Seven Storeys of Decommissioning

- The Complete Decommissioning of a Chemical Engineering Building

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Seven Storeys of Decommissioning

< Seven Years >

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Seven Storeys of Decommissioning

B351 Life Cycle: 1950 - 1997+

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Seven Storeys of Decommissioning

Building Dimensions		Building Fabric	
Height x Width x Length	27 x 50 x 115m	Asbestos Cladding	3,500m^2
Enclosed Volume & Pit Volume	44,6000m^3 & 850m^3	Amount of Concrete & Brickwork	4,000m^3 & 900m^3
Floor Area Covered by Lino	3,600m^2	Amount of Structural Steel	1,200te
Lab & Office Area	4,030m^2	Length of Ductwork	4,200m
Area of Metal Floor Plates	1,700m^2	Length of Lagged pipework	2,500m
Total Floor Area	10,351m^2	Depth of Basemat	2.1m

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Background (i)

- Design began in 1946
- New design in 1948, built 1950-1952
- Galleries + big shielded cells & large Storage Pit
- Experimental, not Pre-production (Windscale)

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Background (ii)

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Background (iii)

- The Large Cells became cannibalised for the ^{233}U Pilot Plant Six
- The Pit was used for fuel cutting, breakdown & dissolution as well as highly active effluents

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Background (iv)

- Suites of cubicles contained Homogeneous Aqueous Reactors ZETR and HAZEL
- Many experiments on:
  - fission product melting
  - uranium/thorium MOX processing

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Background (v)

- In the 1960s new work focused on vitrification, reprocessing, corrosion, separation technology and Na mass transfer
- Diversification into non-nuclear areas:
  - chemical processing
  - pharmaceuticals
  - desalination
  - heat transfer

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Decommissioning Planning

- Looked at options for retaining some parts of building
- Analysed all areas for decommissioning and waste costs
- Considered mothballing with C&M and deferred decommissioning and with prompt decommissioning
- Concluded that best option was prompt decommissioning, as funding permitted

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Reasons for Decommissioning

- A high cost building
- UKAEA split into nine businesses, six in B351
- No long term prospect of commercial sponsor(s)
- Approximately 200 RDAs to manage
- Need for co-ordination
- Site license conditions

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The Decommissioning Programme

- Building Clearance
- FINGAL
- Mk I Gel Precipitation
- SEPP & U Evaporator
- CDFR Dissolver
- Main Active Ventilation
- Building Demolition
- Waste Management

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Analytical Laboratory (i)

- Refurbished in 1957
- Chemical & radioactive hazards
- Dedicated ventilation
- Legacy contamination
- Asbestos in roof spaces & voids
- Unsafe hidden wiring

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Analytical Laboratory - Work Phases

Work Phases	Carried out by
1st clearance & radiological surveys	Occupants, building surveyors
Service isolations	Building electricians, Site Services
Exposure of hidden hazards	Decommissioning contractor
Asbestos removal from pipe voids	Specialised contractor
Decommissioning of fume cupboards & active ventilation	Contractor from Competitive Tender
Floor & wall scabbling	Term Contractor
Cables stripped from roof voids	Building electricians
Asbestos removal from roof voids	Specialised contractor
Demolition (with main building)	Contractor from Competitive Tender

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Analytical Laboratory (ii)

- Mix of in-house & competitive tender
- Archive research
- Cautious, piecewise approach to reduce risks
- Ductwork wrapped for local size reduction
- Segregation of wastes

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Mild Steel Loop (i)

- High temperature & pressure corrosion loop
- Test sections still had Na sections from CDFR
- Isolated, but still left connected to mains
- Multiple feeds
- Directly above Na Lab
- *Marie Celeste* effect

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Mild Steel Loop (ii)



- Disconnected & drained
- Wiring stripped out (unknown feeds found)
- High current Transformer drained of PCB
- Pipework cut out with hydraulic shears (inactive trial for FINGAL work)
- Na sections removed when accessible

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FINGAL (ii)

- FINGAL Flask, active block and γ gate removed
- Several controlled in-cell inspections + surveys
- Unproductive search of records for as-built details
- Intrusive survey from roof with cctv and telescopic β/γ probe
- Planned approach to tackle decommissioning

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FINGAL- abandoned vitrification cell (i)

- Early 1960s plant
- Used active liquors from Windscale (10^{15}Bq)
- Built into Storage Pit with shielded roof blocks
- Incidents led to cell and roof contamination
- Abandoned in mid-60s in favour of Harvest and rotary calciners

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FINGAL (iii)



