

Fabrication and Installation of VTT's new hot cells

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VTT Centre for Nuclear Safety

Reactor materials testing and research



- VTT has been hosting the national hot laboratory infrastructure since it was first constructed and equipped in the 1970's.
 - Principle use has been for handling, testing and examining RPV materials for surveillance testing.
 - In 2011 a final decision was reached to renew the hot laboratory with an all new, green field site project, the VTT Centre for Nuclear Safety
 - Ground was broken at the beginning of 2014
 - Laboratory-wing was ready for move-in June 2016
 - Following an EU tender in 2014, hot cell contract awarded to Isotope Technologies Dresden GmbH.
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- Aging degradation of structures and components is an important aspect of power plant safety.
 - Ageing management requires activities related to the utilization, inspection, surveillance, testing, examination, and degradation mitigation of materials.

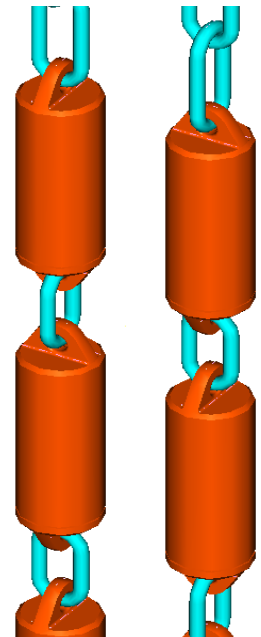
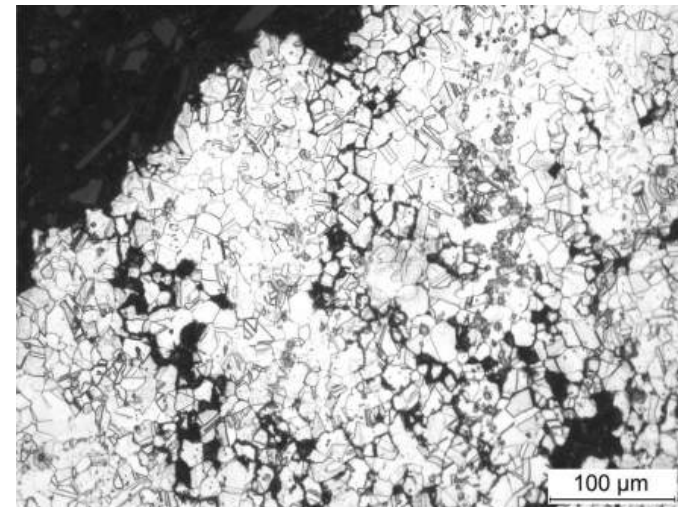


