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ANSTO Camperdown Decommissioning Licence Application

Document AC-D-LA-E6d

ANSTO CAMPERDOWN FACILITY WASTE MANAGEMENT PLAN

(Rev. 1)

**Prepared By
Australian Nuclear Science and Technology Organisation**

August 2010



REVISION SHEET		Document AC-D-LA-E6d			
		Print name, date and sign or initial			
Revision Number	Description of Revision	Prepared	Checked/ Reviewed	Approved	Agreed
0	Original issue	Algis Lencus Project Manager	Enrique Jarquin Waste Operations Duncan Kemp Waste Operations	Lubi Dimitrovski Waste Operations Facility Nominee	N/A
1	Revised to reflect SAC assessor comments	Algis Lencus 7 Sep 2010	N/A	Alec Kimber 7/09/2010	N/A



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1 PURPOSE AND SCOPE

The purpose of this Waste Management Plan is to outline the waste management systems to be utilised by the ANSTO Camperdown Facility Decommissioning project.

This plan sets out significant items to be transferred, their intended destination and the systems used to manage the transfer.

The majority of components removed from the Cyclotron vault and beam rooms are not intended for immediate disposal. Instead, they will be stored at suitable locations for a period to allow for possible re-use. The components will be disposed upon expiry of this period.

The scope of this plan includes:

- responsibilities for management of all waste generated by the decommissioning activities
- a summary of the inventory of waste generated by the decommissioning activities
- waste storage

This plan describes the arrangements and responsibilities for waste management and storage and gives details of the Stage 1 decommissioning activities (refer to the Decommissioning Plan [Reference 3] for a definition of Stage 1 and 2 activities).

There will be two types of materials generated by the decommissioning project:

1. Cyclotron magnetic structure and peripheral components that are intended to be managed for potential re-use;
2. Other items that are to be disposed.

Both of the above types of materials (with exception to the cyclotron magnetic structure) are to be stored at the Camperdown facility. Both types will be managed by the Project until their release to Waste Operations for any necessary waste minimisation, clearance and disposal.

This plan should be read in conjunction with other plans comprising this decommissioning licence.

2 RESPONSIBILITIES

2.1 General

ANSTO, as the licence holder, has responsibility for the management of the ANSTO Camperdown Facility dismantling operations. The CEO of ANSTO has delegated responsibility for the safe dismantling of the ANSTO Camperdown Facility to the General Manager, Engineering & Capital Programs (ECP), Nominee for the ANSTO Camperdown Facility-related licences.

The General Manager, Engineering & Capital Programs (ECP) has overall responsibility for the activities undertaken in the ANSTO Camperdown Facility during its dismantling period (including temporary storage of materials within the Facility), consistent with ANSTO policies and general arrangements.

The Waste Operations (WO) Manager is responsible for the management of all radioactive waste generated by the dismantling process from the ANSTO Camperdown Facility once it is transferred to Waste Operations control. That includes ongoing storage, processing and conditioning of radioactive waste.

2.2 ANSTO Waste Operations Section

Waste Operations (ARPANSA Facility Licence FO0044-4B) has waste transportation, processing and storage capabilities, and currently provides radioactive waste management and decontamination services to all ANSTO facilities, including the ANSTO Camperdown Facility.



The Waste Operations QA system includes requirements for periodic review of procedures on handling, transport, treatment and storage of radioactive waste. It also identifies the process of records maintenance for inspection and environmental monitoring of stored radioactive waste.

Waste Operations will provide the ANSTO Camperdown Facility project team with appropriate advice on Waste Operations procedures and current best practices on working with, safe handling and storage of, the wastes generated during physical dismantling. This will include input and review of appropriate Safe Work Method Statement (SWMS) required for the dismantling of the ANSTO Camperdown Facility cyclotron, hot cells and components.

Waste Operations will provide the following functions:

- Management and coordination of waste materials
- Registration of materials including waste type and database entry for inventory control of disposable waste
- Long term storage of disposed radioactive wastes
- Free release of materials deemed non-radioactive
- Packaging and labelling of materials
- Documentation for transport of materials
- Interim storage of cyclotron and hot cell components for future re-use or re-sale.

