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MECHANICAL ENGINEERING EQUIPMENT OF THE KARLSRUHE VITRIFICATION FACILITY (VEK)

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INTRODUCTION

Within the scope of the decommissioning of the Karlsruhe Reprocessing Facility (WAK), the disposal of the HAWC (High Active Waste Concentrate) stored in the storage tanks of the LAVA-complex (storage and evaporating facility for radioactive waste) from the reprocessing operation of the WAK represents a significant task.

As a whole, approx. 70m³ HAWC, which are stored in the storage tanks of LAVA are to be converted into a form appropriate for the final disposal prior to dismantling of the facility (Sti-WAK). Instead of the originally planned disposal method consisting of external vitrification in Mol/Belgium, the Karlsruhe vitrification facility (VEK) was planned in 1996. With this facility, approx. 70m³ HAWC shall be vitrified on the WAK-site. In Figure 1, the new VEK-building on the WAK-site is shown and identified.

In December 1996, the application for the erection of the VEK was placed at the Ministry of Economy and Environment of the Land Baden-Württemberg. The evaluation of the safety analysis report was concluded in 1997 with a positive assessment of the concept. In the meantime, the design work for the building, the process engineering, the electric and process control as well as the mechanical engineering have been concluded. The Mechanical Equipment is already ordered for fabrication. The licence (2.TEG) of the German authorities for the erection of the VEK-building, including the installation of a great part of the mechanical equipment is expected in October 1999.

The present article describes the mechanical engineering planned by the GNS on the way from a canister of a melting furnace up to its transfer in the CASTOR HAW 20/28 CG transport and storage cask. The way taken by the canisters is shown on the VEK building sections of Figure 2.

MELTING FURNACE CELL V2

In the melting furnace cell, the canister to be filled is docked to the bottom discharge of the melting furnace by means of a canister lifting wagon. The canister lifting wagon is connected to the rails and positioned below the melting furnace by means of limit switches and mechanical centering devices. The vitrified material put in the canister in 4 furnace drosses (partial batches) are weighed by means of weighing cells and the filling procedure is interrupted as soon as the planned loading mass is reached. The canister lifting wagon is provided with emergency motors and is also able to exchange the bottom discharge of the melting furnace with the aid of additional assembly equipment.
After the last furnace dross, the filled canister is put in the accommodating cell V 3 after opening of the sliding bulkhead between the cells V2 and V3 (150 mm radiation shielding). The canister

is removed from the lifting wagon and transferred to the handling cell V5 through the canister outlet by means of a cell crane and a canister gripping device operated by remote control.

HANDLING CELL V5

In the handling cell, all the works necessary for the canister dispatch are performed by remote control. The V5 cell is equipped with radiation protective windows with manual manipulators such as the other cells (V2/V3 and V7). In addition, there are, in the cell, a 12 Mg crane with a canister gripping device operated by remote control and motor-driven turnable hooks. All operational handling procedures in the cell V 5 are performed with the aid of the canister gripping device.

After the transfer of the filled canister from the V3 cell to the handling cell, the canister is placed down on a cooling position planned for this purpose. A maximum of 3 canisters can be simultaneously placed on a cooling position. After a cooling time of approx. 4 days, the canister lid is removed from its magazine by means of a manual manipulator and put on the canister. The canister lid is welded to the canister throat by means of an orbital welding station operated by remote control in the cooling position.

After the following canister decontamination in an ultrasonic bath, wipe tests are performed with the aid of the manual manipulators and then evaluated.

CANISTER TRANSFER V7

After release, the canister is transported to the canister transfer cell V7 through the canister air lock installed between the cells V5/V7. In the V7 cell, a crane is also available. This crane is equipped with two lifting gears (12 Mg/1Mg). A canister gripping device operated by remote control is attached to the 1Mg lifting gear, which makes it possible to remove the canisters from the canister lock and put them in the canister buffer storage (V6). The canister buffer storage effectively shields the other building structures from the radiation of the canisters in interim storage there. The canister buffer storage is designed to accommodate 36 filled and 6 empty canisters. The conduction of the decay heat from the buffer storage is performed by natural cooling. When there is a sufficiently large number of filled canisters in the buffer storage, they are loaded in the CASTOR HAW 20/28 CG cask which is in dock position. In this process, the canisters are removed from the storage cavities by means of the canister gripping device and transferred to the cask.

After the complete loading of the CASTOR HAW 20/28 CG cask, the primary lid is installed on the cask body by remote control, in the V7 cell, with the aid of the 12 ton lifting gear of the cell crane and the opening in the docking equipment is also shut by remote control.

CASK DISPATCH AND OUTWARD TRANSFER

In order to prepare the cask for dispatch, it is transported from the loading position to the dispatch position with the aid of the transfer carriage. The dispatch position is equipped with a 5 ton crane as well as a lowerable handling platform. In this dispatch position, the primary lid is bolted to the cask body and an helium leak test is performed as leak-tightness test. Afterwards, the secondary lid is put onto the cask and also bolted. The handling equipment of the dispatch position makes it possible to inspect both lids, if necessary.

