Substandard

The Trident whistleblower and the safety of British submarines

John Ainslie

On 17 May 2015 the *Sunday Herald* published serious allegations of safety and security weaknesses on Britain's Trident submarines.[1] The article was based on an 18-page report from Able Seaman William McNeilly.[2] McNeilly was training to be a missile technician on a Trident submarine and had been onboard HMS *Victorious* throughout its patrol from January to April 2015. He said 'the Trident programme is a disaster waiting to happen'.[3]

This report places McNeilly's allegations in the context of known safety issues with British nuclear submarines. Individual incidents on submarines have briefly attracted media attention – HMS *Astute* running aground on Skye, the collision between a British and French submarine, a nuclear powered submarine stranded in Gibraltar for one year. However, these episodes slip quickly from the public mind. The list of problems here is long, but not comprehensive, because one recurring feature of nuclear submarines is secrecy.

John Ainslie is Coordinator of Scottish CND. This report, first published on Scottish CND's website on 28 May 2015, shortly after AB McNeilly's own report appeared, placed McNeilly's revelations 'in the context of known safety issues with British nuclear submarines'. We are grateful for permission to reprint it in The Spokesman.

Summary

McNeilly's report brings together descriptions of what he saw onboard HMS *Victorious* and accounts that he heard of incidents and problems on other nuclear submarines. He outlines safety concerns, defects, security breaches and careless practice.

Official reports show that the Navy does not have enough Suitably Qualified and Experienced submariners to operate the Trident missile system or the reactors on nuclear submarines and that the greatest risk to the safety of the Defence Nuclear Programme comes from a shortage of personnel.

An overemphasis on operational requirements, at the expense of safety, has contributed to a number of submarine incidents in recent years.

The Trident missile was designed in a way that introduces a greater risk than other types of nuclear missile.

Between 2009 and 2012, fires on British nuclear submarines took place at a rate of around one every six weeks. Problems identified in a fire on one submarine in 2004 were repeated in a subsequent fire two-and-a-half years later.

There are 13 known collisions involving British nuclear submarines and 11 incidents when submarines have run aground. There have been three major generic defects with the reactor designs on British nuclear submarines. These were discovered in 1989, 2000 and 2012.

There is an unacceptable risk of a terrorist attack on a Trident submarine in the Faslane shiplift and there have been instances of sabotage on submarines in service with other navies.

The reactors on British submarines are much less reliable than those on American submarines. This means that there is a significant risk that a submarine could go into an uncontrolled dive.

Summary of allegations made by William McNeilly

Safety concerns

McNeilly repeats a report he heard of a fire in the Missile Compartment of a Trident submarine. Toilet rolls, stacked in the Missile Compartment, caught fire. This filled several of the decks of the compartment with smoke. The crew struggled to bring the incident under control and had difficulty using their breathing apparatus.

Able Seaman William McNeilly

Despite this earlier incident, McNeilly says that the risk of a fire in the Missile Compartment wasn't taken seriously. A major fire in the missile area can only be brought under control by flooding the compartment with nitrogen. However, he said that the nitrogen cylinders were significantly below the required pressure. Restrictions on personal electronic equipment, which could trigger an electrical fire, were not enforced. McNeilly told his superiors about rubbish near the missiles, which could have caused a fire, but no action was taken.

He was concerned about the risk of an electrical fire. He says no attempt was made to isolate electrical equipment after a leak was detected in the Riders' Mess (Riders are extra personnel on the vessel). There were serious problems with condensation in parts of the submarine. A sprinkler system was accidentally activated in the torpedo room. Some of the personal electronic equipment used by submariners had not been PAT tested.

Crew members who work on the Trident missile system should have a thorough knowledge of CB8890, the manual for Trident safety and security. However, McNeilly's exam on the manual was a sham. Some who missed the test were allocated results at random.

The status of the Trident missiles is monitored at the Control and Monitoring Panel (CAMP), but this was not always manned. An audible alarm on the panel was muted because it was going off repeatedly. A second recurring alarm in the Missile Control Compartment, due to a problem with power from one of the Turbo Generators, was also ignored.

One of the more hazardous operations conducted by missile engineers is the insertion of DC/AC inverters in the missiles before a patrol and their removal after a patrol. To do this they have to open a hatch in each missile tube and gain direct access to the missiles. McNeilly describes how the removal of inverters at the end of their patrol was rushed and they did not follow the written procedures or the practice used on US submarines.

Installing inverters on a Trident missile onboard a US submarine[4]

Other safety issues identified by McNeilly are:

- There was a list of defects on the Trident missile system on HMS *Victorious* and the list was almost full.
- One of the decks in the Missile Compartment was used as a gym and weights were thrown and dropped near missile equipment.
- Extra beds blocked access to DC switch boards and a hydraulics isolation valve.
- Use of banned substance in cleaning material, causing problems with fumes.

- There was an incident when a generator compartment was flooded on a submarine and this could have resulted in the loss of the vessel if it had been handled differently.

