Decommissioning and Re-opening of the Hot Materials Laboratory at Research Centre Jülich

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1.Introduction

Between 1962 and 1966 the fuel cell laboratory (BZL) has been built to investigate single fuel elements (HTR and LWR) and reactor structural materials.(Fig.1)
The big hot cells (GHZ) were completed in 1968, planned to handle big objects with a length up to 5m, for example fuel rod bundles.
Both laboratories were part of the Institute of Reactor Materials. For more than twenty years the hot cells were involved in the development of HTR technology, specially safety and storage aspects. Caused by the reduced acceptance of nuclear technology in Germany during the last few years, research and development activities were also reduced with the logical consequence that the hot cell capacity in the FZJ was to high. The board of directors of the FZJ decided in 1996 to end the operation of the BZL. The GHZ-Laboratory should finish operation stepwise, beginning in 2000. The performance of this decision is delayed up to now.
From 1996 up to 1999 the installations in the cells of the BZL were removed and the cells were decontaminated as far as possible. The procedure of decommissioning was planned and permitted by the regulatory authorities.

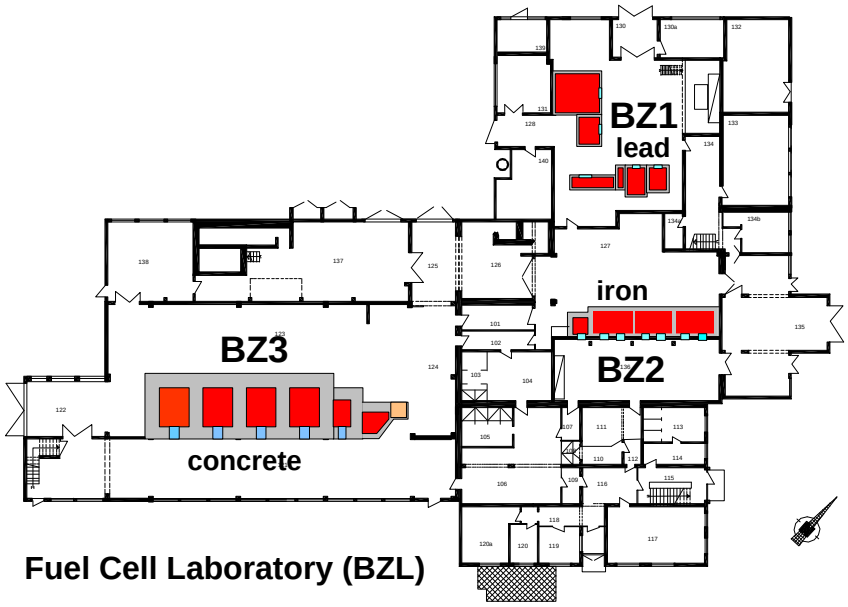


Fig.1 Ground plan of the laboratory before dismantling

2. Decommissioning of the Fuel Cell Lab (BZL)

The laboratory areas (Fig.1) differed primarily by the type of shielding materials. Lead, cast steel and concrete were used as shielding material. Within the framework of the still valid operating licence the dismantling of the cell complexes started in March 2000. The Operation Management Department of Research Centre Juelich was the organisation unit responsible for planning, engineering, administration and disposal within the framework of dismantling measures. External specialists were exclusively used for manual working (e.g.,SAT GmbH).
The dismantling activities started in the BZ 1 laboratory area comprising 5 relatively small lead cells that differed from each other with respect to size, equipment and shielding thickness and one big cell with a floor space of 7 m².
The cells were constructed from lead bricks encased in steel frames and partly lined with PVC or stainless steel boxes. The shielding thickness was between 100 and 250 mm. Apart from the machinery and the manipulators, the dismantling volume consisted of approx. 30,000 lead bricks with a total weight of 300 tons.
Due to the condition of the lead bricks (coated, deformed provided with notches or boreholes) it was only possible to measure approx. 10% of the lead bricks by a special clearance measurement device on site. The rest of the bricks were transferred to the Decontamination Department for reconditioning. The dismantling of the BZ1 laboratory area was completed in Sep. 2000. A great empty hall remained.
As a next step, the dismantling of the BZ3 laboratory area started in 2001. The cell block of the BZ3 was composed of four working cells and two small cells for microscopy and transfer. The concrete used was iron reinforced and the walls were between 1200 and 1400 mm thick. The working cells had internal dimensions of approx. 2.0x2.0x2.1 m. All technical equipment in the form of manipulators and periscopes as well as the inner boxes were removed from the concrete cells and disposed via the Decontamination Department by mid of 2001.
Next the decomposition of the concrete structures was started. The dismantling concept consisted basically of a combined use of diamond rope, hydrostress cleaving and the use of dismantling excavator for the disintegration of great pieces of concrete. With the aim to fill homogenious mixed concrete rubble into 200 l barrels it was necessary to install an additional conditioning step consisting of toggle jaw breaker and concrete shredder. With this concept the size of the concrete fragments was 3 cm and less and the filled barrels could be measured for clearance. A clearance measurement device was taken into operation in the BZL in 2001, based on the principle of total gamma measurement, to ensure an effective and reliable assessment of the dismantled parts with the aim of clearance measurement. The measured data obtained in clearance measurement campaigns have been saved in a database system specially designed for dismantling. For the homogenisation and the measurement SINA Industrieservice GmbH was engaged, which proved efficient in this field due to its technical know-how. Approx. 92% of the dismantled materials from laboratory area BZ3 was measured for clearance. This corresponded to a mass of approx. 1110 tons.

