressure conditions in vessels and piping so far relevant to prevent spread of contamination even when dismantling activities are ongoing in parallel in the LAVA cells, e.g. L4.

Extensive dose rate measurements were carried out to confirm the design basis (cf. Tab. 1).

Table 1: Dose rates and categorization of equipment

Component	Cell	Max. Dose Rate [Sv/h]	Category
Transfer Tank	L3	70	HLW
Other Tanks	L3-L5	1	HLW
Transfer Pipe	L4	0.4	ILW
Off Gas piping	L3-L5	0.2	ILW
Off Gas Scrubber	L5	0.1	LLW
Evaporator	L4	0.001	LLW

In case of the HLLW transfer tank which is located in cell L3 maximum values of up to 70 Sv/h have to be considered. The total equipment was categorized according to their operation purpose and history. The dose rate values in Cell L4 were calculated to be less than 0,1mSv/h in case of the vessels, with the exception of the HLLW transfer and off-gas pipes for which dose rates in contact of about 100 mSv/h are expected.

LICENCE

According to the German Atomic Law licencing procedure of the D&D Project of WAK site is running in a stepwise process. The partial license for the dismantling of LAVA cells was granted in December 2011.

The scope of this licensing step is:

- The manual dismantling of the High Active Laboratory which was used to analyse the HLLW and other processing liquids during vitrification before.
- The manual dismantling of process equipment in adjacent rooms which was required for the installation of new equipment.
- The installation of all necessary systems for the remote handling.
- The actual remote dismantling of these three processing cells L3, L4 and L5 of LAVA building.

With the licence the authority required detailed dose rate measurements in each area to verify the design values before start-up of any remote procedures inside one of the first process cells.

HANDLING TOOLS AND TESTING

In general significant requirement in D&D projects is the use of tested and qualified equipment as well as the operation by experienced and properly trained personnel.

The dismantling activities are carried out to some extend using new developed and advanced remote handling equipment [2]. WAK company decided to use an electric power manipulator system with force reflection (TELBOT TB 1000 from the German

manufacturer HWM) fixed to a telescope as a carrier system. Fig. 2 shows the total carrier system (red colour) set down onto the rack in the dismantling area together with the auxiliary crane (blue colour).



Fig. 2: Electrical Master Slave Manipulator (EMSM) with Telescope and auxiliary crane system

The test and demonstration program comprised the execution of the complete dismantling procedure in a 1:1 Mock up facility including the interface management, cable handling, testing of tools, evaluation of camera-technique, the waste handling and finally training of the operational staff. The 1:1 mock up facility was limited to relevant equipment and most relevant handling steps. The complete Remote handling System as shown above was already obtained for the testing purposes.

As main result of the test program a detailed manual was elaborated for the subsequent hot application for all three cells, describing the whole procedure step by step with all required tools and additional equipment, which was defined during the test phase. The test tools were adapted and optimized according to the technical requirements and the experiences made during the test phase.

These preparatory test experiences and in the meantime also ongoing hot application prove that the selected tools are highly available and sufficiently qualified for the use under this specific hot conditions as well as a good method to train the operators for their tasks.

PROGRESS AND FIRST EXPERIENCES IN DISMANTLING

In June 2015 an important step in the progress at WAK D&D was gained with the first remote cutting of pipes in cell L4 of LAVA storage building. As a precondition detailed dose rate measurements in the presence of the independent experts of TÜV and review of application documents with respective reporting to the authority was necessary.

The main objective of the ongoing remote program step in cell L4 is to totally dismantle the ILW process component, e.g. the evaporation unit, different ILW collecting tanks and other components of smaller dimensions. Besides the removal of the steel structure the handling of the highly contaminated HLLW piping systems is of specific importance. After opening the cell by removal of the shielding lid the upper level of the piping structure had to be remotely removed to get sufficient free space for the remote handling devices and access to the process equipment at the lower level, e.g. the vessels and corresponding steel structure.

Fig. 3 illustrates the starting conditions in cell L4 right at the beginning of the dismantling work.