2.3 Project Manager

The General Manager, Engineering & Capital Programs has delegated responsibility for planning and implementation of dismantling activities to the Camperdown Facility Project Manager. The Project Manager is responsible for planning and managing resources to ensure the dismantling operations are undertaken in a safe manner. The project organisational chart is provided in the Effective Control Plan AC-D-LA-E6a.

The ANSTO Camperdown Facility Project Manager is responsible for the generation of a comprehensive report on the types and volumes of waste generated by the dismantling operations.

2.4 Contractor

Any contractors utilised by the project have the responsibility to comply with this plan and any direction as required from ANSTO and/or Project-authorized persons regarding waste management issues.

3 WASTE MANAGEMENT ACTIVITIES AND OVERVIEW

3.1 Overview

Waste has been produced by the ANSTO Camperdown facility over the operational life of the facility. The operational waste has been through a decay period followed by radiological scanning to determine whether the waste should be classed as radioactive or not. Remaining operational radioactive waste that is currently stored at Camperdown for further decay will be transported to the Lucas Heights facility for waste minimisation and disposal as part of standard ANSTO Waste Operations process.

A significant portion of the ANSTO Camperdown Facility is to be decommissioned to make way for a replacement facility. The existing cyclotron, control cabinets and hot cells components are to be removed from the site and stored for safekeeping with the intention of re-use either at ANSTO or to other organisations. The cyclotron peripheral and beam line components will be dismantled and relocated to the Camperdown Facility basement for storage for safekeeping with the intention of possible reuse either at ANSTO or to other organisations. As such, these items will be assessed, stored and managed, pending an examination of the most appropriate disposal options and utilising



the accepted waste management hierarchy of re-use, re-cycle, recover, treat, dispose etc. If the stored components cannot be re-used, it will be deemed as waste and plans will be prepared to dispose of the waste.

The items stored for possible re-use will not constitute an operable "particle accelerator that has, or is capable of having, a beam energy greater than 1 MeV" and therefore will not constitute a Prescribed Radiation Facility for the purposes of the ARPANS regulations. Furthermore, the collection of items stored will not constitute a full set of components from which a complete accelerator could be constructed without significant engineering works.

The remainder of the ANSTO Camperdown Facility building is to be cleared of unnecessary equipment or waste and decontaminated.

Items that will not be re-used will be collected as part of the decommissioning process. These waste items will be transported back to ANSTO Lucas Heights for waste processing.

There are no gaseous radioactive materials or fissile materials on site.

There is potentially active low level liquid waste in cyclotron pump oils, which will be drained and collected from pumps and transported to ANSTO Lucas Heights in approved packages.

3.2 Waste Management Tasks

Disposal, storage and decontamination of waste will utilise existing ANSTO Waste Operations processes.

Waste management tasks include:

1. Decontamination and cleanup to be carried out prior to decommissioning of the facility. This activity is in progress at time of writing with the intention to clear the building areas to improve safety and ensure that areas are decontaminated to allow for a safer working environment.
2. Packaging of materials for storage and/or transport.
3. Clearance of materials to be taken off-site.
4. Record keeping and tracking of all removed radioactive materials and/or valuable components.
5. Transport of materials (both active and inactive).
6. Ongoing and unchanged use of existing liquid waste effluent system.
7. Storage of removed components (at both the ANSTO Lucas Heights site and ANSTO Camperdown Facility).
8. Ongoing and unchanged maintenance of existing extract ventilation system.

Further detail on decommissioning tasks can be found in the Decommissioning Plan.

3.3 Waste Types

This section relates only to waste items, as opposed to items that have the potential for re-use.

