Australian Government
Department of Industry, Science, Energy and Resources

National Radioactive Waste Management Facility

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Ensuring the safe management of radioactive waste at the facility

Strict waste management controls are fundamental to the safety of operations at the National Radioactive Waste Management Facility, and will guide what material can and cannot be accepted at the facility and how the waste will be managed on site.

Radioactive waste is currently held in more than 100 locations around the country – including at the CSIRO, ANSTO, the Department of Defence, universities and hospitals.

The first layer of control is the Waste Acceptance Criteria that defines processes that need to be undertaken, quality assurances that must be given, and standards that must be met, prior to any waste being sent to the facility. These form one part of the multiple safety measures that underpin the design and operation of the National Radioactive Waste Management Facility.

The facility will ultimately be the location where low level waste is safely disposed, and intermediate level waste is safely stored until a separate intermediate level waste disposal facility is established. Only waste whose contents is fully understood, documented, meets the criteria and which is packaged in a fit-for-purpose and appropriate container (as confirmed by the independent radiation protection and nuclear safety regulator) will be accepted.

The controls are part of a comprehensive set of policies, personnel and infrastructure put in place to ensure that the facility is safe at all times for people, local businesses and the environment. This will be the case at all times – from when the waste arrives, to when it is put in storage, through to when the low level waste will no longer present a hazard, and the intermediate level waste is moved to a permanent disposal facility in another location.

Managing Low Level Waste

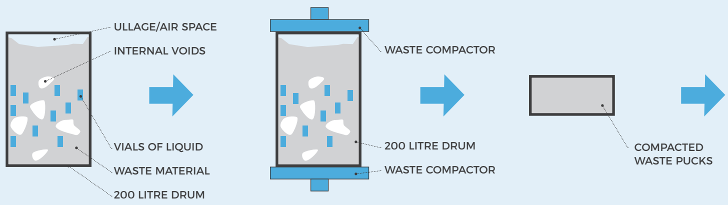
Preparing for transport

In order to meet the Waste Acceptance Criteria, specific treatments will be tailored for each type of waste. An example of such waste treatment is outlined in Figure 1. Here, the proposed treatment process for steel drums containing low level waste from ANSTO's facilities is described. Likely contents would include radiation-contaminated swabs, paper tissues, plastic gloves, used vials and waste metal items like medical tools.

ANSTO will treat laboratory waste by placing the steel drums of waste in a super-compactor and crushing the drum into a stable, puck-shape. Air spaces and any trace amounts of liquids will be squeezed out of the waste (and the liquid is treated separately and safely).

The compacted drums (puck-shaped objects) will then be loaded into a larger drum, and a high performance cement mix will then be poured around them to fill the void spaces in the drum. Therefore, there are three barriers: the original compacted drum, the cement grout and a new outer drum.

Figure 1. Example of low level waste treatment.



Step 1

Low level waste (LLW), in 200 litre metal drum, contains vials of liquid and air pockets.

Drum is scanned to determine the composition and LLW status confirmed.

Step 2

Waste material and drum compacted in a super-compactor.

Step 3

Compacted waste now has no voids and free liquids have been squeezed out.

Waste is now solid.