Defects on Trident submarines

McNeilly says that at the end of the patrol they tested the Missile Compensation System on HMS *Victorious*. This system should quickly restore the balance of the submarine after a missile is launched, to enable each subsequent missile to be fired. The test was carried out three times, and each time the test failed.

The missile hatches on the submarine are powered by the Main Hydraulic Plant. At the end of the patrol they should have tested that they would have been able to open the hatches if required. But they were unable to conduct the test because of seawater in the hydraulic system.

These two problems meant that they could not confirm that the submarine could have launched its missiles when on patrol.

McNeilly says that there was noise from the diving planes when the vessel submerged at the start of its patrol and that this was part of a wider problem with diving planes. Jammed planes can lead to the loss of the submarine in an uncontrolled dive.

There were problems with the turbo generators, which provide the main power source, and with one of the diesel generators, which are the back-up power source. The safety of the submarine would be compromised if both sources of electrical power were lost.

HMS Victorious *under repair at Faslane on 23 May 2015 (bank holiday weekend)*

In addition to these problems on HMS *Victorious*, McNeilly refers to defects on other submarines. He says that there are currently only two operational Trident submarines, probably due to refit and maintenance cycles, and that there are major defects on both the operational vessels.

He visited a Trident submarine in the shiplift and many of the items of equipment were tagged with red markers, either for maintenance or defects. When they were told not to touch anything in the submarine's control room, one of the crew responded 'nothing works, you can touch what you like'. Crew members manning the Missile Control Centre said their equipment was all 'f***ed'.

Security breaches

McNeilly revealed two major breaches of security on HMS *Victorious*. Despite not having DV security clearance, he was given access to Top Secret information showing where the submarine was carrying out its patrol. He also says he could have worked out the key to the Weapons Engineering Officer's safe when he watched him enter the combination. This would have given the junior crew member unauthorised access to the trigger which launches Trident missiles. In addition, McNeilly was told of an officer who frequently left Top Secret documents lying on his bed.

He says there was a lack of adequate security controlling access to Trident submarines. He suggested that it was easier to get into most nightclubs than Faslane.

He gave the following examples of lapsed security:

- The QM sentry (in sentry box at gang plank) was not an effective security check, as he routinely lets people pass unchecked.
- Pass checks and gate checks were not thorough. People are able to pass without showing face, especially when it is raining. It is possible for extra people to get in as part of a group. There are lots of missing Navy ID cards circulating.
- Electronic gate access with PIN not working.
- No checks on bags being taken onto submarine by sailors or civilians. He was able to leave his bags next to the missiles on his first visit to a submarine.

Careless practice

McNeilly described how at times, such as the loading of stores before patrol, the submarine was chaotic. At the end of the patrol both the junior ranks' and the senior ranks' toilets were flooded and he notes that this was an apt summary of the state of affairs on this deadly nuclear-armed vessel.

Staffing problems

In his report William McNeilly said 'the rate at which people are getting pushed through the system because of manpower shortages is scary. SWS [Strategic Weapon System] is so short on manpower it's unbelievable and people are getting pushed through at an alarming rate.'

Official documents show that the MOD does not have an adequate number of people operating the Trident missile system. In each of the last three years the MOD's annual reports have identified the Trident Strategic Weapon System as an area where there is a shortage of personnel, known as a 'pinch point'.[5]

Year	Pinch Point Group	Liability	Shortfall	Difference
2012	Strategic Weapon System Control & Monitoring Panel Rank: Leading Hand	30	-	30%
2013	Strategic Weapon System Rank: Senior Rate	120	20	15%
2014	Strategic Weapon System Control & Monitoring Panel Rank: OR4-OR8 [Leading Hand – Chief Petty Officer]	220	55	25%

These reports also show that there are not enough submariners who are qualified to carry out reactor operations. There has been a 15% shortfall in Category A2 nuclear watchkeepers in each of the last three years. The shortfall in Category B nuclear watchkeepers has been between 10% and 15% over the same period. There is also likely to be a shortage of suitably trained and experienced officers for some key posts, but this is not identified in the MOD's annual reports.

The 2014 report from the Defence Nuclear Safety Regulator (DNSR) says that the greatest risk to the safety of the Defence Nuclear Programme (DNP) is the lack of Suitably Qualified and Experienced Personnel (SQEP) – 'The difficulties in maintaining a sustainable community of suitable nuclear competent staff has been, and is again, raised by DNSR as the principal risk to maintaining safety in the DNP'.[7] The regulator has made similar remarks each year since 2006 and has identified the attractions of alternative employment in the civil sector as a contributing factor. The 2008/09 safety report for the Clyde Naval Base said that human factors were the principal root cause of 70% of nuclear safety events.[8]

Lack of training and experience has been a factor in a number of nuclear

Missile Control and Monitoring Panel (CAMP) Watch on a US Trident submarine[6]

submarine incidents. One reason that HMS *Astute* ran aground on Skye in October 2010 was that the Officer Of the Watch did not have suitable experience for carrying out a boat transfer in the dark in an unfamiliar area.[9] The Board of Inquiry report into the grounding also points out that lack of a chart on the bridge combined with ineffective supervision, 'effectively resulted in the control of navigation resting with a Leading Seaman'.[10]

Manning issues contributed to HMS *Triumph* running aground off the West coast of Scotland in November 2000. The Board of Inquiry found 'evidence that the supervision of very inexperienced Control Room Watchkeepers was, at times, inadequate'.[11] 30% of the crew were new to the vessel. Two officers implicated in the incident, the Officer Of the Watch and the Second Officer of the Watch had only joined the submarine shortly before it sailed.