VTT Centre for Nuclear Safety

Reactor materials testing and research

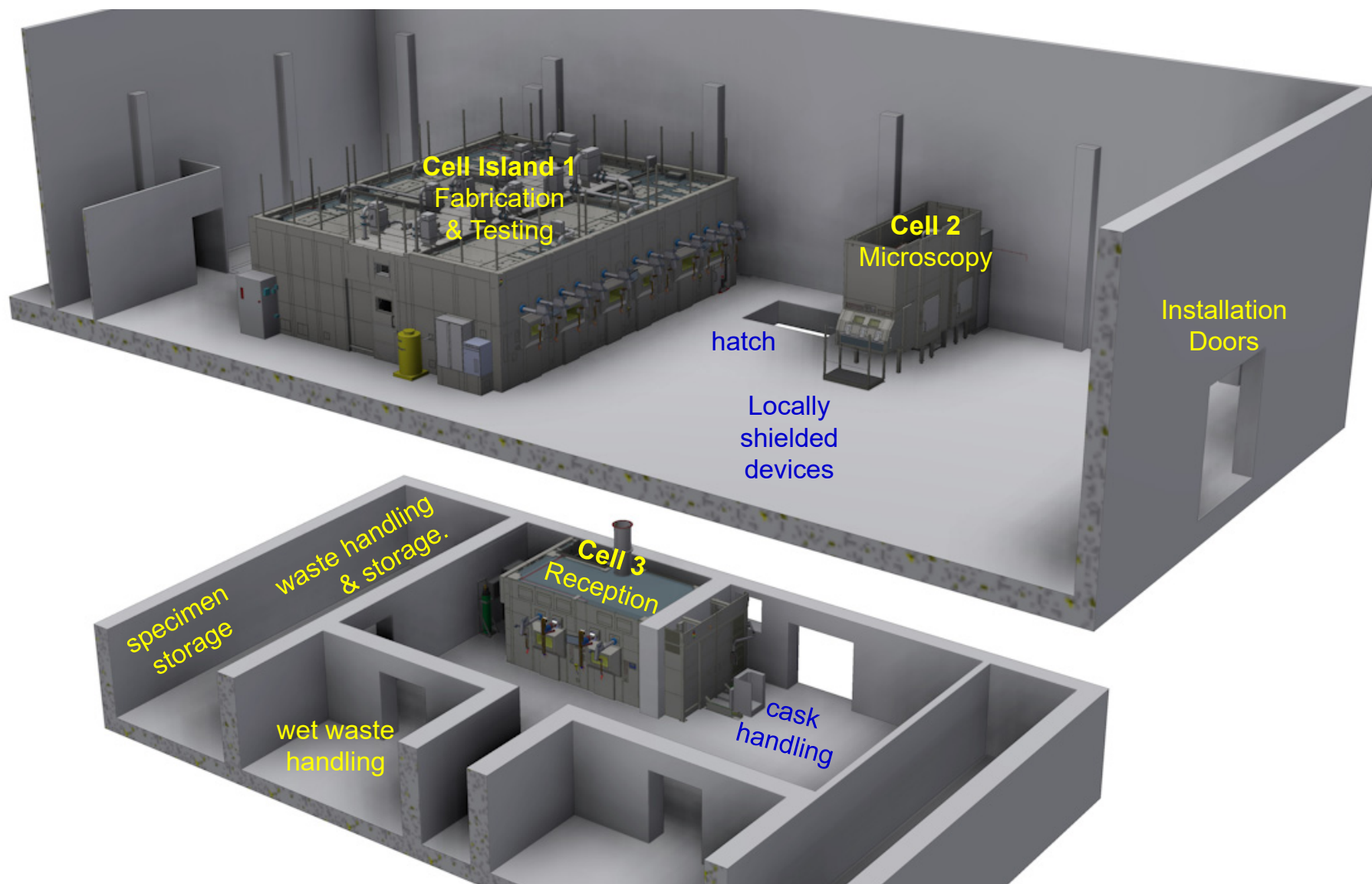


- 2,360 m² laboratory wing includes a basement level and two floors of laboratory space.
- Basement is primarily intended for storage and handling of radioactive materials and waste.
- Laboratory space is arranged around the main high-bay, which houses the hot-cells proper, and includes:
 - mechanical and microstructural characterisation of materials
 - radiochemistry
 - HR-ICP-MS
 - iodine filter testing
 - nuclear waste
 - dosimetry
 - failure analysis



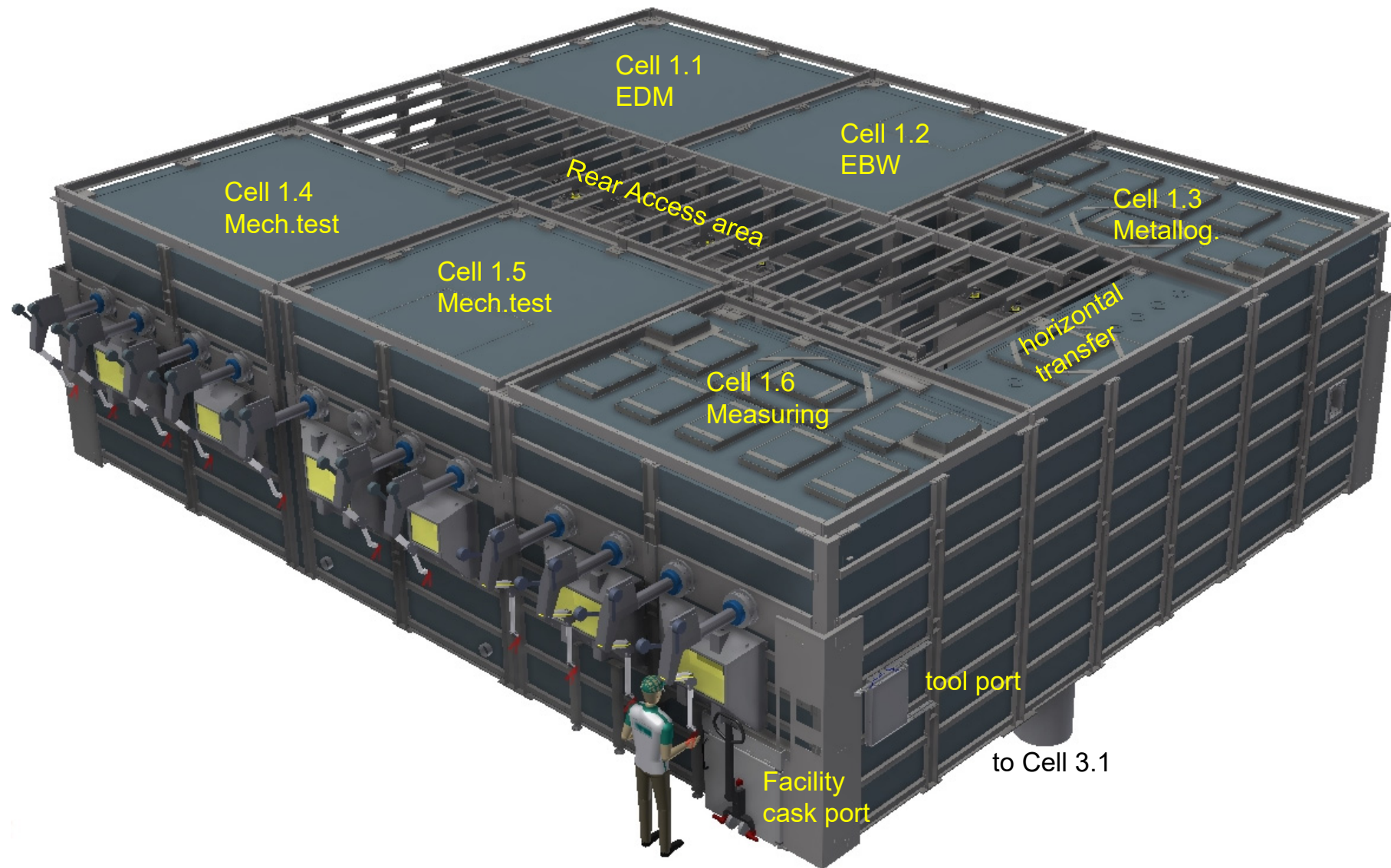
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Radiological laboratory hot cell area