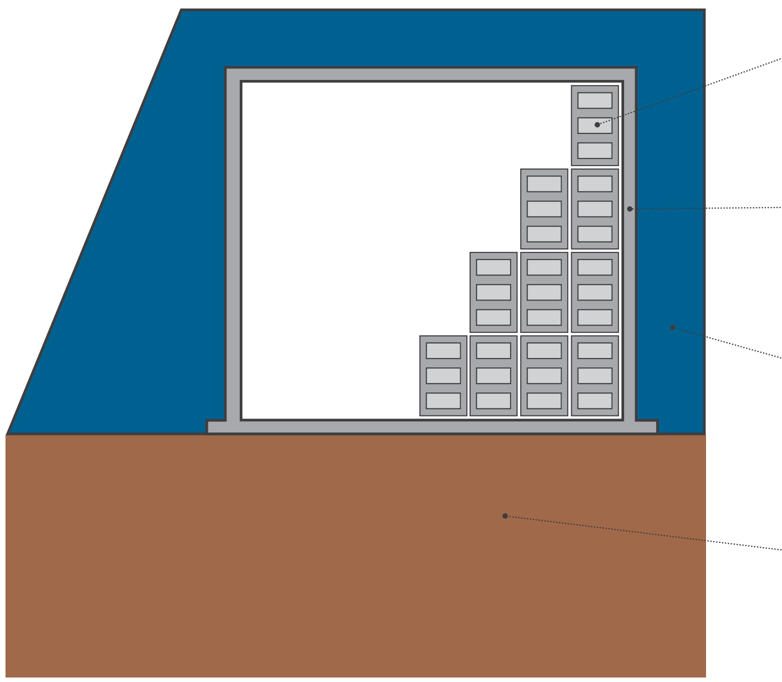
Arrival and disposal

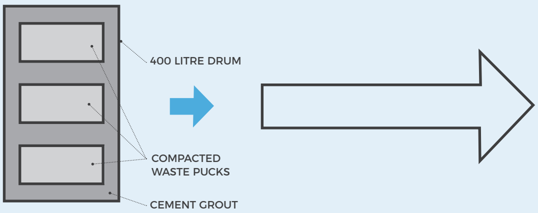
When the low level waste arrives at the facility, checks will confirm the measurements and specifications recorded prior to transport. The waste will then be unloaded at a special receiving area. Any final packing will then be done, noting that at no time will the waste be open to the environment or workers.

Once ready for final disposal, the low level waste will be placed in above-ground, engineered concrete vaults. Each vault, when filled with waste, will be concreted shut and capped. Complete isolation of waste from the environment and containment of radioactivity will be achieved by the combination of these barriers: the waste package itself; the disposal cell and vault construction and properties; the final capping layer; and aspects of the site geology.

These will combine to prevent the release of radioactivity into the environment. The multi-barrier approach is illustrated in Figure 2 (noting that various types of waste packages may be used).

Figure 2. Illustration of multi-barrier vault for low level waste.





Step 4

Waste pucks are cemented into a 400 litre drum.

Step 5

Waste packages are transported to the National Radioactive Waste Management Facility.

If, after testing by experts at the waste producer, it was determined that waste doesn't need any specific conditioning, then it would be packaged appropriately and safely for transport to the facility.

Barrier 1

The waste package itself.

Barrier 2

The disposal cell and vault construction and properties.

Barrier 3

The final capping layer.

Barrier 4

Aspects of the site geology.

Managing Intermediate Level Waste

Preparing for transport

Intermediate level waste is currently stored in a range of conditions and facilities around Australia. Before it can be transported for storage, most of it will require conditioning into a solid matrix and packaging into secure rated containers.

Two methods for preparing intermediate level waste are explained here:

Synroc

An Australian innovation called Synroc will be used by ANSTO to treat intermediate level liquid waste from the ANSTO Nuclear Medicine production facility – turning it into a highly durable, low volume, stable, solid matrix that meets the Waste Acceptance Criteria.

At ANSTO, the liquid waste will be taken from its storage tank and dried in a special drier called a calciner. The dry waste powder will then be mixed with additives. This mixture will then be loaded into a stainless steel can and treated by hot isostatic pressing using pressure and heat, forming Synroc.

Before transport and storage, the Synroc cans will be placed into a shielded container, which absorbs radiation and makes the waste safe for handling and transport from ANSTO to the National Radioactive Waste Management Facility.

Synroc can and cut-away of the synroc wasteform.

Vitrification

Over several years, several shipments of spent fuel from the research reactors at ANSTO were sent over to France for reprocessing.

This essentially involves the recycling of useful material that can still be used as fuel, and the treatment of the remaining material, in a process called vitrification, so that it is solidified and safe for transport and storage.

First, the waste material (after reprocessing) is mixed with molten glass to produce a durable waste form.

The molten glass is then poured into stainless steel canisters, each of which weighs around 500 kilograms when full.