After release, the CASTOR cask is put on the transfer carriage to the transfer position "lifting wagon ". By means of electric lifting motors and the accompanying load lifting equipment, the lifting wagon hoists the CASTOR cask out of the transfer carriage. The CASTOR cask is then driven on the rails out off the VEK to the outside through the outside gate. There, the cask is put on the Federal Railway wagon by means of a lifting beam and mobile crane.

WASTE-GAS CAISSON

Parallel to the axis of the cell section, the waste-gas caisson for the components of the melting furnace-waste-gas is located on the +4.2 m level. These components (filter station for circulating air, washer circuit pumps, fiber mat filter, heater, HEPA and iodine filter) have to be exchangeable by remote control for operational reasons. In addition, the waste-gas caisson is equipped with radiation protective windows, manual manipulators and a manipulator for heavy loads. The loaded filter inserts or components can be put in the filter lock, located below the waste-gas caisson on the 0.0 m level and also equipped with radiation protective windows and manual manipulators, by means of a double-lid carriage for 200 litre drums and drum lifting equipment. The bolting of the 200 litre drum lid by remote control is followed by the transfer of the filled residual material to the shielding cask with a bridge crane. By means of the shielding cask transport wagon, the residual material drum is brought to the transfer position through a shielding gate and an outside door secured against aircraft crash.

OTHER MECHANICAL ENGINEERING EQUIPMENT

In addition to the above described devices which mainly serve for the handling of the canisters, other components are planned within the scope of the mechanical engineering. They mainly serve for shielding the operation and intervention areas against the activity contents to be handled in the cells. The cells are e.g. separated from each other, with respect to radiation, by means of eccentric bulkhead and shielding folding doors. The cell section is also made accessible through shielding plugs. For intervening in cells V3 and V7, a shielding door is planned in each cell.

For the repair concept inside the cell section, a further heavy load manipulator of the same type is planned. It can work below the crane rail of both cell cranes over the whole cell section and practically reach each area for the removal of components. It serves for repairing the cell equipment by remote control. For repairing the cell cranes themselves, an intervention area is planned in the canister transfer cell V7 in which the lifting device to be repaired can be moved by a functional lifting device.

