LESSONS LEARNED WITH THE DISMANTLING OF THE KARLSRUHE REPROCESSING PLANT (WAK)

G. Dutzi, L Finsterwalder, C. R. Jungmann, H. Wiese

Wiederaufarbeitungsanlage Karlsruhe Betriebsgesellschaft mbH
P.O.Box 1263
D-76339 Eggenstein-Leopoldshafen, Germany

ABSTRACT

The German Prototype Spent Fuel Reprocessing Plant (WAK) was shut down in 1991 after 20 years of hot operation. The plant can be divided into two main parts: the process building, including all spent fuel reprocessing installations, and the storage buildings, where 70 m^3 liquid high active waste concentrate (HAWC) remains in two cooled tanks at the site.

Dismantling activities at the process building are well under way since 1996 and will be finished 2005 by termination of all controlled areas at this building. Depending on local conditions, the installation is dismantled by hands on or remote techniques. In a special case hands on dismantling was supported by the use of shielded working platform, poles and tong manipulators.

Precondition for the dismantling of the storage installations is the disposal of the liquid HAWC at WAK. Therefore, a vitrification plant is under construction to solidify the HAWC. The process of on-site vitrification is scheduled to be completed in 2005.

This paper describes the dismantling activities at the process building and mainly presents the experience gained up to now with remote techniques for dismantling.

INTRODUCTION

During hot operation, the Karlsruhe Reprocessing Plant WAK had processed more than 200 tons of irradiated reactor fuel, separating 1.1 tons of plutonium. The average burn up of the fuel was 26.000 MWd/tU. Inner surfaces of the systems have been contaminated by insoluble matter to a different extent. Due to decay of Ru-106 radiation levels in the middle active process cells have dropped considerably during the last 10 years after shut down.

Dismantling activities at the process building started 1996 by disassembling of obsolete systems mainly in the head and tail end section of the process building. E.g. the fuel element storage pond was emptied and glove boxes for plutonium concentration were taken out.

Today, the major part of process installations is dismantled. High, middle and low level laboratories have been emptied after transferring the services to other laboratories. The mixer settlers of the chemical separation process are dismantled and all process cells are emptied.

Depending on local conditions, dismantling work is carried out hands on or using remote techniques. The limiting value is a dose rate of 0.5 mSv/h for hands on dismantling for working personal. Is this value exceeded, shielding or distance is necessary or remote techniques are used. The decision, which technique will be used, is influenced by local conditions like available space and actual dose rate.

REMOTE DISMANTLING TECHNIQUES

Two types of remote dismantling techniques were developed: horizontal dismantling with a crawler type power tool carrier for cells with horizontal access and vertical dismantling with a rope suspended electromechanical two arm slave manipulator assisted by cranes for dismantling cells with vertical access.

For dismantling cells with horizontal access a commercial crawler digger (Brokk 150 E) was modified as a power tool carrier to accept either a hydraulic shear, a hack saw or a high speed grinder. The Brokk 150 was assisted by a modified „Brokk minicut" which carried a camera platform. Two process cell had been emptied successfully, using this technique.

Fig. 1. Horizontal remote dismantling equipment (crawler digger Brokk 150) and control panel

Horizontal remote dismantling will also be used to disassemble the HAWC-storage installations. The storage vessels with cooling coils are contaminated heavily by insoluble fines from dissolution and phosphate precipitates resulting in very high dose rates in the emptied and rinsed tanks. For those conditions special equipment, installations and procedures have to be developed.

For dismantling cells with vertical access (1) a manipulator carrier system with a monobridge gantry crane with 50 / 5 kN hoists was constructed, riding on new crane rails 3 m above the floor of the cell hall. The 50 kN hoist carried a platform for two Electromechanical Master Slave Manipulators (EMSM3) with 8 degrees of freedom (2). The tools, hydraulic shear, grinder with diamond disc and hack saw, are at hand on the „sombrero like" tool carrier magazine above the EMSM3. The EMSM3 manipulators guided the tools and prevented the scrap fall down to the cell floor pan.

