

There are three options for removing the radioactive waste from the submarines.

This stage is called 'initial dismantling' and this factsheet briefly explains the steps involved in each of the options being considered.

Initial dismantling does not include ship recycling (or ship breaking) which is a separate activity.

Introduction

'Initial dismantling' is the first stage in the process of dismantling the submarines. During this stage the residual radioactive materials remaining after the submarine has been defuelled are removed from the submarine. Almost all these materials are confined to the Reactor Compartment (RC) and, in particular, the Reactor Pressure Vessel (RPV) within the RC. However, the whole submarine will be checked and cleared of radioactive contamination to ensure it is below legal limits. The hull can then be transported to a ship recycling facility to be broken up and recycled in a similar way to surface ships.

The three options

There are three ways in which the radioactive material could be removed from the submarines (which are described in more detail overleaf):

- Separate and store the RC 'RC Separation';

- Remove and store the Reactor Pressure Vessel (RPV) 'RPC Removal';
- Remove and size reduce the RPV for storage as 'Packaged Waste'.

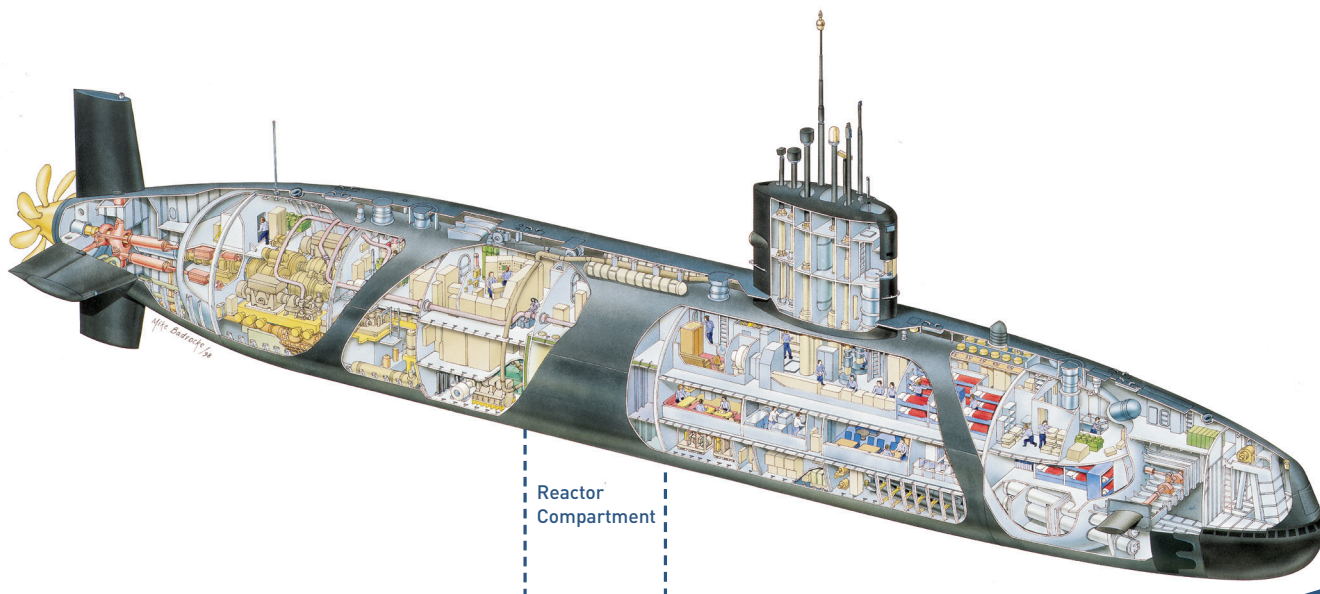
The main difference between the options is the form in which the Intermediate Level radioactive Waste (ILW) is stored and at what stage in the process it is size reduced (ie. cut up into smaller pieces) and packaged. In each option, the waste is size reduced and packed into approved containers before it is sent for eventual disposal in the proposed Geological Disposal Facility (GDF) – for more information see the factsheet **Managing Radioactive Waste**.

Size reduction and disposal in GDF:

The GDF design is still in development and its requirements for accepting waste (eg. size, weight and radioactivity) have yet to be finalised. Current plans assume that the RPV would need to be size reduced (cut into smaller pieces) in order to fit in packages that could be accepted in GDF. However, avoiding the need for size reduction by disposing of whole RPVs to GDF is a significant opportunity that is being explored.