3. Reopening of the laboratory

Before starting the dismantling of laboratory area BZ2 in the middle of 2002, the board of directors of the FZJ decided to preserve this part of the laboratory. This decision is to estimate in relation to the ending of operation in the GHZ. Important options of hot cell technology should be preserved in the FZJ and transferred in a re-opened laboratory with a special setting of objectives.

Future duties of this Lab are

- heat loading tests with fusion reactor materials
- materials characterisation and testing
- service for the DIDO-reactor
- measurements for clearance of waste

With respect to the new course of the laboratory the name was changed to “Hot Materials test Laboratory” (HML). Fig.2.shows the ground plans of the GHZ and the new HML with the planned transfer activities.

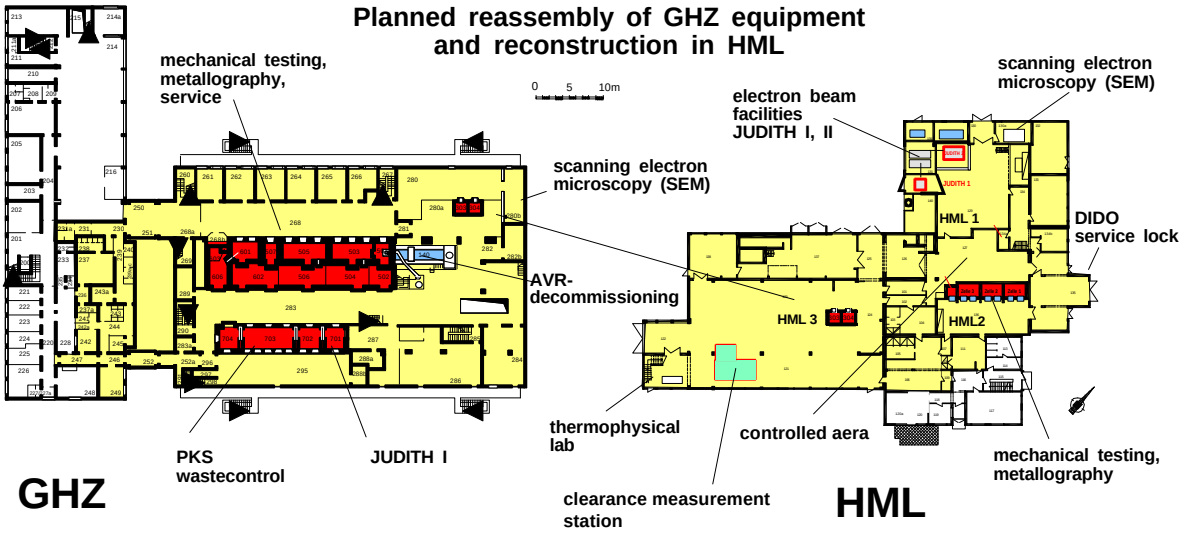
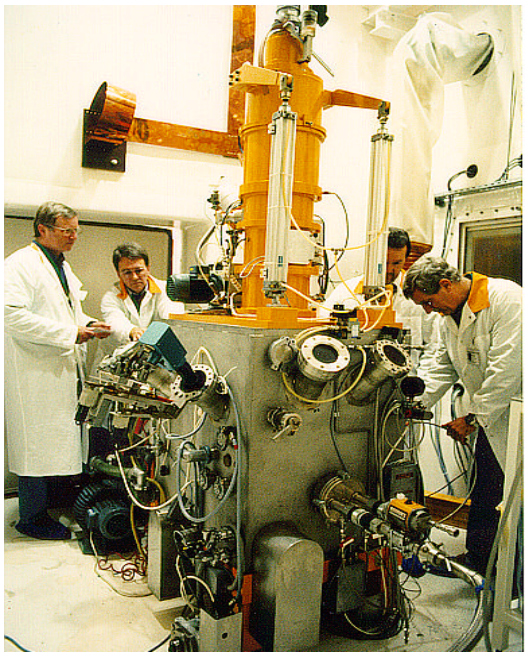