3.3.1 Low Level Solid Waste

Low level solid waste will consist of items that are considered radioactive and have a dose rate below 2 mSv/h at contact. The low level solid waste will consist of: paper packaging, cleaning cloths, paper, gloves, shuttle bodies, contaminated tools, unwanted cyclotron components, parts and wiring, light globes, disposable overalls, activated metals, targets and other items determined to be non-useful which are radioactive. The low level solid waste will be packaged into red 200L drums which are in the ANSTO store have a Certificate of Design Approval as a type A package (085), and are allowed to use to transport radioactive items with a limit of 2 mSv/h at contact on the container.



3.3.2 Intermediate Level Solid Waste

Intermediate level solid waste (ILSW) will consist of items that are considered radioactive and have a dose rate above 2 mSv/h at contact. Any identified ILSW will be appropriately shielded and stored at Camperdown prior to transport to Lucas Heights utilising certified packages.

3.3.3 Low Level Liquid Waste

Low level liquid waste is waste liquids which are radioactive and can't be put into the normal liquid waste disposal process (governed by a permit with Sydney Water). This waste mainly consists of contaminated oils from use in pumps and cyclotron components. There are also chemical wastes which are radioactive and liquid in vials with trefoils. These wastes will be placed into packages that are approved to transport radioactive liquids.

3.3.4 Surface Contaminated Objects

Surface Contaminated objects, such as contaminated ductwork, will be assessed by Health Physics and labelled as SCO-I, SCO-II or SCO-III. The outside of these items will be wiped down at the Camperdown facility and then the item packaged into red 200L drums, as per Section 3.3.1. Any necessary size reduction will be through shear cutting methods to minimise generation of air-borne contamination.

4 SIGNIFICANT ITEMS TO BE REMOVED

The purpose of this section is to list the items to be removed over the course of the decommissioning project and to define the destination and approximate size of the items. The majority of items listed can potentially be and are to be stored and not initially disposed. Items to be removed from the two SPECT beam rooms (Rooms 0051 and 0061) and the SPECT Lab (Room 0048) are not listed – these items are intended for removal as part of Stage 2 work (Reference 3) and are subject to a separate planning and approval process.

Item No.	Component	Destination*	Qty	Packaging Dimensions (m)			V _v (m ³)
				L	W	H	
Cyclotron & "Direct" Ancillaries							
1.1	Cyclotron magnetic structure	L	1	2.7	2.7	2	14.6
1.2	Internal RF Components	C	2	1	0.5	0.5	0.5
1.3	Switching Magnet and assembly (to North SPECT Beam Room)	C	1	1	0.8	0.4	0.32
1.4	Switching Magnet and assembly (to South SPECT Beam Room and PET Beam Room)	C	1	1	0.8	0.4	0.32
1.5	Ion source assembly	C	1	2	1	1	2
1.6	Main Vacuum pump	C	1	1	0.4	1	0.4
1.7	Pedestals (4 off)	L	4	0.5	0.5	0.5	0.5
1.8	Stripper rod arm assembly (North)	C	1	1.7	0.5	0.6	0.51
1.9	Stripper rod arm assembly (South)	C	1	1.7	0.5	0.6	0.51
1.1	Stripper rod carousel assembly (North)	C	1	0.3	0.3	0.3	0.03
1.11	Stripper rod carousel assembly (South)	C	1	0.3	0.3	0.3	0.03
1.12	Stripper rod sleeve assembly (North)	C	1	0.5	0.1	0.1	0.01
1.13	Stripper rod sleeve assembly (South)	C	1	0.5	0.1	0.1	0.01
1.14	Hydraulic Lifters (2 off)	L	2	0.6	0.3	2	0.72
1.15	Cryogenic pumps (2 off)	C	2	0.5	0.5	0.7	0.35
1.16	Cyclotron Platform (assembled size)	L	1	3.5	3.5	0.5	6.13
1.17	RF Cabinet	L	1	0.5	0.7	0.8	0.28
1.18	Vacuum Pumps above cyclotron	C	2	0.6	0.3	0.4	0.14
1.19	Cooling manifold	L-W	1	0.2	1	1	0.2