A lack of relevant training contributed to HMS *Tireless* colliding with an iceberg in 2003. While specific training was mandatory if a submarine was due to be deployed under pack ice, there was no similar requirement for deployment in the Marginal Ice Zone.[12] Fleet Headquarters had not given adequate consideration to the hazards from icebergs in this zone and no under ice training was arranged for *Tireless* before its deployment. The submarine manual, SMP 27, gave the false impression that the submarine's passive sonar can reliably detect icebergs. The crew on *Tireless* assumed that this was correct, but their sonar system gave no advance warning of the iceberg which they hit.

The lack of trained personnel was also a factor leading to the very poor standards of radioactive waste management at Faslane which were identified in a 2009 report, following a succession of coolant leaks from submarine reactors. The Scottish Environmental Protection Agency was so concerned about poor practice at the site that a spokesman told *Channel 4 News* that if Faslane had been a civil nuclear facility they would have shut it down.

Balance between operational and safety considerations

McNeilly asserts that HMS *Victorious* was sent on patrol when it was not in a suitable condition. In a series of incidents it has been apparent that safety has been compromised because of an overemphasis on operational requirements. In December 1987, a Polaris missile was subject to 'adverse shock' during a handling accident while it was being loaded onto HMS *Repulse* at Coulport. The Board of Inquiry found that 'excessive pressure was put on staff' to undertake the operation due to 'an urgent need to exchange the missile'.[13]

There have been a number of serious accidents during Perisher courses, training submarine commanders, where the focus was on providing realistic operational training rather than on safety. In 1990 HMS *Trenchant* sank the Fishing Vessel *Antares* with the loss of four lives. Officers on the submarine were concentrating on a warship which was exercising with them and failed to take due account of the fishing boat nearby. *Trenchant* incorrectly reported that, although a net had snagged, the fishing vessel was safe. The submarine continued with its exercise and search and rescue alert was only made eight hours later.[14] In 2002, HMS *Trafalgar* ran aground near Fladda-Chuain. Navigation aids were deliberately concealed from the trainee commanders and no back-up navigation system was in place.

Fishing Vessel Antares *which was sunk, with the loss of four lives, by HMS* Trenchant *in 1990*

In May 2003, HMS *Tireless* collided with an iceberg. The Board of Inquiry concluded, 'The focus of RN submarine environmental effort is in tactical exploitation and there was insufficient focus (HS and on board) on the hazards to submarine safety presented by icebergs'.[15]

On 28 April 2004, 11 crew members refused to go to sea on HMS *Trafalgar* because they regarded the vessel as unsafe. They included 3 out of 4 safety specialists. One of those involved said there were 250 defects on the vessel.

In the early 1990s, the MOD continued to send nuclear-armed Polaris

submarines on patrol despite a generic reactor fault which resulted in all other British nuclear-powered submarines being kept in port. The MOD did not fully understand the underlying problem with the reactors until two years after the issue was first noticed. Alan Clark was a Junior Defence Minister at the time. His published diaries show that safety advice was ignored, perhaps by the Defence Minister Tom King (TK) or, more likely, by Mrs Thatcher. Clark's diary entry for 31 Jan 1990 says:

> '… news is about to break concerning the trouser-leg fractures in Warspite's cooling system. This could affect every nuclear-powered submarine. The whatever-it-is Authority have already given their advice that we should 'cease to operate' them until the condition is 'rectified'.
>
> '… TK, quite rightly in my view, is continuing to keep the newer ones on station (although whether this is really his decision or was forced on him by the Lady I simply don't know). I suspect the latter because when, sadistically, I rattled him at a meeting, 'If – if there is an accident, it's not just you who resigns; the Government falls', he didn't blench[16].'

Faslane Peace Camp monitored submarine movements over the next two years. HMS *Resolution* carried out two very long patrols of around 108 days in 1990 and 1991. After the second of these patrols the submarine spent only 6 days at Faslane and then went back on patrol. There was no opportunity to repair defects identified during the patrol or to test the vessel and crew before deployment.

Overemphasis on operational factors, rather than safety, was also a factor in some of the other incidents reported below.

Missile safety

On most types of missile the nuclear warheads are placed on top of the rocket motors. Trident is different. In order to produce a long-range missile which is short enough to fit on a submarine, the nuclear warheads are placed around the third-stage rocket motor. This significantly increases the risk of a catastrophic accident. This weakness was identified by Sidney Drell in a US Government review of nuclear weapons safety published in 1990.

McNeilly quotes paragraphs from the Trident safety manual which confirm this problem. The document refers to Re-entry Bodies (RBs) which is an alternative name for the nuclear warheads.

