DECONTAMINATION AND TREATMENT OF CONCRETE BARS FROM THE DISMANTLING OF HOT CELLS

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ABSTRACT

A building with hot cells had been operated at the Siemens company in Karlstein/Main from 1968 to 1989 in order to perform check-ups of radiated fuel rods and nuclear components. The operation of the system was stopped after an operation period of approximately 20 years. The core part of the building to be disassembled is a U-shaped hot-cell block with nine individual cells, consisting partly of heavy reinforced concrete in the ground floor. The main part of the cells was covered with 10 mm steel plates and outfitted with approximately 1,400 openings of different kinds. The wall thickness of the cells was between 0.90 m and 1.10 m. The non-supporting structures of the hot cell-block were sawed into individual blocks while the remaining walls and floors were peeled off using the diamond rope sawing technique. The resulting 235 concrete blocks with a mass of approximately 970 Mg were transported to the Central Decontamination Operations Department of the Karlsruhe Research Center for further treatment.

INTRODUCTION

The Central Decontamination Operations Department (HDB) operates facilities for the disposal of radioactive waste. In general, their objective is to decontaminate radioactive residues for unrestricted release in order to minimize the volume of waste products suitable for repository storage

To minimize the amount of radioactive waste, initially the more heavily contaminated parts of the blocks without openings, such as tubes, cables or ventilating shafts, were removed with the rope sawing technique and packed into a KONRAD–Container as radioactive waste. The remaining blocks were decontaminated by means of steel grid blasting and, after successful clearance measurements, released from the scope of the Atomic Act.

Bars with openings were crushed into small pieces by a remote-controlled power shovel in order to separate different materials. The rubble was packed into drums and analyzed in an automatic clearance measurement system. The metallic reinforcements were handed over for melting and the openings were super-compacted as radioactive waste. If the activity of the rubble did not exceed the clearance levels, the material was disposed of without further regulations for unrestricted use. Otherwise it had to be treated as radioactive waste and filled into KONRAD-containers for the later storage in a repository.

Using this method, more than 75% of the total mass could be completely released while only 13% had to be declared as radioactive waste.

TREATMENT OF THE CONCRETE BARS AT HDB

Before sending the concrete bars to HDB for further treatment, tests are taken from each bar and send to HDB for analysis in advance. There the tests will be analyzed and the treatment of each bar will be planned in accordance with its activity. In addition to taking tests the ends of the openings will be closed by means of sheet metal or polyurethane foam in order to prevent contamination spreading during transport and further handling. The concrete bars produced within the course of the dismantling of the hot cells will be packed into foil by Siemens and transported to HDB in 20‘ containers. Upon unloading the bars from the containers HDB will perform an incoming control (measuring the dose rate and contamination) to check the measuring results and the corresponding treatment plan. The treatment of the concrete bars, as described in the following chapter, will be performed in accordance with a schedule issued by the Federal Office for Radiation Protection under appraisal of the experts responsible.

Nature of the Concrete Bars

Subject to the structure and geometry of the hot cell-block at Siemens the produced concrete bars are different as well. As already mentioned in the beginning, the cell block had been interspersed with openings such as cable ducts or pipelines which were not removed upon dismantling but remained in the concrete structure. The metal coating of the cells was also not removed upon dismantling and thus delivered together with the bars. Due to the experience with the operation of hot cells the possible storage of contamination between the openings and/or the liner and the concrete structure cannot be exempt. There-fore, upon treatment special attention has to be paid to the separation of these junction points thus enabling the measuring-technical accessibility. All in all the cell block was dismantled into 235 concrete bars with a total mass of approximately 970 Mg. The mass of an individual bar does not amount to more than 10 Mg with a geometry of maximum 1,1 m x 1,1 m x 2,0 m. The wipeable Beta-surface contamination of the Bars is maximum 50 Bq/cm², thus enabling the direct blasting of the surface.

Treatment Methods of the Concrete Bars

According to the radiology and nature of the bars you differ between four different methods of treatment:

- Blasting of the bars and direct measuring for later release
- Splitting of the concrete bars by means of a rope saw
- Crushing of the concrete bars by means of a chisel excavator
- Direct storage of the concrete bars into KONRAD-container

These four different methods of treatment are described in more detail in the following. In order to minimize the volume of waste for final storage and to maximize the releasable amount a bar can also be successively treated in several ways.

Blasting of the Bars and Direct Measuring

Concrete bars which are delivered without openings and liner can be blasted direct. Due to the abrasive effect of the dehumidifier the surface and thus the contamination is removed. Fig. 1 shows a blasting box, where a bar is being blasted.

Fig. 1 View into the blasting box with concrete bars

After the blasting the wipeable contamination is determined by means of wiping test sample taking. This way it is decided whether an additional blasting is necessary to improve the result or if the bars can be released. The release of the bars is effected by the direct measuring of the surface with a contamat. Within the course of this a maximum contamination of 0,02 Bq/cm^2 –emitters and 0,3 Bq/cm^2 emitters may be measured. Should these values be exceeded the release of the bars is not possible. Additionally to the direct measuring drill samples are taken from the bars which will be radio-chemically analyzed. This sample taking serves as evidence that no radioactivity has penetrated into the bars and the release limit values have been exceeded despite observance of the contamination limit values.

Should the direct test or the sample taking reveal that a bars cannot be released it is either split by means of the rope saw or directly put into a KONRAD-container, depending on the activity distribution.