Item No.	Component	Destination*	Qty	Packaging Dimensions (m)			V (m ³)
				L	W	H	
1.20	Power and instrumentation cabling and pneumatic lines for services	L-W	1	25	0.2	0.1	0.5
				Subtotal			28
	North SPECT Beam Line Components within Cyclotron Vault						
2.1	Permanent magnet doublet quadrupole	C	1	0.6	0.3	0.3	0.05
2.2	Faraday cup assemblies (body only – not including shutter)	C	2	0.3	0.3	1	0.18
2.3	Beam line table and supporting structure	C	1	2	0.5	0.2	0.2
2.4	Cooling Manifold	L-W	1	0.2	1	1	0.2
2.5	Power and instrumentation cabling and pneumatic lines for services	L-W	1	15	0.2	0.1	0.3
2.6	Vacuum valve	C	1	0.25	0.15	0.5	0.02
2.7	Faraday cup (shutter assbly only)	C	2	0.05	0.1	0.1	0
2.8	Triplet quadrupole (in SPECT wall)	C	1	2	0.5	0.5	0.5
2.9	Vacuum pump	C	1	0.6	0.3	0.4	0.07
2.10	Diagnostic cube	C	1	0.2	0.2	0.2	0.01
				Subtotal			1.53
	South SPECT Beam Line Components within Cyclotron Vault						
3.1	Permanent magnet doublet quadrupole	C	1	0.6	0.3	0.3	0.05
3.2	Faraday cup assembly (body only – not including shutter)	C	2	0.3	0.3	1	0.18
3.3	Beam line table and supporting structure	C	1	2	0.5	0.2	0.2
3.4	Cooling Manifold	L-W	1	0.2	1	1	0.2
3.5	Power and instrumentation cabling and pneumatic lines for services	L-W	1	15	0.2	0.1	0.3
3.6	Vacuum valve	C	1	0.25	0.15	0.5	0.02
3.7	Faraday cup (shutter assbly only)	C	2	0.05	0.1	0.1	0
3.8	Diagnostic "Cubes" and beam detecting fingers	C	1	0.2	0.2	0.2	0.01
3.9	Vacuum pump	C	1	0.6	0.3	0.4	0.07
3.10	Target transfer piping	C	1	9	0.2	0.3	0.54
				Subtotal			1.57
	PET Beam Line Components within Cyclotron Vault						
4.1	Variable doublet quadrupole	C	1	0.6	0.5	0.5	0.15
4.2	Faraday cup assembly (body only – not including shutter)	C	2	0.3	0.3	1	0.18
4.3	Beam line table and supporting structure	C	1	2	0.5	0.2	0.2
4.4	Cooling Manifold	L-W	1	0.2	1	1	0.2
4.5	Power and instrumentation cabling and pneumatic lines for services	L-W	1	10	0.2	0.1	0.2
4.6	Vacuum valves	C	1	0.25	0.15	0.5	0.02
4.7	Faraday cup (shutter only)	C	2	0.05	0.1	0.1	0
4.8	Diagnostic "Cubes" and beam detecting fingers	C	1	0.2	0.2	0.2	0.01
4.9	Vacuum pumps	C	1	0.6	0.3	0.4	0.07



Item No.	Component	Destination*	Qty	Packaging Dimensions (m)			V (m ³)
				L	W	H	
				Subtotal			1.03
	PET Vault Room Components:						
5.1	Beam line (inc. PMQ)	C	1	2	0.4	0.4	0.32
5.2	Target station Rack & Shield	C	1	0.6	1	2.5	1.5
5.3	Support table and structure	C	1	1	0.5	0.5	0.25
5.4	Power and instrumentation cabling and pneumatic lines for services	L-W	1	8	0.15	0.1	0.12
5.5	Cooling manifold	L-W	1	1	1	0.2	0.2
5.6	Faraday Cooling Heat Exchanger	C	1	1.4	0.6	1.3	1.09
				Subtotal			3.48
	Control Room components:						
6.1	IBA cabinets and electronics	L	1	0.7	16	2	22.4
6.2	Cabling to IBA electronics	L-W	1	20	0.15	0.1	0.3
6.3	SCADA computer and cabling	C-W	1	1	1	0.5	0.5
6.4	Furniture	C-W	4	2	1	1	8
6.5	Interlock and alarm system cabling and equipment	L-W	1	0.6	1	2	1.2
				Subtotal			32.4
	GMP area components:						
7.1	4 VonGahlen Hotcells	L	4	1.4	0.95	2.5	13.3
7.2	1 large VonGahlen Hotcell	L	1	1.4	1.2	2.5	4.2
7.3	2 FDG shielded enclosures	L	2	1.4	0.6	1.7	2.86
				Subtotal			20.4