> 'When installed in a Trident II D5 missile, RBs clustered around the Third Stage Rocket Motor are at risk from a rocket motor propellant fire'.
>
> 'An accident or enemy action may cause rupture of the RB, burning or possible detonation of the HE [High Explosive] and release of radioactive contamination.'

The manual also says that a fire can lead to the detonation of explosives in the nuclear warheads:

> 'If the HE [High Explosive] charge is exposed to excessive heat without burning, it may become more sensitive and could cook to (non-nuclear) detonation, releasing radioactive materials and aerosols over a wide area'

The risk assessments for the Faslane shiplift assume that the detonation of one missile will result in the explosion of all the missiles onboard a submarine and the dispersal of plutonium from all of the nuclear warheads.

The shiplift assessments do not take account of the possibility that a missile explosion could result in the dispersal of radioactive material from the submarine's reactor. However, the manual quoted by McNeilly suggests that this might occur. It says:

> 'The chief potential hazard associated with a live missile is the accidental ignition of the first, second or third stage rocket motor propellant. If this were to happen in the missile tube with the muzzle hatch shut and locked, the pressure hull and bulkheads of the MC [Missile Compartment] would burst within a matter of seconds'.

If the bulkhead was breached then there is a significant risk that the blast wave or fragments could damage the reactor and possibly trigger the release of radioactive material from the reactor.

Fires on submarines

McNeilly expresses concern that there was inadequate attention on HMS *Victorious* to the potential for water to cause an electrical fire.

In October 2004 there was a fatal fire onboard HMCS *Chicoutimi*, formerly known as HMS *Upholder*. This British built diesel-powered submarine had been handed over to the Canadian Navy and was in transit from Faslane.[17] Due to inadequate maintenance two hatches had to be kept open while the vessel sailed on the surface in rough seas. 2,000 litres of sea water, from a freak wave, flooded over the coning tower and into the

Fire damage to HMCS Chicoutimi *(formerly HMS* Upholder*)*

submarine. A short time later this sparked an electrical fire. Within seconds there was very thick black smoke. One officer collapsed and subsequently died. Nine crew members needed treatment for smoke inhalation.

Two-and-a-half years later, in March 2007, there was an explosion and fire on HMS *Tireless* under the Arctic icepack North of Alaska. Two sailors died. The Navy had failed to learn from the fire on *Chicoutimi* and the Damage Control and Fire Fighting (DC&FF) issues were seen a second time. The Board of Inquiry into the fire on *Tireless* said 'Many of the DC&FF lessons identified in the HMCS *Chicoutimi* incident in 2004 have been repeated in this incident'.[18] In both cases the control of fire fighting was difficult because large parts of the submarine were affected by smoke. An identical nozzle detached from a hose in both fires. There were issues with Emergency Breathing Apparatus in both cases. In addition, sailors on *Tireless* had not received adequate training to cope with the situation that they faced, in particular attempting to fight a fire from a ladder.

The fire on *Tireless* was caused by the explosion of a Self Contained Oxygen Generator (SCOG). There was a major failure in the assessment of the danger posed by these devices. The Board of Inquiry report said 'There are many systematic failings that contributed to the TIRL explosion which can be collectively viewed as inadequate risk management of the hazards that SCOGs present'.[19]

At the time of the explosion and fire, *Tireless* was operating under the ice pack, North of Alaska. It took three quarters of an hour for the nuclear-powered submarine to find a gap in the ice and surface. During this period the crew were unable to access the area of the fire because a door had buckled. The incident would have been far worse, had it not been for the actions of a surviving member of the crew in the affected area. Despite serious injuries, he was able to dampen down the flames. The Board of Inquiry report said 'The small fire caused by the explosion could easily have taken hold and a major conflagration ensued, with very serious consequences, if xxxxxx had not had the stamina and presence of mind to use all available means to extinguish them'.[20]

McNeilly said that the quality of the speaker system, used to issue safety instructions, was poor. The Board of Inquiry into the fire on *Tireless* noted that this system was inaudible due to noise from the incident. The Cromwell radios onboard were useless. Instructions were passed by word of mouth along the stricken submarine.

McNeilly questioned the rigour of fire drills, pointing out the submariners should be blindfolded to simulate the effects of a fire. The reports from *Chiticoumi*, *Tireless* and other fires show that visibility can be

down to a few inches when smoke fills the compartments of a submarine. The report into the *Tireless* fire also found that emergency lighting was inadequate.

Access to Emergency Breathing Apparatus has been a recurring problem in fires on submarines. In April 1992 there was a fire on board HMS *Turbulent* at Devonport. Maintenance work was being carried out on one of the two electrical switchboards when there was a short circuit and a bang followed by a fire. The switchroom is adjacent to the reactor compartment and separated from it by a bulkhead. The Mechanical Engineering Articifer (MEA) of the Watch was not wearing a face mask when he was required to carry out an essential safety task. Petty Officer Christian Checkley removed his face mask and handed it to the MEA. The essential safety task may have been to shut down the reactor. The reactor was producing power at the time of the fire but was quickly shut down. The consequences of the accident might have been much worse if Petty Officer Checkley had not taken this action – for which he received the Queen's Commendation for bravery. The incident was officially described as 'potentially lethal' and 23 sailors were admitted to hospital suffering from smoke inhalation.