- Cell contained Pb wall >2.5m high with ~800 150kg blocks
- Modular Containment built to give extra space
- Access limited to narrow corridor and 0.75m door
- Ventilation system contaminated and decrepit
- No way to deal with large quantities of LLW

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FINGAL (iv)

- Mobile Filtration Unit (4000 cfm) fitted to RDP
- HISO facility built in Pit using 50 ton crane
- Modified stacker truck and folding cranes used to aid manual handling
- Improved tooling, audio & cctv communications

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Mkl Gel Precipitation Lab (i)

- Used to prepare U/Th spheres for fuel studies
- Simple construction, could still use building ventilation system
- additional hazards of nitric acid, organic solvents and ammonia
- adjacent structures and equipment contaminated

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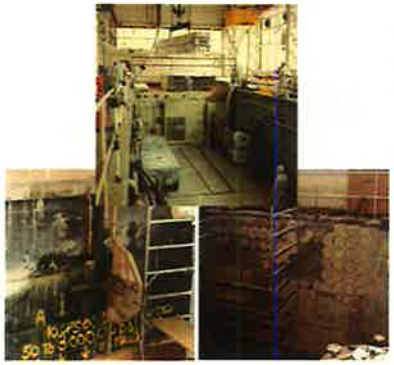
FINGAL & Pit Concrete



- Cell decontamination attempted and concrete sampled (hollow drill)
- Roof blocks removed, cored & decontaminated
- Support walls broken down and disposed of
- Wall bulk removal trials
- Remaining areas cleaned and scabbled/scarified

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Mkl Gel Precipitation Lab (ii)

- Was U storage area and High Temperature Lab
- Catch tray floor and main wall (14m x 14m) contaminated
- Temporary walls hid old contaminated items
- Remote low-loss cabled cctv used to monitor work
- Cherry-picker for survey

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SEPP & the Uranium Evaporator (i)

- Studies of U recovery during fuel reprocessing
- 80m^3 Cubicle with several 12m tall extraction columns over five floors
- Mixer Settler Cubicle
- Evaporator Plant to concentrate uranyl nitrate
- Contaminated TBP/OK

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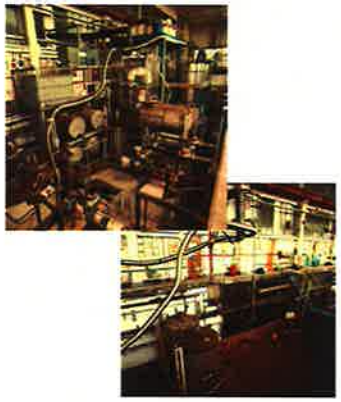
SEPP & the Uranium Evaporator (ii)



- Competitively Tendered
- RPE + safety helmets in cubicles
- Working at height
- Confined spaces
- Corrosive chemicals
- Evaporator contained & vented to building ducts

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SEPP & the Uranium Evaporator (iii)

- No easy disposal route for contaminated solvents
- Contaminated pipework packed into larger vessels and placed in HISOs
- Solvent drained to two SEPP tanks until process options determined
- Ion-exchange process developed for TBP/OK

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The CDFR Dissolver (i)

- Studies of dissolution of spent fast reactor breeder fuel in various dissolvers
- 100m^3 ventilated cubicle with off-gas treatment
- Large storage tanks for liquors (conc. HNO_3, NaOH, uranyl nitrate)
- Substantial stainless steel dissolver

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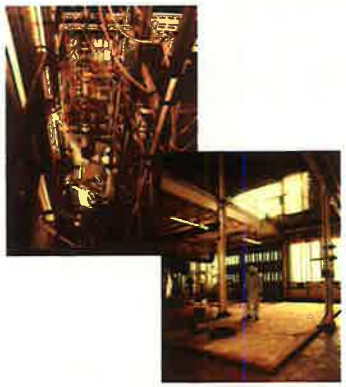
The CDFR Dissolver (ii)



- Competitively Tendered
- "POCO" completed by contractors - liquors analysed and disposed of
- Decommissioning used cubicle containment + new ventilation
- Most materials clean
- In situ plasma cutting of main dissolver

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Main Active Ventilation System (ii)

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Main Active Ventilation System (i)

- Mainly mild steel ducts (~4km and up to 3m x 3m) through building to two Plant Rooms
- Most with HEPA filters
- Competitively Tendered
- Runs tented to allow safe dismantling
- Old ducts insulated with cork and asbestos cement

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Main Active Ventilation System (iii)

- All ductwork, fans and housings size reduced in special facility in B351
- Decontamination used when beneficial
- Cold cutting techniques developed and used (band saws, nibblers, etc)
- Flat-packed waste sent to B351 HISOs for disposal

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Building Demolition - West Wing (i)

- Used as "safe" trial for main building
- Services disconnected & asbestos removed
- All equipment, cubicles, floor coverings, partitions, fume cupboards and duct-work removed
- Floor plates and joists surveyed, decontaminated and removed

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Building Demolition - Delay Tanks (i)

- North Delay Tank Complex to green field
- High pressure water jetting removed most of contamination
- Up-ended tanks allowed non-confined space decontamination work
- Mass size reduction of tank by hydraulic shear

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Building Demolition - West Wing (ii)

- Roof demolished
- Asbestos wall cladding manually stripped
- Structural steel removed
- Proved need to lift plates
- Proved benefits of long range surveillance cctv for management control
- Proved benefits of long reach deployment of man-cages

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Building Demolition - Delay Tanks (ii)

- South Delay Tank Pit Complex totally cleared, eventually backfilled with B351 rubble and capped
- Tanks also cleaned (by HP water jetting and selective flame cutting) to free release and special precautions burial levels
- Pump house demolished

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Main Building Demolition (i)

- Competitively Tendered
- Environmental Impact Assessment (B351 was 11m from Site Boundary)
- Vibration, noise and dust control measures in ITT
- Surveillance cctv installed on masts, relayed to new Project Offices close to site

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Main Building Demolition (ii)

- Demolition began in April 1997 with brick built Office and Analytical Lab Wings
- Storage Pit backfilled with this rubble to allow close, load-bearing access to North Side of building
- Asbestos cement panels removed from cladding frames via scaffolding and cages

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Main Building Demolition (iii)

- Main steel/concrete structures collapsed using wrecking ball and progressive cutting of steel
- Continuous radiological surveys and environmental monitoring
- Demolition completed in August 1997 but basemat and capped Pit on C&M

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Main Building Demolition (iv)

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Waste Management (i)

- Radiation monitoring and sampling rigorously applied to help segregation and minimise volumes
- Waste fingerprints determined before work
- gross activity with β analysis and α- and γ-spectrometry identified isotopes and checked compliance for Drigg

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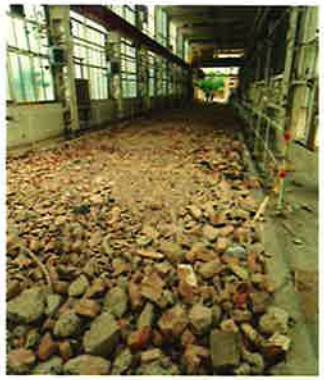
Waste Management (iii)



- Materials recycled on the B351 site (backfill of ducts and Delay and Storage Pits)
- Chemical waste sentenced through AEAT's HDS
- Non-hazardous wastes sold or to landfill via skips
- LLW volumes close to estimates but decontamination techniques failed to scale up adequately

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Waste Management (ii)

- 200l bins (compactable), HISOs (non-compactable)
- ~1 tonne of nuclear material (U + Th) as contact handled ILW
- FINGAL block as 540l ILW in own flask
- 1000's of chemical analyses on ~5ml to tonne quantity bulk materials
- Audited disposals

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LLW & ILW Disposals

Financial Year	Estimate from 1991 Plan	LLW (m^3) Actual	(Including HISOs)	ILW (litres) Actual
1990/91	-	10.5	-	540
1991/92	46.7	32.0	-	0
1992/93	26.5	23.6	-	1,227
1993/94	33.0	54.6	18.0	30
1994/95	262.7	239.6	133.5	0
1995/96	27.9	89.5	58.5	2,450
1996/97	135.0	157.1	133.2	100
1997/98	75.0	91.4	44.4	100
TOTAL	606.80	698.3	387.6	3,907

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Conclusions (i)

- B351 was complicated, contaminated and large
- Safe and successful decommissioning to plan and within budget
- Careful planning by resident management and direct control of all tasks minimised problems, reduced risks and costs
- Consistent standard of work was the result of continuity of the management team and a common approach to contractors

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Conclusions (ii)

- FINGAL drove choice of HISOs but this proved to be the best solution for B351 waste - controlled size reductions for ventilation and easy cross-site transfers
- All tasks subject to rigorous safety assessments and controlled by Method Statements and Permits to Work
- All Contractors underwent site and building specific training
- There were no serious incidents or accidents

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Conclusions (iii)

- CCTV used where areas could not be easily observed - plant/duct inspections and inside containments
- Installed, controllable surveillance systems gave managers direct views of work in progress and allowed progress to be noted safely from a distance
- Techniques developed and used in this project and the lessons learnt have been applied to other UKAEA projects with equal success

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The Team

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