Conditioning of intermediate level waste resin by dewatering

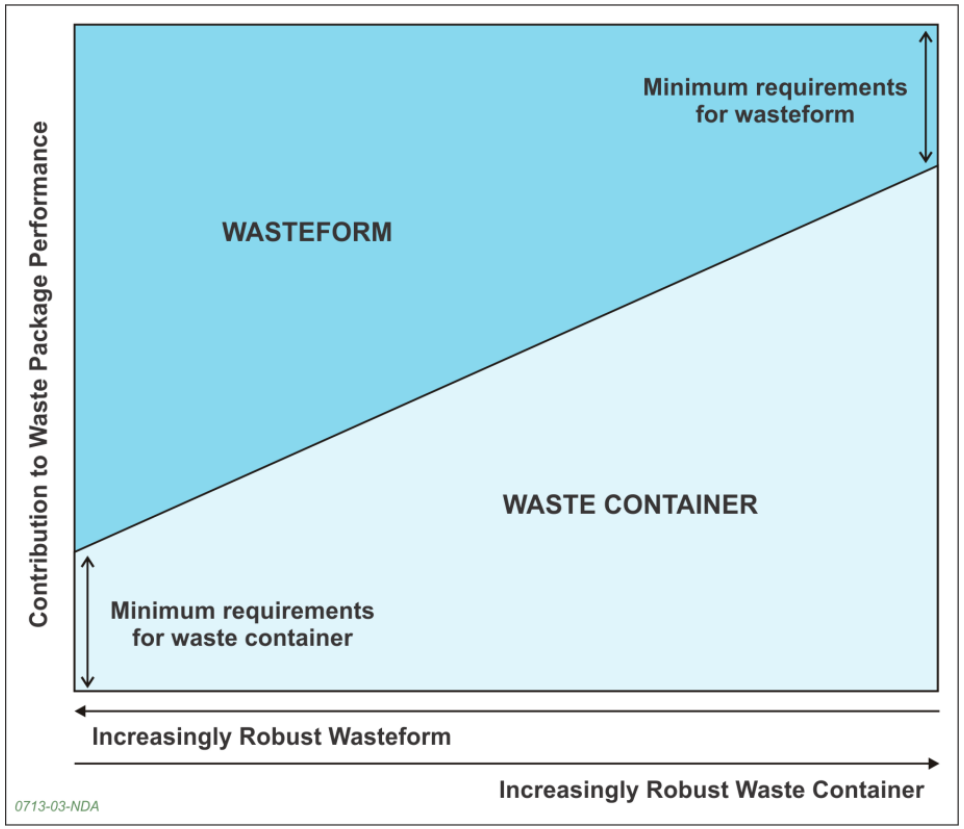
ISOE European Symposium 2014 – Bern, Switzerland

Intermediate Level Waste at Sizewell B

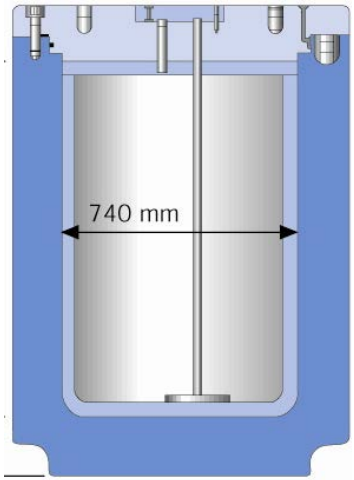
- Definition of ILW for the UK
  - >12 GBq/te (β/γ) or >4 GBq/te (α)
  - No significant decay heat output
- Inadequate storage capacity for ion-exchange resins
  - Design assumption (in 1983) that Geological Disposal Facility would be operational by 2000
- No provision made to condition solid ILW from routine maintenance & inspection tasks (e.g. SG ECT)

