Renewal of Hot Cell 6 at PSI

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ABSTRACT

The Hot Cell 6 of the Paul Scherrer Institute in Switzerland is used for compaction of high active waste and insertion of the resulting pellets into transport cartridges. The systems inside of Hot Cell 6 needed replacement. NUKEM Technologies Engineering Services GmbH (NUKEM) was contracted to bring the internals of Hot Cell 6 to up-to-date technology. The works where performed including all necessary documentation. At the date of this paper the works are close to completion.

1. Introduction Overview and objective

The systems inside of Hot Cell 6 (HZ 6) at Paul Scherrer Institute, Switzerland was planned to be updated to up-to-date technological structure. This included replacement of the waste press and the Hot Cell internal infrastructure. The following works were performed by NUKEM Technologies Engineering Services GmbH (NUKEM):

1. Creation of application documents for approval by authorities
2. Decontamination of components and Hot Cell itself
3. Dismantling of existing components
4. Removal of dismantled components and secondary wastes
5. Complete decontamination and cleanup of HZ 6
6. Installation of new components

The dismantling actions were performed completely inside the HZ 6 with off-the-shelf-equipment. The concept for the new internal structure of the HZ 6 was developed by NUKEM in close cooperation with PSI according to PSI requirements.
The new internal structure needs to perform the following:

Introduction of either “Alpha-Büchse” AB210 or AB050 (Alpha-Büchse=Alpha tight can) into the Hot Cell for compaction and insertion into “Presslingsbüchse” PB250 (pellet cartridge) in a “Lagerungs- und Transport System” (LTS: Storage and Transport System). An emergency retrieval function needs to be implemented for interventions inside of HZ 6.

2. **Basis for planning and works**

The internal layout of the HZ 6 was newly designed and improves safety during treatment. The dimensions of the Cans AB210, AB050 and PB250 are (diameter * height):

- AB 210: 210 mm* 505 mm (some models 512 mm)
- AB 050: 50 mm* 135 mm / 50 mm * 325 mm
- PB 250: 250 mm* 1100 mm

The storage and transport system (LTS) has 16 storage positions for AB210 or PB250. PB250 will be loaded with pellets from compaction.

In average one PB250 is expected to have a surface dose rate of 3 Sv/h up to 10 Sv/h.

3. **Application documents**

Hot Cell 6 is classified as SK4 (lowest of the four safety classes in Switzerland). As the Hot Cell itself provides safety for all relevant cases the new internals could remain unclassified. The main approval documentation was to show retrievability in case of incidents and safety in case of any changes to the hot cell structure. The main change in the hot cell structure is the integration of the new introduction lock system. For this new introduction lock system the shielding design was calculated and shown that the external dose rate for all possible states (both lock shields closed or one of them open during bringing-in operations) are well below legal limits.
4. New Design of Hot Cell 6

In Figure 1 the new design is presented with all new components excluded crane – top view (bold).

The 16 storage positions on the LTS as well as high force compactor, filling station and introduction lock system are presented.
5. **Preparatory works**

After approval by authorities the dismantling of the existing structures inside of Hot Cell 6 as well as the decontamination was performed.

The situation inside of HZ 6 found at start of works is shown in Figure 1.
All existing structures were decontaminated and removed. Afterwards the Hot Cell itself was fully decontaminated (see Figure 3).

Figure 3: same view as in Figure 2 but after cleanup and decontamination
6. **Installation works**

The new equipment was designed, procured and installed. As the safety class SK4 of the Hot Cell itself covers all events, the equipment implemented was classified as “mechanical unclassified equipment” regarding the safety requirements. With the new equipment all incoming AB210 or AB050 can be compacted and packed into PB250 effectively reducing the storage volume. All operations are remotely controlled from the operator room of Hot Cell 6.

Some of the newly installed systems (e.g. LTS and High force compactor, compare to Figure 1) are shown in **Figure 4**.

![Figure 4: view inside of HZ 6 after some installation works](image1)

![Figure 5: View on Tilting Unit and Filling station](image2)
7. Safety aspects

Shielding calculations

To ensure safety of operators during bringing-in operations shielding calculations were performed and described for the three possibilities of the input lock:

- Loading condition 1: Outer lock shield opened, inner lock shield closed
- Loading condition 2: Outer lock shield closed, inner lock shield opened
- Operation condition: Both lock shields closed

The calculation was performed based on Co-60 emissions only. A conservative approach using three PB250 with 30 Sv/h surface dose rate each was chosen to calculate the necessary shielding thicknesses of the lock shields for all three conditions. It was shown, that a shielding tube of 1 cm lead inside of the throughput was necessary in addition to the 18 cm steel shield locks to keep the dose rates at the cold side below legal limits.

Figure 6 shows a view with slightly opened inner lock shield.

Figure 6: View through shielding window. To the left the closed roller shutter door with open inner lock shield is visible.
Safety measures
During operation entrance to Hot Cell 6 is not possible. Due to the positioning of the LTS all PB250 cartridges can be retrieved through the ceiling plug into Hot Cell 4 located directly above Hot Cell 6. After retrieval of the radioactive inventory interventions into Hot Cell 6 are possible.

8. Summary
The internal equipment of Hot Cell 6 at PSI was completely removed. Dismantling and decontamination to a clean interior was performed. All works including the new design and installations where approved by ENSI (Swiss authority). The new internal structure was installed within the planned time frame. At the time of HOTLAB 2016 site acceptance tests will be finished.