DECOMMISSIONING AS AN OPPORTUNITY FOR A NEW START

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Abstract

In 2005, the Fusion Materials Laboratory (FML) of Forschungszentrum Karlsruhe took new lead-shielded materials testing cells into operation. These cells had been set up largely using components of the decommissioned old lead cells.
The former cell facilities had been operated for nuclear research. As the FML has been focusing on fusion research for some years now, its cell capacities had to be adapted and operation costs had to be reduced considerably. In addition, the costs of new materials testing cells had to be minimized. Consequently, the existing lead-shielded cells were decommissioned. Major and expensive components were decontaminated, partly repaired, and integrated in the construction of the new test cells. Among them were lead and special stones, lead glass windows, manipulators, locks, steel components, and others. The components that could not be reused were compacted and disposed of. Experience that had been gained while operating the old facilities proved to be of high use when constructing the new cells and in particular when equipping the workplaces. Latest inspection and preparation technology was integrated in the cells. The new cells were tailored to modified boundary conditions in terms of available space, scientific investigation needs, and flexibility.
It will be reported about how new, modern, and flexible cells were constructed at low costs by dismantling old facilities. The potentials of the new test cells will be highlighted.

1. Introduction

In the past the Karlsruhe hot cell laboratory exclusively dealt with research in materials for nuclear fission. Due to the changed political situation in Germany a complete change was carried out from the research in the nuclear fission, to the research in the nuclear fusion, in our house. The high running costs which were caused by the old cell structure had to be reduced. Also the cell capacities had to be adapted to the new situation. Thereby it was necessary to decommission cells and build up new adapted cells. This had to be carried out with as low as possible costs.

2. The new KIT

The university of Karlsruhe and research centre Karlsruhe merged together to the new great institution, for research and science, KIT. This happened on the 01.07.2009 by the official contract signing. KIT stands for Karlsruhe Institute of Technology. Together approx. 8000 employees work in both parts. The institute of material research II is settled in the research centre Karlsruhe. The research centre Karlsruhe is embedded furthermore in the program structure of the Helmholtz community. This is a community of the 13 biggest research establishments of Germany. The research programs of the centre are divided in 4 subranges and 11 programmes. The IMF II-FML is active in the area of Energy and in the programme Nuclear Fusion.

3. Decommissioning and a new start

The activities of the FML cover the investigation of structure materials for of the first wall, materials with plasma contact and materials for the helium cooled pebble beds. Also the question of the tritium breeding is examined. On this occasion, destructive material investigations, investigations of the absorption and desorption are carried out with tritium in different materials, investigations of the thermal and mechanical properties of materials and investigations of the microstructure of the materials. The investigations are performed on inactive, neutrons activated and radioactive materials.
In the past the hot cell laboratory exclusively dealt with research in materials for nuclear fission. Complete nuclear fuel rods, or parts of them were examined or also other materials. This activity enclosed a time frame from 1966 to approx. 2002. Due to the changed political situation in Germany a complete change was carried out from the research in the nuclear fission, to the research in the nuclear fusion, in our house.
The high running costs which were caused by the old cell structure had to be reduced. Also the cell capacities had to be adapted to the new situation. Therefore it was necessary to decommission cells. This had to be carried out with as low as possible costs.
We started approx. in 2000 with the planning of a complete move of all workstations from the older partial sections I and II and integration in the newer section III of our laboratory building. On this occasion, the old cells should be decommissioned. The important and expensive components from the old cells, were to be used then to the construction of new, smaller and problem adapted cells. Also the whole infrastructure was moved. It was paid attention during the planning of the single workstations that only modern, the measuring duties matching equipment was purchased.
During the decommissioning the main attention was laid on two cells. First the material test cell which is designed as a beta gamma cell and second the metallography cell which is designed as an alpha gamma cell. Especially for these both existing cells spare cells had to be built in a contemporary way.
During the construction of the cells the boundary conditions were authoritative in the BAIII. An advantage was a separately existing ventilation system and maintenance equipment existing in the BAIII. During the construction of the new cells the construction of the present cells was used as a basis. On this occasion, the shielding strength, the wall thickness resulting from it, ergonometry of the cell working station and the experiences from the old facilities were taken into account. Also it had to be considered that all former practicable investigation possibilities also had to be available in the new cells. The time schedule had to be set up in such a way that the dismantling of one cell walked along in a contemporary way with the construction of the other cells. The down-times to cell working station had to be minimized. All activities had to be done compliant to the permission.
During the decommissioning of the old cells the following parts were recycled in particular for the new construction:
Manipulators (hot arms, cold arms), lead glass windows, special lead components, stones of lead and steel components
These parts would have caused considerable costs with a new procurement and the project would not have been financeable. The parts were checked after the dismantling for contamination, and decontaminated if necessary and made available to the reconstruction.
Both new material test cells are in operation since the middle of 2005.
As investigation equipment modern test technology was installed. A universal test machine Zwick Z50 with vacuum recipient is installed in the material test cell. The arrangement works in a temperature range from room temperature up to 1200°C. Mechanical testings as tensile tests, low cycle fatigue tests are carried out on this machine.
Furthermore a fully automatic pendulum is installed with up to 25J hammer. A preparatory station, with storage for up to 400 sample capsules , was built up besides.
The metallography is equipped with modern preparation equipment and with a new inverse fully motorised light microscope with hardness tester and image analysis system.

All cells are equipped with locks for the infiltration of small parts, liquids etc.. Active parts and material can be posted by means of shielded casks. Big components are posted through openings in the cell ceiling.

4. Investigation possibilities

The investigation possibilities in the new IMF II – FML are the following:

- Mechanical testing: tensile, fatigue, charpy (from -190 up to +1200 °C)
- Registering hardness test
- Crush load test
- Metallography
- Mechanical machining
- Densitometry
- Investigation of tritium absorption and desorption
- Light microscopy with hardness test and image analysis system
- Scanning electron microscopy incl. EDX, WDX
- Transmission electron microscopy incl. EDX, EELS, EFTEM, HAADF
- Gamma – spectrometry

5. Next step

As a next step both old building parts I and II and the concrete cells therein will be decommissioned to a “green meadow” during the next years. This will be done by a separate company WAK which is also situated on the campus of Forschungszentrum Karlsruhe.

6. Conclusion

For the realisation of the projects it was important that the costs could be low. The reuse of components from old cells was vital. The reduction of construction costs and low workshop times was vital. Also the reduction from mass of decommissioned waste and strongly reduction of running costs of the new facility were the important points. Advantages of the new arrangement are the modern test and preparation equipment and a compact facility construction. Disadvantage is a very small remainder of laboratory space for new arrangements.