Australian Nuclear Science and Technology Organisation

Management of Radioactive Wastes ANSTO

November 2007

Overview

- **ANSTO has processed and stored its radioactive wastes in a SAFE manner for more than 49 years since commencement of the HIFAR reactor in 1958**
- **Radioactive waste is managed under a defined systems of control :**
  - **Regulatory control via ARPANSA – through licensed facilities**
  - **ANSTO Policy - Radioactive Waste Management**
  - **OHSE Management Standards**
  - **Operational procedures and instructions (ISO 9001 certified Quality Assurance System & ISO 14001 certified EMS)**
  - **Trained and competent technical and operational staff**

Waste Operations Facilities

Waste Treatment & Conditioning

- Low Level Solid Waste
- Laundry Services
- Decontamination Services
- Waste Conditioning
- Low Level Solid Waste Storage
- Technical Support – Gamma spectrometry

Waste Processing

- Intermediate Level Solid Waste Storage
- Intermediate Level Liquid Waste Processing
- Low Level Liquid Waste Treatment
- Intermediate Level Solid Waste Storage
- Spent Radioactive Waste Storage

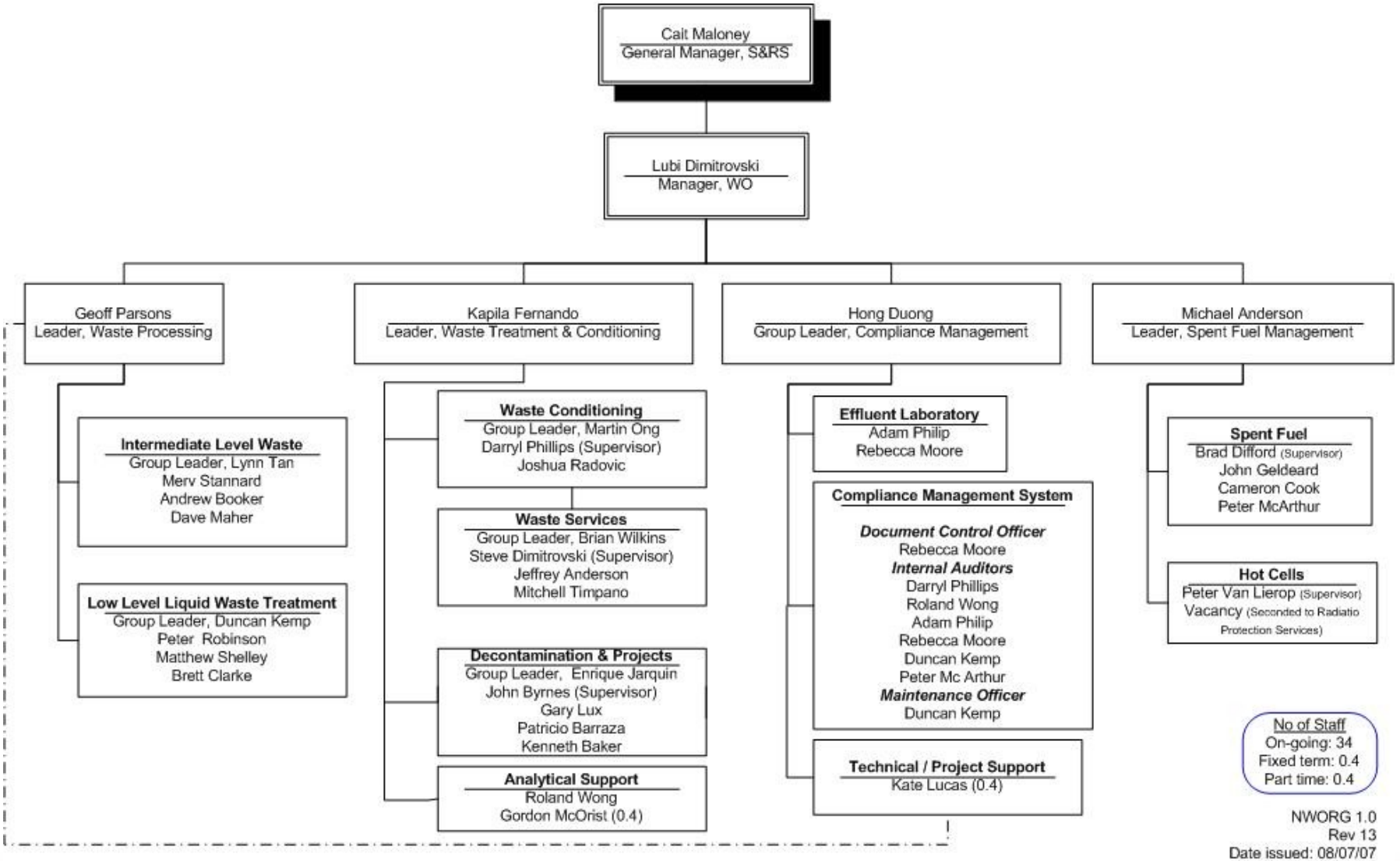
• Compliance Management

- Analytical Laboratory
- QA System Control

• Spent Fuel/Hot Cell Services

- Spent Fuel Shipments
- Hot Cell Services
- Spent Radioactive Sealed Source Management