On 19th August 1993 at Devonport, toxic diesel exhaust fumes spread through part of HMS *Torbay*. All the 32 sailors who had been on board were taken to hospital. 13 were kept in over the weekend and some were still suffering from the effects of the accident several weeks later. Commenting on the incident, Captain Richard Sharpe, editor of *Jane's Fighting Ships* said: 'We are dealing with an incredibly small hull which is machinery intensive. The smallest amount of smoke spreads with amazing rapidity'.

Lists of fires

In 2009, the government disclosed that there had been three fires which required external assistance since 1987:[21]

Date	Vessel	Location	Notes
17 February 1992	HMS Renown	Clyde	
30 April 1992	HMS Turbulent	Devonport	Explosion and fire in switchroom; 24 casualties from smoke
24 October 2003	HMS Trafalgar	Devonport	

In 2009, the government said there had been 20 medium scale fires (which were brought under control using ship's resources) since 1987.[22] These were defined as 'a localised fire such as a failure of mechanical equipment

creating smoke and flame requiring use of significant onboard resources'.[23] This parliamentary answer included one fire in 1984 and is show below.

Date	Vessel	Location	Notes
10 December 1984	HMS Courageous	Alongside	
29 July 1987	HMS Sceptre	Not recorded	
26 August 1987	HMS Conqueror	Alongside	Engine room damage and burns casualties
15 November 1987	HMS Renown	Not recorded	
10 October 1988	HMS Renown	Clyde	
5 August 1989	HMS Valiant	Clyde	
22 December 1989	HMS Valiant	Alongside	
21 November 1991	HMS Trenchant	At sea	
3 November 1992	HMS Superb	At sea	
11 January 1993	HMS Tireless	At sea	
29 July 1993	HMS Revenge	At sea	
22 October 1993	HMS Tireless	Alongside	
7 April 1994	HMS Sovereign	Rosyth	
22 August 1995	HMS Sovereign	Rosyth	
16 October 1995	HMS Victorious	Alongside	
18 January 1999	HMS Talent	Devonport	
17 June 2001	HMS Sovereign	Clyde	
22 April 2002	HMS Victorious	At sea	
11 October 2006	HMS Vigilant	Clyde	
21 March 2007	HMS Tireless	At sea	Explosion and fire; Two fatalities

Known fires on British nuclear submarines prior to 1987[24]

Date	Submarine	Location	Notes
1963	Valiant	Barrow	Fire in reactor compartment while under construction
1965	Dreadnought	Rosyth	Fire in control room
September 1968	Valiant	Chatham	Two small fires

Date	Submarine	Location	Notes
August 1970	Resolution	Rosyth	Fire in control room
3 July 1972	Repulse	Rosyth	
January 1975	Repulse	Faslane	Fire from equipment overheating
July 1975	Courageous	Faslane	
1976/77	Repulse		Fire causing £200,000 damage
2 May 1976	Warspite	Liverpool	Major fire lasting 5 hours, 1 seriously injured and 4 others taken to hospital, 2 years to repair
March 1980	Revenge	Faslane	Electrical fire, jetty cable
18 September 1983	Conqueror	Devonport	
September 1985	Repulse	Rosyth	Fire on jetty heating system
1986	Splendid	Devonport	Fire in generator
26 August 1987	Conqueror	Devonport	Fire causing engine room damage and burns casualties

Between 1987 and April 2009 there were 213 small scale fires on British nuclear submarines.[25] By July 2014 this had risen to 243; of these 67 were on ballistic missile submarines (Polaris/Trident).[26] This means that between April 2009 and July 2014 there was a fire on average once every 6 weeks. Between July 2012 and November 2014 there were a further 14 small scale fires on submarines.[27]

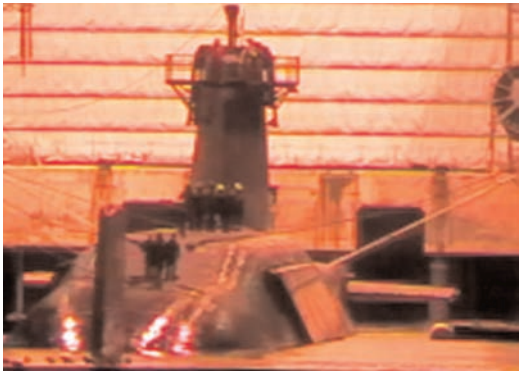
Fire on HMS Astute*, Barrow, 18 April 2009*

Collisions and Groundings

Collisions

McNeilly reports that details of the collision between HMS *Vanguard* and *Le Triomphant* in February 2009 are a closely guarded secret. He recounts that a Chief Petty Officer, who had been on *Vanguard* at the time of the crash, told him 'We thought, this is it, we're all going to die' and explained that the French submarine had taken a chunk out of the front of *Vanguard*, grazed down the side of the boat and dislodged High Pressure Air bottle groups.