Those containers are sealed and inserted into a TN-81 transportation and storage cask which is made from forged steel.

The TN-81 cask is 6.5 metres long and 3 metres in diameter, with walls more than 20 centimetres thick. It weighs 95 tonnes when empty and can hold up to 28 containers of vitrified waste.

In line with international obligations, in 2015 the TN-81 cask returned to Australia (as shown below).

Arrival and storage

Properly conditioned and packaged intermediate level waste can be managed safely for very long periods of time above ground, but will eventually need to be moved to a final disposal site. While the material inside the containers will be more radioactive for far longer than low level waste, storage of the intermediate level waste packages will pose no risk to people or the environment. You will be able to stand next to the buildings storing the most radioactive intermediate level waste, with no special or protective clothing.

The intermediate level waste will be stored at the National Radioactive Waste Management Facility in one of two ways:

1) Intermediate level waste packages in dual-purpose transport / storage containers, such as the TN-81. These waste packages are shielded and will be stored at the facility without needing shielded buildings.

2) Intermediate level waste packages transported in shielded reusable transport containers: these waste packages will be removed from a transport container, and then stored in a secure shielded storage building.

The TN-81 container is so shielded, that standing about 10 metres away for one hour, you would receive the equivalent radiation dose to eating half of one banana.

Defence in depth approach to safety

Fundamental to the safety of the facility is the defence in depth approach. What this means is that a hierarchy of systems, controls and barriers perform safety functions independently of each other, so that even if one of the systems, controls or barriers fail, a number of others will function independently to ensure protection of the health and safety of people and of the environment.

At the highest level the management controls, including Waste Acceptance Criteria, will assure that the facility will receive:

- Australian low level waste, for permanent disposal
- Australian intermediate level waste, for temporary storage
- Waste forms that are physically and chemically stable, solid, non-dispersible, not reactive and not flammable
- Waste packaged in fit-for-purpose containers that are resistant to degradation
- No radioactive waste generated by other countries
- No high level waste (which Australia does not hold or generate)
- No liquid or gaseous wasteforms

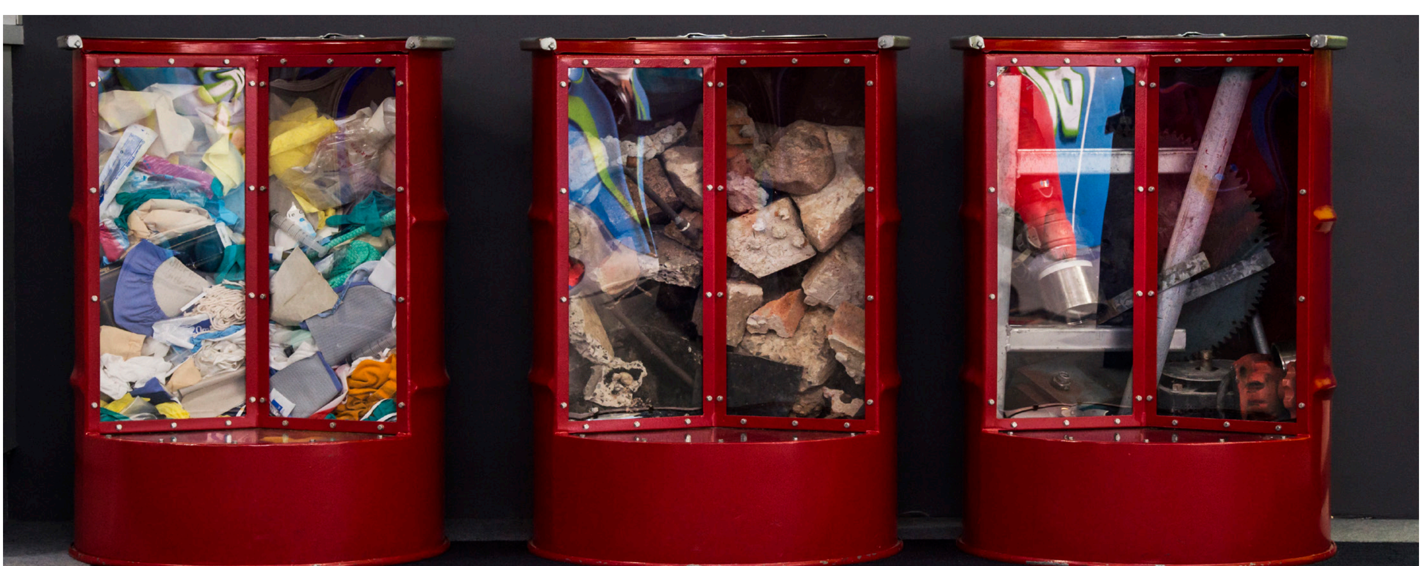
Where is the development of the management controls and Waste Acceptance Criteria up to?