Waste Operations Organisation Chart



Radioactive Waste Types

Liquid	Solid

Low Level, < 2 mSv/hr contact dose

Comprises ~ 98 % of ANSTO radioactive waste

Intermediate Level, > 2 mSv/hr (shielded)

Comprises ~ 2 % of ANSTO radioactive waste

Exempt Level
(Checked prior to free release to municipal tip, scrap yards and industrial tips)

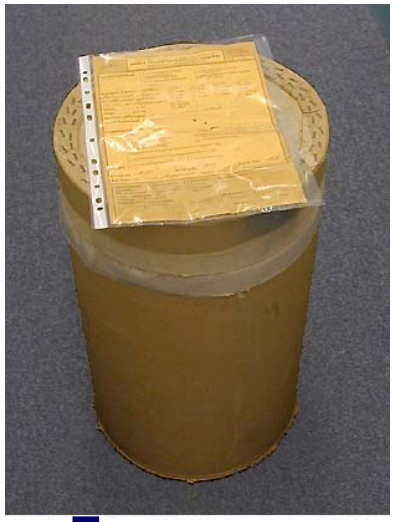
ANSTO Radioactive Waste Inventory

Solid Waste

Waste Type	Classification	Volume (m3)
Drummed Solid Waste	Low Level	1245
Contaminated Items	Low Level	420
Used Filters (HEPA)	Low Level	160
Used Charcoal	Low Level	3
Solid Waste from Mo99 Production	Intermediate Level	12
Solid Waste from HIFAR Operation	Intermediate Level	14
Mixed Waste	Intermediate Level	183
Residues	Intermediate Level	165
Metal Scrap	Intermediate Level	2

