A Novel Concept for the ESS Target Station Hot Cells

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www.europeanspallationsource.se
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Target Monolith Components

Vertical Cut View

- Safety valve
- Target drive housing
- Target monitoring plug
- Shutter
- Neutron beam extraction
- Target wheel
- Proton beam window
- Proton beam instrumentation plug
- Moderator and reflector plug
- Neutron beam window
Target Monolith Components Cont.

Moderator & Reflector Plug
Weight: 25 tons
Materials: Be, Al, SS
Dim: Ø 1,5 m x 2,8 m

Proton Beam Window

Target Wheel
Weight: 14,4 tons
Materials: W, SS
Dim: Ø 2,5 m x 5,3 m

Proton Beam Window
Weight: 200 kg
Materials: Al, SS
Dim: 0,4 m x 0,4 m
In-house Radioactive Materials Logistics

Component introduced in cask for removal from its operating position

Cask transported in the high bay

Component introduced in the hot cells for further processing
The Active Cells Layout

- **Process cell** – Introduction of radiated components from the high bay, processing of components and preparation for interim storage and shipment as well as refurbishment in specific cases.
- **Maintenance cell** – Maintenance of equipment and logistical hub for transfer inside the active cells.
- **Storage pits** – Intermediate storage of vessels awaiting off-site shipment.
- **Technical galleries** – Contains the remote handling interfaces for active cell operations, component storage, PIE activities, human logistics around the cells and air locks for entrance into the maintenance cells.
- **Transfer area** – For off-site shipment of casks, control and decontamination of shipment cask surfaces.

Size:
- Height 15 m
- Length 30 m
- Width 12 m
The Active Cells Main Functions

The top level functions that has to be fulfilled by the active cells are; to fulfill safety criteria and to manage waste from the target station. By applying these functions on the active cells systems, the two main functions could be described as:

• The self-preservation of the active cells as an operational facility, basically making sure that the hot cell barrier function is operational, maintainable and repairable.

• Ability to treat, process and/or refurbish the radioactive components originating from the spallation source and prepare the components either for reuse or to fit into the logistics of the offsite shipment.
The Novel Concept

• The baseline is based on traditional design

BUT

• ESS is a green field facility
• We still have time to explore concepts
• The facility should be operational for 45 years and we are obliged to find viable solutions for future operations
Purpose of the Novel Concept

WHAT?

- Decrease operational costs
- Increase efficiency
- Improve safety
- Simplify maintenance
- Increase modularity/redundancy
- Improve ergonomics for the operators

WHY and HOW?

- The ESS active cells should be operational for +45 years, thus it should be built for the future
- The ESS active cells are not a classical hot cell facility
- The classical hot cell work station set up could/should be challenged
- ESS is a green field facility and has no heritage from prior hot cell operations
- ALARA, best available technic (BAT) and the HMI should be drivers for the design
Backbone of the Novel Concept

• The principles are based upon decoupling of the physical interface (HMI) between the operator and the operation.

• As a result, the design of the hot cell systems as well as the mode of operation can be changed.
  – Workstations with joysticks in front of a video feed
  – Ergonomics for personnel improved significantly
  – Operator fatigue reduced
Backbone of the Novel Concept cont.

Traditional mechanical setup

Proposed motorised setup

Optimization of MSM layout

Taking into account the moved HMI:

- Optimisation of working area
- Optimisation of working direction

Master slaves: Out from wall working direction

Power manipulator: Towards wall working direction
Optimization of MSM Layout Cont.

Possibility to optimise manipulator working volume since there are many possible locations to put them.

Wall penetrations could be adopted to where it is useful instead of at convenient operator height.

Manipulator working volumes

Workstation

Plugged penetrations for future use
Wall Crossings

- Equal size fits all
- Distributed crossings to fulfil any task provides a lot of flexibility
Visualization

• Through wall camera plugs
• No need for shielded glass windows
• Synthetic viewing including camera/CAD/heat signal etc. overlays
• Light requirements significantly reduced

Needed?

Street LED light?
Operation

- Synthetic viewing
- Haptic controls
- Force feedback
- Virtual mock-up possibilities

http://www.heemskerk-innovative.nl/
In the Future

http://www.instantreality.org/exhibition/
Summary / Conclusions

• With the implementation of the described concept the potential benefits are:
  – Increased efficiency
  – Simplified maintenance
  – Increased modularity/redundancy
  – Improved ergonomics for personnel
  – Increased availability
  – Built in mock-up possibilities

• The systems shall be built to be capable of incorporating upgrades to meet the technologies of tomorrow