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Novel Hotcells to support nuclear R&D

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UK Nuclear Industry Experience

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- Progressive fragmentation of the industry over the last 30 years
  - Boundaries to information sharing (commercial/Government owned)
  - Loss of experience
  - Loss of continuity in strategic decision making
  - Loss of oversight regarding facility usage

- Formation of Nuclear Decommissioning Authority(NDA)in 2005 – to increase focus on decommissioning activities

UK Recent Experience

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- Need for energy security and diversity drives re-evaluation of UK nuclear position

- New build now emerging (plus growth of interest in Gen IV and fusion) which requires appropriate facility infrastructure

- Competing demands - ongoing support to operating reactors/processing of legacy wastes/new build

- Controlling mind remains largely Nuclear Decommissioning Authority

- National Nuclear Laboratory formed and operates UK Hotcells
  - Windscale Laboratory – Hotcells operational
  - Central Laboratory – Hotcells require commissioning

Hotcell Demand

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- National project demand for Hotcells often identified in isolation, and generally assumes no capacity constraints

- No overall view on balance between demand and capacity

- Recent review for UK Nuclear Decommissioning Authority (NDA) regarding Central Laboratory Hotcells has enabled the overall Hotcell situation to be evaluated

- Capacity rather than capability has emerged as a key issue

Hotcell Demand

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- Majority of the existing Hotcell capacity (Windscale Laboratory) already fully committed for foreseeable future (2025)

- Opening Central Laboratory Hotcells would ease the situation

- Commissioning of Central Laboratory Hotcells recommended by recent House of Lords review

- NNL propose to fund the commissioning of Central Laboratory Hotcells

Hotcell Demand

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- Allows NNL and the wider industry, plus academia, to use the most suitable facility for each piece of work – simplistically
  - Windscale Laboratory for large scale processing
  - Central Laboratory Hotcells for more sensitive studies

Windscale Laboratory - Shielded Cells

- 60 heavily shielded work stations over 13 hotcells (typically 11 x 2.5 x 4m internally)

- Flexible cask handling arrangements – vertical and horizontal loaded

Generic R&D Capability – Windscale Laboratory

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- Built in the 1960's for the inspection of uranium metal (Magnox) fuel

- The Windscale Laboratory has been developed and modified over the decades to provide capability for water reactor and gas reactor fuel and to handle decommissioning wastes across the Sellafield site

- Refurbishment programme now underway to assure plant availability to 2035 – but availability and output must be also maintained

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NNL Central Laboratory

General Description

Central Laboratory

- £250m investment in new facilities for nuclear R&D
- Low active and inactive laboratories
- Uranium-active rig hall
- Plutonium active laboratories
- Highly Active alpha/beta/gamma cells
- Supporting infrastructure to meet the requirements of 300 technologists

Central Laboratory

- Non-active laboratories – featuring a mixture of fume cupboard, bench and floor space modules
- Active laboratories –(low - medium active R&D studies)
- Alpha radiation laboratories - glovebox modules designed to support research into, and handling of, Pu, and the manufacture of MOX or novels fuels

Overarching Capability - Laboratories

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Central Laboratory – Rig Hall

Capable of accommodating large process and experimental rigs

Includes a high tower, reagent storage area, workshops and a series of rig bays

Central Laboratory– Hot Cells

- These comprise a number of high integrity shielded alpha sealed containment boxes
- High quality operating environment capable of supporting sensitive analysis
  - solution-based radiochemical analysis
  - analytical studies on plant materials and components/systems