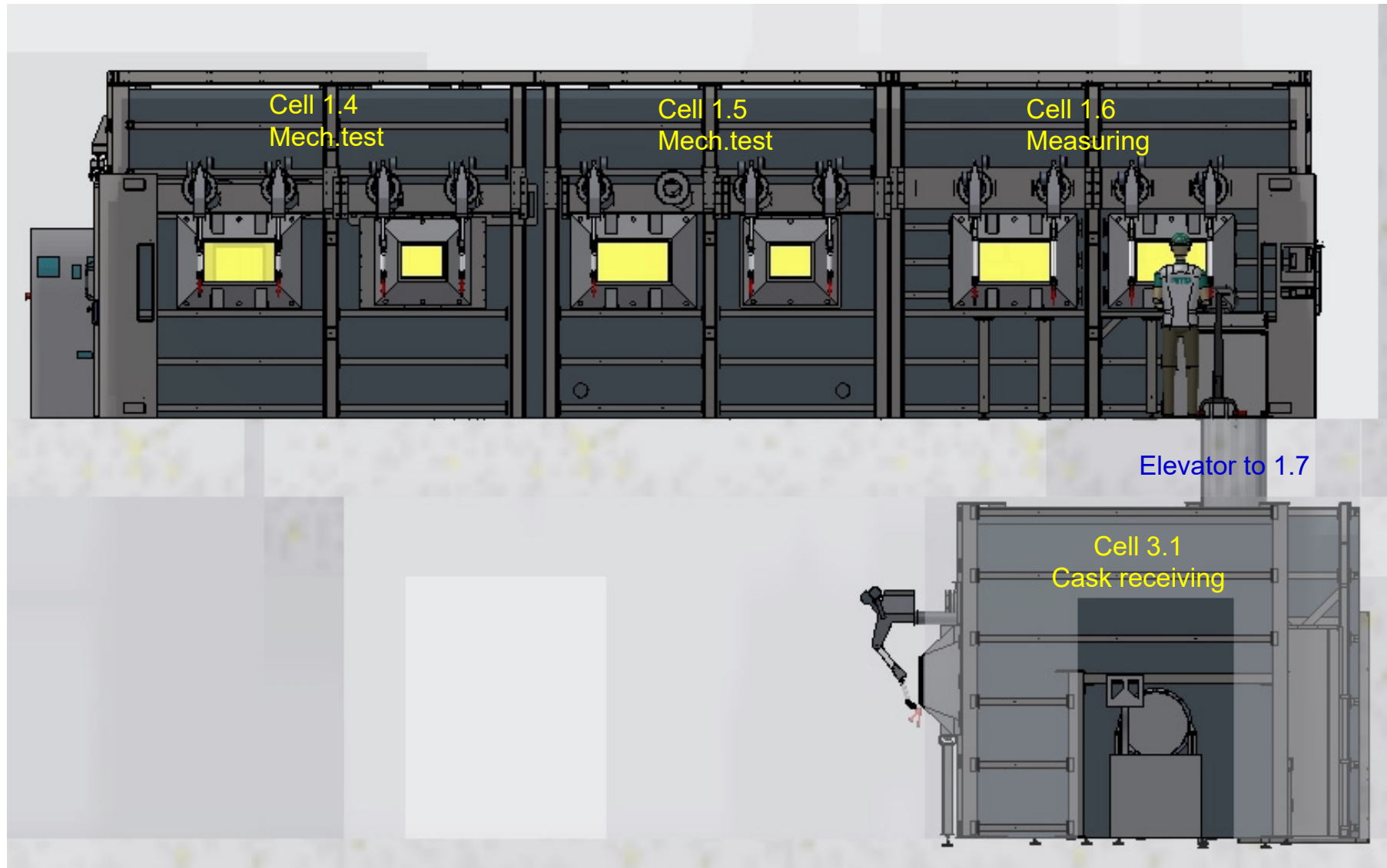
Hot Cell Design & Fabrication

Isotope Technologies Dresden GmbH



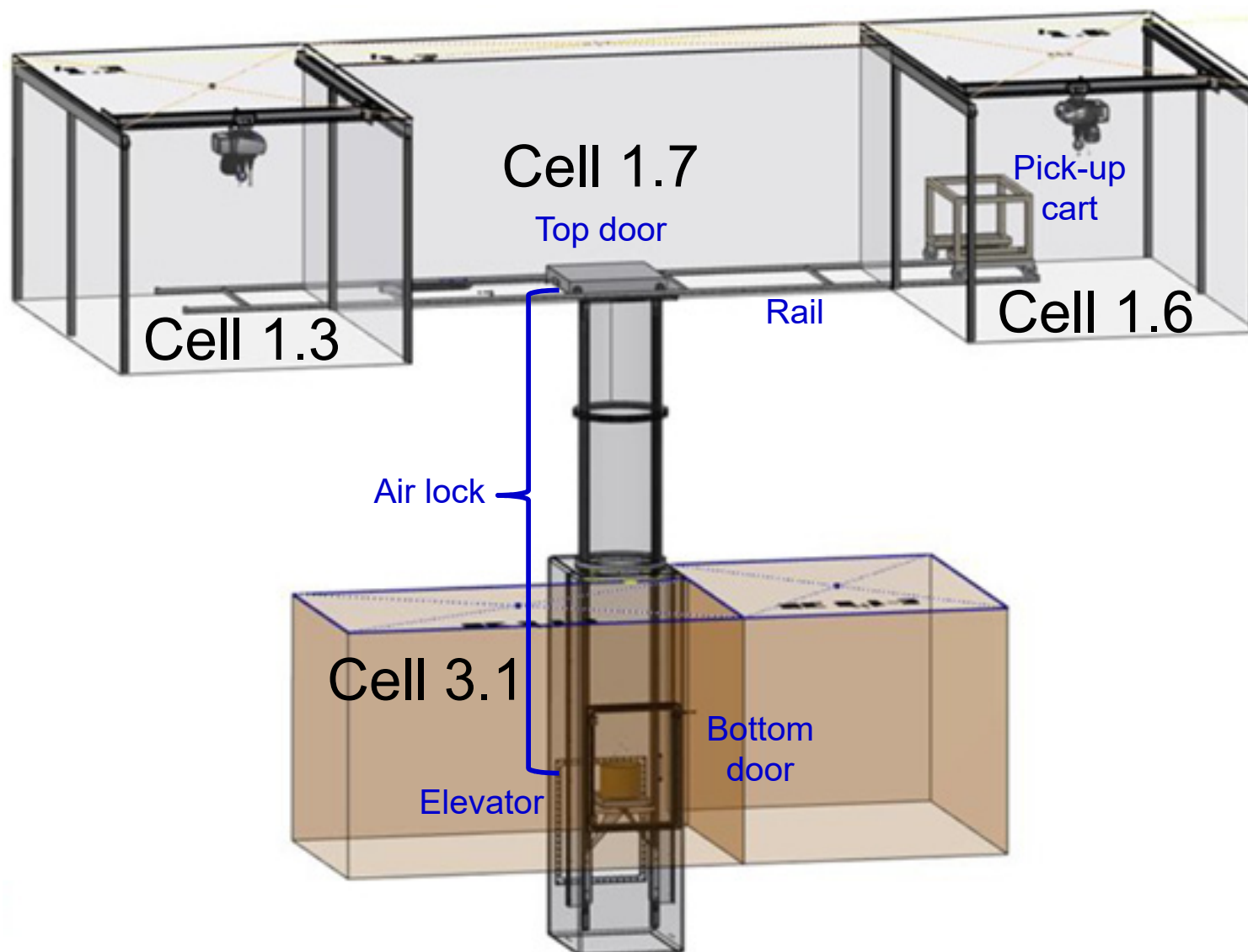
Hot Cell Design & Fabrication

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Hot Cell Design & Fabrication

Custom ITD design for shielded transport system



Hot Cell Design & Fabrication



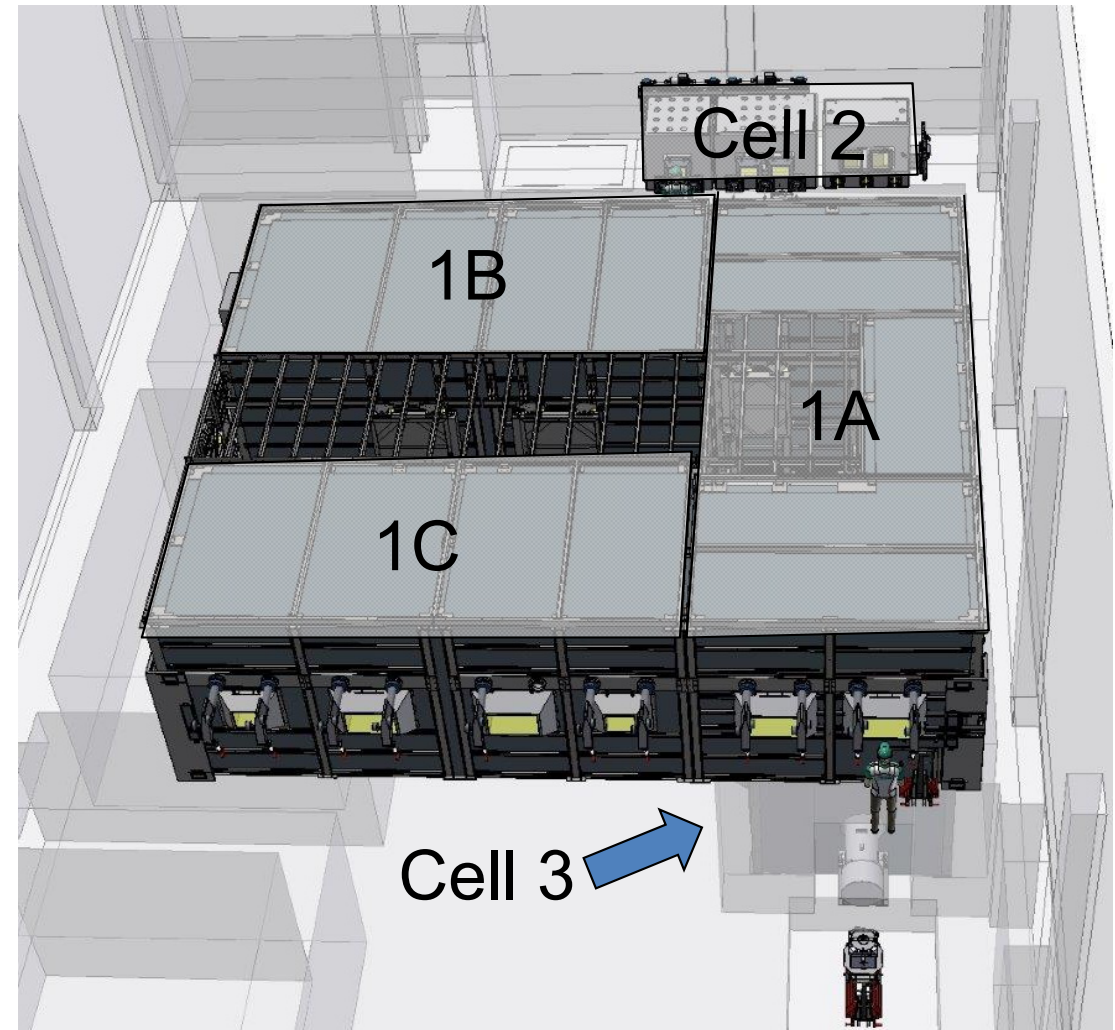
Modular fabrication at ITD's factory and then on-site installation

Fabrication and subsequent installation was done as a series of modules.

Conveyor system required installation of 1A with 3.

That was followed by 1B and 1C

Cell 2 is on its own, so it was fabricated last.



Hot Cell Design & Fabrication



Three main constituents: frames, containments and shielding

- Welded stainless steel containments of stainless steel must operate at 200 Pa under-pressure.
- Gamma shielding is realized in a conventional fashion, by lead chevron blocks and leaded glass windows.
- Structure is by welded and bolted steel frames and beams.

