Windscale Laboratory Hotcell

The challenges of maintaining operations during a major refurbishment

Des Wright
NNL locations

The main ‘hot cell’ centre in the UK is located at Windscale ➔
Overview of Windscale Laboratory

• Originally constructed in 1960’s for Post Irradiation Evaluation (PIE) of uranium metal (Magnox) fuel and adapted for AGR fuel as the civil UK fleet developed

• Extended to provide capability for all other reactor fuel types, including PWR & BWR

• Continually upgraded and modernised

• More than 50 years of continuous experience
Hot Cells

13 Large Hot Cells
- 2.5m x 4m x 11m
- 5 workstations
- Internal crane
- Services
- MSMs
North flask receipt

Transport flasks up to 60te
Overview of Windscale Laboratory

• Flexible - capable of handling a full range of nuclear fuels and irradiated materials, delivered in a wide variety of transport flasks

• Heavily shielded hot cells (60 work stations)

• Majority of work is undertaken to underpin safety cases: fuel performance & development, reactor operation & life extension, waste disposal & storage

• Why is refurbishment required?
  • Modern safety case standards
  • Obsolescence
  • Reliability
Major refurbishment

• Scope of work (50 – 60M Euro over 5 years)
  • Revised safety case
  • Facility cranes (60te, 40te, 25te)
  • Shield door interlocks and hydraulics
  • Horizontal posting ports
  • Ventilation
  • Electrical services
  • Seismic strengthening

• Major cell refurbishments:
  • ZnBr window replacement with Lead Glass
  • In cave hoist replacement
  • Services and consoles
  • Installation of power manipulator
  • Radiometrics and instrumentation
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Delivering customer work
Challenges

• Customer work
  • Very busy PIE facility – competing priorities
  • Total shutdown for refurbishment is not an option

• Legacy waste in the facility
  • Fissile and non-fissile material from historic projects (some many decades old)

• Resources
  • Limited engineering resources to support scale of work

• Planning and delivery
Cell refurbishment - preparation

- Some cells not operational for many years
- In cell equipment unreliable
  - No crane
  - No power
  - Import / export of material
- Removal of legacy waste material was a major challenge
Cave refurbishment

- Once cell is empty and decontaminated the work can start
- Draining of ZnBr windows
- Removal of window carcasses
- Removal of old infrastructure
- New lead glass windows
- New in cave crane
- New services
- Internal refurbishment
- Installation and commissioning of PIE equipment
Decontamination and preparation

Robust radiological control
Predicted dose budget was 35.8mSv
Total dose received was 23.98mSv
Highest individual 1.63mSv

- Remote cleaning and decontamination
  - 12 weeks
  - 1st man entry
    average readings
    10µSv/min
- Hands on decontamination
  - 4 weeks
  - Dose levels achieved
    <1µSv/min
Window replacement

• First window replacements in over a decade
  • New equipment required
    • Hydraulic rams to remove ZnBr window carcass
    • Push Lead glass window into position

• Plan for the unexpected!
  • Undocumented previous work
Installation of Lead Glass Windows

• New bench design
  • Transport lead glass windows – 6te
  • Push window into position

• Use machined lead to seal and source test

• 8 windows successfully replaced in the last 2 years
• Why
  • Safety case review identified obsolescence and safety shortfalls in current system
  • Repeater panels and warning signs necessary

• Significant timescale challenges
  • Designed, installed and commissioned within 12 months

• Need to minimise disruption to ongoing operations
  • Close relationship with supplier
  • Parallel installation on plant
  • Enhanced factory testing
Key features

• Dual feed to each instrument - one break or unplanned disconnection ensures the system remains fully functional, this will also flag an alarm condition.

• Remote interface stations will work independently to record and display live RPI status and data.

• The plug / socket arrangement will ensure connection and disconnection is possible without exposing the current carrying conductors within the node junction box.

• Installation risk reduced due to expanded factory testing scope off site.
Result

- 130 instruments installed
- Brand new design
  - Improved safety features
  - Improved reliability
  - Reduced installation costs (£1M saving)
  - Reduced future maintenance costs
- New product on market (Omniflex)
  - Planned for other buildings on the Sellafield site
Challenges and Learning

• Plan with realistic timescales
  • Demonstrated performance

• Plan for the unexpected
  • Fitting new equipment to old hotcells
  • Inaccurate plant drawings
  • Installation and removal issues
  • Be prepared to innovate

• Integrated plan
  • Understand the pinch points
    • Resource, space, waste, operational restrictions
  • Clear communication of priorities

• Communication / Culture
  • Open, honest communication of progress and issues
  • One team!