EM-53 Lessons Learned Bulletin

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Lessons Learned from the Upfront Planning of the Karlsruhe Reprocessing Plant (WAK) Distmanting

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Statement:

The Karlsruhe Reprocessing Plant (WAK) was built between the years 1967 to 1971 by the former Nuclear Research Center Karlsruhe. During its 20 years of operation, the WAK-plant processed 208 tons of irradiated oxide fuel heavy metal from research and power reactors. On June 30, 1991, the plant was closed with decontamination and dismantling of the plant starting in 1994. The dismantling activities were carried out by hands-on techniques, remote techniques, or a mixture of both, depending on radiological conditions. 70 m³ of high level liquid waste concentrate, accumulated during operations, was processed at the HLW vitrification facility on site. Unprocessed fuel in the storage pond was shipped to La Hague. An estimated 5,500 tons of contaminated solid waste, 3,200 m3 of liquid waste, 130 canisters of HLW glass, and 75,000 tons of rubble were to be removed from dismantling the plant.

Discussion:

The plan for D&D of the WAK site consisted of six discrete steps: 1) Decommissioning of obsolete systems, 2) Dismantling of processing equipment in head and tail sections, 3) Dismantling of all process and auxiliary installation, decontamination of all rooms/cells and the use of suspension process in controlled areas, 4) Decommissioning of the waste storage buildings and vitrification facility, 5) Dismantling all equipment in waste storage and vitrification facility and, 6) Demolition of all installations and buildings. Dismantling work was carried out by either using hands-on techniques or by remote techniques depending on local conditions. A very conservative radiation protection concept for the dismantling of the WAK-plant was agreed on by the regulators. If the limiting dose rate for hands-on dismantling was exceeded, shielding or distance was used to reduce exposure or else the use of remote techniques was required. The decision of which technique to use was influenced by local conditions such as available space and actual dose rate encountered.

Significant upfront planning, including the use of a mock up facility for operator training, operations planning, equipment testing and dose rate analysis was conducted on this project. Particular attention was paid to the parallel development of radiation protection measures and an optimum organization structure to ensure the safety of the operations personnel and the environment. Due to this planning, there were no serious safety incidents reported during cleanup operations and the project appears to have met its baseline cost and schedule targets.

Analysis:

- The use of a mockup facility for training operators can be very important in planning work and limiting individual dose rates during actual operations.
- The use of a conservative plan for individual dose limits provides flexibility and margin for operations personnel when local conditions changed.
- Experience gained during the testing in the mockup facility was very helpful in eliminating issues with complicated equipment that was prone to frequent failure.
- Based off of the lessons learned from the mockup testing, a handbook was created as a planning instrument to evaluate and optimize equipment, tools and procedures. The handbook was refined several times as a result of the test work in the mock up. During operations, it served as a guide for the work.
- Unique remote dismantling techniques were tested prior to their use.
- Commercial equipment was modified for use as a power tool carrier to accept a hydraulic shear, a hack saw or a high speed grinder.
- Operators were assisted by the use of cameras strategically mounted on the tool for better control during operations.
- The crane was modified with a shield around the hook to avoid contamination of the cell hall during transport of contaminated parts to the uncontaminated areas.
- To better manage and control the spread of contamination, a series of airlocks and rollers were installed. Low active components were brought out directly while components with a higher activity level were size reduced and packed into drums.
- For better command and control during operations, the system for remote vertical dismantling was operated from a central control room.
- The original concept of vertical remote dismantling was modified during the mockup 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.
- The use of a high speed grinder with diamond disc was the most effective tool but its use became restricted when two small fires occurred in process cells. Hack saws and hydraulic shears were the prime cutting tools; however, vibration of the hack saw caused wear on the gears of the EMSMs. Service and repair of the power tools were required on a daily basis.
- Most failures of Electro-Mechanical Master Slave Manipulators (EMSMs) resulted from overload or misuse by the operators.
- Daily manual maintenance was vital to solve minor problems and maintain continuous operation of remote equipment.

Actions:

1. FPDs should ensure that significant upfront planning is conducted prior to the start of operations on cleanup projects involving signicant levels and amounts of radioactive waste disposition. Planning should include operator training and where needed, facility mock ups to allow for safe, efficient use of equipment by operating personnel.
2. FPDs can read more about Lessons Learned from this project to evaluate applicable elements to their projects and activities. Reports are contained: https://www.dndkm.org/DOEKMDocuments/LessonsLearned/47-Lessons%20Learned%20with%20Dismantling%20Karlsruhe%20Reprocessing%20Plant%20Wak.pdf and http://www.wmsym.org/archives/2001/38/38-5.pdf

Critical Decision(s): Post CD-4

Facility Type(s): Reprocessing/Vitrification

Work Function(s): Decontamination, Decommissioning and Dismantling radioactive facilities

Technical Discipline(s): N/A

Horizontal remote crawler/digger tool; Vertical remote dismantling equipment

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3. Lambert, F. & Volkov, Y. Safety Improvements through Lessons Learned from Operational Experience in Nuclear Research Facilities, Springer Science and Business Media, May 22, 2007.