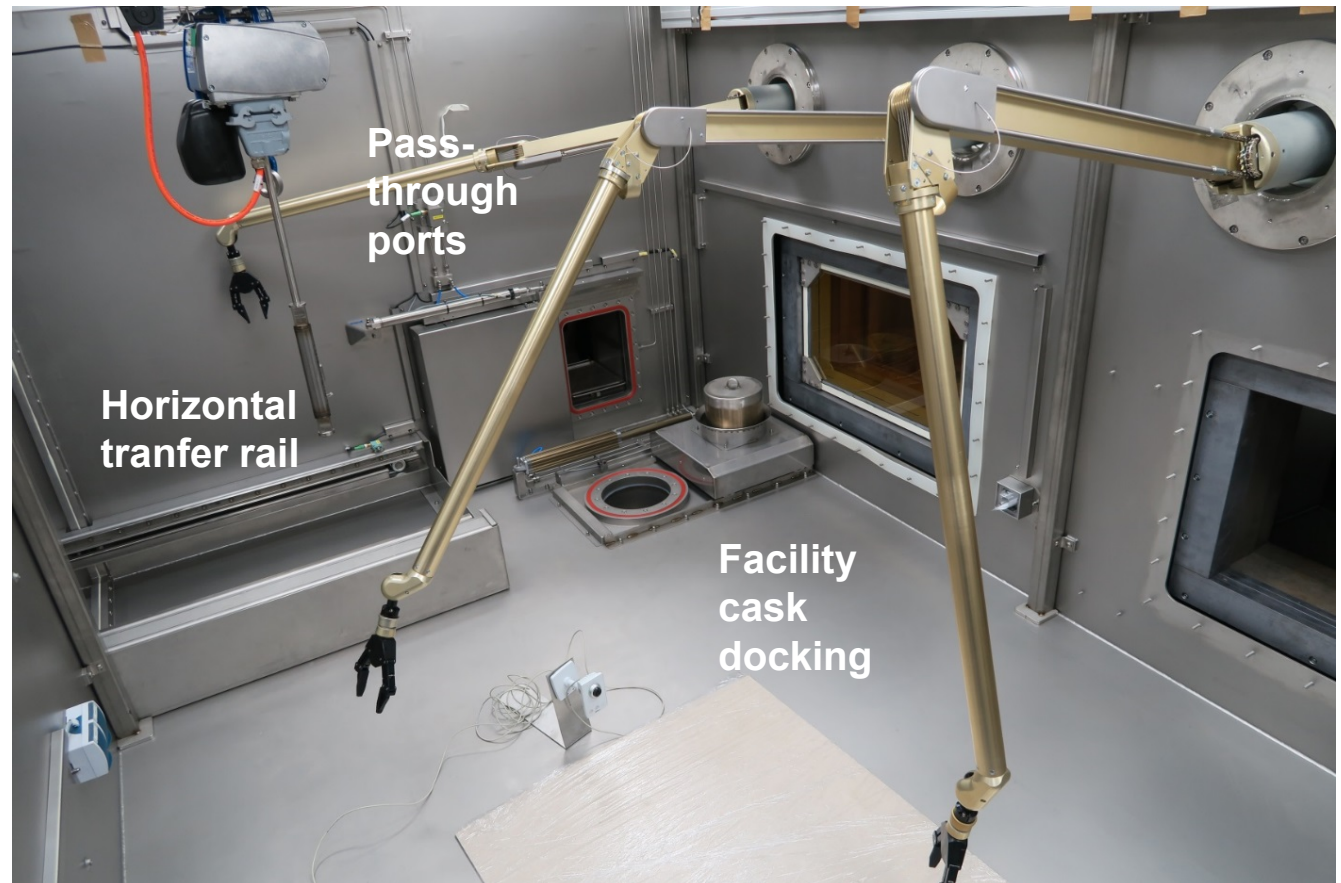


Hot Cell Design & Fabrication



Factory Acceptance Testing carried out at ITD's Rossendorf factory

- All frames and containments were prepared for FATs at ITD, equipped with doors, cranes, pneumatics, electrical, etc.
- Most manipulators, windows, lead were sent straight to VTT.



Fabrication and On-Site Installation



First materials November 2016; Installation began in January 2017

- 28 trucks of components sent from ITD's Rossendorf factory.
- 23 trucks with lead bricks came from Helsinki harbour.
- Transport doors at one end of high bay were primary access.



Fabrication and On-Site Installation



Module 1A: Cells 1.3 and 1.6 for table-top devices, 1.7 conveyor

Lead shielding and windows were installed on-site as the cells were built up; front face 20 cm, rear and between cells 15 cm.



Fabrication and On-Site Installation



Module 1A: Cells 1.3 and 1.6 for table-top devices, 1.7 conveyor

- Final finished appearance takes shape with painted frames and covers, windows and control panels installed.
- With on-site installation, full function of conveyor was proven.