Liquid Waste

Mo99 Product Waste	Intermediate Level	5700 litres



LLSW Processing, Characterisation and Storage

Drumming **Scanning** **Storing**

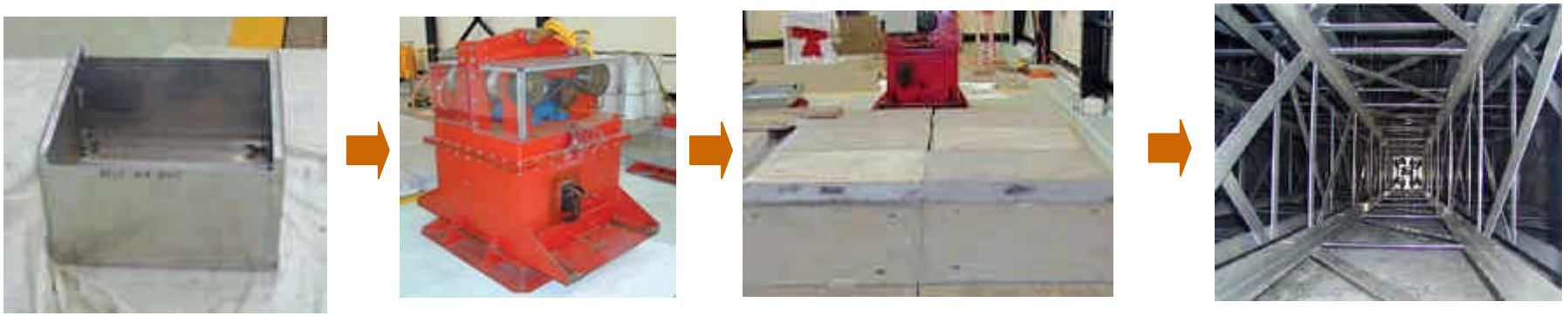
Low Level Solid Waste Store

Low level waste is compacted and stored in 200 litre steel drums

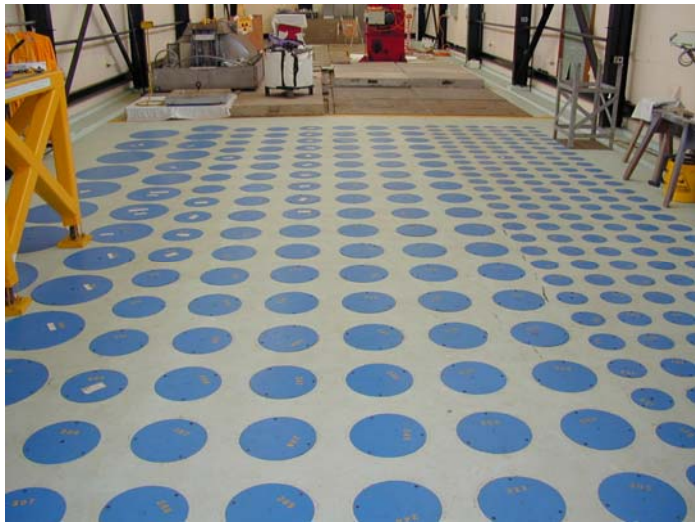
Safely stored for over 40 years

Intermediate Level Radioactive Solid Waste

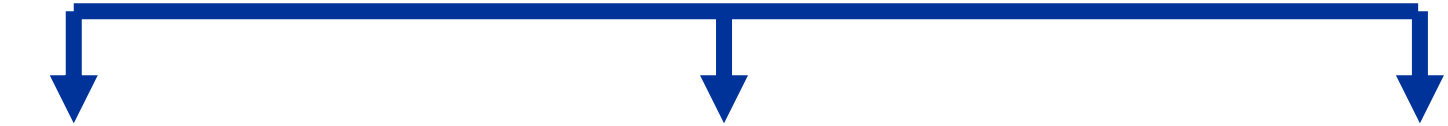
- The solid waste is pre-conditioned and placed in 72 L aluminium bins
- The bins are loaded into a specially designed shielded flask and transferred to shielded and safe below-ground storage racks for decay



Intermediate Level Solid Waste Storage



Liquid Waste Processing



Inactive effluent

45,000 m^3

From HIFAR cooling towers, inactive labs & workshops.

Waste water is analysed before discharge to sewer.

Active effluent

5,000 m^3

From isotope production and other active laboratories including laundry operations

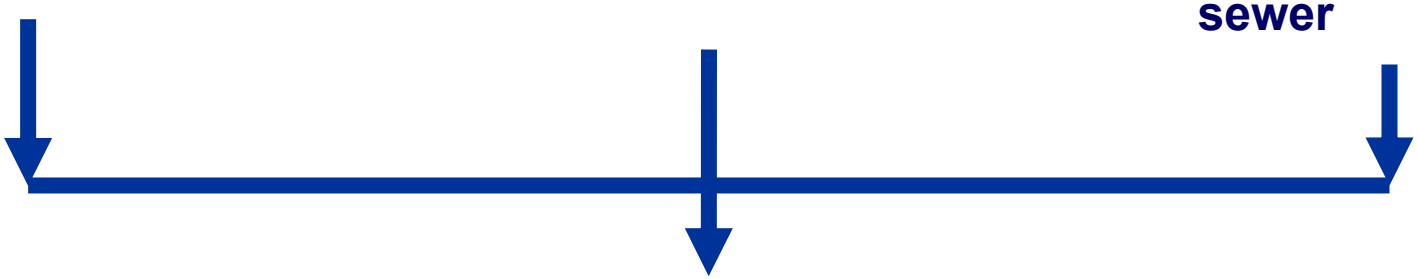
Waste water is treated to remove radioactivity that ensures compliance with Trade Waste Limits set by Sydney Water

Sewage

50,000 m^3

From showers, toilets, lunch rooms.

Sewage is combined with the waste water, analysed before discharge to sewer



Sydney Water Sewage System

Effluent Treatment Plant



Decontamination Centre

- Contaminated items from active areas are decontaminated in the Decontamination Centre.
- For return and re-use at ANSTO
- For safe disposal

Laundry

Inactive and Active laundry are washed and dried separately

Exempt Level Waste Management

- Waste is scanned in a low background area and either cleared or rejected.
- Cleared white waste is scanned by the gate monitor before it is taken off site.
- Rejected contaminated waste is processed and stored as low level waste.

Metal Recycler

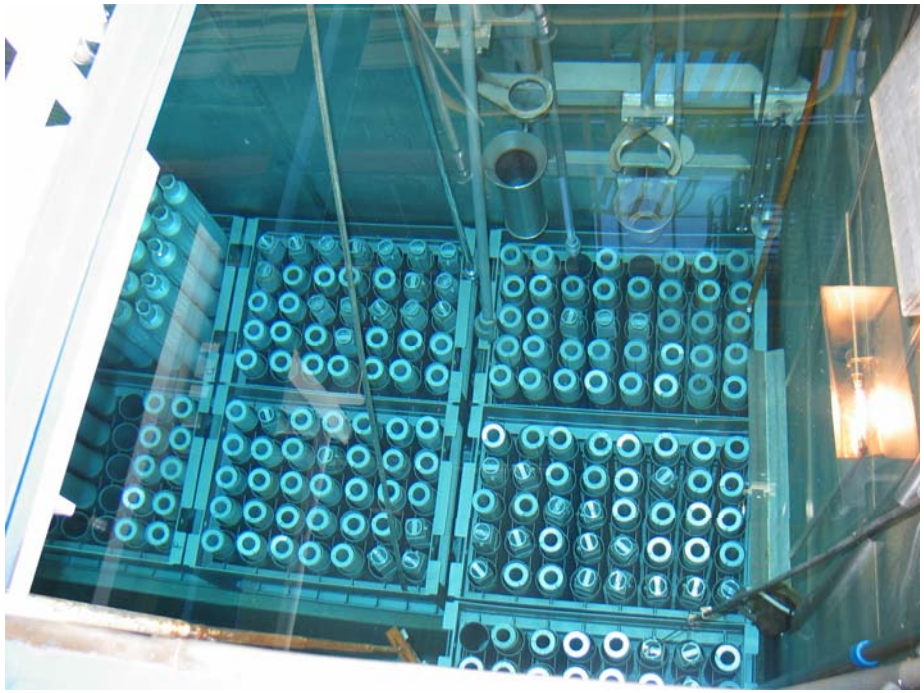
Tip

Environmental Monitoring Program

- Reporting to ARPANSA
- Sampling and analysis of:
  - air
  - water (surface & groundwater)
  - soil
  - biota
- Measurement of radioactivity (alpha, beta & gamma)
- Meteorology and hydrology
- Results are available to the public via the web or hard copies (Annual E-Report)

