



Australian Government

Australian Nuclear Science and Technology Organisation

# MOATA DECOMMISSIONING & DISMANTLING

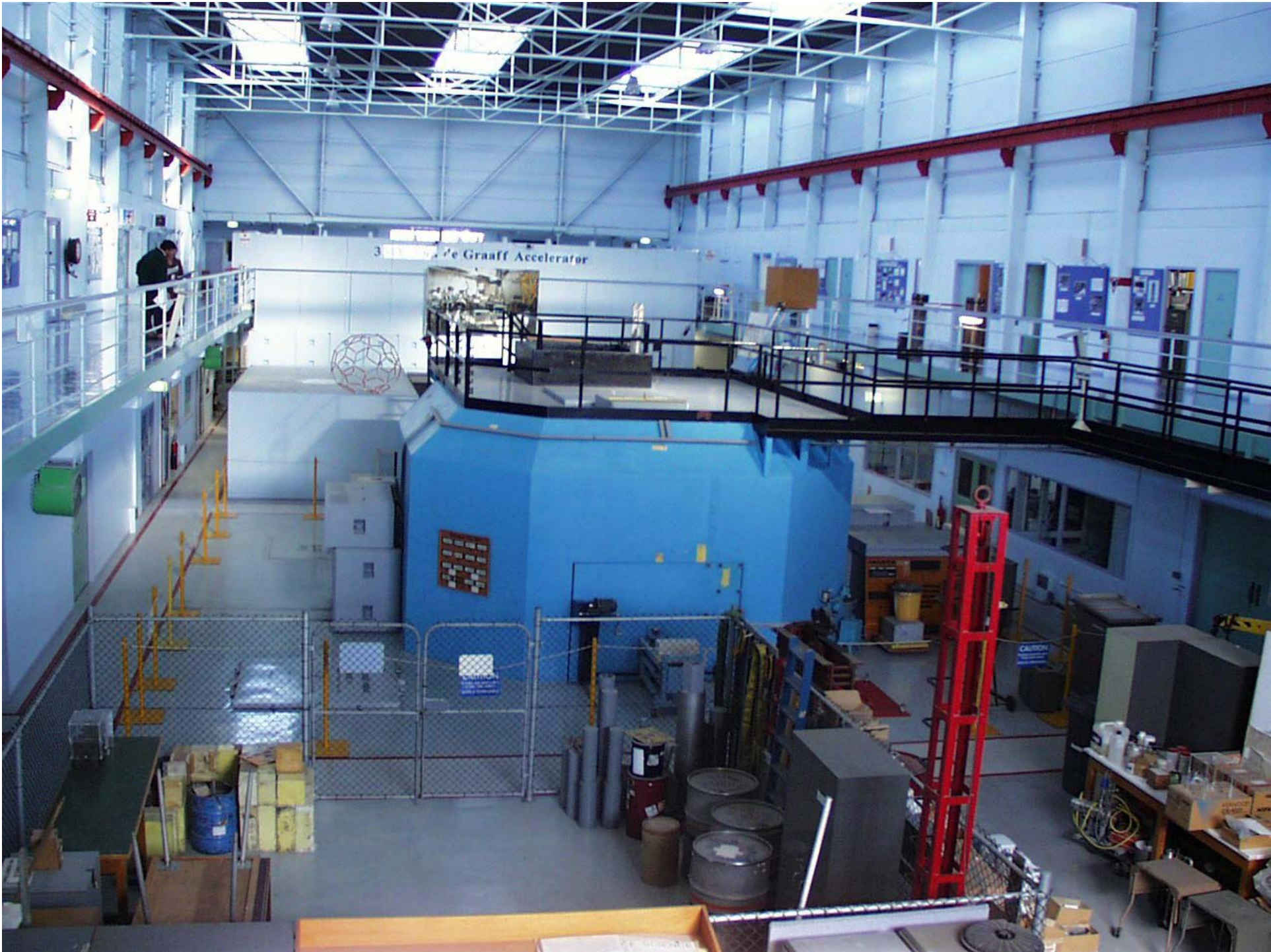
**Geoff MALONE,  
Sungjoong KIM**

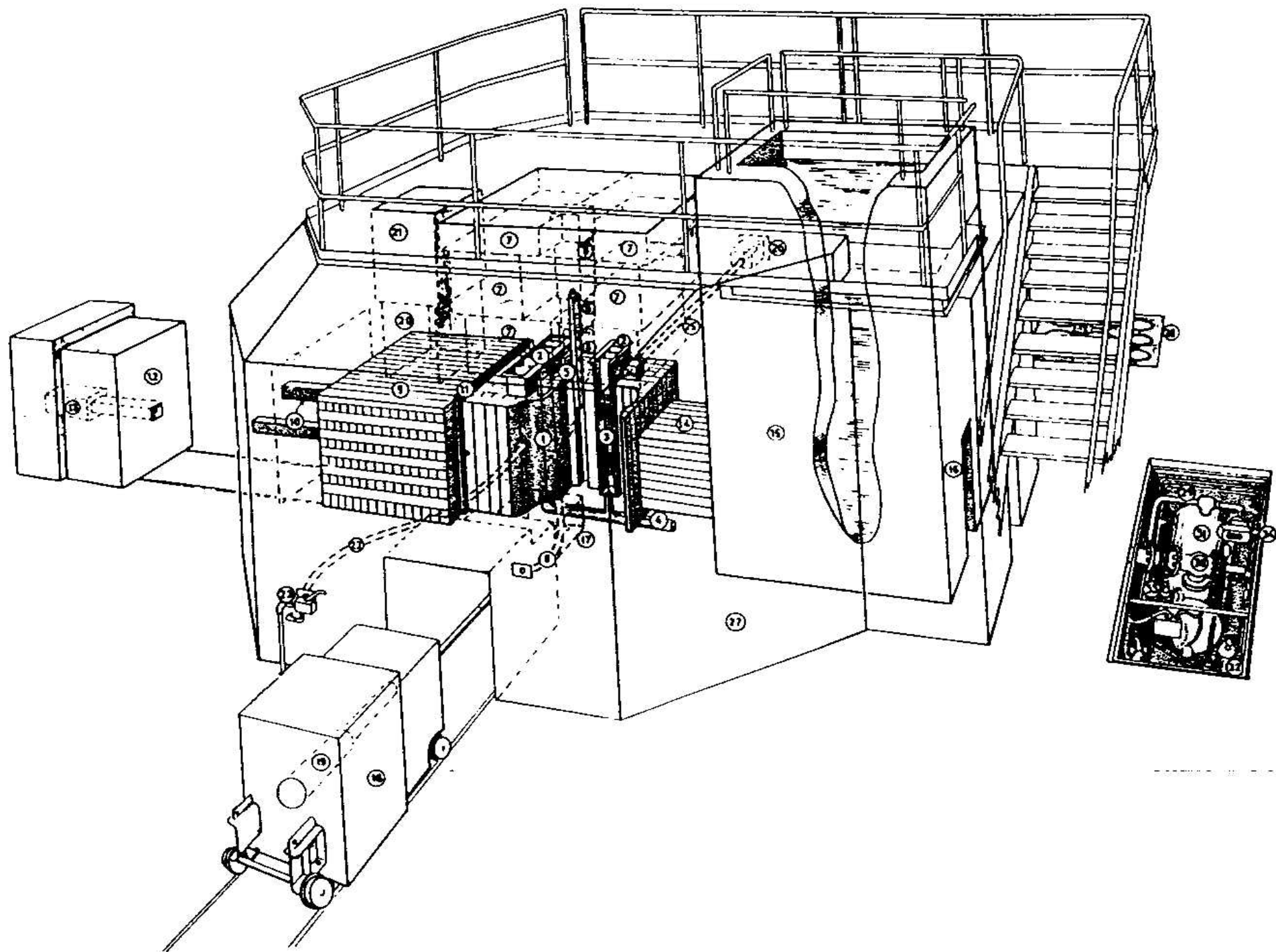
ANSTO Technical Services & Facilities  
Management

# MOATA Reactor

- MOATA = "Fire-stick"
- 100 kW, ARGONAUT Type  
(Argonne Nuclear Assembly for University Training)
- 1961 to 1995
  - Neutron Radiography (Inspections of turbine blades of Australian made Rolls Royce jet aircraft engines)
  - Soil Analysis (Concentration of Uranium)
  - Cancer Treatment Research (Boron Neutron Capture Therapy)
  - Quality Control for HIFAR







# Moata - Current Status

## Decommissioned for Safe Storage:

- Fuel unloaded (May 1995);
- Coolant drained and Cooling system removed (Feb 1997);
- Reactor Control System removed (May'98);
- Control Room - renovated into office/lab.
- Care & Maintenance License (Jun 2000)
- Fuel sent to USA (Dec '06)

## Dismantling:

- Planning has commenced for Dismantling and Site Remediation (Oct '07).

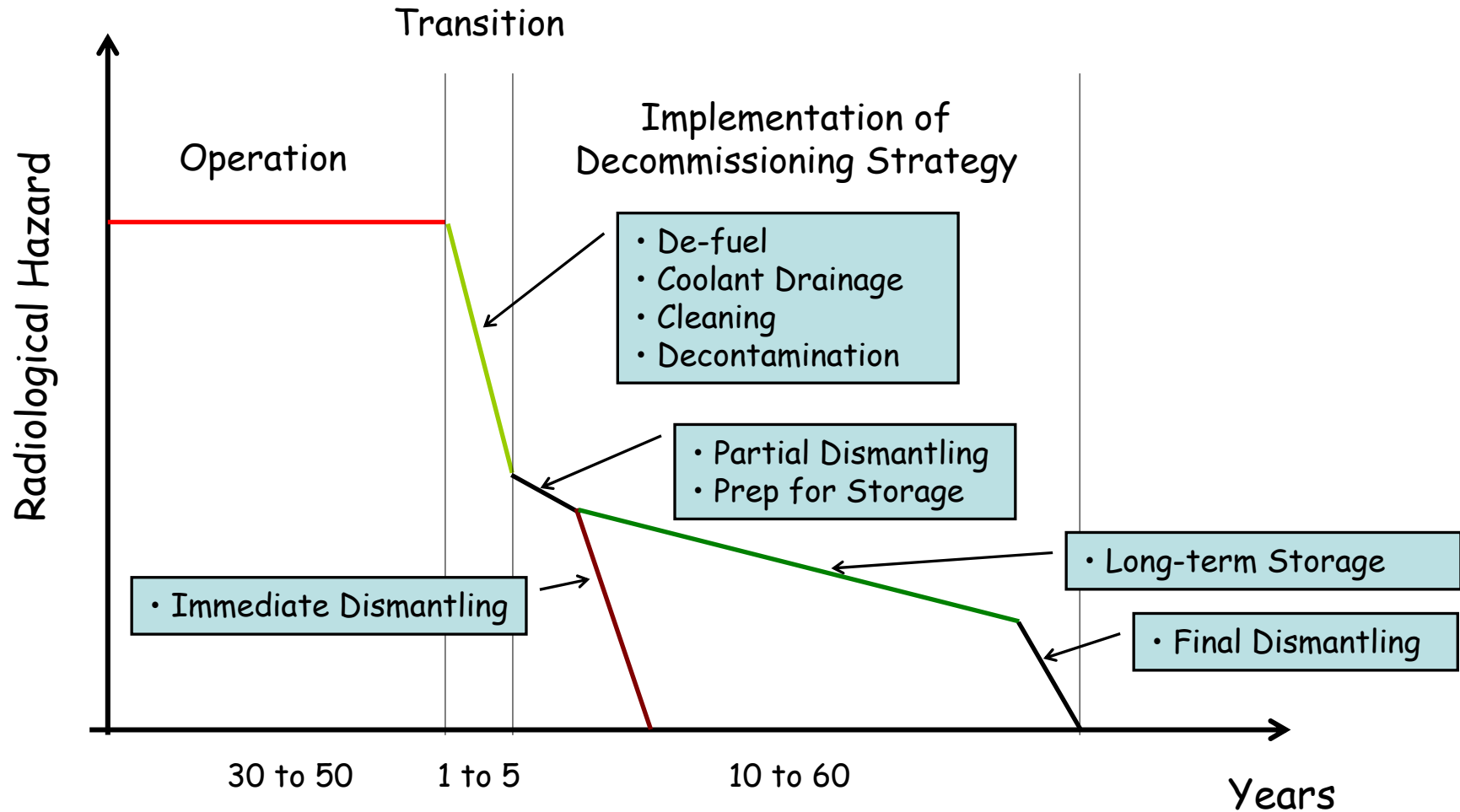
# Why was Moata decommissioned?

- Basically because it was uneconomic to operate!! Limited use vs. licensing and operating costs [staff & maintenance]
- In 1995 the ANSTO Board agreed to put Moata into a “state of irreversible shut-down” and safe storage until dismantling was viable.

# Why dismantle now?

- The main reason is the need for the area occupied by the reactor. The area is required for expansion of beam-lines and facilities on ANSTO's smaller tandem accelerator commissioned about 3 years ago in the adjacent area of the building.
- It provides an ideal and timely opportunity to develop, on a simpler reactor type, the skills and procedures relevant to the future dismantling task for HIFAR.

# Reactor Lifecycle





# Job Plan for MOATA Dismantling

## • Phase 1: Planning & Pre-dismantling

Team Mobilisation✓

Dismantling plans & procedures

Task or  
Project Plan✓

### Safety Case

- Dose estimate
- Waste estimate
- Safety plans
- Risk Management

### Characterisation

- Surveys
- Rad. Inventory
- Decay calculation

Resource Plans & Cost Estimate

### Submission/Report

- Regulator
- ANSTO
- Environmental Agency
- IAEA

**Approval to proceed  
to phase 2 !!!**

## Phase 2 : Dismantling

Team Mobilisation

Hire contractors

### Staff Training

- Safety induction
- SWMS
- Procedures
- Roles & Duties

Site arrangements

### Dismantle

- Core elements
- Doors/plugs
- Waste segregation
- Rad. Survey (continual)
- OHS inspections
- Zoning: active/non-active
- Dust/noise control set-up
- Demolition – non-active
- Non-active waste removal
- Containment set-up
- Demolition – active
- Active soil
- Fuel storage pits
- Active waste removal
- Process pit
- Graphite

**Dismantling Report**

# Phase 3 : Post Dismantling & Site Remediation

(Team Mobilisation)

Site Handover

Radiation Survey

Final Report

Validation for site release  
-Greenfield or brown field-

Submission - De-licensing

Approval for site release

Project Review

Make good (remediate)

**Completion!!!!**

# Project Deliverables for the Planning Phase

These have been developed by looking to the requirements of the 2nd and 3rd phases of the project to determine those things that should be fully covered in this planning phase.

- **1. Project Plan:** To define the scope of the project and tasks to be performed.
- **2. Cost Estimate.** This will provide a reasonable estimate of costs of all aspects of the dismantling and remediation phases to project completion.
- **3. Characterisation report.** Provides a summary of radiological surveys, estimates and calculations of radioactive materials inventory, including verification examinations of the structure.
- (Cont'd 1)

# Project Deliverables (cont'd 1)

- **4. Environmental report.**

- assessment of all likely environmental aspects and impacts of the project, and,
- recommendations & proposals for environmental controls and management.

- **5. Safety Report.**

- Estimates of dose to staff engaged on the project and others;
- Risk assessment and control measures– to cover both radiological, environmental and industrial aspects;
- Safety evaluation and recommendations;
- Both site work and waste handling to the time of disposition from the ANSTO site.

- (Cont'd 2)

## Project Deliverables (cont'd 2)

- **6. Dismantling proposal report.**

- Specific dismantling plan to describe the way the job is to be done.
- Resource plan to identify staff and equipment requirements;
- Expressions of interest and supporting data from suitably qualified contractors;
- Contractual proposal for engaging outside contractors for allocated work packages.
- Safety Plans to define how safety will be achieved during the dismantling and remediation phases.
- Active and non-active waste segregation and handling procedures, equipment and disposition;
- Agreement on the level of decontamination to be achieved for the site's intended use following dismantling and remediation.
- Safety training proposals for all staff and contractors;
- Summary of site controls for safety and environmental aspects;
- Outline of a summary report following dismantling.

(cont'd 3)

# Project Deliverables (cont'd 3)

- **7. Post-Dismantling proposal report.**
  - Proposal for site radiological survey and validation procedures to the agreed level of decontamination / cleanliness following dismantlement of the Moata structure;
  - Proposal for remediation of the site to an agreed state.
  - Proposal outline for a final report and submission to allow the site to be de-licensed and released for suitable usage by its owner and occupants.
- **8. Submission report.** This will cover all relevant safety, environmental, operational aspects and cost of the dismantling program and be suitable for submission to our regulator and other relevant authorities for approval to proceed to the second (dismantling) and final (site remediation) phases of dismantling.

(end of Deliverables)

# MOATA Dismantling Estimates

- **Cost:**
  - Planning: \$0.9M
  - Dismantling: \$2.0M
  - Remediation: \$0.9M
  - Total: \$3.8M (over 3 years)
  
- **Materials:**
  - Free release materials (mainly concrete and external structure): 75 cu.M
  - LLSW: 61 cu.M
  - MLSW: 0.15 cu.M



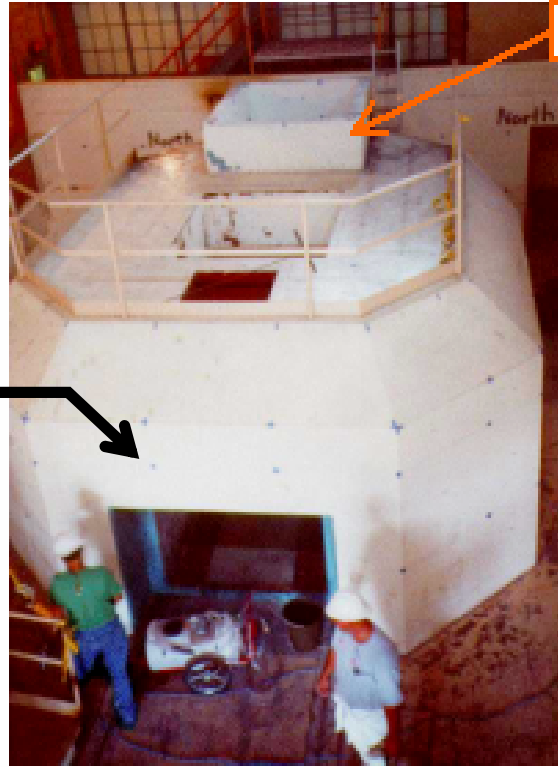
# Decommissioning - ARGONAUT Reactors

- USA
  - Virginia, 100kW, 1988, US\$0.6M
  - UCLA, 100kW, 1992, US\$1.7M
  - Iowa State University, 10kW, 2000, US\$1.0M
  - University of Washington, 100kW, planned, US\$2.2M
- UK
  - The Universities Research Reactor, 300kW, 1996, £4M
  - Jason, Greenwich, 10kW, 1999, £7M
- Taiwan
  - THAR, 10kW, 1993

Photographs

Front View

Iowa State Uni.  
Reactor, USA



Water Tank



Rear View





9:52:31  
2006-2000



Figure 12. Graphite Removal by Hand



Figure 13. Graphite Removal by Crane



Figure 14. Active Graphite Packaging



Figure 15. Graphite Removal Completed





14:54:52  
22. 6. 2000

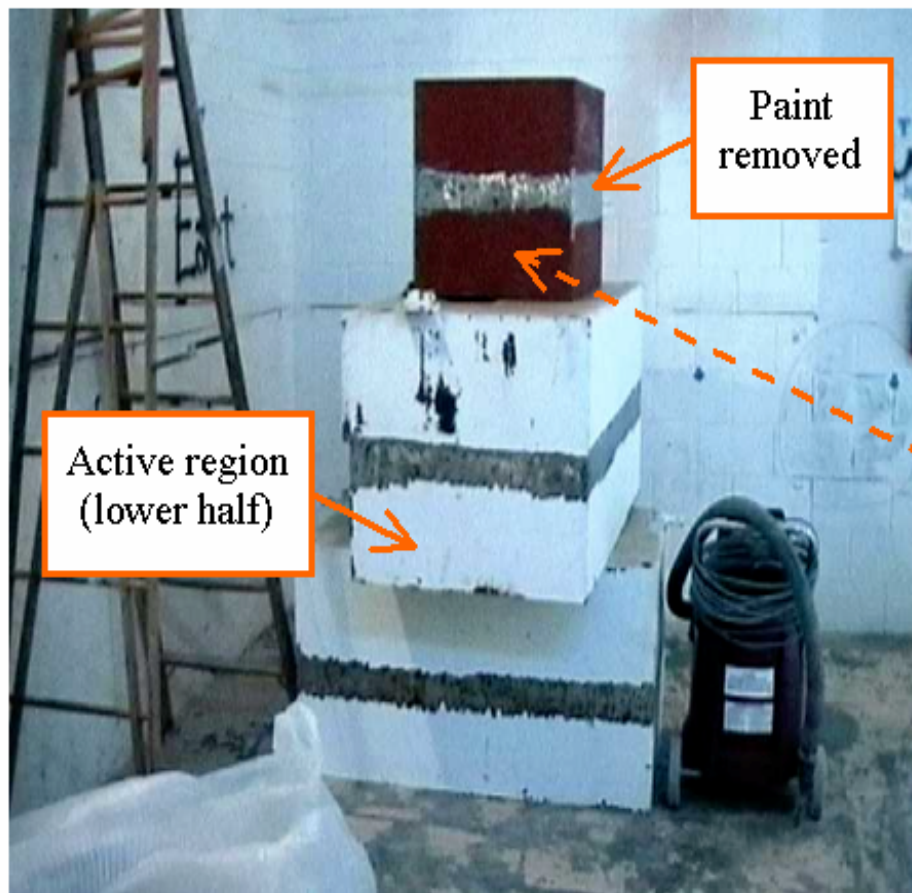


Figure 10. Active Plugs

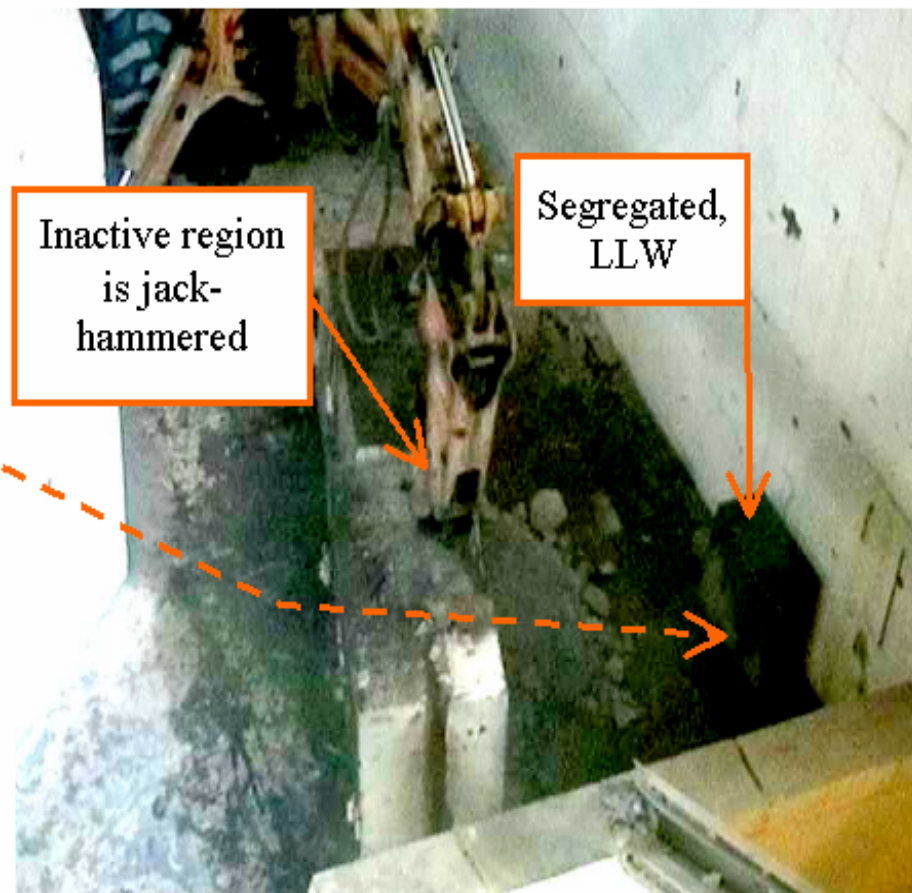


Figure 11. Active Plug Segregation

10:17:07  
21. 6.2000





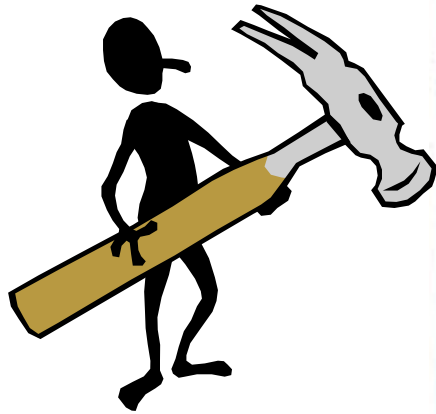


Figure 16. Aluminium Frame Removal

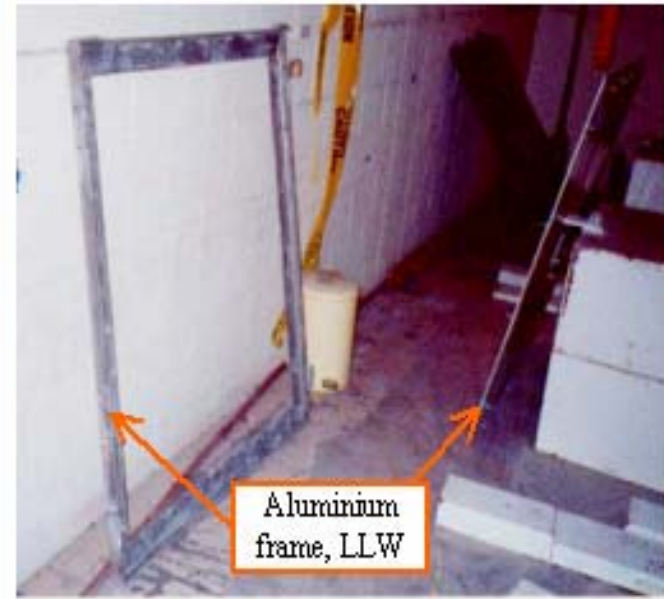


Figure 17. Aluminium Frame

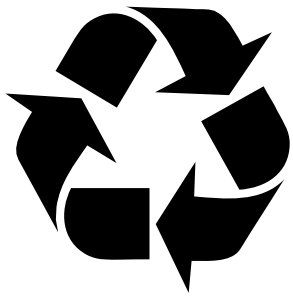


Figure 18. Active Portion of Lead, LLW



Figure 19. Radiation Survey - Recycled

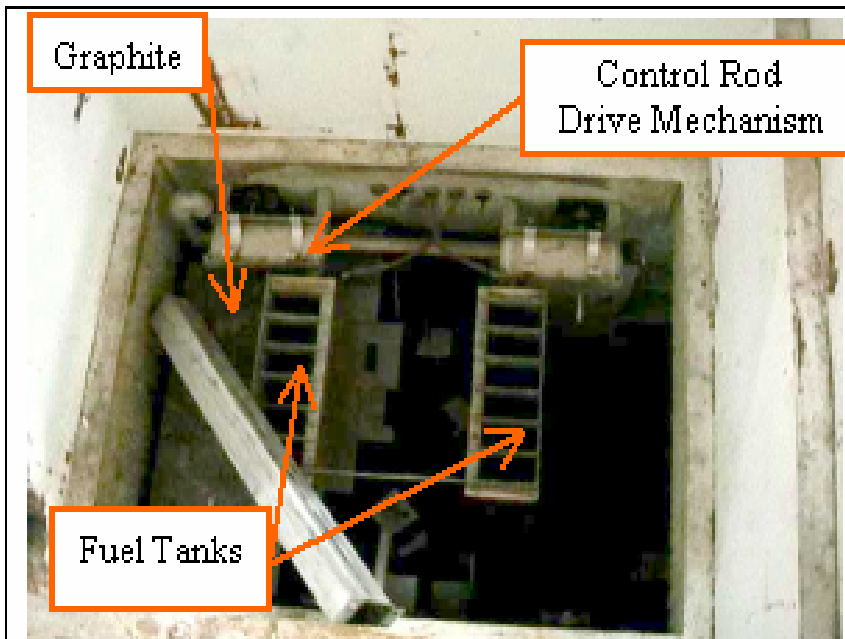


Figure 20. Core Cavity Components

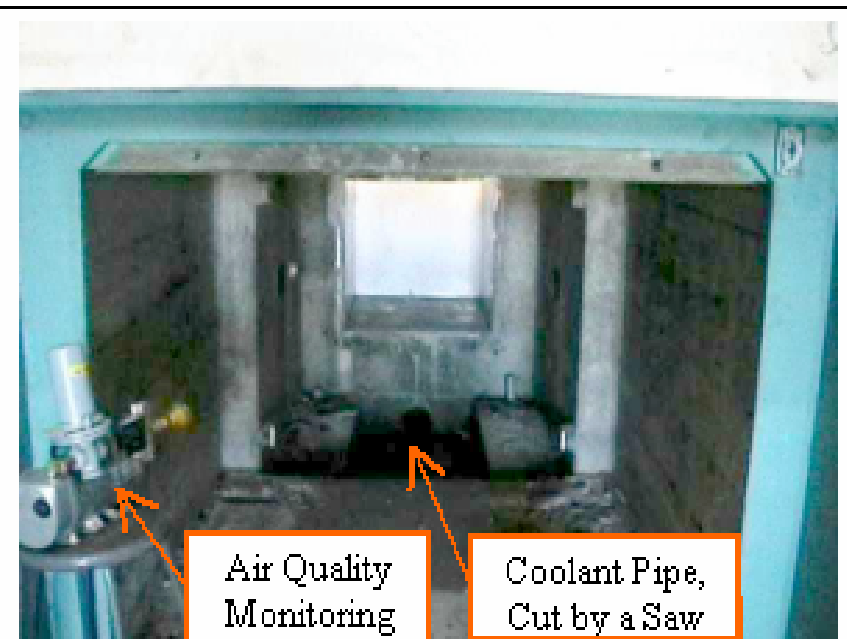


Figure 21. Components Removed

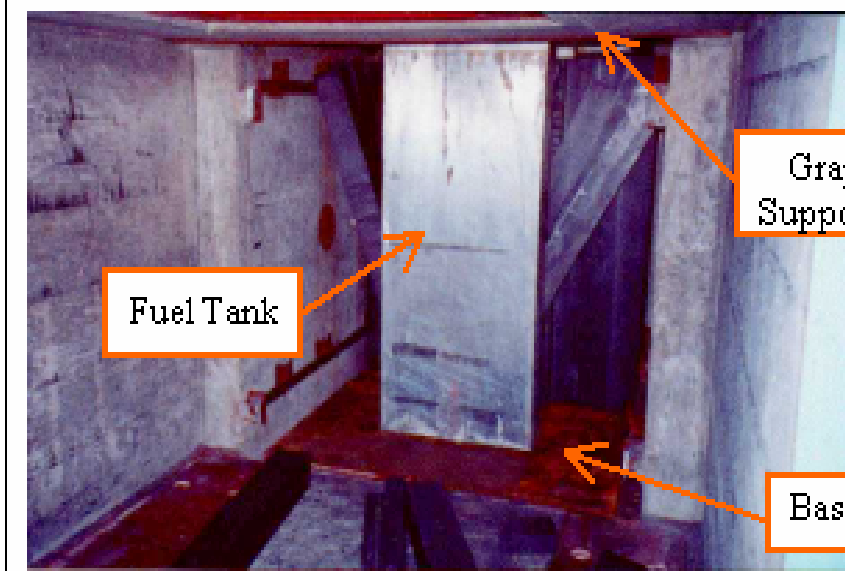


Figure 22. Fuel Tanks

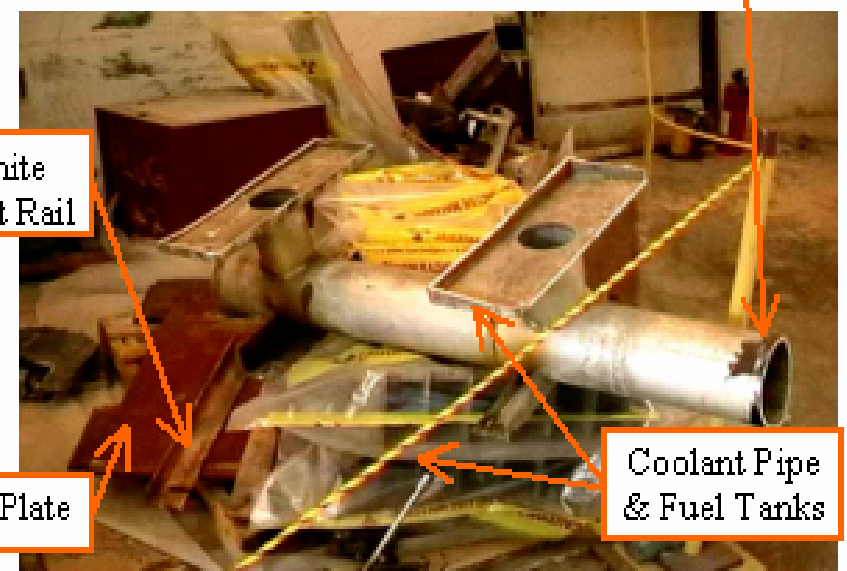


Figure 23. Removed Components, LLW



21. 6. 2000



Figure 24. HEPA Filter Set-up



Figure 25. Paint Removal in Progress

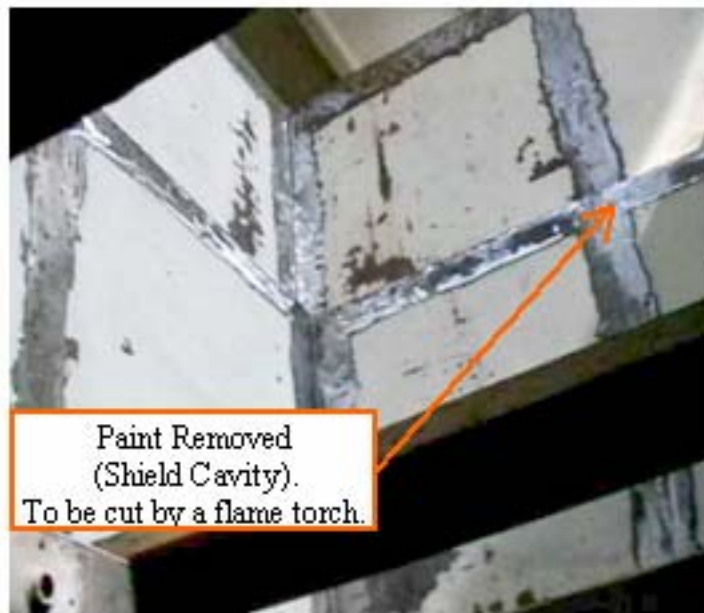


Figure 26. Shield Cavity Liner



Figure 27. Fuel Storage Pit



13:08:19  
5. 7. 2000

23. 6. 2000






Figure 30. Scoring the Concrete



Figure 31. Scores on the Wall



15:25:52  
20. 6. 2000



A photograph of a door handle, likely a push-button style, mounted on a light-colored door. The handle is dark and has a rectangular top section. The door has vertical paneling. In the bottom left corner, there is a digital timestamp overlay in white text with a black outline.

12:09:04  
21. 6. 2000



Debris,  
Small pieces

Figure 32. Day 1 – Jack-hammering Starts



Figure 33. Day 4 – Jack-hammering Stops



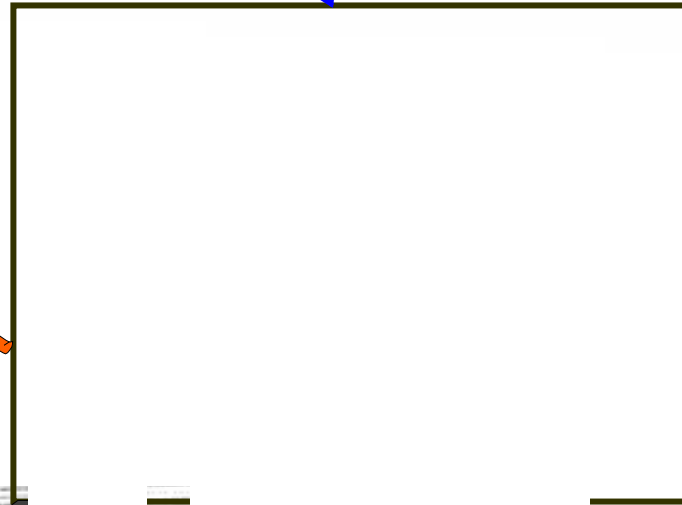
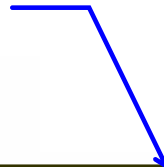
A person wearing a full white protective suit, a respirator mask, and a cap is kneeling in a dark, confined space. They are holding a red power tool, possibly a sandblaster or a similar high-pressure device, which is directed towards a light-colored rectangular area on the wall. The scene is dimly lit, with a bright light source illuminating the person and the wall. In the bottom left corner, there is a digital timestamp.

10:24:09  
29. 6. 2000

Moata



Containment,  
Active  
ventilation



Active Zone

Figure 29. Activation Profiles for Moata and ISU Reactors



Figure 34. Drilling – 20 minutes per hole



Figure 35. Drilling and Vacuuming



Figure 36. Holes being filled with CaO

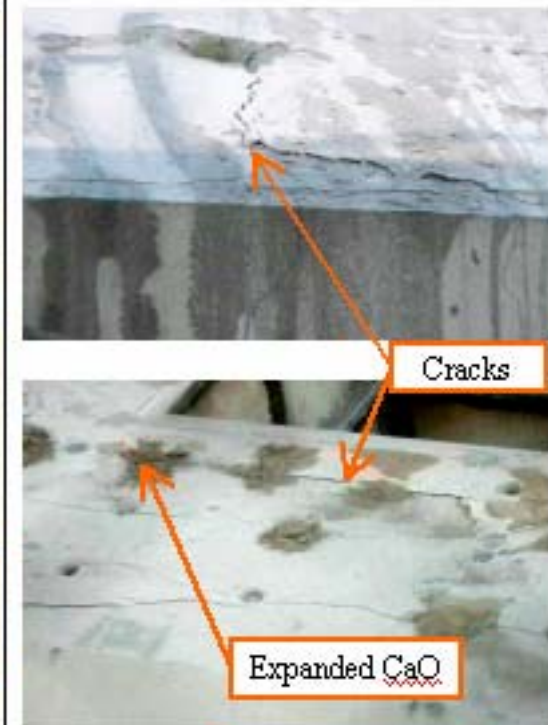


Figure 37. Cracks Developed



16:07:13  
5. 7. 2000





7 P. 21000

MAGT



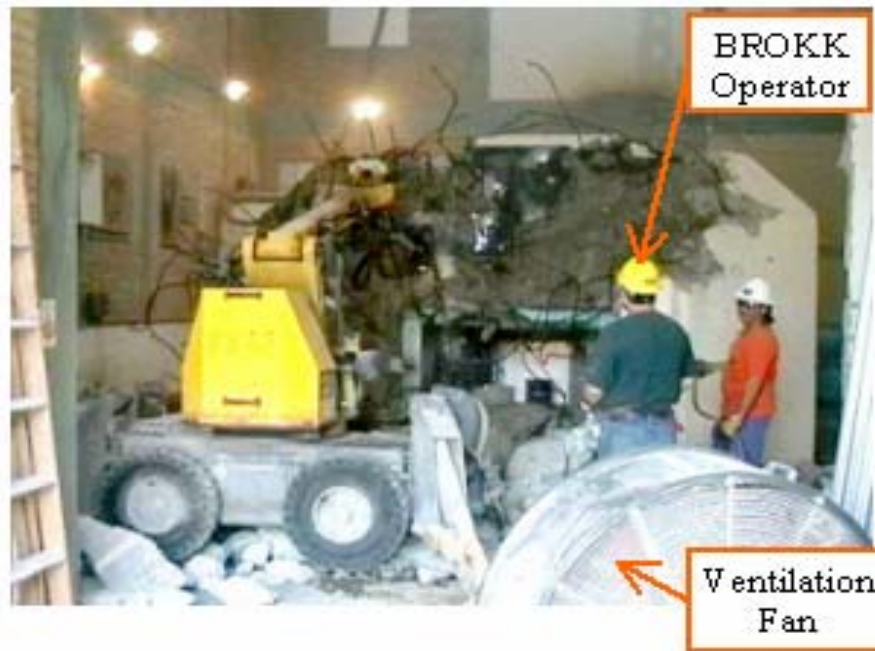


Figure 40. Day 1 of Brokking



Figure 41. Day 2 of Brokking



Figure 42. Day 3



Figure 43. Day 4





13:07:27  
11. 7. 2000



Figure 38. Waste Survey Prior to Disposal



Figure 39. Clean Waste Disposal





Figure 44. Day 4 (PM) – Floor Levelling



Figure 45. Day 4 – Containment Set-up





Figure 46. Day 5 – Containment



Figure 47. Day 5 – Demolition



Figure 48. Day 5 – Active Waste



Figure 49. Day 5 – Active Waste Handling



12. 7. 2000



Figure 50. Active Rubble – 8 Containers

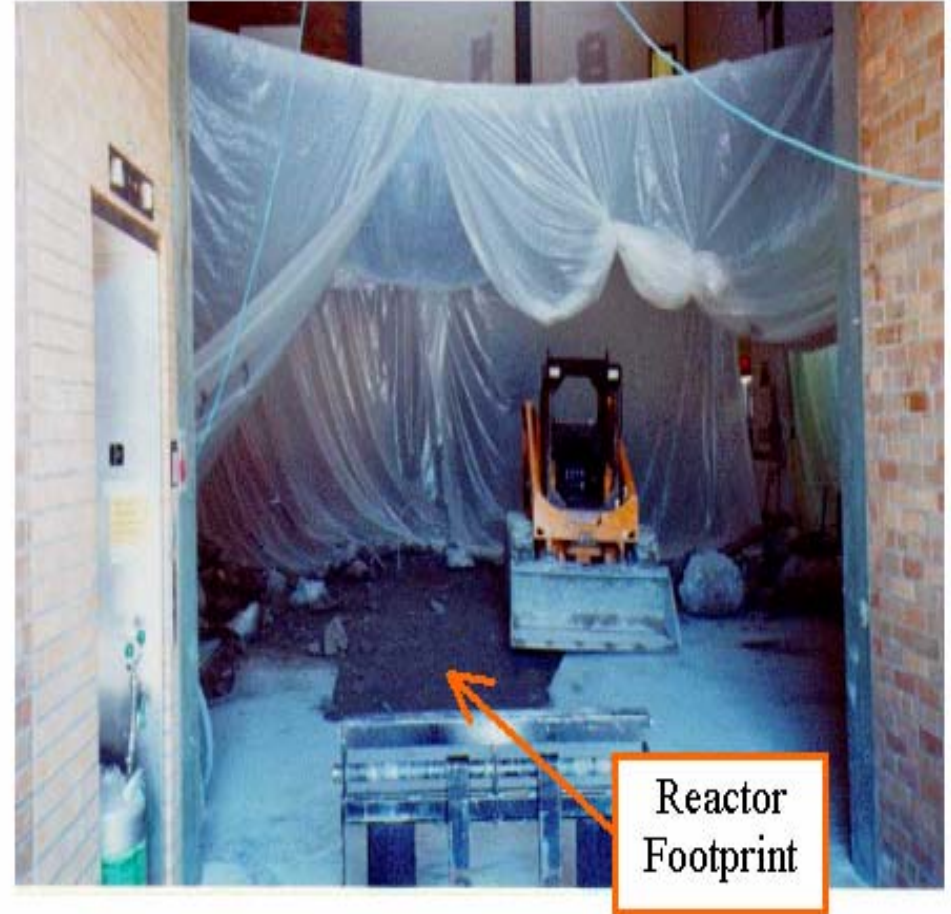


Figure 51. Demolition Completed



Figure 52. Pipeline Pit



Figure 53. Reactor Footprint



Figure 54. Activated Floor/Soil Removal



Figure 55. Activated Zone Excavated

# The End

Thank you for your attention  
....and....

Happy Decommissioning &  
Dismantling!

...and then Discussion Session

# Prepared and presented by:

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{ ANSTO, TS&FM, Nuclear-Mechanical Design Unit }

# Site Visit to MOATA Reactor

- Please have passports available for issue of passes.
- No cameras including mobile phones with cameras