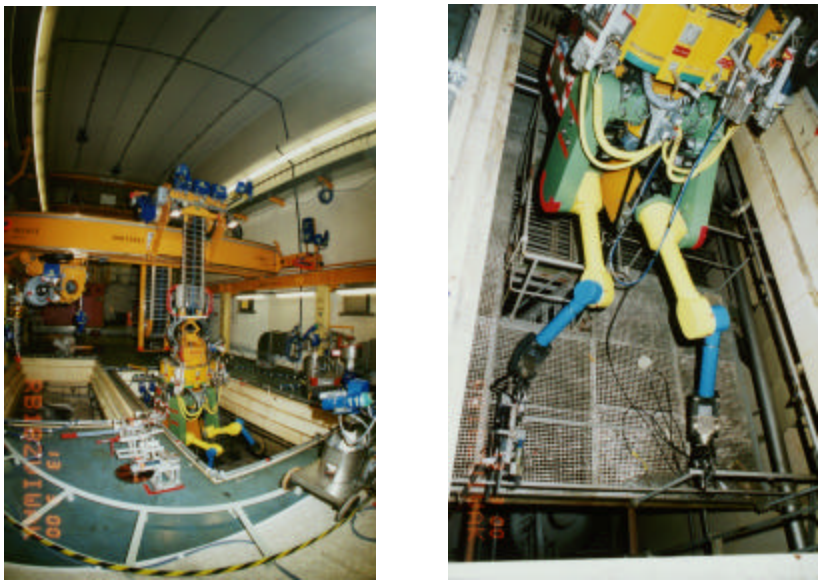

Fig. 2. Vertical remote dismantling equipment in action

To assist dismantling, a 50 kN gantry crane was installed on the tracks of the old cell hall crane. This crane was equipped with a greenhouse around the crane hook to avoid contamination of the cell hall during transport of contaminated parts to the locks.

The existing 150 kN crane in the cell hall was used to support the manipulator carrier system during normal and abnormal operation.

To manage the dismantled material, a complex system of airlocks and roller blinds has been installed in the cell hall. Low active components can be brought out directly while components over 0,5 mSv/h average contact dose rate were size reduced in the former head end cell and packed into 150 l drums, which are locked out of the cell in 200 l drums by a double lid system.

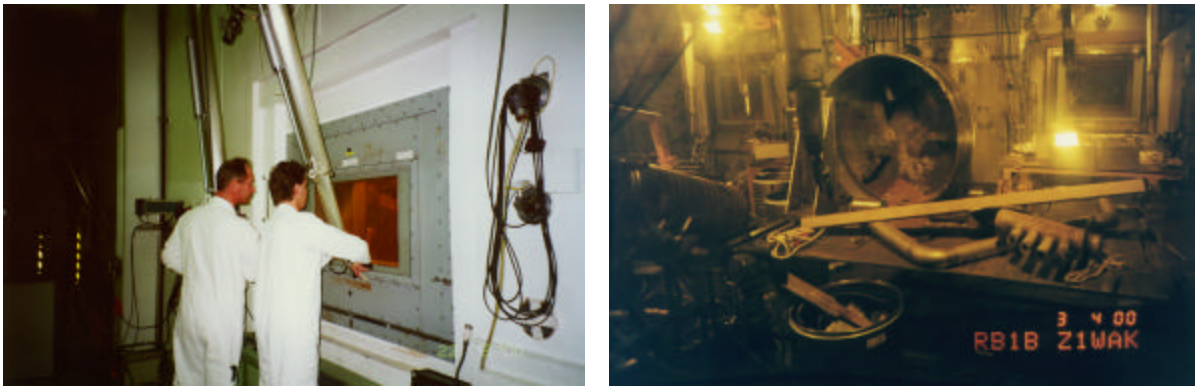

Fig. 3. Size reduction of dismantled components in the former head end cell

The complete system for vertical dismantling was operated from a central control room, especially constructed outside the controlled area on the roof of the old product storage.

Fig. 4. Central control room outside the controlled area

A dismantling handbook was created as a planning instrument to evaluate and optimise equipment, tools and procedures. Remote work in the cells was broken down in main sections, tasks, subtasks down to important single actions. The handbook was refined several times as a result of the test work in the mock up and served as a sound basis for time schedules. During dismantling it served as a guide for the work.

EXPERIENCE WITH VERTICAL REMOTE DISMANTLING

The original concept of vertical remote dismantling was modified during the test phase in order to speed up operation and to increase flexibility. By using troughs instead of drums, pipes and fixtures could be transported in larger parts to the locks. As a result, double lid locks and drum monitors in the cell hall were abandoned. Low active parts were packed in large metal boxes. Middle active parts were transported into the former head end cell to be size reduced by shear or grinder, packed in drums and locked out by the existing double lid system of the head end cell.

Operations for the remote systems were trained three months in the test station. Dismantling was carried out in a three shift operation five days a week. Normal staff in a shift was eight, minimum five. Working efficiency was about half of manual work.

The use of high speed grinder with diamond disc was the most effective tool but restricted when two small fires and a deflagration had occurred in process cells. Hack saws and hydraulic shears were the prime cutting tools. The vibration of the hack saw caused wear on the gears of the EMSM3. Service and repair of the power tools required daily manual interventions in the cell hall. Reasons for the frequent disruptions were:

- abnormal operation of the ventilation systems,
- contamination of air locks and
- damage of the transport truck.

Bottle neck of operation was the waste management.

Equipment in the dismantling cell performed satisfactory. Most failures of master slave and power manipulators resulted from overload by misuse operation. One grinder caught fire, which was quickly extinguished with the installed fire fighting system.

KEY RESULTS

Up to now decommissioning work in the WAK plant went ahead on schedule. Dismantling of a reprocessing plant is mainly a problem of containment of contamination and less a problem of direct radiation.

The equipment for remote dismantling performed rather successfully. Experience gained during the tests at MZFR was very helpful to eliminate complicated equipment prone to frequent failure. Daily manual assistance especially for the one arm Brokk crawler digger was vital to solve minor problems and maintain continuous operation of remote equipment.

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