Table 1: Items to be transferred as part of decommissioning

* Destination for transferred items as follows:

L Stored at ANSTO Lucas Heights for approximately a 2 year period

C Stored at ANSTO Camperdown Facility (Basement storage area) for approximately a 2 year period

L-W Disposed to ANSTO Lucas Heights for categorisation and clearance

C-W Disposed to Municipal Waste Collection

Total packaged volumes for the above items with respect to each storage / disposal location is as follows:

Destination	Packaged Volume (m ³)
Stored at ANSTO Lucas Heights	65
Stored at ANSTO Camperdown Facility Basement	11
Disposed to ANSTO Lucas Heights	4
Disposed to Municipal Waste (clean waste)	8.5

There is capacity to store the above items at all proposed locations.

With exception to the cyclotron that is activated and will be removed via the cyclotron vault roof plug, the vast majority of items to be taken off-site will be inactive and will be removed via the Camperdown Facility Loading Dock.

The transfer of any items to other organisations will follow the ARPANS legislative requirements.



5 STORAGE

No new stores are to hold the components to be removed by this project. Two key areas will be used for storage of the cyclotron and its beam line components:

- ANSTO Lucas Heights – Hut 36 (managed by ANSTO Waste Operations):
 - Cyclotron magnetic structure, pedestals, hydraulic jacks and platform are to be stored at this location;
 - This site is managed by Waste Operations.
- ANSTO Camperdown – Basement, Room L1002 (managed by ANSTO ECP):
 - Beam line components and cyclotron peripherals are to be stored at this location;
 - This site is managed by Engineering & Capital Programs.

Both locations are suitable for the solid components that are to be stored and have adequate space for storage, stacking and sorting and will have radiation surveys recorded as advised by the ANSTO Radiation Protection Adviser. All equipment will be appropriately packaged for the storage timeframe. Radiation warning signs will be maintained at the entrance to both stores.

The dose rate in Room L1002, which will be used to store cyclotron vault and PET beam room components will be monitored and storage of any activated components in this area will be arranged such that dose rates to staff entering the area will remain low. This will be achieved by sorting, positioning and shielding activated items.

Where necessary, items with relatively high levels of activity will be stored in the heavily shielded SPECT Beam Rooms to minimise dose rate levels within the Basement.

Clean (non-radioactive and uncontaminated) equipment will be transferred to other stores at ANSTO Lucas Heights.

The ANSTO Camperdown Basement storage facility floorplan is shown in Figure 1 below:

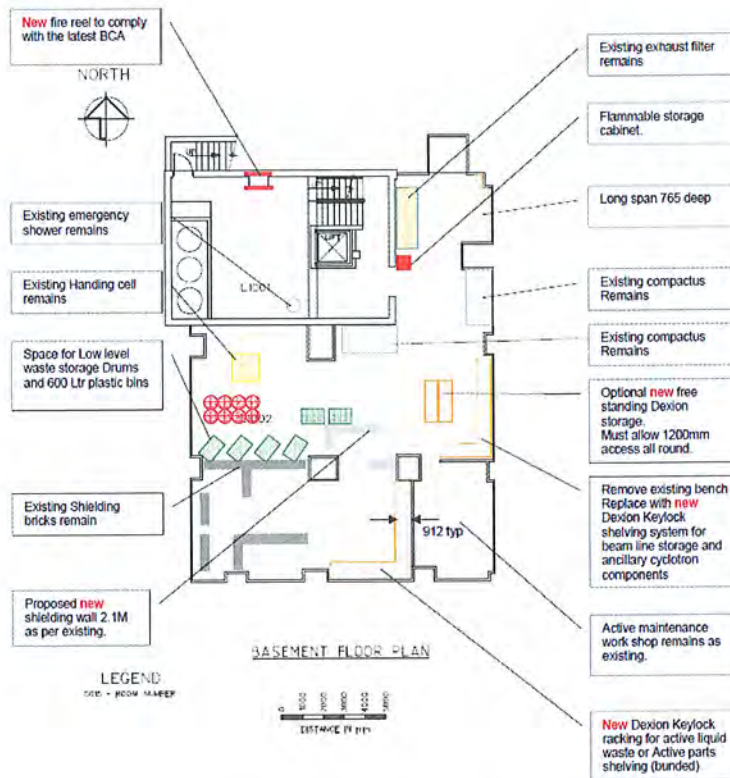


Figure 1: Basement Storage Layout

6 WASTE MINIMISATION AND TREATMENT

The majority of items to be transferred from the ANSTO Camperdown Facility have the potential for reuse. It will be managed as waste, but will not undergo a waste minimisation or treatment process initially. Nevertheless, identified waste that may have undergone neutron or proton irradiation or may have contamination will undergo waste minimisation and/or treatment as per standard ANSTO Waste Operations practice. This will occur at the ANSTO Lucas Heights site at dedicated Waste Operations facilities.

Any waste is generally stored for a minimum of 7 years and then reassessed to determine if stored materials have decayed below exemption levels. Materials below exemption levels will then be re-used or recycled.

The cyclotron magnetic structure is to be stored at the ANSTO Lucas Heights site for approximately a two year period. If it is not reused, it too, will undergo a waste minimisation process under another project.

7 PACKAGING

All items to be transported from the ANSTO Camperdown site are assessed to determine packaging in accordance with Reference 1. All packages are to be labelled as per Section 7.4.

7.1 Cyclotron Packaging

The 55 tonne cyclotron magnetic structure has been assessed by way of sampling, gamma spectrometry of samples and computational analysis (Reference 2). The cyclotron will be packaged for transport based on this assessment.



7.2 Waste Packaging

Waste will be collected into drums and will be weighed and scanned by Health Physics using portable gamma spectroscopy instruments and contamination monitors. The Health Physicist will then calculate the most likely radionuclide and the quantity of that material in the drum. This information will be recorded in a spreadsheet, on the drum and on the manifest for the transport. The drum will then be moved to the loading dock for transport.

Any drums containing liquid waste will be put into Hazspill (approved hazardous goods secondary containment) containers before being loaded for transport.

7.3 Packaging of Items for Potential Re-use

An assessment will be conducted for all items removed from the cyclotron vault and beam rooms, even if they are not to be removed from the Camperdown Facility. These will be assessed on site by recording dose, radionuclides, weight and a determination of most restrictive specific activity to determine packaging requirements. Data recorded for cyclotron vault and beam room items will be kept in a database retrievable by label attached to the item. The assessment for these items will be conducted in Room L1001 of the Camperdown Facility basement, which is a low background (low dose-rate) environment, prior to its storage in Room L1002. Assessment results will be used to arrange for suitable packaging for when these components are to be transported.

Assessment of hot cells will be conducted as they are disassembled. The hot cells in the GMP Area (Rooms 0037 and 0038) are expected to be inactive, uncontaminated and below exempt levels. The disassembled hot cells will be moved to the loading dock for transport.

All other items to be transported from the ANSTO Camperdown site for potential re-use will also require an assessment to determine packaging in accordance with Reference 1. Many components to be transported are likely to be below exempt levels, this includes the Camperdown Facility Control Room cabinets. These items will be moved to the loading dock for transport.

7.4 Labelling

All packages containing radioactive material will be clearly labelled with a radiation trefoil. The label will include a description of the contents, radionuclide information, the estimated activity when packaged, date of packaging, Transport Index and ANSTO contact details in the event of an abnormal occurrence. The dose rate of each package will be recorded for the at-contact and at-one-metre distance to the surface of the package. This dose rate information will be included in the dated package label.

