

## **Handling of Highly Radioactive Radiation Sources in a Hot Cell Using a Mechanically Driven Cell Crane – 13452**

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### **ABSTRACT**

In 2010, Siempelkamp Nukleartechnik GmbH was awarded the contract for design and erection of a Hot Cell for handling and storage of highly radioactive radiation sources. This Hot Cell is part of a new hot cell laboratory, constructed for the NHZ (Neues Handhabungszentrum = New Handling Center) of the Nuclear Engineering Seibersdorf GmbH (NES).

All incoming radioactive materials from Austria are collected in the NHZ, where they are safely conditioned and stored temporarily until their final storage. The main tasks of the NES include, apart from the collection, conditioning and storage of radioactive waste, also the reprocessing and the decontamination of facilities and laboratories originating from 45 years of research and development at the Seibersdorf site as well as the operation of the Hot Cell Laboratory [1].

The new Hot Cell Laboratory inside the NHZ consists of the following room areas:

- One hot cell, placed in the center, for remote controlled, radiation protected handling of radioactive materials, including an integrated floor storage for the long-term temporary storage of highly radioactive radiation sources
- An anteroom for the loading and unloading of the hot cell
- One control room for the remote controlling of the hot cell equipment
- One floor storage, placed laterally to the hot cell, for burial, interim storage and removal of fissionable radioactive material in leak-proof packed units in 100l drums.

The specific design activity of the hot cell of 1.85Pbq relating to 1-Me-Radiator including the integrated floor storage influences realization and design of the components used in the cell significantly.

### **DESCRIPTION OF THE HOT CELL**

The hot cell (Fig.1) is equipped with 22 storage ducts integrated into the floor storage. These storage ducts are protected by lead plugs with a thickness of 500mm. There is also a shielding wall at the front of the floor storage, consisting of 22t of lead (500mm x 2,500mm x 1,670mm). 9 Lead plates (65mm) shield the floor storage on the top. A total of 50t of lead has been used as protection material in the cell. The cell body itself consists of an interior and an exterior steel liner with a wall thickness of 10mm. The lining serves simultaneously as permanent formwork for the heavy concrete filling (barite concrete) with a thickness of 1m and a density of 3.45kg / dm<sup>3</sup>. The working areas in the cell can be observed via 2 lead glass windows. These lead glass

windows originate from the stock of the NES and will be dismantled from formerly used hot cells and installed into the newly built cell.

For the handling, 2 manual manipulator systems manufactured by the company Wälischmiller (model HWM100) will be used. For the locking in and the locking out of small parts during the handling of radioactive sources in the cell a transfer drawer will be installed. If there are no sources to be handled the access to and the loading of the cell is realized by means of a mobile shielding door (mass: 50t) being moved by a hand ratchet, which is rendered possible by the fact that exclusively enclosed radioactive sources are handled and therefore no open contamination is on hand. The locked-in transport and shielding casks will be set down on the lifting table in the cell, then the table will be descending and the casks will be decapped. Afterwards the sources can be transported from their recipients to the floor storage. Given that a luminance intensity of 2,000 Lumen is required for the working area, particular high pressure sodium vapor lamps have to be installed. The resulting heat development entails a complex ventilation system for the cooling of the lamps.