The Nuclear Information Service submitted a Freedom of Information request for reports of the collision. A heavily redacted version of several documents was released. This gives no indication of the circumstances or effect of the collision. It confirms that both submarines were on patrol at the time of the incident.



HMS Vanguard *entering Faslane shiplift at night after collision with* Le Triomphant

Excessive secrecy surrounding nuclear submarine collisions is not new. In 2013 a submariner described for the first time a collision between HMS *Warspite* and a Russian submarine in October 1968. Ian Wragg said 'There was an almighty bang and the boat rolled 360 degrees over. Nobody really knows why it happened, but most people feel that the Russian boat had slowed down and we ran into the back of it. We were all given a tot of rum[28].' *Warspite* limped back to British waters and came into Lerwick with a damaged coning tower. Official reports said that the vessel had collided with an iceberg.

Groundings

There have been a number of occasions in recent years when British nuclear submarines have run aground. Common features in these incidents have been a lack of navigation skills and poor communications.

On 19 November 2000, HMS *Triumph* ran aground off the West coast of Scotland. The submarine had just completed a five month deployment when the submarine was sent out again, from Devonport, on a submarine command training course. Because the original crew had already been at sea for so long 30 % were replaced with personnel from other submarines.

The submarine was sailing towards the North Channel. They were approaching the continental shelf where the seabed rises to a depth of around 200m. A plan was prepared for the submarine to rise to 100m when they approached the shelf. The officers on duty did not use the automated Submarine Navigation and Processing System (SNAPS) properly. They also failed to make full use of the echo sounder to detect the rising seabed. As a result the submarine was 2.6 nautical miles away from its estimated position. The submarine hit the seabed at a depth of 200m and speed of 20 knots. Emergency Stations was piped. Then the main ballast tanks were blown and the submarine was brought to the surface.

The Board of Inquiry concluded that

> 'The grounding was caused by poor navigation. Contributory factors included a widespread misunderstanding of SNAPS organisation and poor chartwork[29].'

Ten days after this incident, on 29 November 2000, the Trident submarine HMS *Victorious* ran aground on Skelmorlie Bank in the Clyde estuary. As submarines depart from the Clyde a Towed Array Sonar system is attached by a long cable. HMS *Victorious* had planned to attach the Towed Array near Bute. However, when they approached Bute the wind was too strong. They decided to change course and go to the North of Cumbrae. When manoeuvring in this area a rope almost became tangled in the submarine's propulsor. So a third option was chosen. The submarine would sail to Loch Long and check the situation there. No clear plan was made for the move from Cumbrae to Loch Long. The Petty Officer who was logging the submarine's position was unaware that the submarine had increased speed to 10 knots. There was then an error in taking bearings to determine the vessel's position and the wrong course was selected. Skelmorlie bank is a sandbank in the Clyde estuary which is clearly marked with a large buoy. However, no-one on the submarine realised that they were sailing towards the wrong side of the buoy. They were 400 yards on the wrong side of it when the submarine grounded. At that point they were around 2.2km from the shore. Emergency Stations were sounded. The submarine then returned to Faslane.

The Board of Inquiry concluded:

> 'The primary cause of the grounding was a failure of standard navigational practice and a lack of awareness amongst all members of the navigation team of the increased danger to safe navigation as soon as the submarine had deviated from its pre-briefed navigation plan[30].'

On 6 November 2002, HMS *Trafalgar* ran aground on Fladda-Chuan, 6 kilometres north of Skye, while taking part in a submarine command course. Navigation aids had been deliberately concealed. This was done 'to increase the

degree of navigational difficulty and hence pressure on the students'.[31] There was confusion on the submarine as to who was formally responsible for navigation. The trainee in control was using tracing paper which concealed some of the information on his chart. He did not properly take account of the significant tidal stream around Fladda-Chuain. As a result the submarine struck the bottom heavily at a speed of 14.7 knots. The Board of Inquiry concluded that HMS *Trafalgar* grounded because of human error. The Commanding Officer and the course teacher were both disciplined in a Court Martial.

The inquiry report said 'Although a safety organisation was in place [on the submarine] and had worked effectively up until then, it failed to operate when most needed.'

The report said that there was 'good reason' for depriving the trainee commander of navigation aids and did not recommend that this practice should cease. Submarine Command Courses have continued to take place using nuclear submarines off the West coast of Scotland. The training deliberately places the trainees in difficult and confusing situations. The trainees control the submarine as they conduct a series of exercises, some of which are at high speed and close to other vessels.

On 26 May 2008, HMS *Superb* grounded on an underwater mountain in the Red Sea. A late decision was made to carry out the traverse at depth, without adequate attention to navigation. The Navigation Officer had failed to make full use of the two charts of the area which were available.[32] As a result of the damage, *Superb* was scrapped a few months after the incident.