Fabrication and On-Site Installation



Cell 3 in basement, for reception of material transports

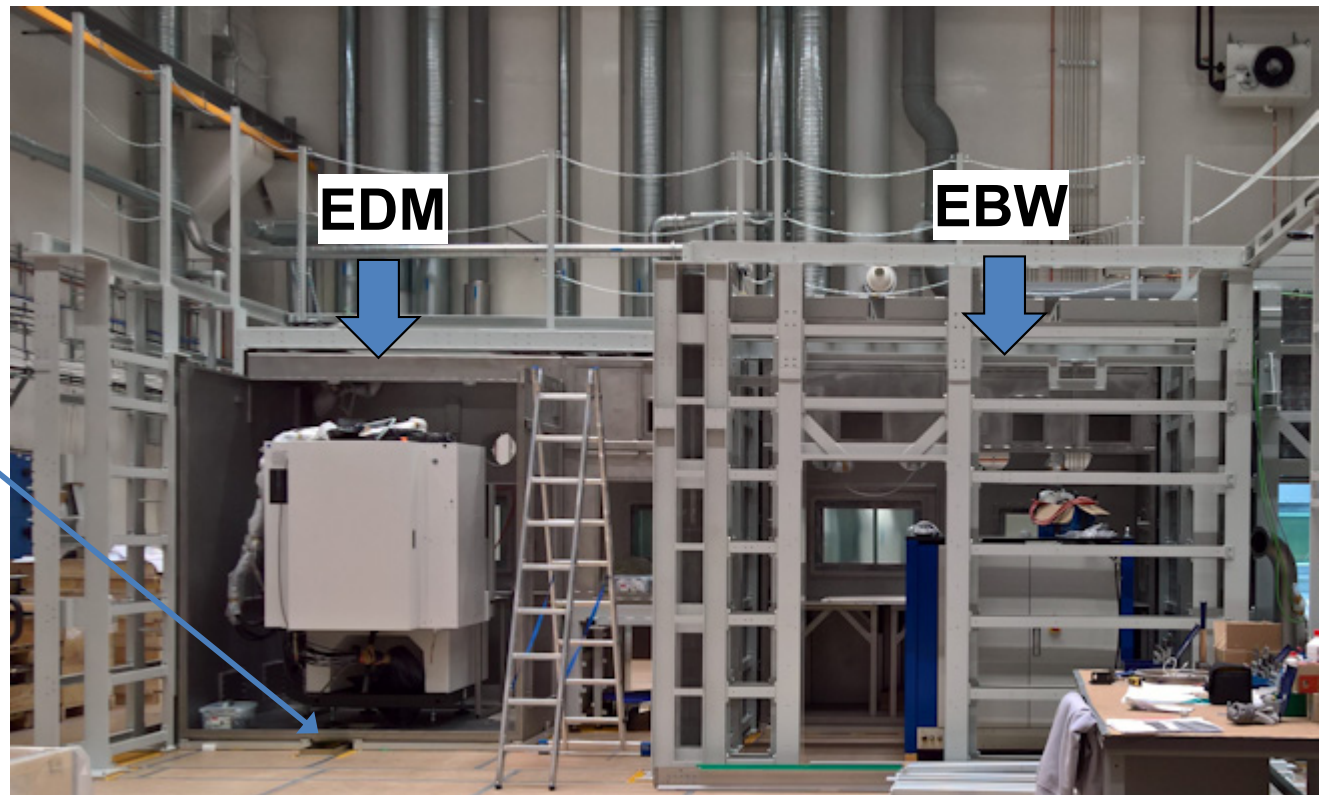
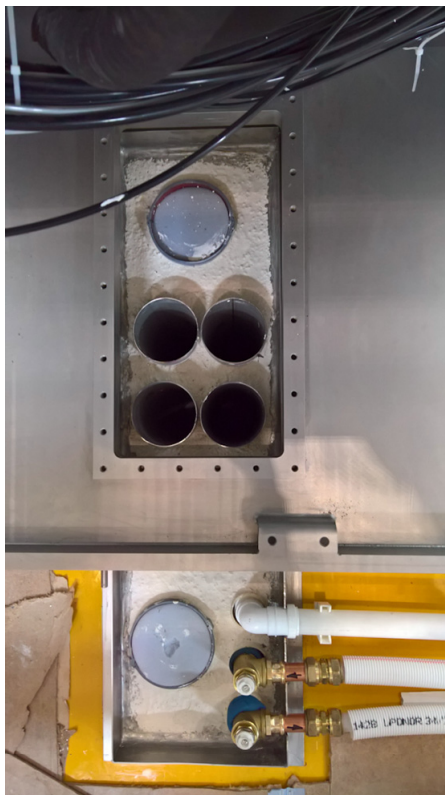
- Material transport cell features docking of large casks in either horizontal or vertical orientations, with special lift.
- With 25 cm of lead shielding at front wall, installation of corresponding windows was challenging with the low ceiling!



Fabrication and On-Site Installation

Module 1B, Cells 1.1 & 1.2 with large VTT equipment

- CNC electric discharge machining is used to cut hot material.
 - It has a particle separation circuit in the basement room.
- Electron beam welding is used to reconstitute hot specimens.
 - As a significant heat source, it has a water cooling circuit.
- Both devices are industrial-grade and were already at VTT.



Fabrication and On-Site Installation



Module 1C, Cells 1.4 & 1.5 with mechanical testing equipment

- ITD integrated a semi-automatic Zwick HIT50 impact testing device and Zwick Z250SW tensile testing device into Cell 1.4.
- These were installed first for the FAT, then again on-site.
- An existing MTS hydraulic tensile tester was installed in 1.5