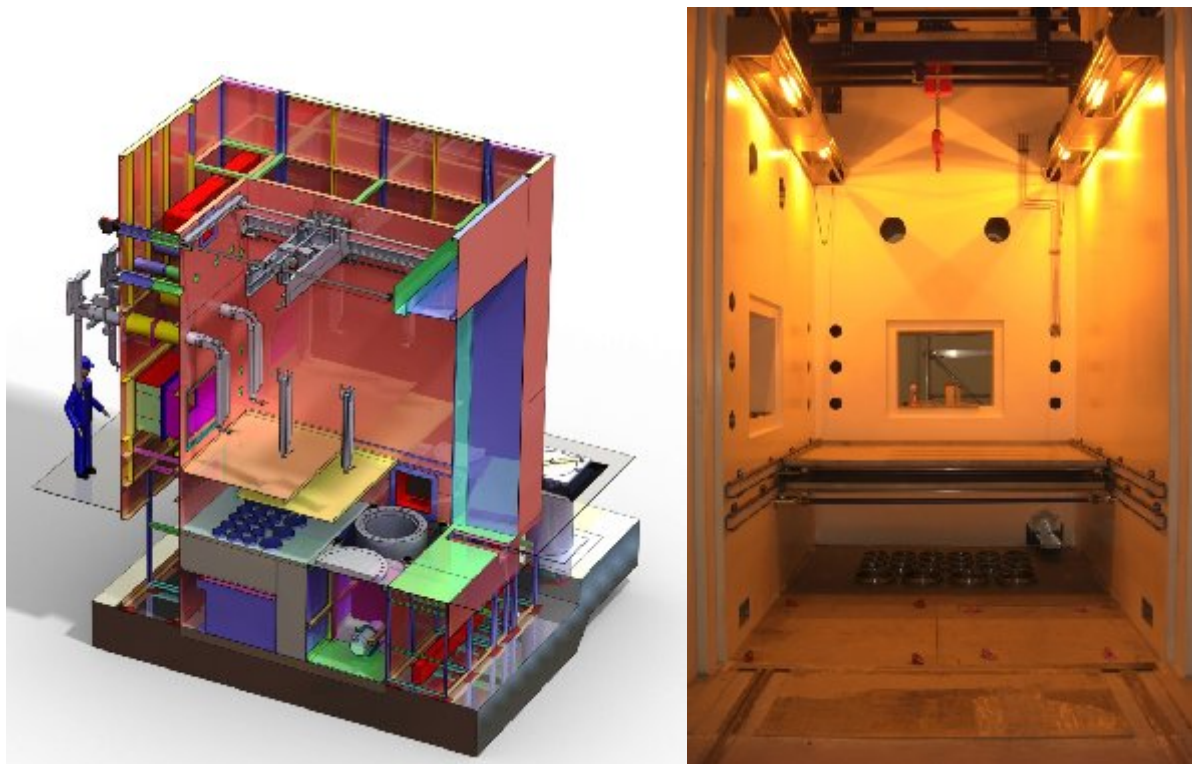


Fig. 1

Views of Hot Cell including integrated floor storage; 3D Model and picture during installation work

## DESCRIPTION OF THE MECHANICALLY DRIVEN CELL CRANE

The conceived cell crane used in the cell posed a technical challenge. Due to radiological reasons, all electrical components (engines, gear limit switches) of the crane drive chains for bridge carriage, trolley traveling winch and hoisting gear have been placed outside the hot cell. Within the hot cell, the cell crane is solely constructed of mechanical parts. The crane itself consists of a carbon steel welded-bolted construction and had to be specifically modified: the torques are transferred into the cell via radiodense shaft ducts through the cell walls to the mechanical drives of cell crane assemblies, bridge traveling unit, trolley traveling unit and hoisting gear.

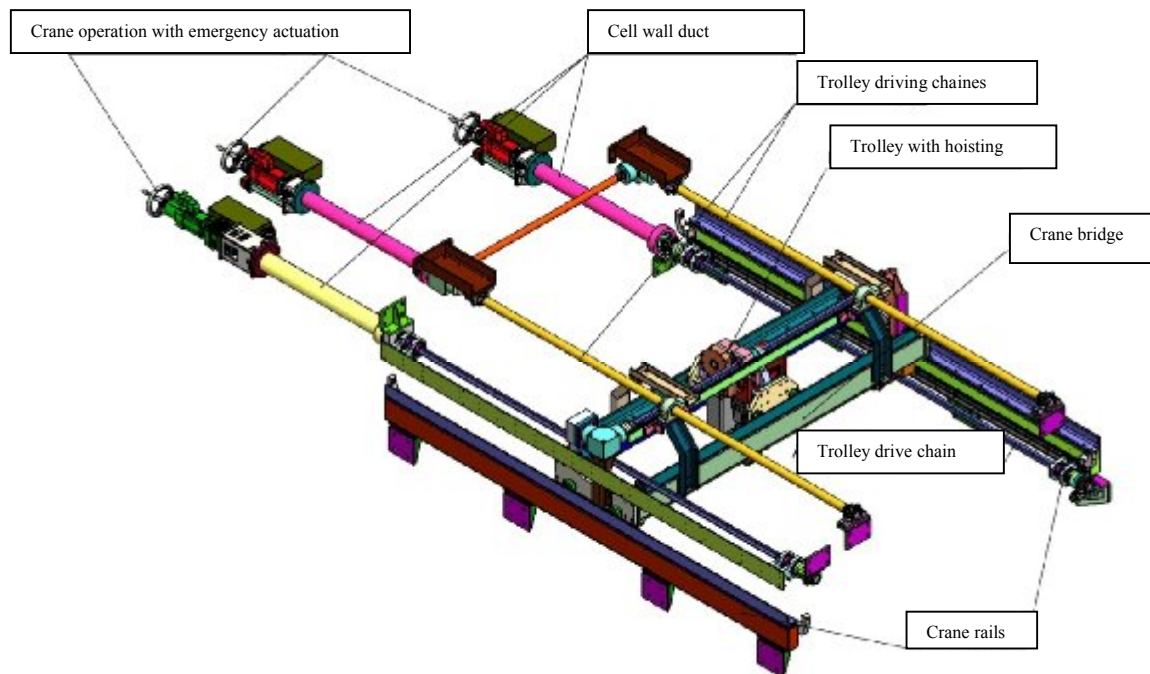


Fig. 2

3D view of cell crane with mere mechanical body within the Hot Cell

The designed hoisting capacity of the crane amounts to 20kN, the maximum hoisting range amounts to 6000mm.

The optimized operating radius permits to keep the load hook at a distance of 400mm to each outer outline of the cell and up to 900mm beneath the cell ceiling.

