

Materials Research Facility (MRF) Hot Cells

Client: KAEA Culham CCFE

Aims and objectives

The objective was to design, manufacture, and install, a suite of Hot Cells at the UKAEA Culham site in Oxfordshire. The cells are used to accept irradiated material samples and prepare them for analysis, employing Scanning Electron Microscope (SEM) and charpy impact listing.



Shielded Facilities

Cyclife EDF Group - Subsidiaries





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The client

Culham Centre for Fusion Energy (CCFE) Materials Research Facility (MRF) will become the UK's newest, and most advanced, Nano material testing centre, complementing the studies being carried out on the Culham site.

The nature of fusion and fission specimens is such that they require different environments, handling techniques, and shielding, than standard material samples.

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Project overview

Culham Centre for Fusion Energy (CCFE) is the UK's national laboratory for fusion research. Owned and operated by the United Kingdom Atomic Energy Authority (UKAEA), CCFE (formerly known as UKAEA Culham) is based at Culham Science Centre in Oxfordshire.

At CCFE, the Authority, under contract to the European Commission, operates Joint European Torus (JET) - Europe's flagship fusion facility and the only machine capable of significant fusion power (multi-megawatt).

Scope and Project Solution

The project scope included the detail design, manufacture, works, assembly, and listing of a suite of containments and hot cells.

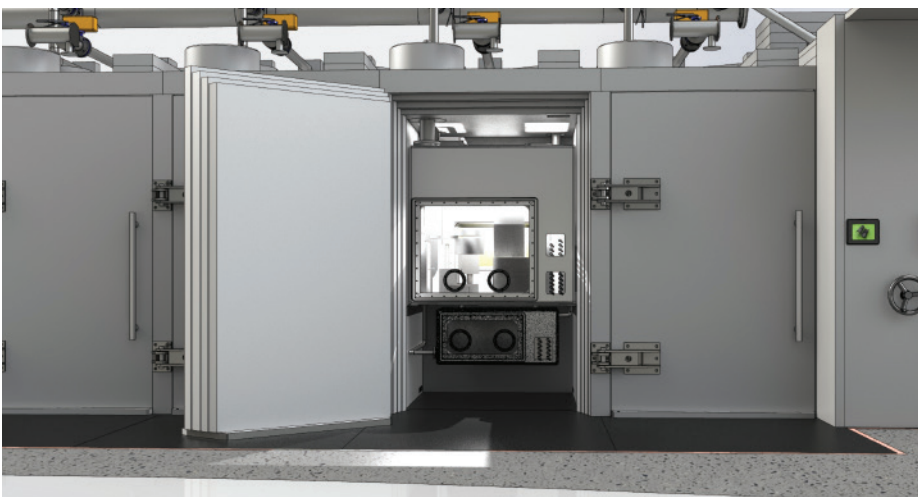
The shielding material employed was mild steel up to 450mm thick. The total weight of the hot cell suite exceeded 300 tonne and required the installation of a steel spreader plate over the whole area.

The Materials Research Facility (MRF) is a centre for researching the material properties of irradiated specimens.

These specimens will come from a range of experiments and nuclear facilities, largely in support of current, and future, fusion and fission power plants.

The Sample Preparation Facility is a suite of shielded hot cells which have been designed around the preparation of irradiated material samples for further analysis.

The MRF will enable universities and companies to access cutting edge methods of evaluating radiological degradation in materials, which is key to improving their performance and ensuring known characteristics in service.



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Equipment Description

The plant consists of 4 shielded zones:

- Receipt Cell
- Hot Cell 1, 2, and 3

Each shielded zone has a gamma monitor, pressure monitors, in-cell cameras, and lead glass window for direct viewing of the cell.

Shielding is provided by laminated mild steel panels bolted together to form a rigid structure, layered up to 350mm thick to meet localised shielding requirements.

The active ventilation system is mounted on the roof of the cells. The Receipt Cell has an extraction HEPA filter, while the hot cells have inlet and extract HEPA filters. Each hot cell includes a services labyrinth for the C&I cable routing with its associated compensation shielding.

Receipt Cell

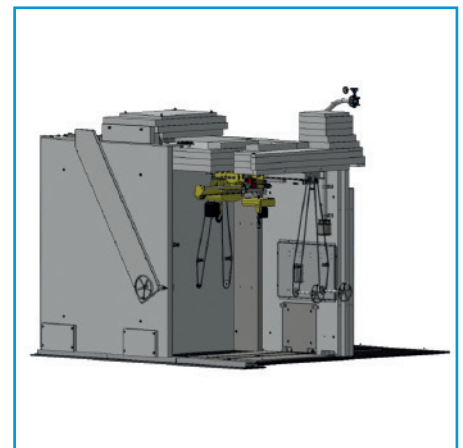
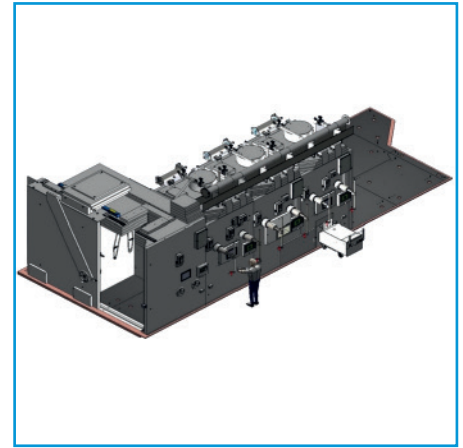
The Receipt Cell allows samples to be unpacked from their transport package. The roof of the Receipt Cell features a recess to allow the transport package to be positioned within the cell, using the building crane. On top of the cell, a Roof Shielding Assembly provides shielding around the crane/cell interface to minimise transient shine paths as the Inner Posting Pack Assembly is removed from the flask.

