

DECOMMISSIONING OF NUCLEAR SUBMARINES

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Nuclear submarines can be problematic, with many uncertainties, becoming hazardous especially as they age, littering the ocean and causing storage issues at docks; spent nuclear fuel that's hard to get out. Decommissioning requires dismantling of the submarine, which has proved challenging; they need to be sealed and the reactor blocks de-fuelled, as carried out by the US Department of Defense's Puget Sound Naval Shipyard in Bremerton, Washington. Russia also started to employ this method of decommissioning. This involved improving technology and storage at their de-fuelling facility in Severodvinsk and their dismantling facility, and by building a land-based storage facility for the decommissioned reactors. Land based storage, sometimes remote, is important to protect from elements of the weather. In the UK, nuclear submarines are being decommissioned and the UK is assisting Australia in a three way partnership with the US to acquire nuclear submarines but lacks a clear plan on how to decommission the submarines and safely dispose of the nuclear waste in Australia.

United Kingdom

In a world first, the UK is attempting to dismantle a vessel. The Submarines Delivery Agency (SDA) is responsible for dismantling 27 nuclear submarines, 21 of which are decommissioned but 20 are yet to be disposed of. If it is cut up by 2026, the UK will be first country to achieve that and will be a global first. "To completely dispose of an active nuclear submarine there are several steps." (Navy Lookout, 2022) The process has been a long time in the making so safety is achieved. About 10 years has been spent investigating alternative methods but dismantlement has been adopted. The UK Department of Defence needs the necessary space, infrastructure, skills and regulatory approvals. The Submarine Dismantling Project (SDP) finally started at Rosyth in December 2016, around 15 years behind schedule. (Navy Lookout, 2022) They were originally not being de-fuelled as facilities were not meeting requirements. Sites of where to store the pressure vessels and spent fuel were yet to be determined, raising community concerns as the number of defunct vessels rises. Many of the older boats have asbestos lagging around pipes, which also has to be removed with exceptional care and disposed of in sealed containers. (Navy Lookout, 2022) The Ministry of Defence (MoD) has now selected the Capenhurst Nuclear Services (CNS) site in Cheshire as the preferred site to store radioactive reactor pressure vessels (RPVs) meaning that decommissioning work could begin on the submarines. The decision was made based on policy, operational, health and safety and environmental factors as well as whole life costs and the responses from public consultation on the short-listed sites for storage. A major cause of delays has been the selection of a land storage site for radioactive waste. Currently no site has been selected for a geologic disposal facility (GDF). The MoD has dealt with this uncertainty by making plans to store the submarine wastes at Capenhurst until 2120 if necessary.

Nuclear submarines have been in operation since the 1960s and disposal at sea was banned by the London Dumping Convention in 1983. "Successive governments failed to make arrangements for the timely disposal of these boats." (Navy Lookout, 2022) Safely disposing of them has only been addressed more recently yet the UK is still struggling with the dismantling and storage of radioactive parts from its decommissioned boats. Small reactors sealed up and contained within the submarines safely while awaiting dismantling can be expensive. Rules have also become stricter and more complex, delaying the process and increasing the amount of nuclear waste to be disposed of and adding to costs, environmental and reputational risks, capacity and dock space. "In the civil nuclear industry, operators are required by law to put aside funds and make plans during the life of the plant to pay for decommissioning." "While awaiting dismantling, decommissioned submarines are stored afloat in a non-tidal basin in the dockyard." (Navy Lookout, 2022) Risk still remains. This can cause concern for residents living nearby and those opposed to nuclear submarines.