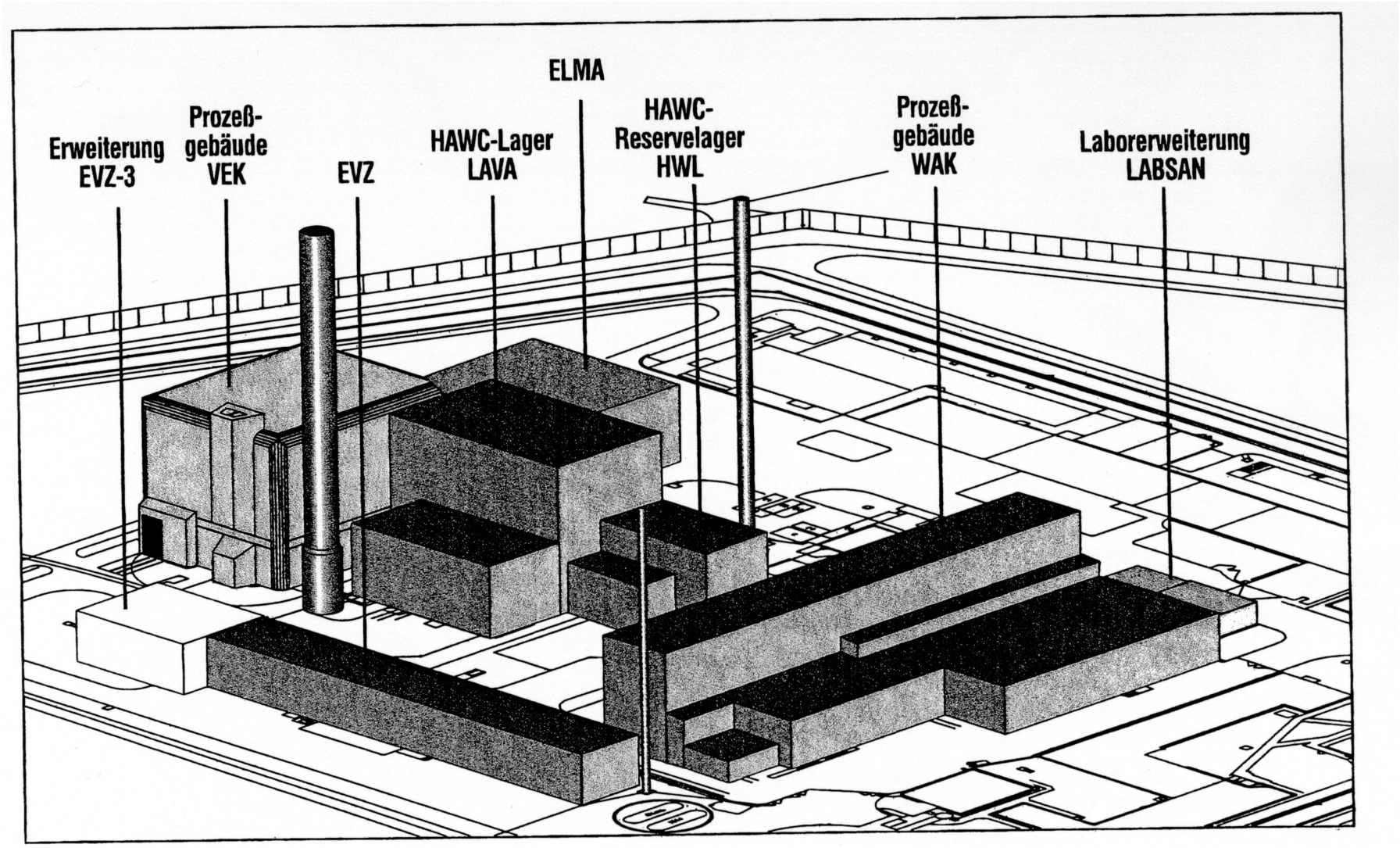

Figure 1: The VEK on the WAK-site

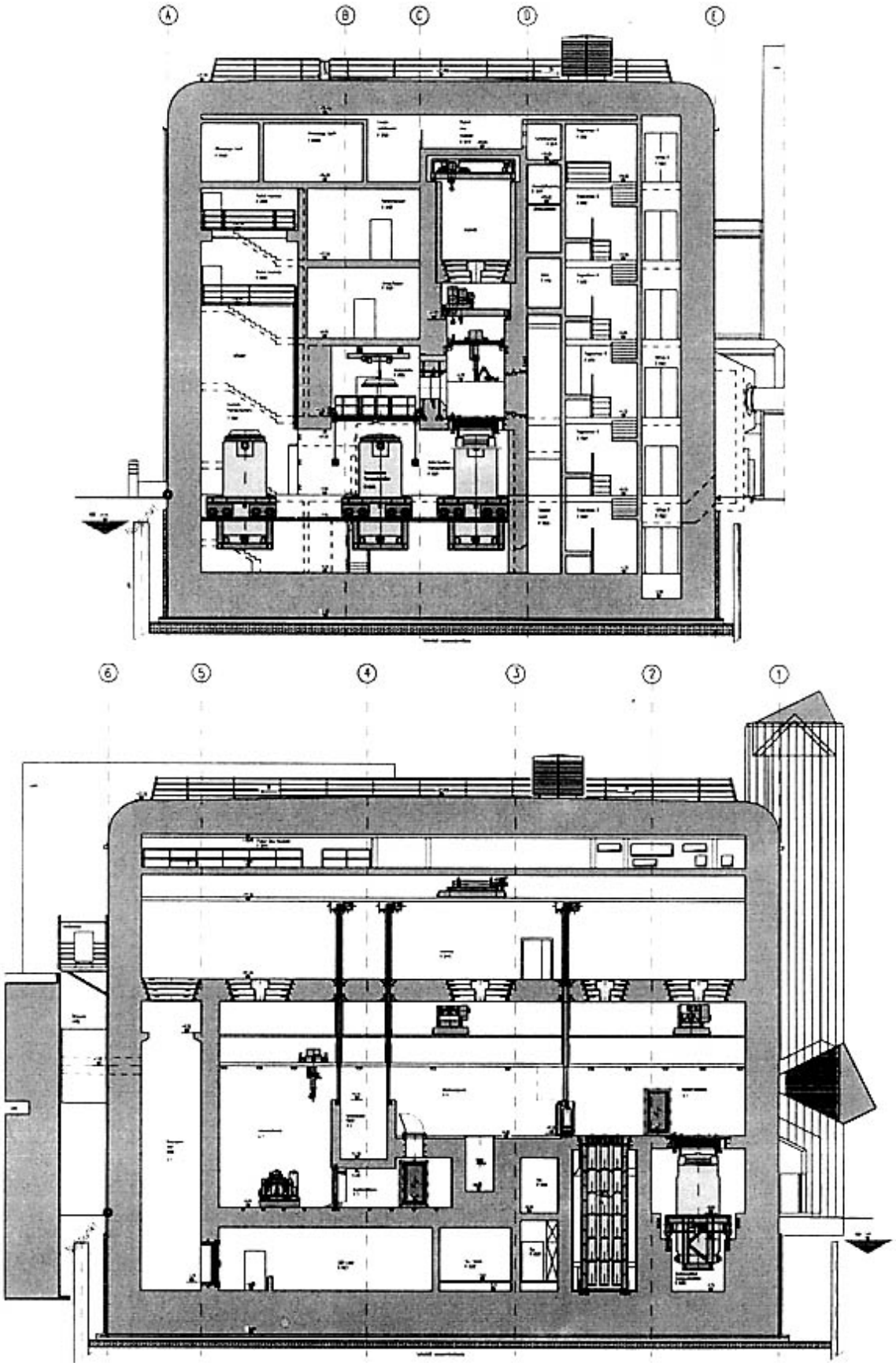

Figure 2: Sections through the VEK-building (process-cells)