The Receipt Cell incorporates two overhead crane assemblies, both are driven along an overhead rail using a chain drive system. The chain runs inside the Receipt Cell from the hand wheel to shafts mounted in the overhead assembly.

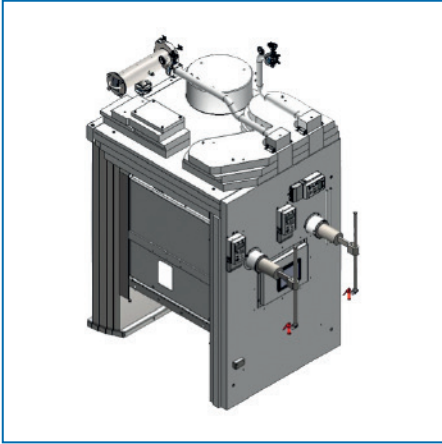
Hot Cells 1, 2, and 3

Common hot cell features include:

- Stainless steel containment carcass (cell)
- Toughened glass operators cell window
- Toughened glass rear maintenance cell window with two 6" round glove ports
- Toughened glass roof mounted cell light windows with LED floodlights (x4)
- Toughened glass roof mounted cell camera windows (x2) with camera mounting posts and camera
- In-cell transfer tunnel shield doors, inflatable seals and interlocks
- Cell gland plates for electrical and fluid services transits
- In-cell fire detection sensor
- Ventilation ducting, filters, and controlling dampers
- Shielding labyrinth for services penetrations
- Rear hinged shield door with open and close dampers
- In-cell viewing provision (camera and screen or leaded glass window)
- Operator Human Machine Interface (HMI)
- Gamma monitoring
- Cell pressure gauge
- 13A power sockets



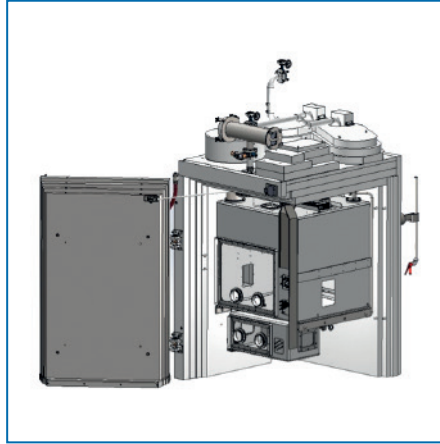
Hot Cell 1



Viewing provision within Hot Cell 1 is provided by a flat screen monitor, coupled to an in-cell camera, mounted on the window aperture blanks. The window blanks offer the ability to replace camera monitoring for a leaded glass window in the future.

In addition to the common features, Hot Cell 1 contains a blanking plate in the base of the cell, providing provision for the possible future installation of a DPTE type transfer port.

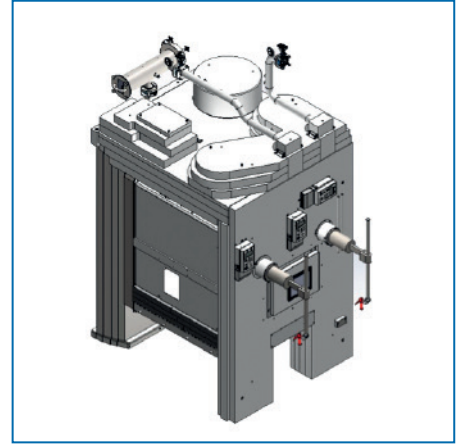
Hot Cell 2



Viewing provision within Hot Cell 2 is provided by a leaded glass window. Hot Cell 2 features a Liquor Containment below the primary Containment, with a conduit linking the two.

The lower containment allows for stock fluids used in the sample preparation process to be stored outside of the primary containment. There is a gland plate to the rear of the Liquor Containment to facilitate required services.

Hot Cell 3



Viewing provision within Hot Cell 3 is provided by a flat screen monitor, coupled to an in-cell camera, mounted on the window aperture blanks. The window blanks offer the ability to replace camera monitoring for a leaded glass window in the future.

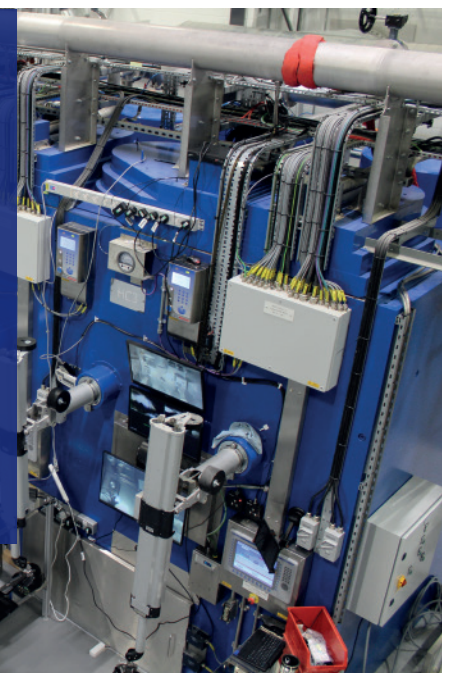
In addition to the common features, Hot Cell 3 contains a Post Out Port and Post Out Gamma Gate, to be used in conjunction with the Transfer Trolley, to remove an encapsulated sample from the sample preparation facility.

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Summary

Aquila was engaged from concept and prepared the scheme designs and full work breakdown structure. This project is a good example of concept right through to installation.



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