High Integrity Containers – A novel idea for the UK

"Traditional" UK ILW packages

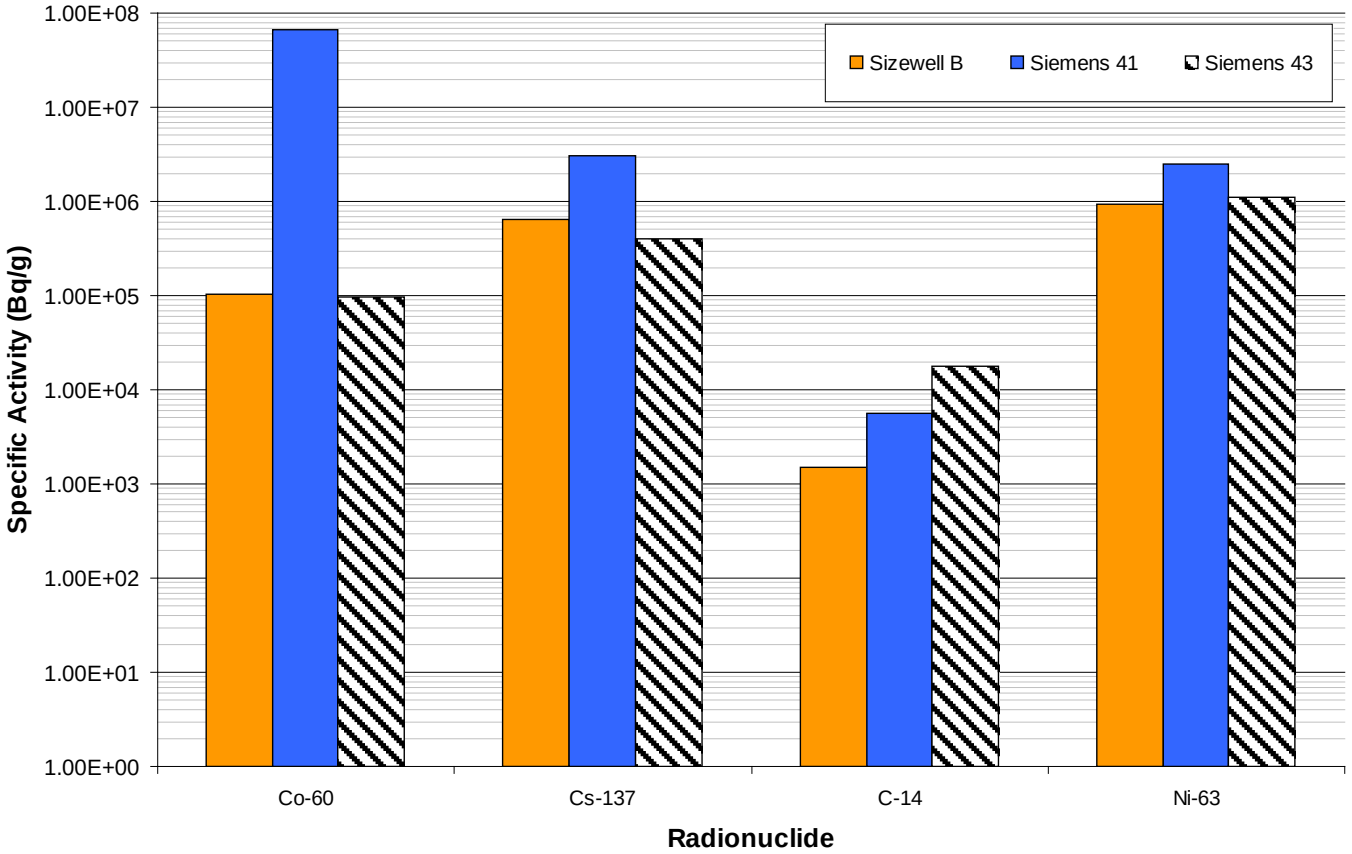


"Novel" UK ILW packages



- Extensive dialogue with regulators and stakeholders over 4 years
- Weekly telephone conferences, monthly meetings – **"No surprises"**