On 22 October 2010, HMS *Astute* ran aground while conducting a boat transfer near the Isle of Skye. On three occasions the Officer of the Watch ignored instructions from other crew members to change course. It was several hours before the vessel could be refloated. During the attempt to dislodge the submarine it collided with the tug which was assisting it.

The Board of Inquiry found,

> 'Preparations for, and conduct of the watch by the Officer of the Watch fell short of the standards required to maintain submarine safety. The planning for the boat transfer was insufficient to ensure safe completion and lacked appropriate command oversight'.

Communications between the bridge and the control room were poor. There were also problems communicating with MV *Omagh*, the vessel involved in the boat transfer.

Lists of collisions and groundings

In 2009 the government published a list of 13 incidents where submarines had collided with other vessels or ran aground since 1988.[33] This can be

supplemented by lists compiled by Scottish CND, reports of collisions with Russian submarines and other sources.[34]

The following is a combined list of known collisions.[35]

Date	Submarine	Location	Notes
October 1968	Warspite		Collision with Russian submarine, crew told to say they had hit an iceberg
7 October 1969	Renown	Kintyre	Collision with Irish MV Moyle while surfacing at night
1969	Revenge	Clyde	Collision with cattle boat while surfacing
January 1973	Repulse/ Revenge	Faslane	Collision while leaving dry dock, Repulse hydroplanes damaged
1981	Sceptre	Barents Sea	Collision with Russian submarine, crew told to say they had hit an iceberg
10 June 1985	Resolution	Florida	Collision while at US missile range
24 December 1986	Splendid		Collision with Russian submarine, towed array lost.
2 July 1988	Courageous	North Channel	Sank yacht Dalriada
November 1990	Trenchant	North of Arran	Sank Fishing Vessel Antares
13 May 2003	Tireless		Collision with iceberg in Marginal Ice Zone at depth of 60 metres.
4 February 2009	Vanguard		Collision with Le Triomphant, both submarines on patrol
22 October 2010	Astute	Skye	Collided with tug after running aground
April 2015	Talent		Collision with iceberg, £500,000 damage to coning tower.

HMS Astute *aground on the Isle of Skye 22 October 2010*

HMS Repulse *aground on the sand at Barrow after launch*

Below is a list of occasions when British nuclear submarines are known to have run aground.[36]

Date	Submarine	Location	Notes
5 November 1967	Repulse	Barrow	Ran aground after launch
17 April 1971	Renown	Clyde	Hit sea bed in post refit trials, Captain court-martialled
13 October 1989	Spartan	Loch Linnhe	
March 1991	Valiant	North Norwegian Sea	
July 1996	Trafalgar	Off Isle of Skye	
July 1997	Trenchant	Off coast of Australia	
19 November 2000	Triumph	West coast of Scotland	Hit sea bed at depth of 200 m and speed of 20 knots
27 November 2000	Victorious	Clyde	Ran aground on Skelmorlie Bank
6 November 2002	Trafalgar	North of Skye	Hit seabed at 15 knots
26 May 2008	Superb	Red Sea	Hit underwater mountain. As a result the vessel was scrapped.
April 2009	Torbay	Eastern Mediterranean	
22 October 2010	Astute	Skye	Aground on Skye for several hours

Reactor Defects

McNeilly alludes to reactor problems which might result in reactors having to be replaced. This probably refers to the core cladding failure on the prototype submarine reactor at Dounreay in 2012. This incident was kept secret, including from the Dounreay Stakeholder Group, for over a year. The incident has a potential impact on all current British nuclear submarines. As a result of the problem, an additional nuclear refuelling has been arranged for HMS *Vanguard* and may be needed for HMS *Victorious*. This is only one of a series of major defects in the reactors on British nuclear submarines.

In 1989 cracking was discovered in the primary coolant circuit of the reactor on HMS *Warspite* during a refit. In January 1990, Scottish CND received a number of anonymous phone calls from someone working in Faslane. We were told 'there are cracks around the watery leg pipework in the primary circuits in the SGs [Steam Generators] in SSN and Polaris boats and they don't know how to fix them'. When asked how dangerous this was, the caller replied 'Let's just say we're talking about Chernobyl'. In a further call, we were told 'the emergency cooling system doesn't work at all. There was an incident at Faslane about two years ago when there was a near meltdown'. Hunter-killer submarines were initially confined to port, but Polaris submarines continued to be sent out on patrol. Checks were carried out on all nuclear submarines and several were scrapped as a result.[37]

On 12 May 2000, there was a leak of coolant from the reactor on HMS *Tireless* when the submarine was deployed in the Mediterranean. Experts in the UK wrongly advised the crew to restart the reactor, which made the problem worse. The vessel limped to Gibraltar where a year-long repair was carried out, promoting serious concerns from both the Spanish government and the authorities in Gibraltar. This was also a generic fault which could affect all submarines with PWR1 reactors. Checks and repairs were conducted over several years.

HMS Tireless *stranded in Gibraltar August 2000*

Terrorism Risk

McNeilly was particularly concerned about the risk of a terrorist attack on a Trident submarine and the lack of adequate security arrangements, including the failure to check bags that were taken onboard by sailors and civilian staff.