Fabrication and On-Site Installation

Cell 2 for microscopy activities

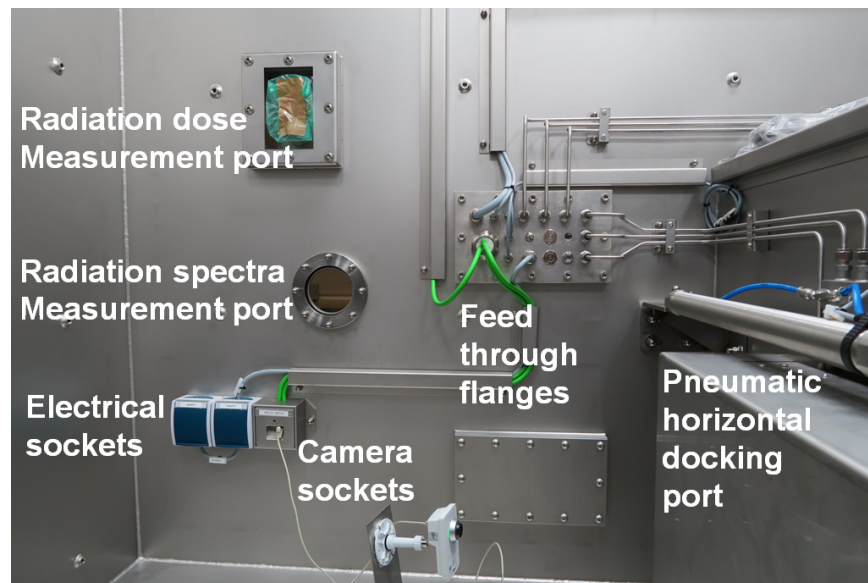
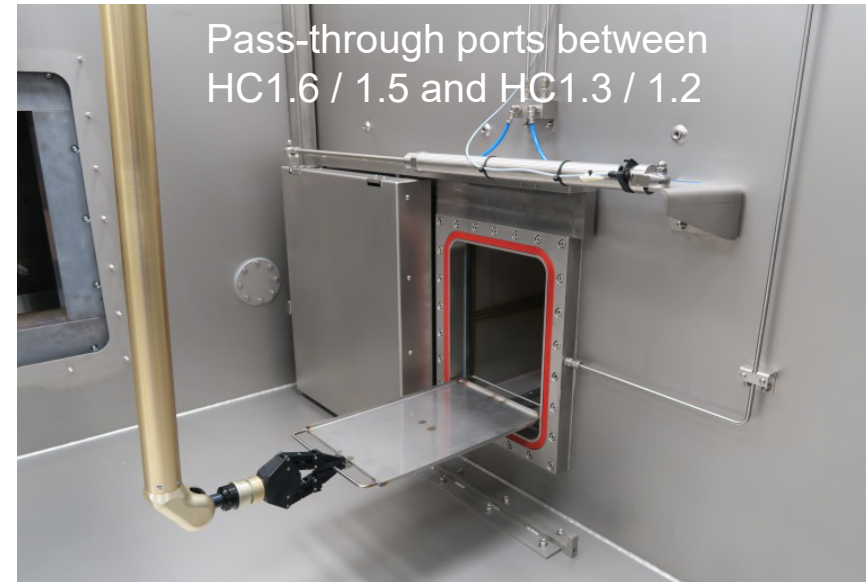
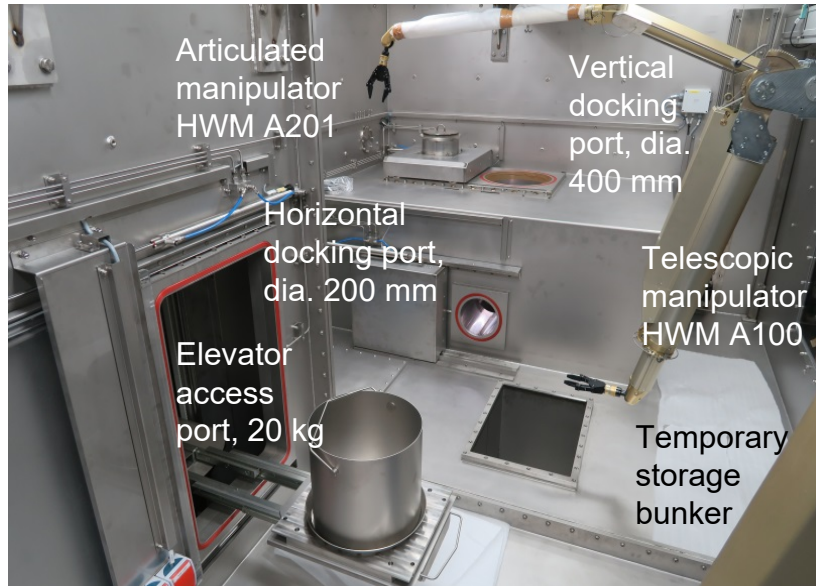


- Cell 2.1 for a light-optical metallography microscope.
 - Cell 2.2 for preparing excisions and cross-sections for SEM and TEM specimens.
- Cell 2.3 is a lightly shielded glovebox.