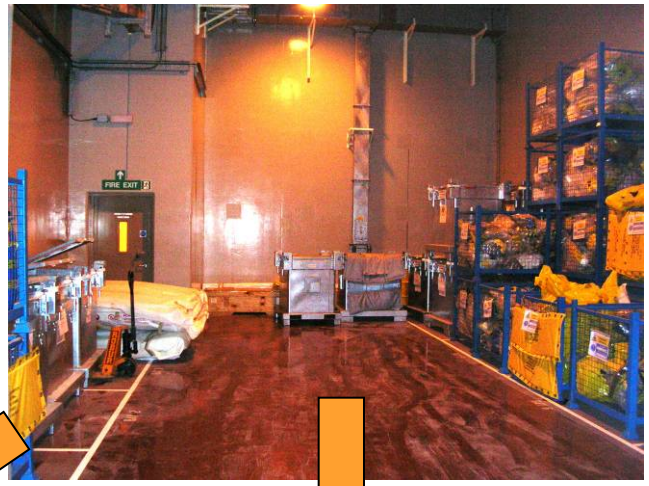
Comparison of ILW resin source terms



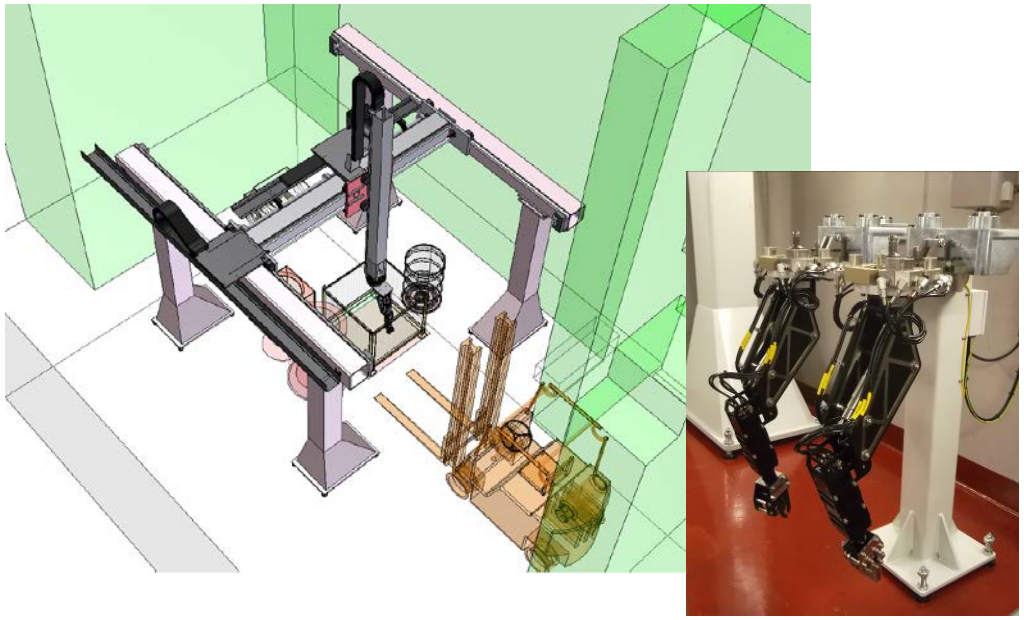
- FAFNIR, NEWA & MOSAIK are designed to condition resins from S41plants
- Sizewell B source term is very similar source term to Konvoi (S43) NPPs

Enabling Works - Clearance of existing waste store

- High doserate compactable waste
  - Accumulated for 18 years
  - 500 bags in 40 x 1m^3 cages & IBC's
  - 2 – 50 mSv/h in contact
  - General area ~300μSv/h.



Enabling Works - Clearance of existing waste store



- Benchmarking at Ringhals identified robotic manipulator for ILW processing
- 3-axis gantry+ manipulator arms
  - Intermeshing jaws & parallel acting jaws