The MOD treat the threat of a terrorist attack differently from the hazard of nuclear accident. One example is the Faslane Shiplift. Risk assessments for the shiplift show that if a large aircraft collides with the shiplift while there is an armed Trident submarine inside, then the building will collapse and all of the missiles will detonate, scattering lethal plutonium over a wide area. However, the accident assessment says that this risk is acceptable because the probability that an aircraft will accidentally fall out of the sky and land on this particular part of the earth is very remote. Common sense would suggest that the risk of a terrorist deliberately crashing an aircraft into the shiplift is much higher. The compliance criteria for the shiplift show that there is not a huge margin between the calculated risk of an aircraft accidentally causing the facility to collapse and the required safety criteria. This would suggest that the risk of a terrorist incident causing a nuclear accident at Faslane is unacceptably high.

Faslane Shiplift

Sabotage

McNeilly raises the prospect of deliberate sabotage of a Trident submarine by someone onboard. One example, which McNeilly quotes, of the potential for extreme behaviour on a nuclear submarine was the shooting dead of one officer and wounding of a second by a sailor on HMS *Astute* in Southampton in 2011. There are several examples of submarine sabotage from other parts of the world.

In 2001 Ernesto Cimminio, a Petty Officer in the US Navy, was charged with deliberately damaging more than 100 cables on the Trident submarine, USS *Alaska*.[38] Cimminio was abusing drugs at the time and having an affair with the wife of another sailor.[39] There were also reports that valves were deliberately shut when they shouldn't have been and that

reactor control valves were cut on USS *San Juan* in 1996.[40]

The destruction of the Indian submarine INS *Sindhurakshak* in 2013 has been reported as likely to have been the result of sabotage. There was an explosion and fire which led to the detonation of torpedoes stored on the vessel. All 18 crew members who were onboard were killed.[41]

Uncontrolled dive

McNeilly says that there were problems with the diving planes on HMS *Victorious*. He said 'There were jokes about the fore-planes being defective throughout the entire submarine. They joked about getting them stuck in dive mode'. The diving planes on British nuclear submarines are critical. He also refers to problems with the diesel generators. A combination of reactor, diving plane and generator problems could be catastrophic on a submarine operating close to maximum depth.

Tail fin of USS Thresher on the seabed

On 9 April 1963 the USS *Thresher* was conducting trials when it went into an uncontrolled dive. The vessel sank to a depth of 2,600 metres and was lost with all 129 crew members. A Court of Inquiry concluded that the reactor had probably shut down, resulting in a loss of propulsion, and that the ballast system had also failed, possibly as a result of freezing temperatures.[42]

Today the US Navy has design principles to prevent a recurrence of this disaster. However, current British submarines fall short of these standards. This was revealed when the MOD failed to properly redact an electronic document issued to Scottish CND under the Freedom of Information Act.[43] The report from the Defence Nuclear Safety Regulator (DNSR) said that the reactors on British submarines are much less reliable that the reactors on American submarines. The hidden text in the document said:

> 'US established practice is to deliver a high reliability of propulsion, from the main propulsion system, even under reactor fault conditions. UK practice in current class submarines is to accept a much lower reliability from the main propulsion system, and to back this up with a very low power (but high reliability) emergency propulsion system. This system will not provide

> sufficient dynamic lift, so safety is achieved by procedural controls constraining the combinations of speed and depth, backed up by ballast systems (but this may not be effective under all circumstances).'[44]

This means that, whereas safety is engineered into US submarines, on British submarines safety is based on personnel following procedures. The DNSR report revealed that, when compared with US standards, 'it is clear that the UK programme currently falls short of current relevant good practice.'[45]

A British submarine faced with a loss of power at close to maximum depth could be placed in an uncontrolled dive without the means of regaining the surface. McNeilly recounts an incident on HMS *Vanguard* when the submarine was 'extremely close to being lost'. This is almost certainly a reference to a near disaster on the submarine when operating in the Celtic Deep at close to maximum depth in July 1998. A sailor contacted the *Sunday Mail* and told them 'The boat was shuddering and shaking. We were on our knees praying. Everyone was scared out of their wits because we had never experienced anything like this'.[46]

Apparently, the reactor on HMS *Vanguard* had shut down. The crew tried to get a back-up power system going but it failed to work. By this time the submarine was descending rapidly in a deep dive. The vessel was eventually brought back under control when the reactor started up again. John Large, a nuclear engineer, said 'This is an extremely serious problem for this class of submarine. It's horrific – the worst nightmare.' The Royal Navy admitted that HMS *Vanguard* had been forced to make 'an unscheduled surface during a training exercise', but denied that there was any cause for concern.

Notes

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4 The photo shows two sailors on top of each other. McNeilly says the UK wasn't following this practice. http://navy.togetherweserved.com/usn/servlet/tws.webapp.WebApp?cmd=ShadowBoxProfile&type=TrainingExt&ID=92862
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6 November 2002, HMS *Montrose*, 12 November 2002
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God gave Noah the rainbow sign,
No more water, the fire next time.