Spent Fuel Shipments

Shielded Transport Flask for Spent Fuel Elements at ANSTO



Transport Cask for Spent Fuel Elements Loaded and ready for Shipment

SPENT FUEL SHIPMENTS

- 1963 Dounreay 150 FA
- 1996 Dounreay 114 FA
- 1998 US SRS 240 FA
- 1999 COGEMA 308 FA
- 2001 COGEMA 360 FA
- 2003 COGEMA 344 FA
- 2004 COGEMA 276 FA

Total 1792 Fuel assemblies in 7 shipments

Reactor Decommissioning

There are internationally defined transitional stages from a final reactor shutdown to final decommissioning

- ***Stage 1*, reactor is permanently shutdown, the fuel is removed, the fluids drained from the facility and external materials can be disconnected or removed.**
- ***Stage 2*, the care and maintenance stage, where a state of monitoring and maintenance is maintained until the documentation and arrangements are in place for the third stage.**
- ***Stage 3*, the decommissioning, covers the entire decommissioning process including the removal of all radioactive and other wastes.**
- ***Stage 4*, the final stage called the unrestricted site use and the site is permitted to return to a "green field" site or used for other purposes without restrictions being imposed.**

Advantages of prompt decommissioning are:

- Decreased waste disposal/handling costs
- Decreased burden on future generations.
- Utilisation of existing technical know-how and expertise.
- Existing legislative and radiological standards are known.
- Reduced long-term care and maintenance costs.
- Increased confidence of the local community and stakeholders that the funding and expertise will be available to perform the decommissioning.

HOWEVER when there is not a national nuclear waste management policy and strategy in place then the above advantages are not feasible.

Solid Waste Generated at Each Stage of Decommissioning of the HIFAR Reactor

Type of waste	Tonnes	Tonnes	Tonnes
	Stage 1	Stage 2	Stage 3
Inactive Waste for off-site disposal	96		5,300
Low level waste	130	Limited	460
Long lived Intermediate level waste	8	0	492

Australia does not have a Radioactive Waste Disposal Facility

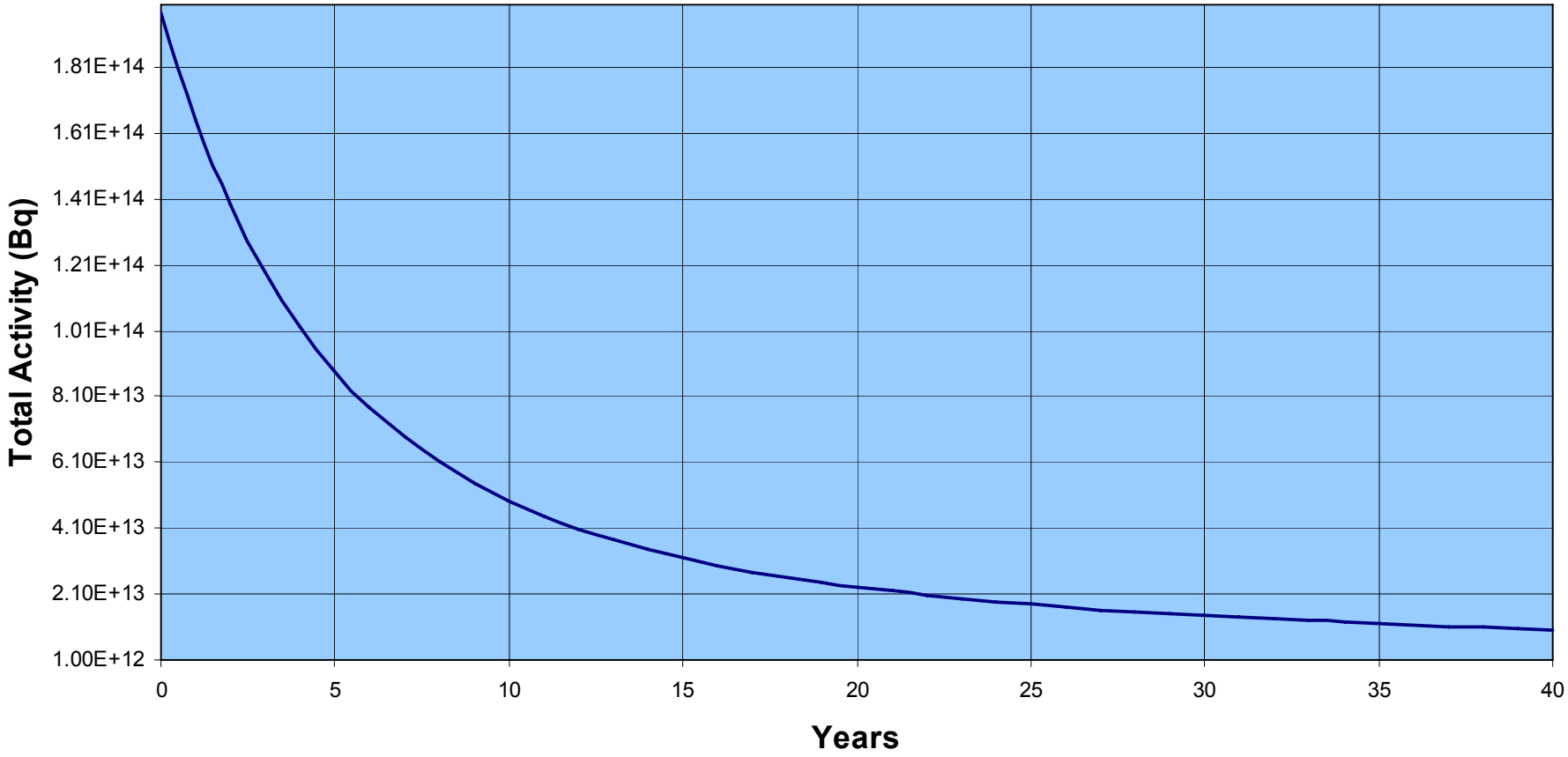
- Availability of a suitable radioactive waste disposal facility is still under review.