Submarine	Location	OSD	Hull age	Reactor	Notes
Dreadnought	Rosyth	1980	62	Defuelled	
Conqueror	Devonport	1990	53	Defuelled	
Warspite	Devonport	1991	57	Defuelled	
Churchill	Rosyth	1991	54	Defuelled	
Swiftsure	Rosyth	1991	51	Defuelled	LLW removed Dec 2016 - Aug 2018
Courageous	Devonport	1992	52	Defuelled	Preserved as a museum vessel
Revenge	Rosyth	1992	54	Defuelled	LLW removal began Mar 2020 (delayed by COVID)
Valiant	Devonport	1994	59	Defuelled	
Resolution	Rosyth	1994	56	Defuelled	LLW removed Dec 2018 - Mar 2020
Repulse	Rosyth	1996	55	Defuelled	
Renown	Rosyth	1996	55	Defuelled	
Splendid	Devonport	2003	43	Fuelled	
Sovereign	Devonport	2006	49	Fuelled	
Spartan	Devonport	2006	44	Fuelled	
Superb	Devonport	2008	48	Fuelled	
Trafalgar	Devonport	2009	41	Fuelled	
Sceptre	Devonport	2010	46	Fuelled	
Turbulent	Devonport	2012	40	Fuelled	
Tireless	Devonport	2014	39	Fuelled	
Torbay	Devonport	2017	37	Fuelled	
Trenchant	Devonport	2021	36	Fuelled	
Talent	Devonport	2023*	34		Extended in service
Triumph	Devonport	2025*	31		Extended in service
Vanguard	Devonport	2031*	30		Exact OSD dependent on Dreadnought programme
Victorious	Devonport	2034*	29		
Vigilant	Devonport	2037*	27		
Vengeance	Devonport	2040*	24		

OSD = Out of Service Date Hull age = from year of launch to 2022 LLW = Low Level (nuclear) Waste *Estimated OSD

Figure 1 - Dismantling of nuclear submarines in UK. Source: Navy Lookout.

United States

“Other nations use a much simpler process and cut the entire reactor compartment out of the submarine and transport it structurally complete for burial in land storage facilities.” “The US has successfully disposed of over 130 nuclear ships and submarines since the 1980s.” (Navy Lookout, 2022) France has already disposed of 3 boats from their much smaller numbers. (Navy Lookout, 2022) There was concern about fuel storage in the US. The compartment enclosing the reactor and primary system needs to be cut out, sealed and disposed of, requiring repository space. The repository space can be reduced by recycling of the contaminated primary system by decontamination and melting. Radioactive material needs to be contained above ground and even then, some radiation leaks can occur. No country in the world has a repository for high-level nuclear waste. The only deep underground nuclear waste repository in the world – the Waste Isolation Pilot Plant in the US, for disposal of long-lived intermediate-level nuclear waste – was shut down from 2014 to 2017 following a chemical explosion in a waste barrel (Green, 2021). Some waste is also still being stored unsafely underground above aquifers in the US, threatening water sources and crops. Nuclear submarines are still being built in the US and Russia despite these expensive and long-term measures required to make them safe.

AUKUS

In September 2021 the Australian, UK and US heads of state announced a new partnership “AUKUS” and their intention to assist nuclear-powered submarines for Australia. (ICAN Australia, 2022) Eight nuclear-powered submarines will be built in Adelaide, operated by the Royal Australian Navy, with construction beginning before the end of this decade. The Australian Government intends to maximise participation in the 18 month program to identify an optimal way to achieve this capability. It has been announced that the Department of Defence will sponsor defence employees and other public servants at the Australian National University as part of its Nuclear Science Academic Program, training a workforce capable of building and

maintaining these nuclear submarines. Currently, there is a petition circulating objecting to this (www.change.org/p/vice-chancellor-brian-schmidt-no-aukus-at-anu/).

Although nuclear submarines have better speed, manoeuvrability and endurance when compared with conventional submarines, Australian nuclear submarines pose a threat to the Nuclear Non-Proliferation Treaty, the broader safeguards regime and peace in our region (ICAN Australia, 2022). “This would undermine global efforts to phase out the use of highly-enriched uranium. It would encourage other countries to seek nuclear submarines fuelled with highly-enriched uranium.” (ANFA, 2021) “Further, Australian nuclear submarines would increase nuclear dangers and are an unnecessary, precedent-setting and retrograde step.” (ICAN Australia, 2022) “A nuclear submarine program would leave a legacy of many tonnes of low-, intermediate- and highlevel nuclear waste. The Australian government has been silent about disposal of nuclear waste generated by a nuclear submarine program.”

Australia does not have a central facility for the storage or disposal of radioactive waste. Past attempts to site a national waste repository were unsuccessful due to community concern and resistance from state governments. Waste from a nuclear submarine program would likely be dumped on Aboriginal land, as is the case with the federal government's current plan to dump Australia's nuclear waste. “Instead of adding to the legacy of nuclear waste and the elevated risk of nuclear conflict, the government should clean up existing radioactive sites and take steps to build peace and justice.” (ANFA, 2021)

References

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