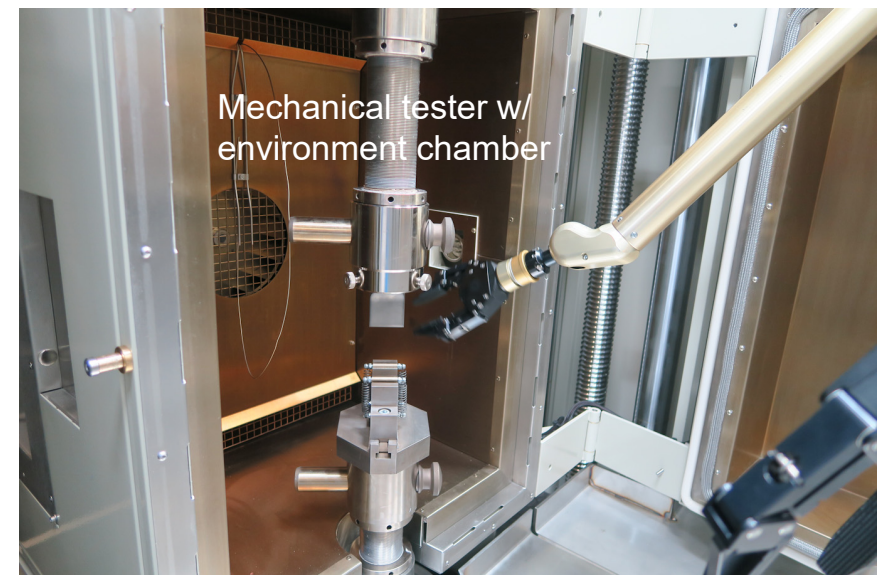
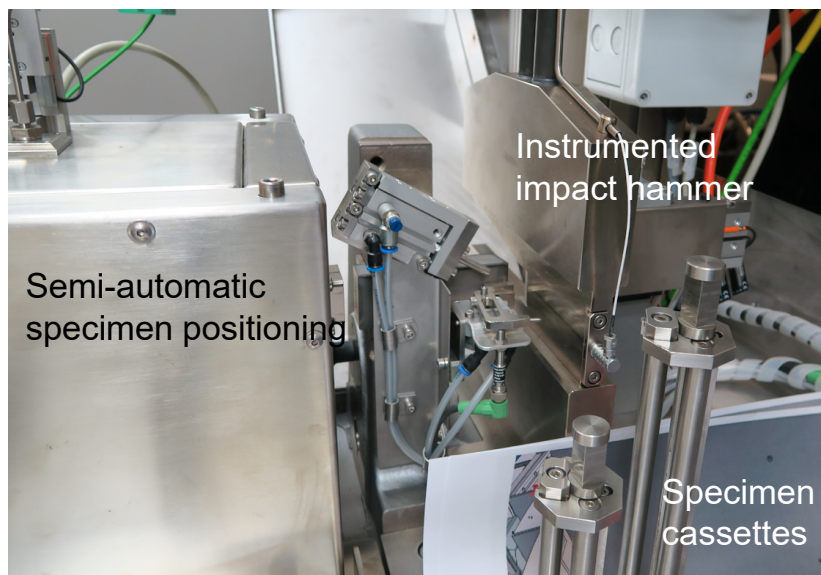
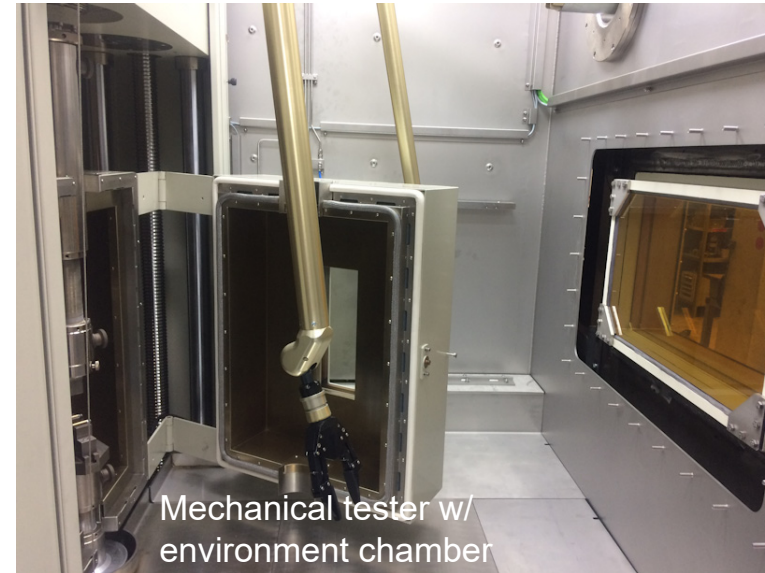
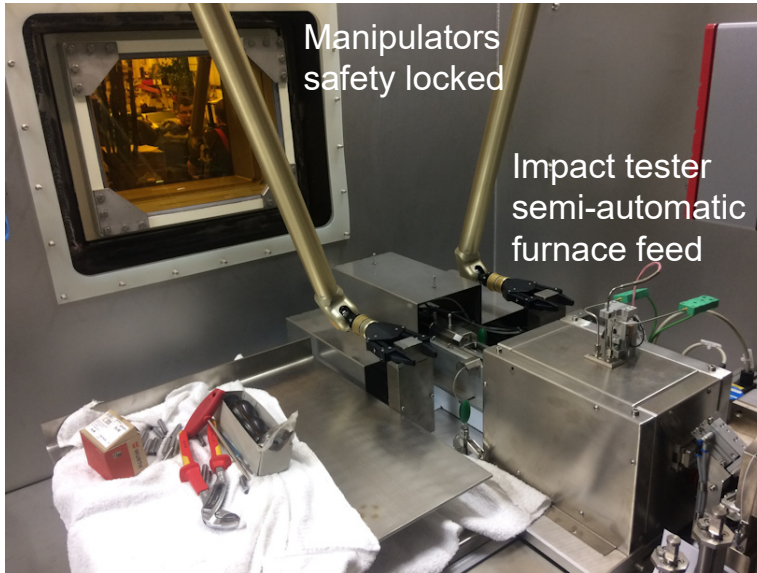
Fabrication and On-Site Installation

In-cell features of the installed hot cells



Fabrication and On-Site Installation

In-cell features of the Zwick mechanical test devices



Summary



Summary



- Hot cells designed by Isotope Technologies Dresden GmbH for VTT in 2015 were manufactured during 2016, and now successfully installed in VTT's new Centre for Nuclear Safety radiological research and testing facility.
- The new hot cells are aimed at the mechanical testing and microstructural characterization of beta- and gamma-emitting materials of nuclear power plants.
- Several unique features were incorporated into the hot cells per VTT's needs:
 - Accommodation of several large pieces of equipment that were already existing at VTT
 - A special shielded, enclosed conveyor for transporting test specimens between the main cell lines
 - A special transport cask docking system to accommodate transport casks of different sizes and orientations
 - Integration of key mechanical testing equipment to accelerate VTT's readiness.
- The final installed result is of high quality, and can be expected to serve VTT's needs for many decades to come.

VTT wishes to acknowledge the important support of the Finnish Nuclear Waste Management Fund, VYR for making the infrastructure renewal financially possible.



TECHNOLOGY FOR BUSINESS