- Commonwealth Radioactive Waste Management Facility (CRWMF) being proposed in the Northern Territory to receive waste by 2012

- In reality this date is unrealistic.

- For the decommissioning of the HIFAR reactor there will be a waiting period of approximately 10 years to allow the CRWMF to be available by this time.

Radioactive Decay of DIDO Activity Inventory in Structural Materials over 40 years
(Isotopes included: ^{3}H, ^{14}C, ^{55}Fe, ^{60}Co, ^{63}Ni, ^{65}Zn, ^{113m}Cd, ^{133}Ba, ^{152}Eu & ^{154}Eu)



Processing

Decommissioning Wastes

HIFAR Facility Licence Application Part B(4)

RADIOACTIVE WASTE MANAGEMENT PLAN FOR THE HIFAR FACILITY

Document ANSTO/06/749/2/FP-4

May 2007

www.arpansa.gov.au/pubs/hifar/partb4.pdf

RADIOACTIVE WASTE MANAGEMENT ARRANGEMENTS

Waste Minimisation

- Segregation of wastes,
- Waste classification and characterisation,
- Delay and decay,
- Recycle and reuse,
- Exempt level waste system,
- Improved decontamination facilities,
- Waste management optimisation – pre-treatment, treatment, conditioning, transportation, storage and disposal.

Compliance with Appropriate Codes

- Code of Practice for the Disposal of Radioactive Waste by the User (1985);
- Code of Practice for the Near Surface Disposal of Radioactive Waste in Australia (1992); and
- Code of Practice for the Safe Transport of Radioactive Material (2001).

Limiting Exposure to Radioactive Waste

- Design and location of storage facilities (shielding and occupancy),
- Capture of wastes at source (eg dust collection when sample gathering),
- Delay and decay process,
- Radiation and contamination monitoring of waste items to ensure appropriate storage and segregation of waste items, and
- Appropriate shielding of transport containers.