Design Principles of Hotcells

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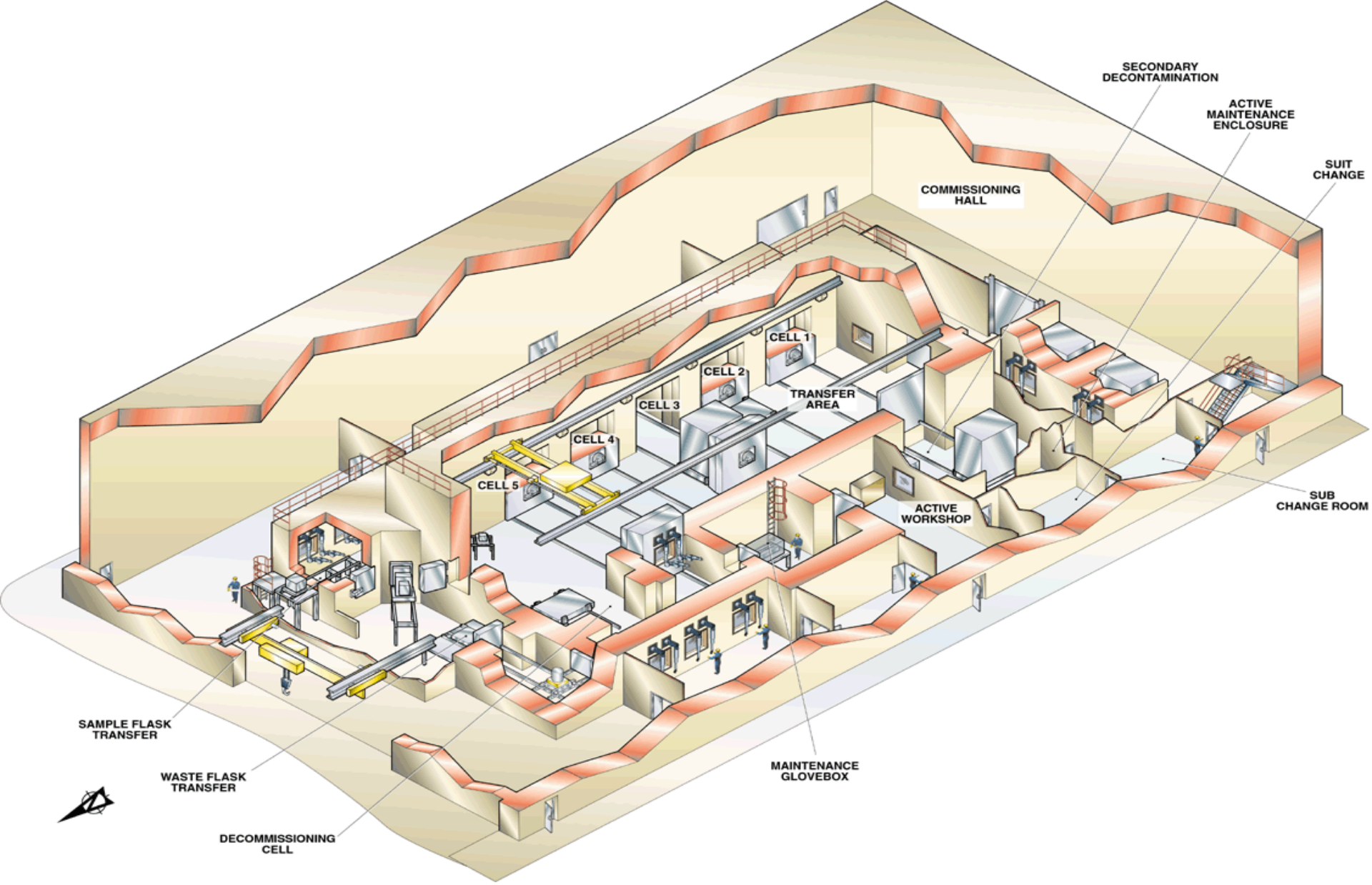
- The purpose of the HA cells is to provide:
  - a high integrity, contained and shielded environment in which experiments may be conducted on alpha, and highly active beta /gamma materials
- Operating conditions are achieved by using mobile stainless steel containment boxes into which experiments may be assembled and inactively commissioned prior to moving into biologically shielded concrete cells where the active materials/components are introduced


SECONDARY DECONTAMINATION
ACTIVE MAINTENANCE ENCLOSURE
SUIT CHANGE
COMMISSIONING HALL
CELL 1
CELL 2
CELL 3
CELL 4
CELL 5
TRANSFER AREA
ACTIVE WORKSHOP
SUB CHANGE ROOM
SAMPLE FLASK TRANSFER
WASTE FLASK TRANSFER
DECOMMISSIONING CELL
MAINTENANCE GLOVEBOX

High Integrity Removable Containment

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Alpha Sealed Containment Box