Preparing the submarine

Before any dismantling begins, the defuelled submarine will be moved into a dry dock, which enables access all the way around and underneath the submarine. Any of the submarine's systems which still contain liquids will be drained, in preparation for dismantling and ship recycling.



Option 1: Separate and store the RC

The entire RC is separated from the front and rear sections of the submarine and stored whole. This leaves the hull of the submarine in two pieces, which then have to be sealed, by welding metal plates over the open ends, or rejoined so it can be transported to the ship recycling facility.

Prepare the submarine

- Make a cradle and weld it to the underside of the RC to provide support while it is being separated from the hull.
- Isolate and seal any internal pipe work or cables protruding from the RC.

Prepare the RC

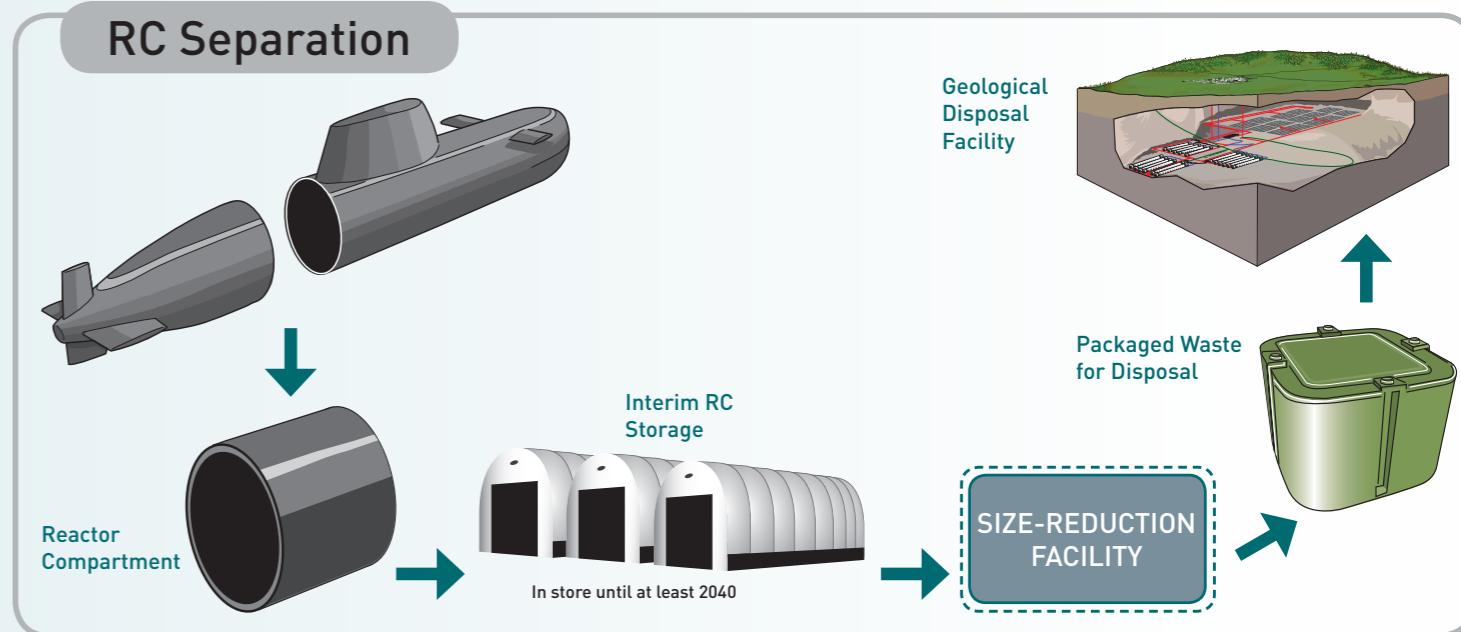
- Make two cuts either side of the RC (uses similar cutting techniques to commercial shipbuilding since work inside the RC is not involved).

- Separate the front and rear sections of the submarine hull from the RC.
- Weld metal plates to each side of the RC.

Separate and store the RC

- Move the RC to the dockside.
- Move the RC to interim ILW storage facility.

At some point in the future, the RPV would be removed from the RC, cut into smaller pieces and the ILW packaged for disposal in the proposed GDF (sometime after 2040).



Option 2: Remove and store the RPV

The RPV and other radioactive materials are removed through a hole in the hull of the submarine, leaving the submarine intact. The hole is closed afterwards to make the submarine watertight again for transport to the ship recycling facility.