Decontamination

Decontamination Protective Equipment

Using of Strippable Adhesives

Embedded

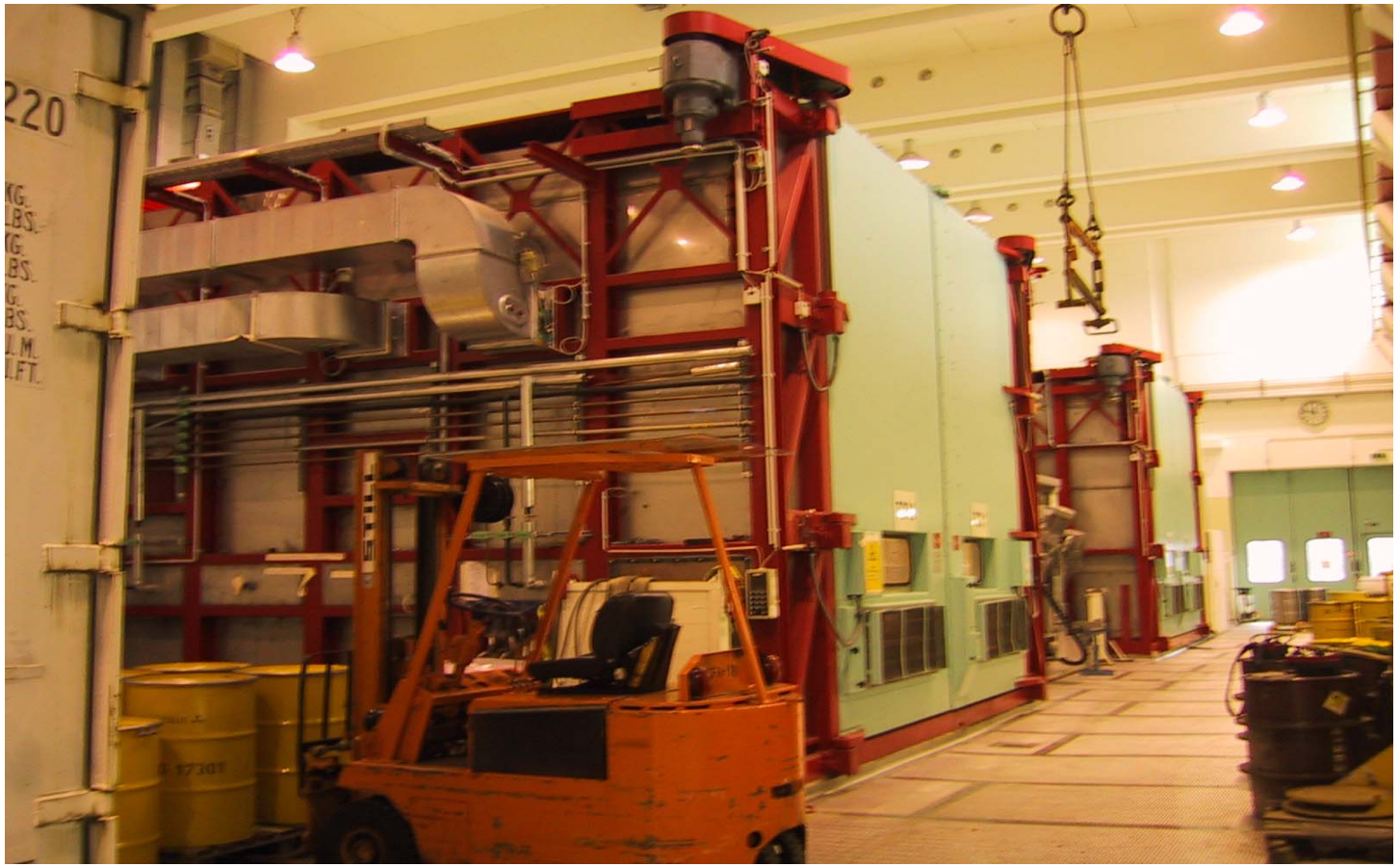
Non-etching (non-aggressive)

Etching (aggressive)