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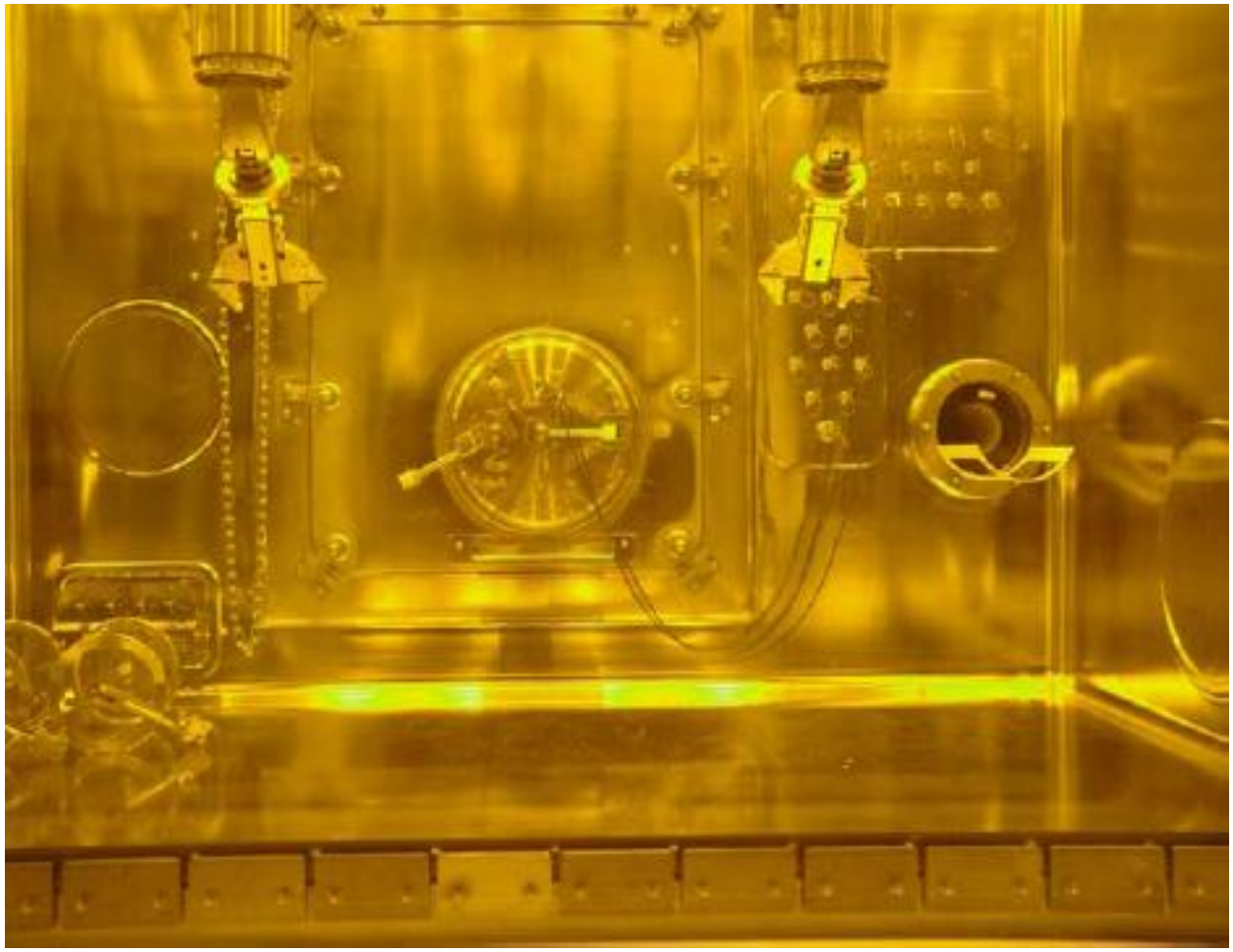