Enabling Works - Clearance of existing waste store

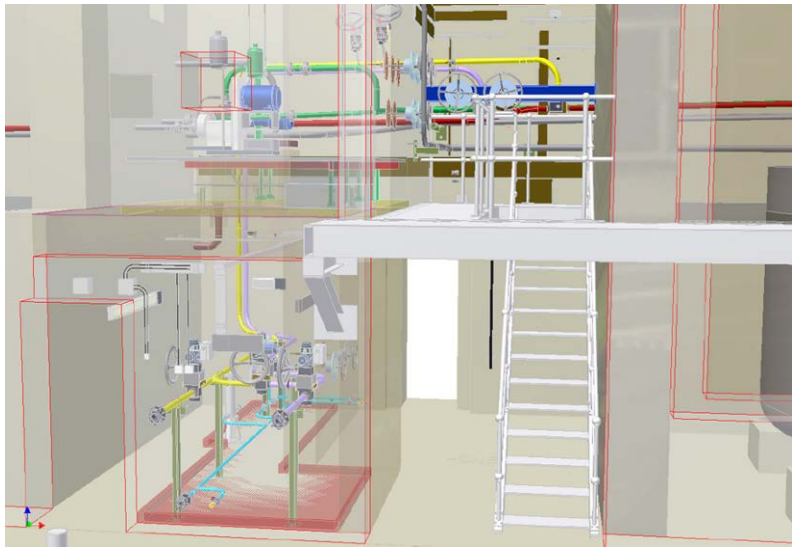
- Sentencing based upon external doserate
  - Bags were not opened
  - L/ILW doserate limit reduced to 1mSv/h i/c
    - Manipulator VRF <2, cf. Shredder-compactor VRF ~5

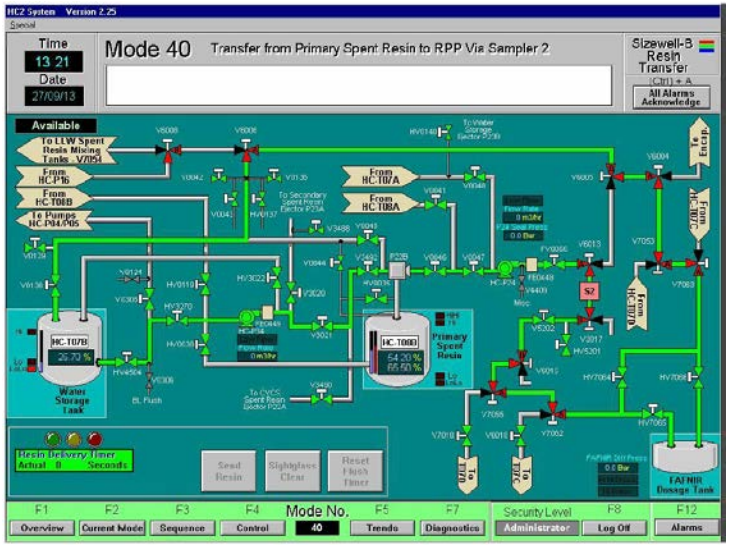
- 45 x LLW drums: 0.75 mSv/h i/c (0.002 – 3 mSv/h)
- 22 x ILW drums: 6.1 mSv/h i/c (0.18 – 25 mSv/h)

- Collective Dose: 1.9 man.mSv over 14 days.

Enabling works – Resin Transfer System upgrade

- New docking station for resin dewatering machine
- SCADA upgrade for new resin transfer modes





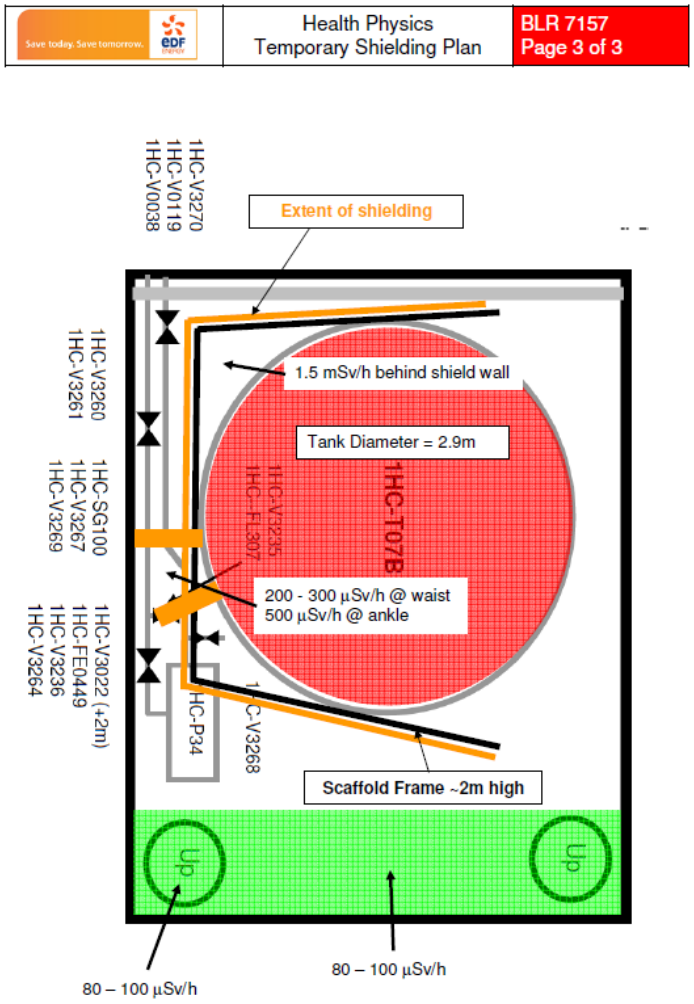
- Extended duration of design & construction phase **+15 months**
- Collective Dose: 12 man.mSv (228 people from Jan 2010 to Jan 2014)
- Max. individual dose: 1.5 mSv