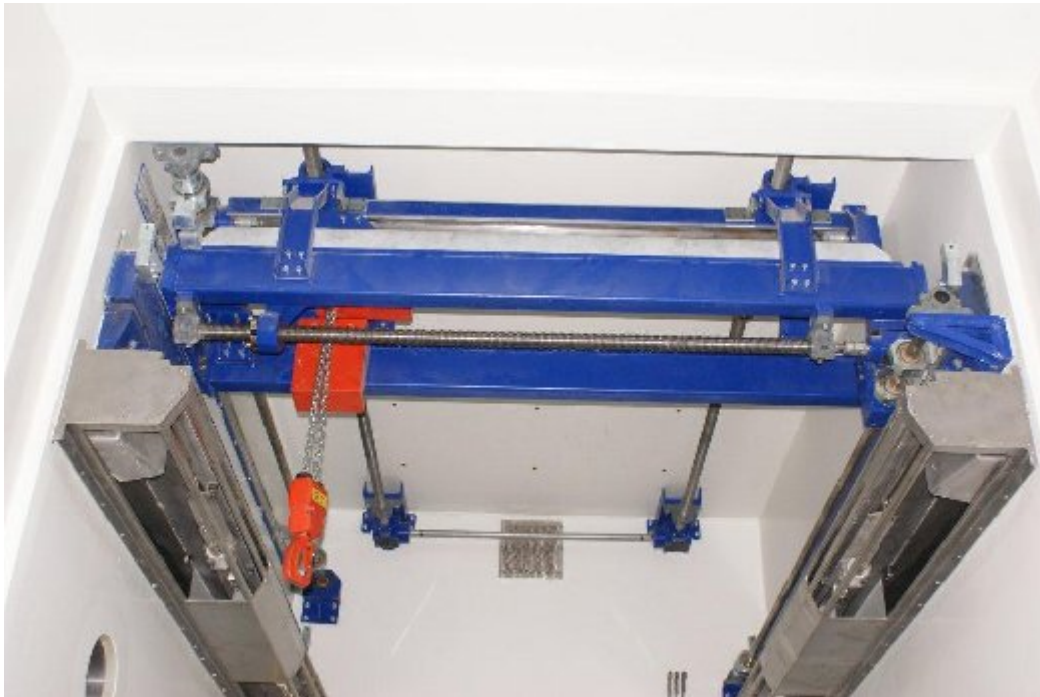


Fig. 3

Total view of the cell crane including the cell illumination installed beneath

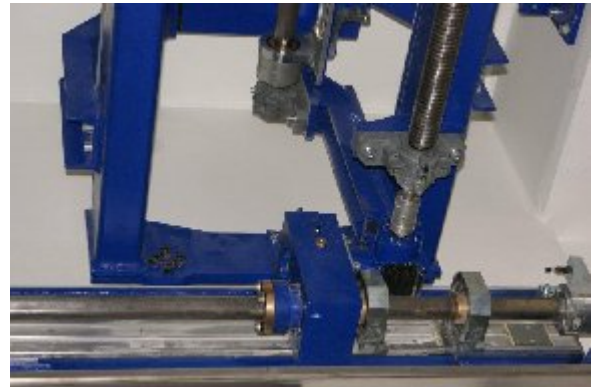
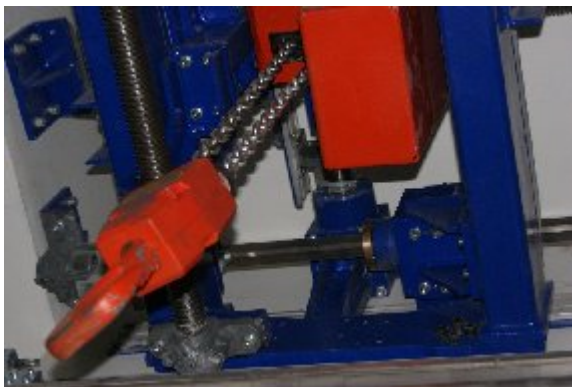


Fig. 4

Detailed view of hoisting gear (left picture) and trolley propulsion unit (right picture)

The three drive chains

- bridge carriage
- trolley traveling winch
- hoisting gear

consist of various linkages of gear drives and shafts. The bridge carriage is moved linearly in longitudinal direction to the cell by means of 2 trapezoidal spindles. The crab is displaced by means of a polygon axle (machine direction) and a trapezoidal axle (transverse direction). For the realization of the lifting procedures 2 polygon axles at right angle to each other and diverse gear drives (4 units) have been used. A simplified view of the assembly structure of the crane is presented in figure 2. Details of the hoisting gear and the trolley propulsion unit are shown in figure 4.

## **CONCLUSION AND NEXT STEPS**

Due radiological reasons, all electrical components of the crane drive chains for bridge carriage, trolley traveling winch and hoisting gear have been placed outside the hot cell. In addition the crane provides outstanding approach dimensions for utilization due to limited space inside the cell. Siempelkamp was able to fulfill these special requirements by NES regarding the cell crane, which is solely constructed of mechanical parts within the hot cell.

The commissioning of the cell and its entire infrastructure shall be finished in April 2013 successfully.

## **REFERENCES**

1. <http://www.nes.at> - Nuclear Engineering Seibersdorf (NES)