

Size Reduction Equipment in the ESS Active Cells Facility

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The European Spallation Source (ESS) is a multi-disciplinary research facility located in Lund, Sweden. Currently under construction, this facility will become the world's most powerful neutron source.

Because of the vast amounts of high-energy neutrons produced, many of the components within the ESS Target Station will become highly radioactive. These components weigh up to 14.5 tonnes, and are 6m in length, removing the possibility of placing them straight into a storage facility. A novel approach to remote size reduction and handling operations is needed to safely cut up, package, and store these activated components, maintaining maximum operation time of the ESS facility.

The ESS Active Cells Facility (ACF) is a windowless hot cell facility designed to reduce the size of the irradiated material produced by ESS, so it can be transported from the facility and stored. As part of the UK's in-kind contribution to the project, RACE have been contracted to deliver the ACF to the ESS project in collaboration with industry.

Size Reduction Equipment Selection

ESS and UKAEA followed a systems engineering approach to define requirements for the facility, including a full list of components to be disposed of; radiation dose rates from these components; defined waste container sizes; and activity and mass limits within the containers. Sub-systems were derived to fulfil these requirements; such as Size Reduction, Handling, Confinement and Shielding, Control, Power and Signalling, and more.

Within the Size Reduction work package, a cutting plan was developed to define component cut locations. One of the driving requirements was to minimise the production of contaminated dust and swarf, so the number of cuts required was minimised. The cutting plan was developed using the following methodology:

- A. Identify all the components that will meet the shielded container limits with no size reduction.
- B. Those that will not fit within a shielded container, specify cut locations so that they would.
- C. Group cuts into similar cut types.
- D. Iterate between b & c to reduce the number of cut types required.

This process refined the Size Reduction equipment into five categories; shaft cutting, precision cutting, pipe cutting, lip-weld cutting and bolt removal. With the locations of the cuts defined, packing allocations were presented, and surface dose rates were calculated. This ensured that all components fit within the shielded containers and did not exceed the mass and surface dose limits.

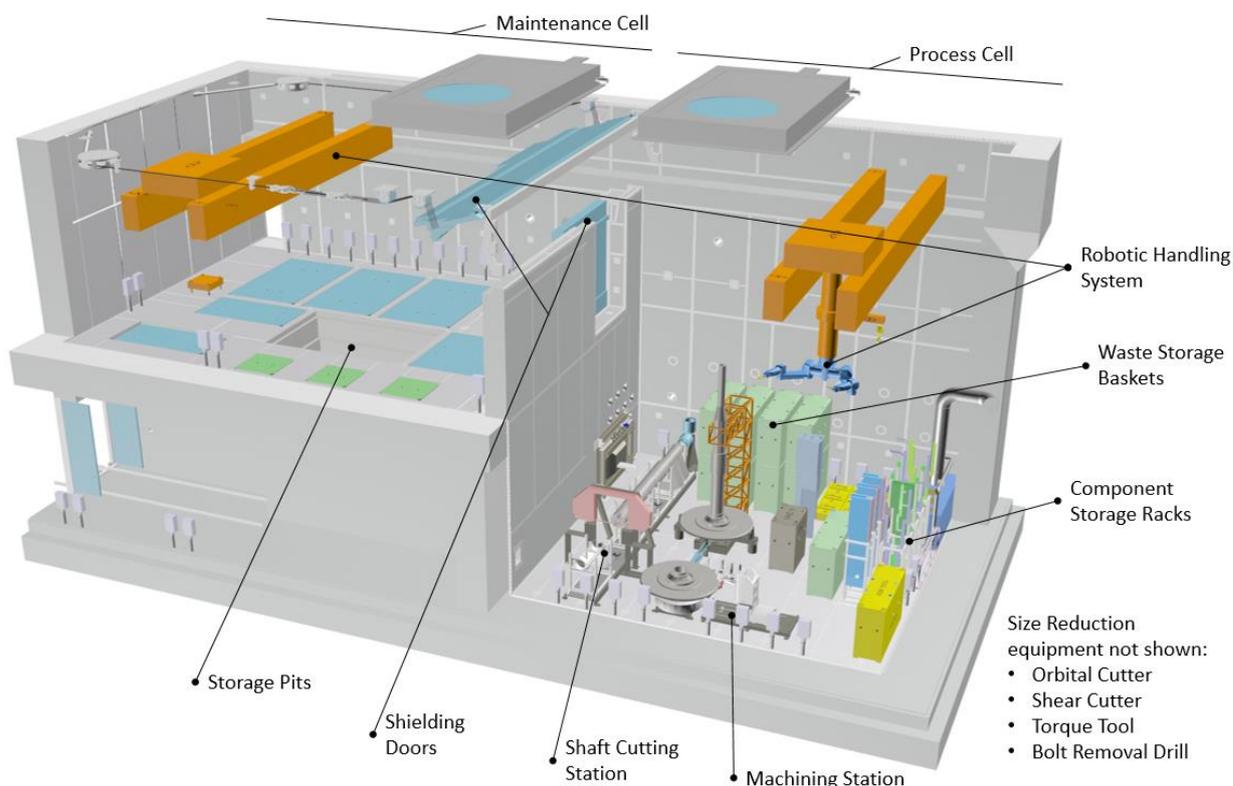


Figure P3: Cross-section of the ESS Active Cells Facility

Size Reduction Equipment Verification

UKAEA identified potential technologies for each of the cut types and concepts were selected on a set of criteria including contamination control, remote maintainability, swarf production and more. Concept studies were carried out on the selected technologies to gain confidence that the system requirements could be met, and cutting trials were performed on representative cut samples to address three main concerns: 1. dry-cutting, as fluid coolants are prohibited in the cell, 2. the most challenging cuts were possible with available technology, 3. dust levels produced were not excessive. Other physical trials were also performed, such as the testing of a remote bandsaw blade changing rig. These were successfully completed for the major Size Reduction equipment categories, shaft cutting and precision cutting, providing high confidence in the candidate concepts.

The equipment will now be developed, manufactured, installed and verified in collaboration with industry.

Size Reduction Equipment Summary

Large activated components within the ESS facility shall be produced on a regular basis, needing size reduction and safe storage. The ESS Active Cells Facility shall be the hot cell facility to remotely handle, size reduce, package, and store these components.

The size reduction cutting equipment can be grouped into five categories: shaft cutting, precision cutting, pipe cutting, lip-weld cutting and bolt removal.

The two major categories being the shaft and precision cutting stations were validated through physical cutting trials and theoretical analysis to provide confidence in the system design.

UKAEA are seeking industrial collaborators to deliver the systems to ESS.