8 TRANSPORT

Information on the transport of the cyclotron is provided in overview in Reference 3 and in detail in Reference 4.

Items below exempt levels (inactive and uncontaminated items) to be sent to ANSTO Lucas Heights will be transported from the ANSTO Camperdown Facility loading dock.

Transport of all other items above exempt levels will be from the ANSTO Camperdown Facility loading dock only if appropriately packaged and documented.

Appropriately packaged items above exempt levels in the loading dock will have the weight, dose rate, Transport Index sticker, radioactive trefoil symbol, brief description of the waste (liquid/solid/metal) and a unique identifier. The identifier will be the connection to the manifest, spreadsheets and other documentation for the waste shipment. Barrier tape can be set up for any active materials which is significantly above the background dose rate to prevent people resting near, or walking past, radioactive materials.



A dangerous goods transport vehicle and driver will be used for the transport and will be labelled front and rear with Dangerous Goods Category 7 labels. The truck will then leave Camperdown and travel to Lucas Heights via the following route:

From Camperdown

- Missenden Rd, Camperdown
- King St, Newtown
- Princes Highway, St Peters to Arncliffe
- Forest Rd, Bexley
- Stoney Creek Rd, Bexley
- Forest Rd, Beverley Hills
- Henry Lawson Drive
- Alford's Point Bridge
- New Illawarra Rd, Lucas Heights
- ANSTO

At Lucas Heights the truck will be unloaded. The waste will then enter the normal Waste Operations processes.

9 ROUTINE DISCHARGE OF WASTE

With exception to sewer and municipal waste, there is no routine discharge of waste at the ANSTO Camperdown Facility as part of this project.

Existing effluent and ventilation extract systems will remain unchanged. Monitoring of discharge will be maintained and reported.

10 RECORD KEEPING

ANSTO Radiation and Contamination Clearance Certificate (RCCC) forms shall be used for the removal of all items from the ANSTO Camperdown Facility. Copies of these forms shall be attached to the item in question and a reference copy kept by the Project.

ANSTO Waste Operations Service Request (WOSR) forms shall be used for the removal of all waste items from the ANSTO Camperdown Facility. Copies of these forms shall be attached to the item in question and a reference copy kept by the Project.

Dangerous Goods Shipper's Declaration forms shall be used for all active and/or contaminated items from the ANSTO Camperdown Facility. Copies of these forms shall be attached to the item in question and a reference copy kept by the Project.

A label-based inventory database will be maintained by the ECP for all cyclotron and beam line components that are to be stored. A waste register will be maintained by Waste Operations. Both systems will keep a record of a description of the item along with dose, weight and radionuclide information.

Waste Operations maintains a waste inventory of all its stores and maintains a record of all WOSR forms.

Design records associated with the cyclotron and beam line components will be maintained by the project.



11 REGULATORY STANDARDS

There are a number of ARPANSA standards relevant to waste management that have been utilised by ANSTO as part of its current arrangements. These include:

1. For radiation requirements, refer to the Radiation Protection Plan AC-D-LA-E6c;
2. Safety Guide for the Predisposal Management of Radioactive Waste (2008); and;
3. Code of Practice for the Safe Transport of Radioactive Material (2008).
4. "Environmental guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes"; NSW Dept of Environment, Climate Change and Water

In addition, a Trade Waste Permit is in place between ANSTO and Sydney Water for discharge of trade waste effluent to the sewer.

12 REFERENCES

1. ARPANSA Code of Practice, "Safe Transport of Radioactive Material", Radiation Protection Series 2, 2008 Edition.
2. "NMC source term evaluation" memorandum from Fernando Esposto to Algis Lencus, NASDOC RP10-0154
3. ANSTO Camperdown Decommissioning Licence Application, "Decommissioning Plan", AC-D-LA-E7a
4. Cyclotron Removal & Transport: Transport Plan – Toll Project Services