Enabling works – Resin Transfer System upgrade

- Existing water tank contaminated with ILW resins and crud – no filters had been installed
- New pneumatic actuators & local control panel for existing valves next to motive water storage tank

Enabling works – Resin Transfer System upgrade

- Shielding plan developed to create low doserate area for installation of new actuators



Contamination control issues during construction

Gap under foot = contamination trap

- Poor house-keeping during construction – no cleaning plan
  - Dirt & cement dust made contamination monitoring very difficult

- Contamination traps identified during plant commissioning
  - Electrical cables not enclosed in conduit
  - Gaps under x-y-z gantry manipulator legs not sealed
  - Damaged floor surfaces not automatically repaired

Plant commissioning & hand-over

- Physical tests of plant performance
- Task Observations carried out of workers using the procedures
- Surveys performed along resin transfer route
  - Verify permanent shielding installation – OK where fitted…
  - …Some shielding features agreed in the detailed design could not be constructed in practice
  - Two water-filled temporary shield blocks found to be empty!

Lessons learned – plant design & modifications

- Design phases not aligned with safety case development stages.

- Designers & Project Managers not experienced in good radiological design
  - ALARA design standards and good practices NOT well known
  - Need to incorporate ALARA Design Guidelines (e.g. IAEA NS-G-1.13) into company's design & modification process

- Easily decontaminable surfaces
  - "Nuclear-grade" has little meaning to designers
  - "Food or pharmaceutical grade" products are readily available and familiar to designers & installers

- Lack of Radiological Protection hold-points in design & construction process
  - How is advice communicated & action/inaction tracked?
  - How are shortfalls identified, tracked and resolved?
  - Include RP issues in Operations Hand-Over Certificate process?

Dewatering resins into High Integrity Containers

- MOSAIK II-15
  - IP-2 ductile cast iron cask (no lead liners fitted)
- FAFNIR V & NEWA
  - Resin dosing & MOSAIK dewatering equipment

Management of high radiation areas

NOT PROTECTIVELY MARKED

POI-HC006
Issue 015
TRANSFER RESIN FROM 1HC-T08A TO 1HC-T08B (MODE 6) AND POST TRANSFER FLUSH

Appendix 1
PRE-SLUICE ACTIONS All Pre-Sample Actions are performed by Operations

BLR	No. of Doors & Levels	Pre-Sluice Actions	Comments	Ops Sign	Peer Check Sign
7158	**One** door at +2.7m level	**Search** for, and remove, all persons from each room. **Lock** door(s). **Post** "R4" & "No Entry – Resin Transfer" signs. **Contact** HP to update CALog.			
7167	**One** door at +2.7m level				
71G6	**One** door at +2.7m level				
71G8	**One** door at +2.7m level		Restricts access & egress from 71H4		
71G3	**One** door at +2.7m level				
71G4	**One** door at +2.7m level		Restricts access & egress from 7147 & 7157		
71G5	**One** door at +2.7m level				
71F8	**Two** doors; one at +2.7m level (from 71F7), one at 6.5m level (from 7224)				
7240	**One** gate; at eastern end of room		Post R3 sign only, on gate		
71F4	**One** door; at +6.5m level		Restricts access and egress to 71F3 (+2.7m level)		
71F5	**One** door at +2.7m level (from 71F4)				
7136	**Two** doors at -0.1m level; one from 7146; one from 7154				
7165	**One** door BLR 7165/7166				
71F9	**Corridor** **Two** doors leading into corridor at +2.7m level: one from 71H2 & one from 71F7.	**Post** "R3" signs. **Contact** HP to update CALog.	To be classified R3 due to high dose rates experienced in corridor whilst moving ILRW resins		