Waste Treatment and Packaging Facility

Volume Reduction by Super-compaction

Decontamination Chamber



Australian Government

Australian Nuclear Science and Technology Organisation

Exemption and Clearance of Wastes at ANSTO including Wastes from Decommissioning

Australian Regulatory Framework

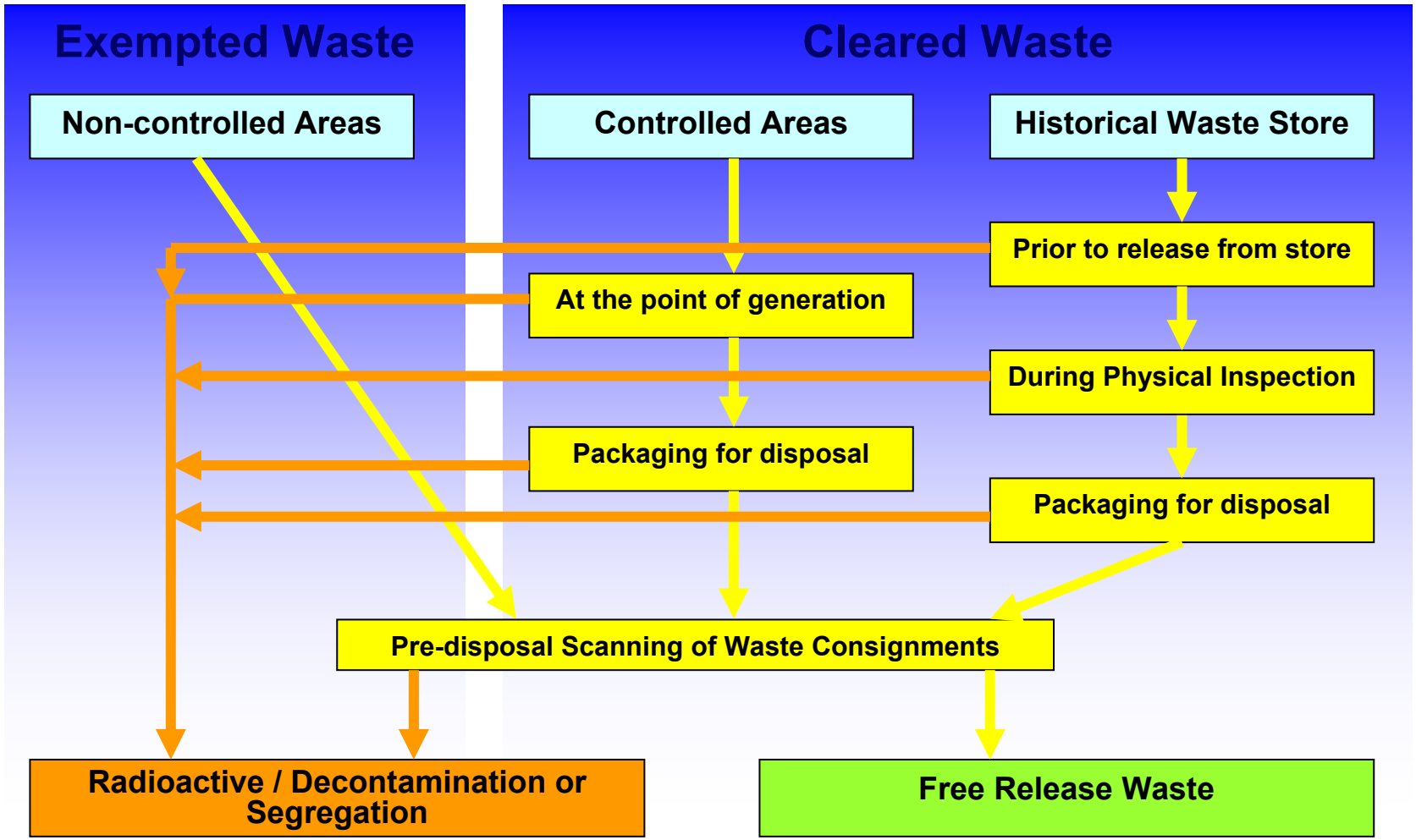
- Exemption
  - **Australian Radiation Protection and Nuclear Safety Regulation 1999**
  - **Different regulations in States and Territories**
  - **National Directory for Radiation Protection**

- Clearance
  - **RS-G-1.7 limits meet all other relevant limits for exemption for ANSTO**
  - **To be formally adopted by the national regulator (ARPANSA)**
  - **Good starting point for a national debate on clearance levels**

Assessment of Waste

- Defence in Depth approach to waste assessment
  - Multistage waste assessment
  - Visible and transparent processes
  - Long standing good working relationships with stake-holders
  - Managed under ISO 9001:2000 QM and ISO 14001 EM systems.

Assessment of Waste



Assessment of Waste

- Criteria
  - Contamination and dose
    - **Dose : Less than 1 μSv/hr above background**
    - **Contamination: 4 Bq/cm^2 of beta/gamma emitters and 0.4 Bq/cm^2 of alpha emitters**

Dose rate and contamination monitors

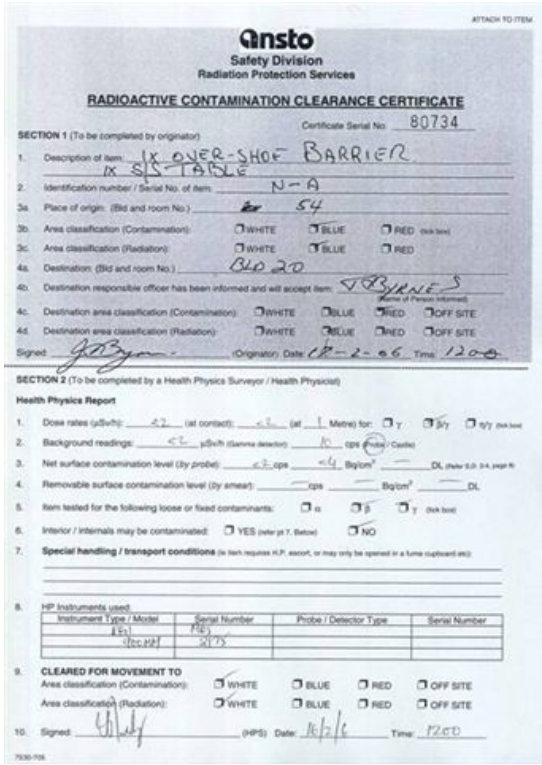
  - Activity concentration
    - **IAEA Safety Guide RS-G-1.7**
    - **Australian Radiation Protection and Nuclear Safety Regulation 1999**
    - **Radiation Control Regulation 2003 (NSW)**

Bulk gamma ray spectrometry

Assessment of Waste

- Contamination measurements

Health Physics Surveyors assessing waste



Ansto
Safety Division
Radiation Protection Services

RADIOACTIVE CONTAMINATION CLEARANCE CERTIFICATE

Certificate Serial No 80734

SECTION 1 (To be completed by originator)

1. Description of item: IX OVER-SHOE BARRIER IX S/S TABLE
2. Identification number / Serial No. of item: N-A
3a. Place of origin. (Bld and room No.) Bld 54
3b. Area classification (Contamination): ☐ WHITE ☐ BLUE ☐ RED
3c. Area classification (Radiation): ☐ WHITE ☐ BLUE ☐ RED
4a. Destination. (Bld and room No.) BLD 20
4b. Destination responsible officer has been informed and will accept item: T BYRNES (Name of Person Informed)
4c. Destination area classification (Contamination): ☐ WHITE ☐ BLUE ☐ RED ☐ OFF SITE
4d. Destination area classification (Radiation): ☐ WHITE ☐ BLUE ☐ RED ☐ OFF SITE

Signed: (Originator) Date: 12-2-06 Time: 1200

SECTION 2 (To be completed by a Health Physics Surveyor / Health Physicist)

Health Physics Report

1. Dose rates (μSv/h): <2 (at contact): <2 (at 1 Metre) for: ☐ γ ☐ β/γ ☐ n/γ
2. Background readings: <2 μSv/h (Gamma detector) N cps (Probe) / Counts
3. Net surface contamination level (by probe): <2 cps <4 Bq/cm² DL
4. Removable surface contamination level (by smear): cps Bq/cm² DL
5. Item tested for the following loose or fixed contaminants: ☐ α ☐ β ☐ γ
6. Interior / internals may be contaminated: ☐ YES ☐ NO
7. Special handling / transport conditions

8. HP Instruments used:

Instrument Type / Model	Serial Number	Probe / Detector Type	Serial Number
[illegible]	[illegible]		
[illegible]	[illegible]		

9. CLEARED FOR MOVEMENT TO
Area classification (Contamination): ☑ WHITE ☐ BLUE ☐ RED ☐ OFF SITE
Area classification (Radiation): ☑ WHITE ☐ BLUE ☐ RED ☐ OFF SITE

10. Signed: (HPS) Date: 12/2/6 Time: 1200

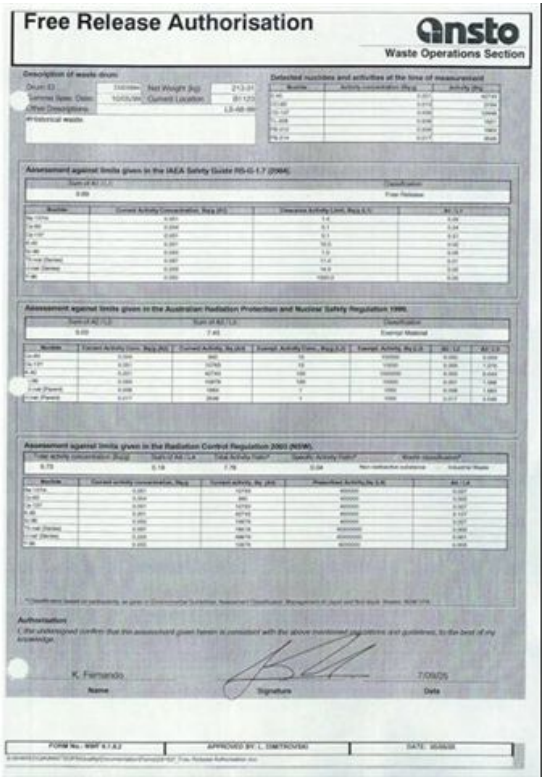
7530-705

Radioactive Contamination Clearance Certificate for disposal issued

Assessment of Waste

- Gamma ray spectrometry

Canberra® Q2 low-level waste assay system used



Free Release Authorisation issued for drums suitable for clearance

Assessment of Historical Waste

- Radiologically scanned by HP Staff during physical inspection

Waste removed from drums

Cleared waste scanned for contamination

Assessment of Historical Waste

- Scanned by Health Physics Staff after physical inspection and repackaging

Dose rate measurement after physical inspection and repacking

Empty drums cut into section to prevent re-use off site

Assessment of Waste

- Pre-disposal scanning of waste consignments

Exploranium AT-900 Vehicle Monitoring System

Future

- **5 Year Radioactive Waste Management Capital Plan approved to provide ANSTO with ongoing best practice Radioactive Waste Management Facilities**
- **Commonwealth Radioactive Waste Management Facility by 2012**
  - Co-located Near Surface Low Level Waste Repository
  - Above ground Intermediate Level Waste Store
- **MOATA 100Kw Research Reactor Decommissioning Plan has commenced**
  - All spent fuel has been removed and shipped to the US
  - Small volume (1m3) of ILSW to be processed and stored within existing ANSTO ILSW Storage Facility
  - Low level solid waste (about 60 m3) to be packaged in engineered containers for future processing by cement encapsulation for disposal to the proposed CRWMF .
- **HIFAR 10Mw Research Reactor in 10 Year Possession and Control Phase**
  - All spent fuel elements removed (last of HIFAR spent fuel to be shipped to the US in 2009
  - Stage decommissioning completed.
  - 10 Year Possess and Control Phase awaiting opening of the proposed CRWMF
- **Decommissioning of other facilities (radiation or nuclear facilities)**