

DISARMING TRIDENT

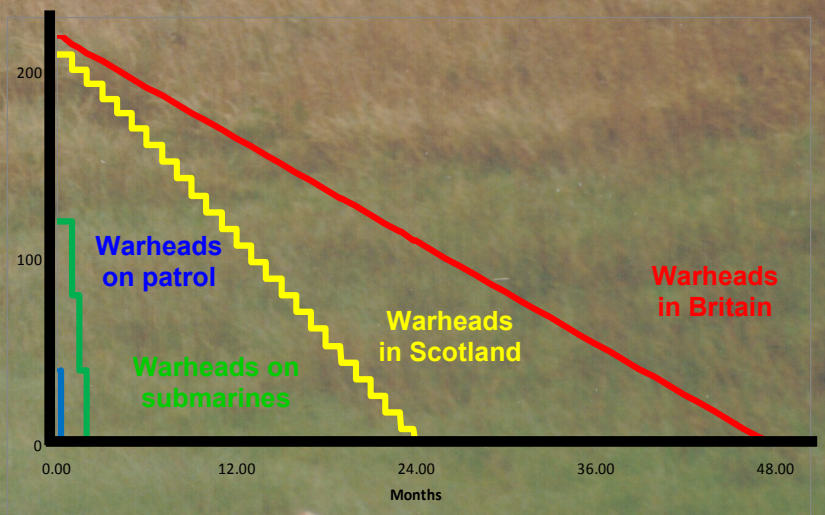
A practical guide to de-activating and dismantling the
Scottish-based Trident nuclear weapon system



Scottish CND



Scotland's for Peace



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The cover photograph shows a convoy on the M8 transporting nuclear weapons from Coulport to Burghfield [Scottish CND].

DISARMING TRIDENT

A practical guide to de-activating and dismantling the Scottish-based Trident nuclear weapon system.

Fifty years after the Cuban Missile Crisis, Britain still has large numbers of nuclear weapons poised to destroy Moscow, or any other target chosen by the Ministry of Defence. Moving away from this, towards disarmament is not an impossible dream. There are practical steps that can be taken within a short timescale. We don't need to wait for many years.

In the event of Scottish independence, the parliament in Edinburgh would have the legal right to require the London government to remove nuclear weapons from Scotland. Holyrood could establish a timetable for the de-activation of Trident, within days and week, followed by the removal of all nuclear warheads from Scotland within two years. The Scottish government could verify that these measures had been taken.

In the event of a decision by an independent Scottish Government to call for the removal of nuclear weapons there would be no reason for them to delay. There is nowhere for Trident to be moved to. Any postponement would encourage the Remainder of the United Kingdom (RUK) to put pressure on the Scottish Government in the hope that their policy would change.

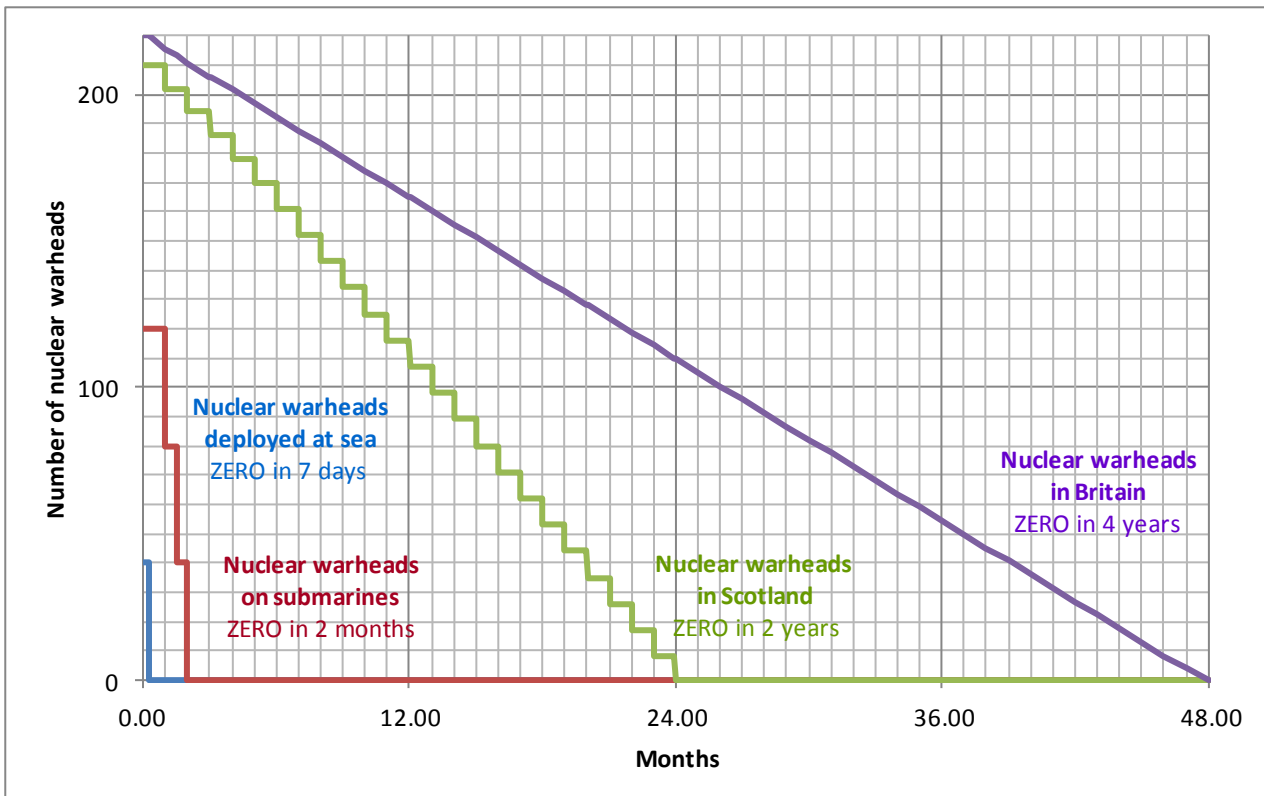
In a UK context, if the Labour or Conservative parties changed their policy and became serious about abolishing nuclear weapons, then a UK government could use the proposals in this paper as a blueprint for disarmament. They could first ensure that British nuclear weapons could not be used in anger and then they could dismantle all nuclear warheads within four years.

John Ainslie
June 2012

Disarming Trident - Timetable

| | Action | Timescale |
|---------|---|-----------|
| Phase 1 | End operational deployment of submarines | 7 days |
| Phase 2 | Remove keys and triggers | 7 days |
| Phase 3 | Disable missiles | 8 days |
| