Sellafield Ltd

Developing a New Criticality Methodology to Support Decommissioning of Legacy Plutonium Facilities

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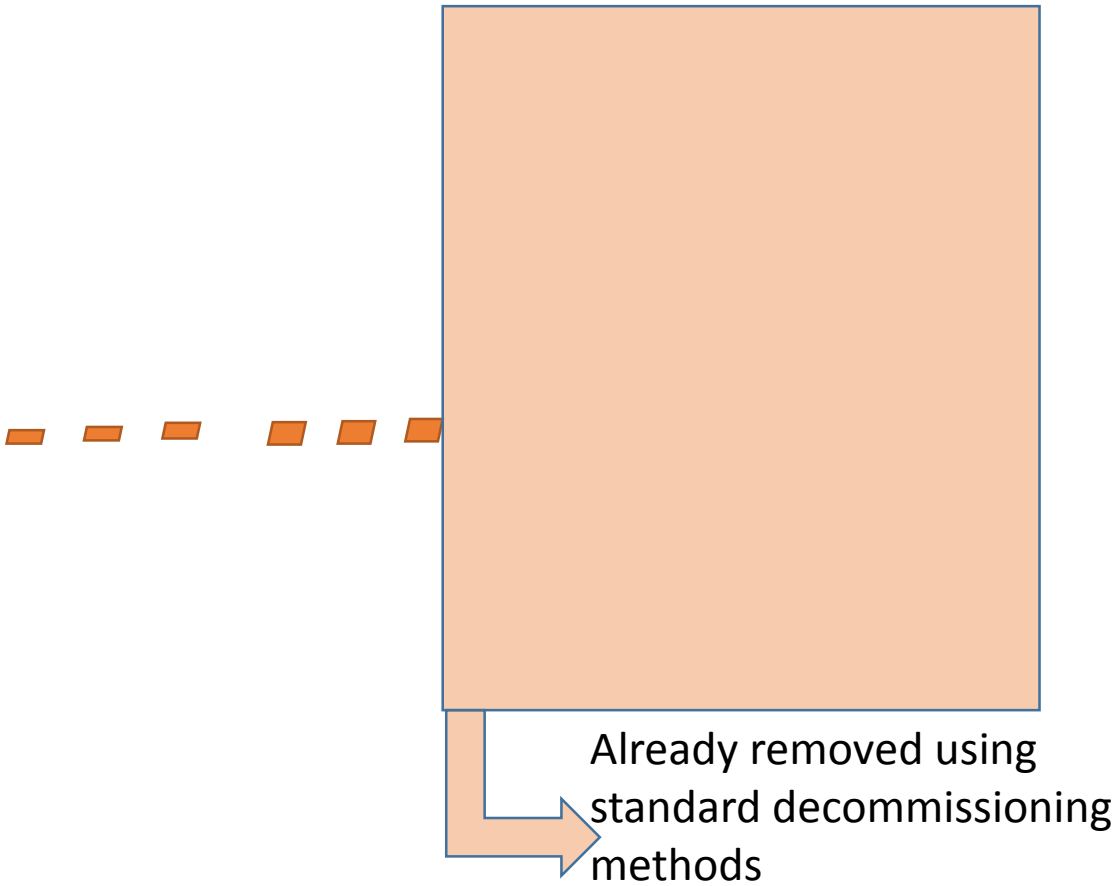
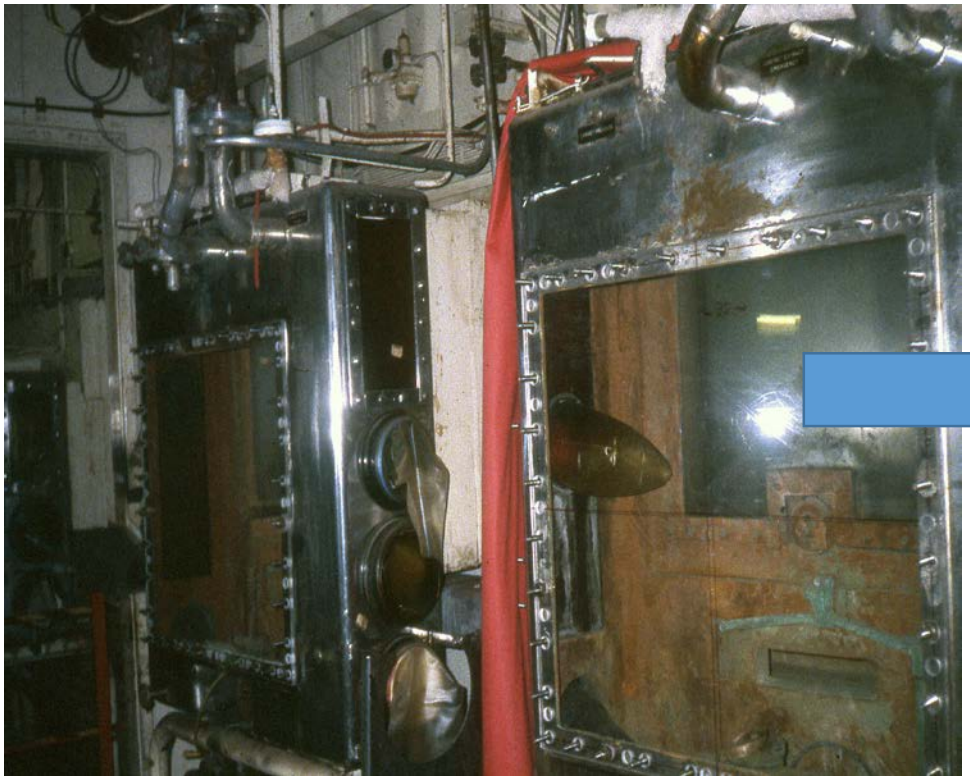
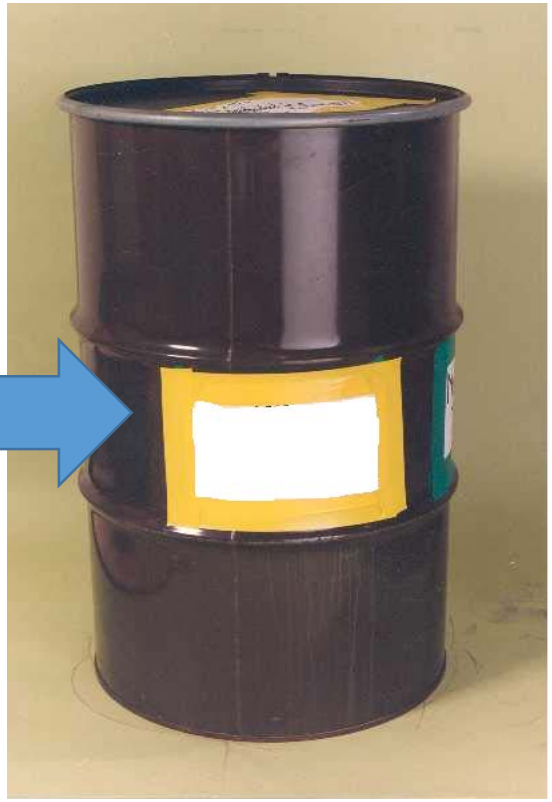
Legacy Plutonium Facility



Standard decommissioning method

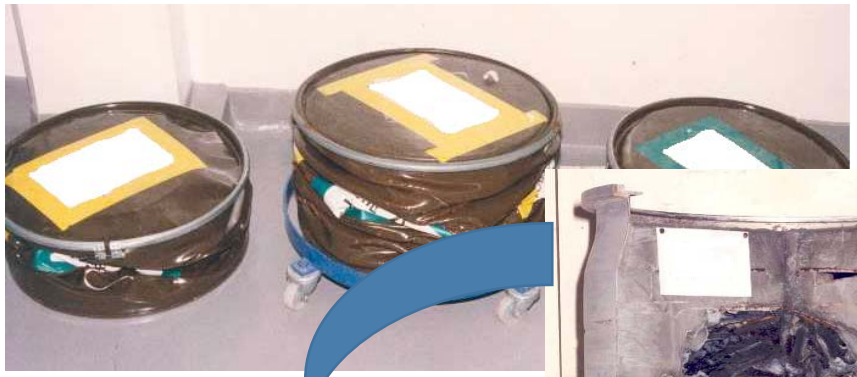
- Gloveboxes were removed and size reduced using hands-on methods, placed in a 200 litre (55 gallon) PCM drum and assayed





Downstream plant requirements

- This was to meet downstream waste plant requirements
- Assayed PCM drums crushed into pucks, which were then put into 500 litre (132 gallon) drum for storage



Challenges

- A few instances of operators receiving non-trivial doses
- Associated with hands-on cutting methods employed for size reduction
- Could future gloveboxes be exported without the need for size reduction?
  - Reduce potential for operator dose uptake
  - What about deriving an assay value for the glovebox to comply with downstream plant storage arrangements?
- In-situ monitoring (portable gamma and neutron)
  - Space restrictions, high contamination and background levels, might give very conservative mass estimates requiring further work

Challenges

- Prior to glovebox removal, intensive residue recovery programme
  - Remaining fissile content expected to be low
- Could we maintain low criticality risk for export operations *and* reduce potential radiological risks to operators?
- Translate to criticality safety
  - Demonstrate that the crate containing the cleaned-out glovebox would not present any greater risk than the collection of PCM drums that would have been generated from the size reduced of the glovebox

