

## Introduction

The Submarine Dismantling Project (SDP) is the MOD's programme to deliver a safe, secure and environmentally responsible solution for dismantling 27 defuelled submarines. This involves recycling the bulk of the submarine and safely disposing of the remainder.

The submarine's Reactor Pressure Vessel (RPV) contains Intermediate Level radioactive Waste (ILW) and must be stored for an interim period until it can be processed and sent to a proposed Geological Disposal Facility (GDF) sometime after 2040.

This Topic Summary provides information on the RPVs and the Transport and Storage Container.

## Reactor Pressure Vessels

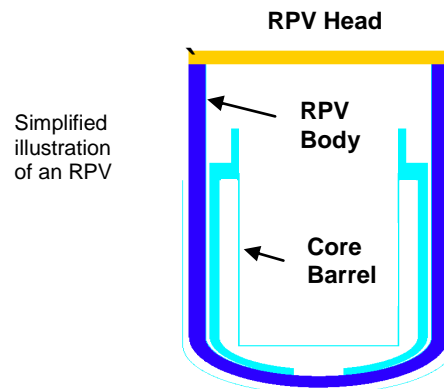
The Reactor Pressure Vessel consists of a main RPV body and the RPV head which is bolted to it. It contains a number of internal steel components, including the core barrel which holds the fuel when operational.

High pressure, high temperature water circulates through the RPV and then through what is known as the primary circuit. The water transfers the heat generated by the nuclear fission reaction in the fuel to the steam generators where steam is raised for conversion to propulsion and electrical power.

RPVs are made of forged steel tens of centimetres thick. Depending on the type, a defuelled RPV is typically around 3 metres in diameter and 4 metres high and weighs between 50 and 80 tonnes.

As the RPV has been exposed to neutron radiation during service, it will have become radioactive itself ('activated').

Radiation levels vary throughout the RPV but are very much lower at the outside of the RPV compared to the internal surfaces. However, because the RPVs will be stored whole - as agreed following the previous public consultation - the entire RPV is treated as ILW.



## Preparations for Removal and Transport

Prior to transferred to the SDP for dismantling, the submarine will have undergone a De-fuel, De-equip and Lay-up Preparation (DDLUP) process at the dockyard. Before the submarine dismantling process starts, all of the nuclear fuel will be removed, leaving the core barrel in place and the primary circuit will be drained.

Some other components of the reactor system, for example the primary coolant circuit, primary shield tank and steam generators, will also be either activated or contaminated but predicted levels are much lower and they will be removed and sent for disposal as Low Level Radioactive Waste (LLW). All levels of radioactivity will have to be measured, monitored and formally demonstrated to the regulators.

In preparation for the extraction of the RPV body from the submarine, any remaining free liquid will be removed from the RPV. The drying procedure is not yet finalised and therefore subject to change but might include inert gas dehumidifying.

The RPV head will then be removed and a simpler replacement head fitted utilising the existing bolting system. The original RPV head is known to be LLW and will be disposed of through established LLW decontamination and disposal routes.



The nozzles connecting the RPV body to the primary cooling circuit pipework will be cut and the nozzle openings closed with blanking plates to ensure that the RPV remains sealed.

The replacement head will hold the core barrel in place and provide shielding against the high dose rates from the internal components of the RPV. It will also facilitate lifting the RPV from the submarine.

The RPV itself will then be removed from the submarine and placed into a bespoke container which protects it and provides shielding.



The Container lid is removed and RPV is loaded into container



The Container is lifted onto transport trailer

## The RPV Container

The current pre-concept design described here would allow a robust thick-walled steel container with internal shock-absorption and external impact protection for both transport and storage. The containers will have to meet applicable national and international standards for both purposes.

Alternative approaches will, however, continue to be explored, including the use of different materials and different packaging combinations for transport and storage.

The RPV and container together will weigh approximately 90 tonnes for the reactor types from the earlier submarines and 135 tonnes for the later, larger, reactor type. Due to the weight, special handling fittings will be required on the container.

The SDP is currently assessing two types of packaging for practicability and suitability for the transport of the RPVs: 'Industrial Package Type 2' (IP-2) and 'Type B'. The choice will be made in consultation with the appropriate Regulators. The principal differences between the two will be the detailed construction, the dimensions and the test regimes.

Based on the pre-concept IP-2 design, typical overall dimensions of the transport container are estimated as follows.

- Transport container for the first generations of RPVs from older submarines: Length 4.8m x Width 3.2m x Height 3.2m.
- Transport container for the second generation of RPVs: Length ~6 m x Width ~4m x Height ~4m

If a Type B container was to be used, it is expected that the external dimensions and bounding masses of the laden container would substantially increase.

## More Information

Further information and all SDP consultation documents are available at:

<https://www.gov.uk/government/publications/submarine-dismantling-project-interim-storage-of-intermediate-level-radioactive-waste>

In particular, see *Supporting Information on RPVs and RPV Store*.