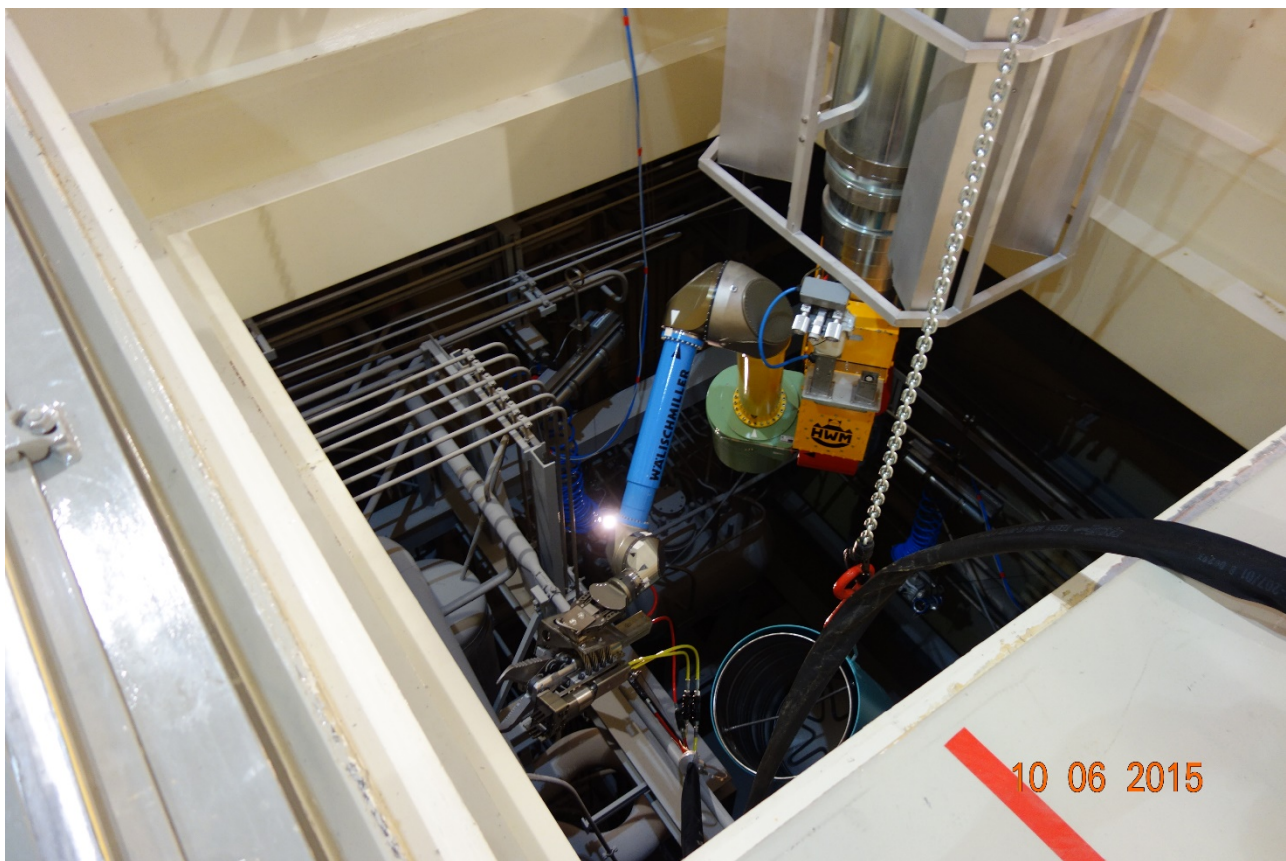


Fig. 3: Start of remote dismantling in cell L4 with EMSM in operation

The following main experiences were made during the first phase of dismantling work:

- In general the new designed specific tools, new installations, remote handling devices like the power manipulator and its telescope carrier shaft, the crane and other equipment of minor importance were running as expected. Minor interruptions with the potential of improvement were detected.
- The estimated dose rate at single components of less than 0.1 mSv/h came out to be higher by a factor of 10,000
- The original design boundary conditions like the vessels and pipes being completely dry, the vessel off-gas systems' under pressure being not severely influenced by the dismantling activities, even manually access insight be an option due to expected small dose rates resulted to be not definitely correct.
- The removal of smaller dimensioned vessels as a whole piece could not be realized because flange connections at the components backside were not accessible.
- Higher dose rates at components were not suitable for the locking in one piece in containers. (Further dismantling was necessary inside cell for locking the wastes with drum locking station)

The following specific goals of this phase of the WAK D&D Project should be mentioned:

- During the dismantling of the cell L4 the HLLW transfer-pipes should be protected to prevent any cross contamination of minor contaminated components with highly active material from the inner surface of the transfer pipes.
- The vessel off-gas system which is one combined system for VEK and LAVA process installations should be kept in operation as long as possible. Therefore it was necessary to protect major piping of this system and to insert plugs in already open pipes and vessel flanges to keep the required under pressure level of their system.
- The operator team should already be involved during the installation and commission phase of new D&D equipment to keep the personnel familiar with the equipment for all operational and maintenance aspects. In addition they should be extensively trained in the respective 1:1 Mock up under conditions close to reality.
- At least three operators with different tasks should form a remote handling team. One of them is responsible for the operation of the power manipulator system. A different person is operating minor systems like cameras and tools and a third one responsible for cranes and carrier systems. This operation of tasks and responsibilities by different persons is well experienced and guarantees high efficiency. The hydraulic shear is the key equipment to cut pipes (operator 1). In general at a minimum two camera views are required to follow up the remote dismantling activities (operator 2) and the waste drum connected to the crane is kept in a position close to the operation space for realising the removed parts (operator 3).

ACHIEVED STATUS

During the dismantling of Cell L4 we disposed of 19.6 Mg in total approximately 8 Mg of Process Components (pipes and vessels), 4 Mg of Steel Structure and 1 Mg of secondary wastes. The material will be stored in the interim storage facilities of the waste treatment department of WAK.

The dismantling activities are carried out on day shift basis and until now without any major interruptions caused by maintenance or any safety reason.

The next discipline is now to prepare the cell for subsequent manual activities like the modification of the ventilation system and other preparations for the dismantling of the adjacent cells L3, L5. Therefore it is necessary to reduce the dose rate as far as reasonably possible.

CHALLENGES

The loss of under pressure in the vessel off-gas line is a safety relevant subject that still needs to be considered also in the future. The general measures to be taken are identified and under realization.

During the design and preparation phase for this phase of WAK D&D Project all boundary conditions were reviewed and agreed internally and with the Authority. One main subject of design was the possibility to treat even large components as a whole with dose rates up to 100 mSv/h for handling in the crane hall of LAVA building. During the realization this significant boundary conditions changed with the consequence that unconditioned waste with dose rates of more than 2 mSv/h (measured in contact) can only be accepted in drums and no longer in containers. Therefore the overall concept had to be adapted to these new conditions. The dismantling strategy was modified with respect to the use of tools mainly for the cutting of bigger components like vessels. Because of the available know how on that field the technical problem could be solved in general but it had negative impact of the Project time.

This dismantling project has interfaces to other areas in the HLLW storage buildings, e.g. ventilation and off-gas. During the planning one precondition was that the dismantling of HLLW storage tanks had already started with the consequence that the off-gas system in LAVA is already out of operation. Because of a delay in Project execution the situation is different and the vessel off-gas system is still required to be kept in operation. Therefore any opening in pipes connected to the off-gas system must be closed separately, which is a time concerning different step in Project execution.

CONCLUSIONS

WAK reprocessing site is in an advanced stage of D&D. While in the former process building for reprocessing the concrete surface decontamination activities are running, the component dismantling in the HLW buildings – the HLLW storage LAVA and the vitrification VEK – has recently started with a good progress. Some of the design boundary conditions of the cells in the ILW/HLW areas came out to be too optimistic and had to be revised. On the other hand the new designed remote handling manipulator and related devices together with the total remote concept resulted in a full success for safety and efficiency reasons.

Mock-up test and demonstration programs were an important measure to qualify equipment and to train the personnel.

The Project is now running as expected and challenges during the start-up phase could be solved and optimized. The total dismantling strategy is without doubt successful. The treatment of highly contaminated material from HLW dismantling is a challenge that still needs specific efforts for optimization.

REFERENCES

1. *K.-J. Birringer, J. Fleisch and W. Pfeifer*
Concept for Dismantling the HLLW Treatment Facility on the former WAK Reprocessing Site,
Proc. WM2007 Conference, Tucson AZ, Paper No. 1370
2. *J. Dux, D. Friedrich, W. Lutz and M. Ripholtz*
Dismantling of Highly Contaminated Process Installations of the German Reprocessing Facility (WAK) - Status of New Remote Handling Technology,
Proc. WM2013 Conference, Phoenix AZ, Paper No. 13287