Fig.2 Ground plans of the Great Hot Cells and the Hot Materials Test Laboratory

HML 1 (former BZ1)

The so-called HML1 will be equipped as a thermo-test laboratory. The electron beam facility “JUDITH” (JUelich DIvertor Test facility in Hot cells) operated successfully in GHZ during the last 10 years and shall be transferred into the new lab. This facility with a beam power of 60 kW is specially suitable for heat loading tests with actively cooled modules in the frame of the fusion project. In order to simulate material damage by 14 MeV neutrons in a Tokamak reactor, the specimens are irradiated with neutrons in a fission reactor before heat load testing. Because of the activation it is necessary to handle these samples by remote technology. The vacuumchamber of the JUDITH facility with diagnostic systems and the electron gun is installed in a shielded cell. Fig.3.shows the facility in the GHZ during inspection.
It is planned to install a second electron beam facility, the JUDITH 2, with a beam power of 200 kW in the HML1. In the frame of collaboration with the fusion project it is necessary to test larger components with higher power densities.



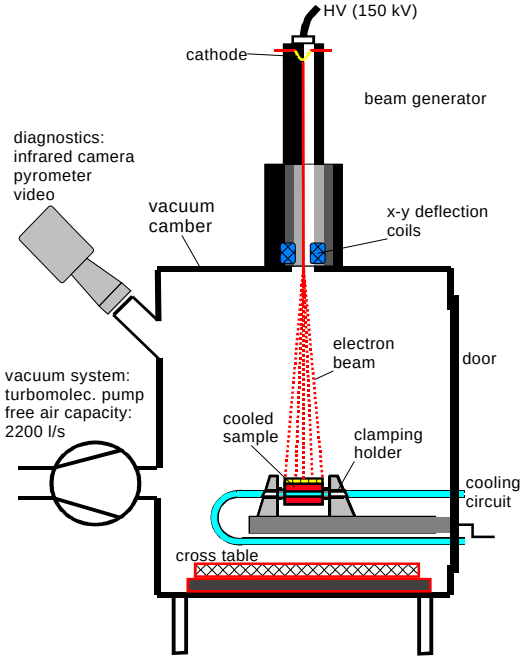


Fig.3 JUDITH electron beam facility

Additional to the heat testing facilities a scanning electron microscope for investigation with hot samples will be installed in this part of the laboratory.

HML 2 (former BZ 2)

The HML2 laboratory area consists of 3 working cells with a cast iron shielding of 400 mm thickness, a small transfer and waste cell and a glovebox . The working cells have a internal dimension of 3000 x 1900 x 2650 mm (LxWxH). All cells are equipped with stainless steel boxes and lifting gears. The entrance cell can be loaded by a locking system, which fits with two in the FZJ common used transport flasks. In addition the Padirac transport system is installed. The entrance cell is reserved for mechanical processing the other two cells for materials testing, metallografy and preparing of samples.

HML 3 (former BZ 3)

At the moment the laboratory area HML3 consists of a large empty hall, which is very suitable, to install facilities with relatively large floor space. Therefore it is planned to dismantle two lead shielded cells of the GHZ and reconstruct them in the HML 3.

The internal dimensions of each cell are 2200 x 1500 x 1800 mm (LxWxH). The shielding walls consist of lead bricks of 200 mm thickness. A Padirac transport system is installed.

The cells will be used for gamma spectrometry measurements including tomography and materials testing.
In addition an efficient clearance measurement device will be installed in the HML 3 in collaboration with SINA GmbH. Waste barrels of future dismantling projects should be dispatched. Fig.4

Fig.4 Clearance measurement device constructed by RADOS GmbH

One part of the HML 3 is reserved for installation a thermo physics laboratory. This part of the building is nearly free from vibration and very well suited to install a laserflash device for measuring thermal conductivities of relevant materials.

It is planned to complete the renovation of the laboratory and the installation of the facilities in 2005.