Splitting of the Concrete Bars by Means of a Rope Saw

Concrete bars, on which only a small volume proportion if interspersed with openings and/or on which an increased very adhesive contamination is determined on a few points only, are split by means of a rope saw. The parts with the openings and/or with the increased very adhesive contamination are separated by means of the rope saw. The parts separated are then immediately stored into a final deposit container or crushed by means of a chisel excavator, whereas the remaining bar piece can be blasted to remove the surface contamination. The further treatment is as already described below.

Fig. 2 Splitting of a concrete bars by means of a rope saw

Crushing of the concrete bars by means of a chisel excavator

In order to perform a direct release measurement, all places which are subjected to contamination must be freely accessible. This cannot be guaranteed with a concrete bar with several openings and liners. To prevent having to take these complete bars to the waste for final deposit, the same are crushed by means of a chisel excavator (see Fig. 3). The concrete fragments arising within the course of this work have a maximum diameter of 20 cm. The smashing of the concrete bars enables to separate openings, liners and in this case also reinforcement from pure concrete and can thus be further treated in different ways. The arising rubble is filled into 200-l-drums and measured in the release measurement sys-tem. This is to check whether the release limit values of HDB can be observed or if the material has to be conditioned as radioactive waste. The HDB-permission stipulates the $5*10^{-5}$ of the release limit according to the "old" Radiation Protection Directive as release limit values for the unlimited release. The inspection concerning the observance of the release limit values underlies the nuclide vector permitted by the Siemens control boards. The rubble will be released and disposed as conventional rubble if the release limit values are not come up to. The rubble will be used to fill up KONRAD-containers if the values are exceeded.

Fig. 3 Crushing of concrete bars and separation of different material by means of a chisel excavator

The iron reinforcements and metal liners removed within the course of the crushing are handed over for melting in order to have them economically decontaminated by this process. The slag and dusts arising within the course of the melting are then high-pressure pressed. Contamination cannot be excluded at the openings but as it is very difficult to prove them, the openings are packed into piling drums and are high-pressure pressed. The pressings arising are packed into 200-l-drums and are transported to Siemens for interim deposit and later transport to a final deposit.

Direct Placing of the Concrete Bars into KONRAD-containers

As already described in the chapters before not all concrete bars can be completely released. Some bars are partly or completely highly adhesive contaminated that the release limit values are exceeded. With these bars the conditioning is effected to waste bindings for final deposit. The bar pieces are put into KONRAD-type-IV-containers volume optimized (see fig. 4). The remaining hollow space in the container is filled up with the non-releasable rubble resulting from the crushing with the chisel excavator. Thus it is achieved to make best possible use of the container volume saving costs for interim- and final deposit.

Fig. 4 View of a partly filled KONRAD-container

RESULT OF THE TREATMENT OF THE CONCRETE BARS

When planning the treatment of the concrete bars Siemens and HDB have proceeded from the fact that approximately 60 % of the total mass can be released unlimitedly, 6 % will have to be handed over for melting with nuclear permission and 34 % of the total mass will have to be conditioned as radioactive waste.

However, with regard to the actually releasable quantity this planning has clearly been underestimated. Within the course of the treatment and subject to the treatment methods decided on approximately 75 % of the total mass were released unlimitedly, approx. 12 % were handed over for melting and further 13 % were packed into KONRAD-containers as radioactive waste. Figure 5 shows the exact arrangement of the masses to the individual ways.

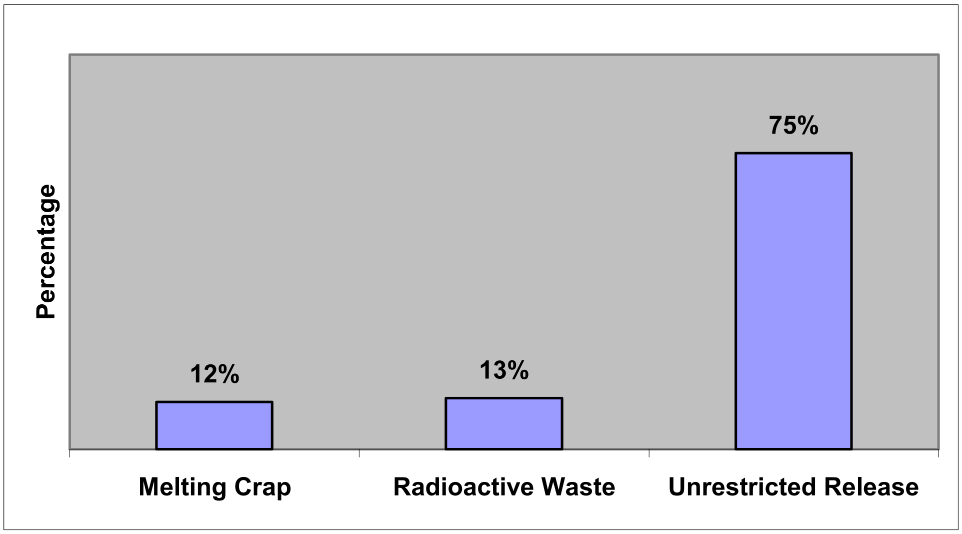

Fig. 5 Arrangement of the masses to the individual ways

RESULT

The quantity of radioactive waste could be reduced to a minimum within the course of the treatment of the concrete bars due to the combination of several treatment methods. By separating contaminated and non-contaminated parts, by means of wire cutting technique and by the crushing of the bars to rubble the optimal separation of radioactive and releasable material was possible. This resulting in allocating 80 % of the total mass to harmless utilization and only 10 % of the total mass were subject to interim deposit as radioactive waste and later handed over to a final deposit.