Developing LCR Methodology

- Review the operational records of the glovebox
- Review any details of Post-Operational Clean Out (POCO) operations
- Review the equipment history of vessels or other items within the glovebox
- Understand if any process items had already been removed
- Review any photographs or drawings of the glovebox
- Use the above information to inform on the most suitable computer modelling approach, if required
- Also allows for results from in-situ monitoring, health physics surveys and/or intrusive surveys and sampling

Developing LCR Methodology

- Once complete, review of LCR argument by Criticality Safety, plant representatives and project manager
- Identify recommendations/hold-points as required
- Allows these to be reviewed/actioned in flight
- Closed out in advance of actual glovebox removal to minimise unnecessary delays

Applying LCR Methodology

- Review the operational records of the glovebox
  - Furnace received Pu powder to dry, allowed suitably bounding material specification to be derived, along with conservative safe mass/volume
- Review POCO records and glovebox history
  - Good POCO undertaken in 1980s/1990s so clear records.
  - Internal vessels all removed
  - Able to confirm not enough material remaining to challenge safe mass
  - BUT, some areas couldn't be seen, so HOLD POINT derived.
    - During residue recovery process, take photos to demonstrate effectiveness, estimate remaining fissile content
- Review photos/drawings of glovebox
  - Identified any potential hold-up areas prior to residue recovery

Before and after comparison

- Still some staining seen after clean-out, plant technical derive bounding mass to compare with criticality safe mass

Before and after comparison

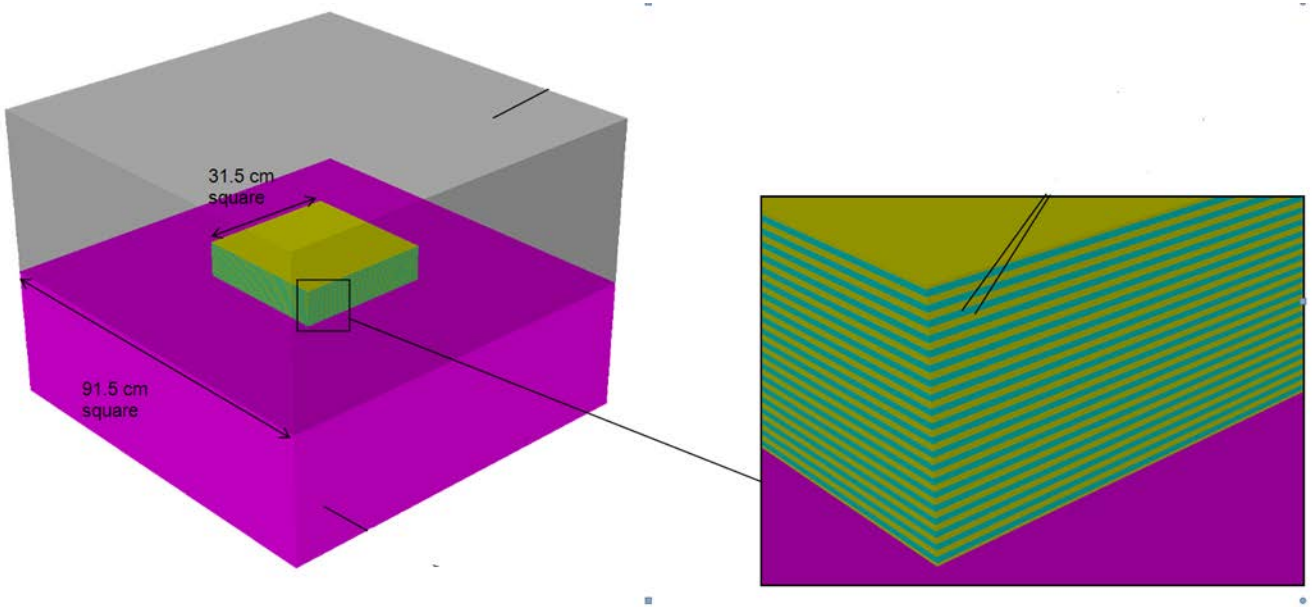
- Still some staining seen after clean-out, plant technical derive bounding mass to compare with criticality safe mass

Contamination and Moderation

- To ensure any residual contamination stays in place, apply fixative
- But this is a pretty effective moderator…

Applying LCR Methodology

- Computer modelling to give idea of safety margins



Models demonstrate that a criticality hazard either requires large amounts of fissile material (unlikely given residue clean-out) or large volumes of fixative (unlikely due to strict operational controls)

Conclusion

- Able to demonstrate no credible criticality risk even under large deviations of the factors that are relevant to criticality control from the conditions that are judged to exist or potentially arise
- No assay values needed, glovebox placed whole in crate, which was exported to downstream waste store
- Implications
  - No spacing requirements during movement (distances to walls, other fissile material)
  - No spacing requirements during storage in downstream plant (close packed crates allowed)
  - No CAAS needed during transport/storage
- Achieved aims of radiological risk reduction and maintained low criticality risk profile. Associated cost savings for removal and storage

Crate Liner 1

Questions?