Prepare the submarine

- Manufacture and install lifting arrangements for the RPV.
- Construct a temporary containment structure around the RC section of the hull.

Prepare the RPV

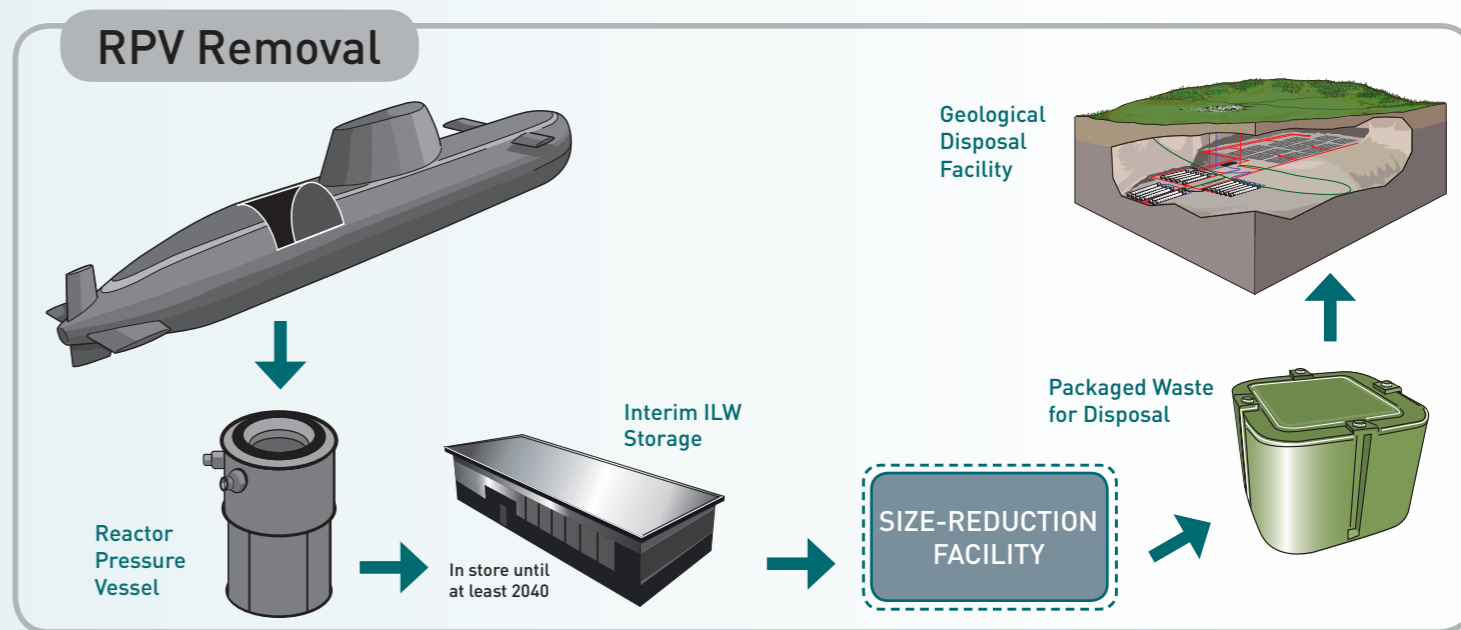
- Cut an access hole in the submarine's hull, large enough for the RPV to be removed.

- Cut and seal all pipes and systems connected to the RPV.
- Prepare RPV to be moved.

Remove and store the RPV

- Remove the RPV from the submarine and place in an approved container.
- Remove pipe work in the reactor system for decontamination and / or packaging as radioactive waste.
- Transport the RPV to the interim ILW storage facility.

At some point in the future, the RPV would be cut up into smaller pieces and the ILW packaged for disposal in the proposed GDF (sometime after 2040).



Option 3: Remove and size reduce the RPV for storage as packaged waste

The RPV and other radioactive materials are removed through a hole in the hull of the submarine, leaving the submarine intact. The hole is closed afterwards to make the submarine watertight again for transport to the ship recycling facility.

Prior to storage the RPV is size reduced and packaged for transport to the interim store.

Prepare the submarine

- Make a cradle on which to lift the RPV.
- Construct a temporary containment structure around the RC section of the hull.

Prepare the RPV

- Cut an access hole in the submarine's hull, large enough for the RPV to be removed.