Just as the facility design and the safety case will be developed further as the project progresses, so too will management controls such as Waste Acceptance Criteria. As the site has been identified, they will be developed and refined to ensure they are fit-for-purpose and right for the site.

The controls and Waste Acceptance Criteria concepts are developed in consultation with a range of national and international technical experts and key waste holders and stakeholders (such as ANSTO, CSIRO, the Department of Defence and ASNO). They are based on standards set down by the IAEA, operating experience from the United Kingdom, France, Spain and Belgium, but also set to meet Australia's needs.

We will make preliminary and operational documents about the Waste Acceptance Criteria available to the public. Further, the final Waste Acceptance Criteria will be required as part of the licence application, and will therefore be assessed as part of the license application by the radiation protection and nuclear safety regulator ARPANSA.

As part of their licensing process, ARPANSA will invite submissions and conduct public consultation on the license application, including the Waste Acceptance Criteria. More information is available at www.arpansa.gov.au.



Operational life of the facility

The facility will have an operational life of 100 years. After that it will be decommissioned and monitored for a further 200-300 years subject to regulatory approval, until residual low level waste materials are fully safe and needing no further controls. The waste management controls for low level waste being employed at the facility will be appropriate for these timeframes. Intermediate level waste will be temporarily stored at the facility for several decades, until a separate long-term disposal site is developed and built. Controls for temporary storage at the facility will be appropriate for these timeframes. Intermediate level waste requires disposal at greater depths than low level waste, because of its radioactivity.

Table of comparable radiation doses

Radiation exists naturally in the environment, normally present in rocks and soil and even in bricks, mortar, tiles and concrete. In Australia, the average background radiation dose is approximately 1.5 millisieverts (mSv) per year.

We can also be exposed to additional doses of radiation in a number of common ways – from air travel, medical scans, granite, concrete and other construction materials. These everyday items and activities can minimally increase our radiation dose, but they do so well within safe limits.

At the boundary of the facility, radiation levels will be indistinguishable from the existing background levels, and will be well within safe levels inside the facility itself. This will be guaranteed by the multi-barrier approach to waste management.

SOURCES OF DOSE	AVERAGE DOSE	COMMENTS/COMPARISONS
Normal background radiation in Australia	1.5 mSv per year	This is the radiation we all receive from day to day natural sources (our houses, our food, and the sun, earth and atmosphere).
The average dose that a radiation worker at ANSTO receives per year	1.75 mSv per year for radiation workers	This is added to the background dose that a radiation worker – who works directly with the material – receives per year, to give the worker a dose of 3.25mSv/y. This is the equivalent of receiving one abdomen scan (13mSv) every 7.4 years.
ARPANSA safety limits for radiation workers	20 mSv per year for radiation workers	These limits are additional to the background radiation. As you can see, ANSTO manages exposure levels for workers and to the public well below ARPANSA limits.
ARPANSA safety limits for the general public	1 mSv per year	These limits are additional to the background radiation. By way of comparison, if you stood at the boundary of ANSTO for an entire year, you would get a maximum additional dose of 0.1 mSv. This is equivalent to radiation caused by the sun at altitude, received in a flight from Melbourne to London.

This document is part of a series of factsheets providing information on the process to site the National Radioactive Waste Management Facility.

For more information

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