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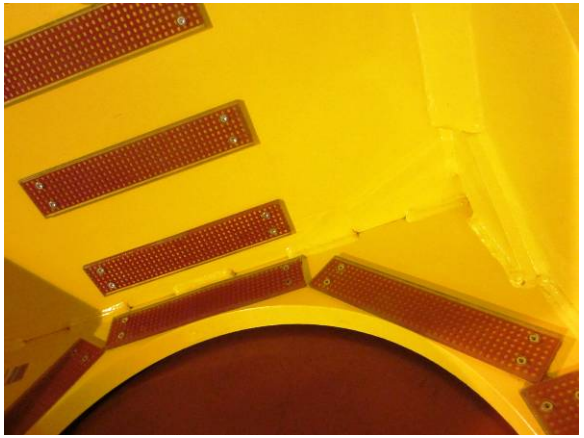
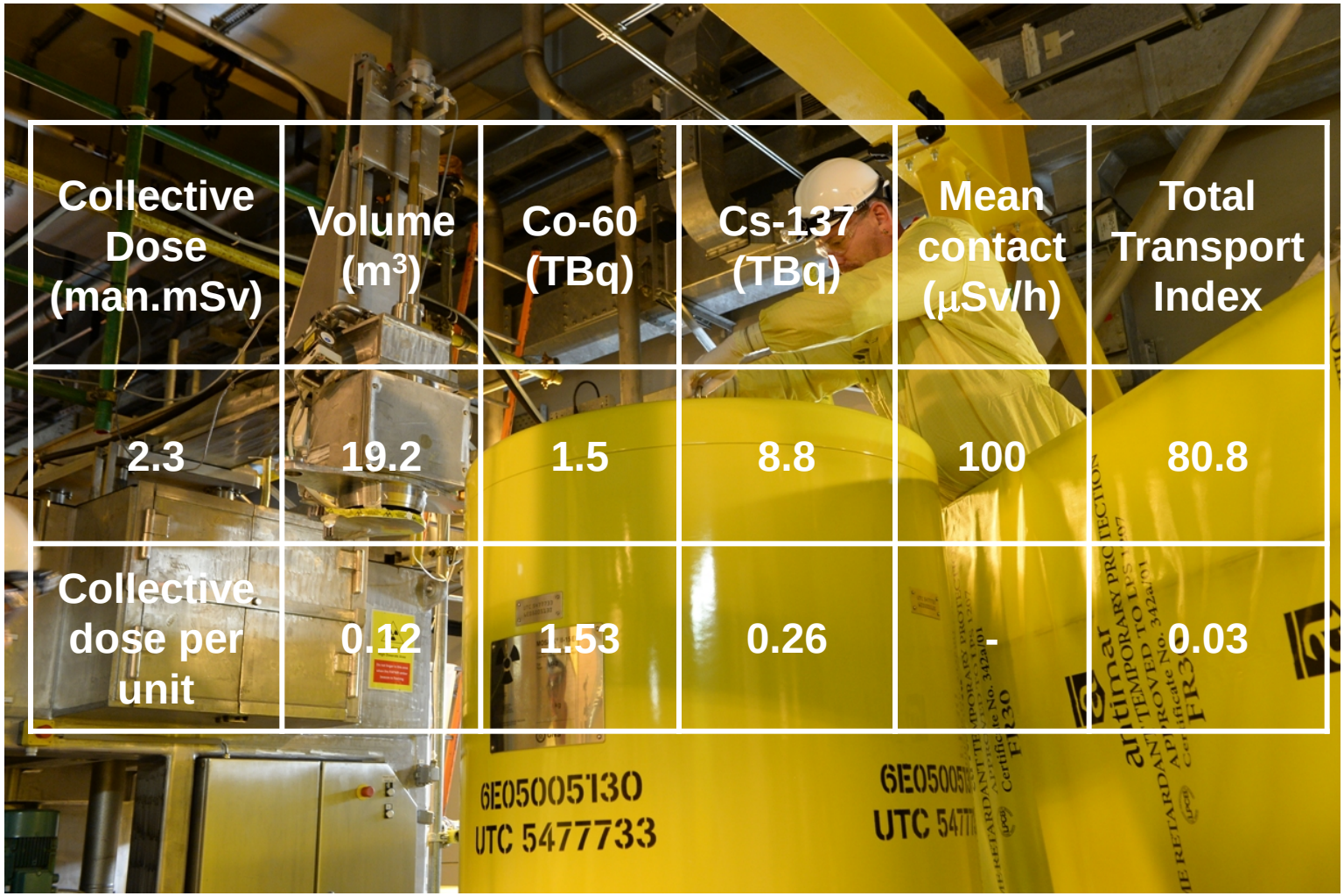
MOSAIK handling