- Cut and seal all pipes and systems connected to the RPV.
- Prepare RPV to be moved.

Remove and transfer the RPV

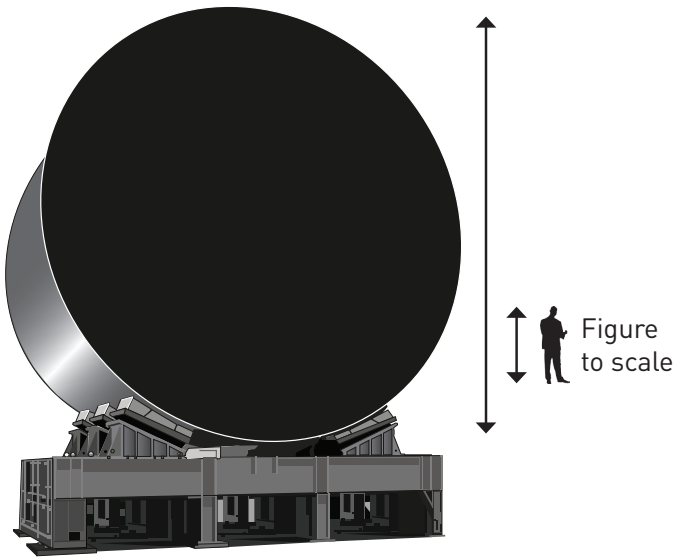
- Remove the RPV from the submarine and place in an approved container.
- Transport the RPV to the size-reduction facility.

Size reduce the RPV

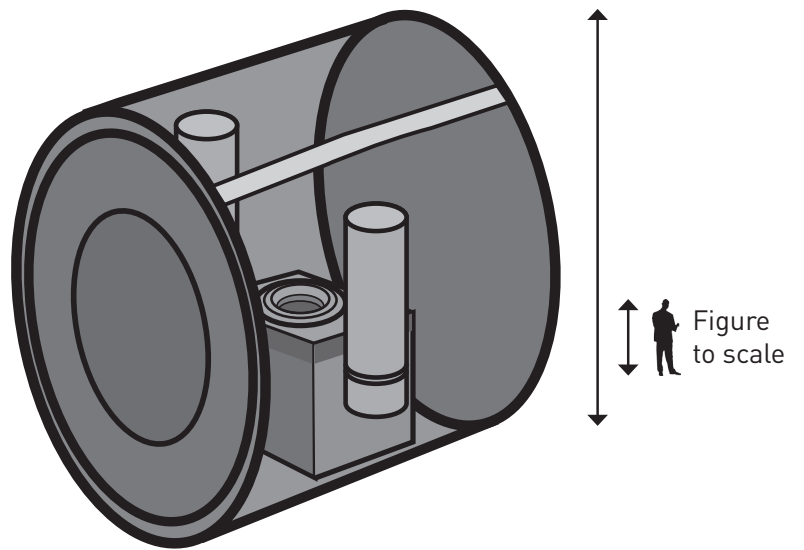
- Cut up the RPV and pack the pieces in approved containers.
- Transport the packaged ILW to the interim ILW storage facility.

No further cutting up or packaging would be required in future and the ILW containers would be transported for disposal in the proposed GDF once it is available.

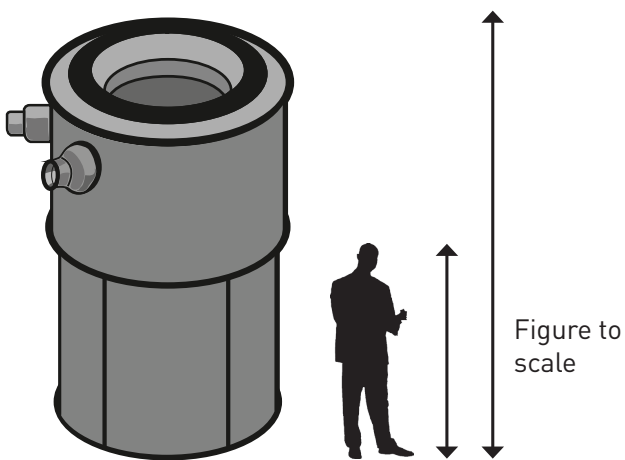




A Reactor Compartment during the building of a submarine.



RPV inside RC



A Reactor Pressure Vessel

Scaled illustrations of Reactor Compartment and Reactor Pressure Vessel