Alpha Sealed Containment Box

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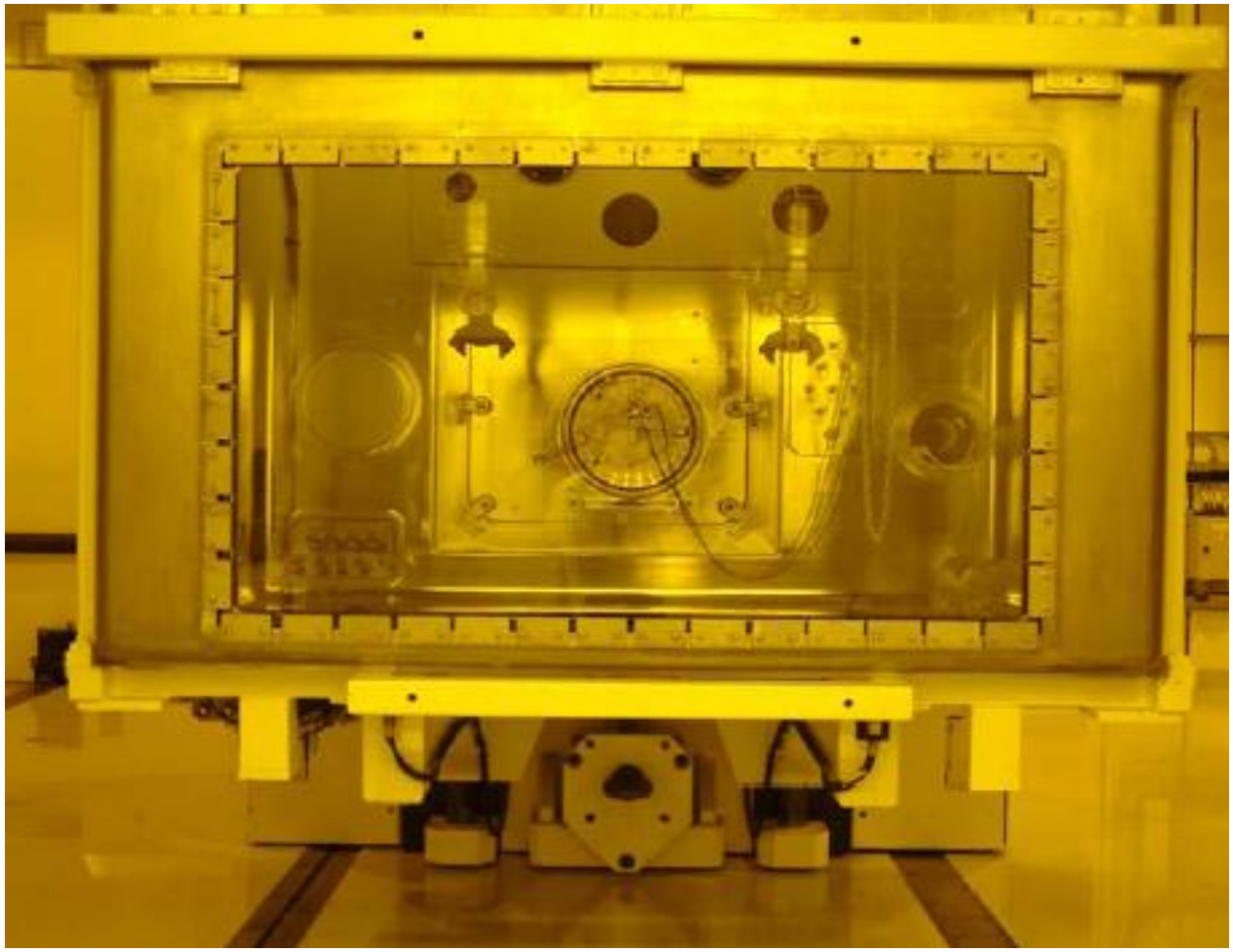

Rear Shield Doors

Operating Work Face

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Decontamination and Re-Use

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- On completion of the experiments, an internally contaminated containment box can be transferred to the Decommissioning Cell to facilitate its decontamination to 'hands on' radiation levels
- Additional decontamination operations will then be carried out on 'hot spots' after transfer of the containment box to the Secondary Decontamination area
- The whole decontamination operation will result in radiation/contamination levels being reduced to levels which allow transfer of the containment box back to the Commissioning Area

Resultant R&D Capability

- The Central Laboratory provides an R&D complex capable of supporting the full range of nuclear fuel cycle operations

  These include:

  - Radiochemical assay and materials characterisation
  - Flowsheet development
  - Studies to support oxide and metal fuel reprocessing
  - Studies to support waste vitrification
  - Mixed oxide and novel fuel production capability
  - Post Irradiation Examination capability
  - Studies to support intermediate level waste treatment and storage
  - Investigation into methods of decontamination and decommissioning

World Leading Facility

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Ability to Support UK Nuclear Industry

Global Clean-Up Skills

Provision of Advanced Fuels

Support to Existing and Advanced Reprocessing Technology