- Lessons from bench-marking visits to Biblis & Grohnde
  - Plastic strakes fitted to Cask Lifter to protect MOSAIK paint
  - MOSAIK movement plan developed

Seal Change	QUARANTINED		MODIFIED CLOSURE			Receipt QC Reqd		
	* Log Book Hold							
MOSAIK INFORMATION			LOCATION			FINAL STORAGE		
Batch No	UTC No	Delivery	Empty	Settling	Complete	X	Y	Z
01	5477720	On-site				3	1	2
	5477685	On-site				3	1	1
	5477721	On-site				4	1	2
	5477688	On-site				4	1	1
02 1 x Sample	5477725	On-site				2	2	1
	5477696	On-site				2	1	2
	5477729	On-site				2	1	1
	5477684	On-site			71A5	Y09		
03	5477706	On-site				3	2	1
	5477700	On-site				4	2	2
	5477704	On-site				4	2	1
	5477715	On-site				3	2	2
04	5477728	On-site			Y09	Guarantee Measurement required		
	5477724	On-site		17/03/14 on NEWA	Y09			
	5477710	On-site			Y09			
	5477734	On-site			Y09			
05	5477719	On-site	6U	Y05	Y09			
	5477722	On-site	6L	Y05	Final			
	5477717	On-site	3U	Y05	Final			
	5477723	On-site	3L	Y05	Final			
06 1 x Sample	5477686	On-site	1L	Y06	Final			
	5477692	On-site	2L	Y06	Final			
	5477701	On-site	8U	Y06	Final			
	5477695	On-site	3U	Y06	71A5	Y09		
07	5477691	06-Mar-14	6L	Y07	Final			
	5477693	06-Mar-14	5U	Y07	Final			
	5477733	06-Mar-14	5L	Y07	Final			
	5477687	06-Mar-14	2U	Y07	Final			
08	5477708	On-site	2L	Y08	Final			
	5477703	11-Mar-14		Y08	Final			
	5477707	11-Mar-14	7L	Y08	Final			
	5477714	11-Mar-14		Y08	Final			

Performance to date



Collective Dose (man.mSv)	Volume (m^3)	Co-60 (TBq)	Cs-137 (TBq)	Mean contact (µSv/h)	Total Transport Index
2.3	19.2	1.5	8.8	100	80.8
Collective dose per unit	0.12	1.53	0.26	-	0.03

Lessons learned – Resin dewatering

- Cask operating instructions are mandatory
  - Better accuracy from the Design Authority is required
    - Do you really mean “100% of surface free from any defects”?
  - Better clarity is required
    - 4 tiers of documents must be read together, to understand requirements

- 20 years of ILW resin
  - 55 MOSAIK casks packaged for disposal in 10 weeks
  - Predicted Collective Dose = 4 man.mSv

- Why do we allow liquid radwaste demineralisers to operate as LLW?
- Why do we continue to cement-encapsulate LLW resins?
- Should we operate all demineralisers to become ILW?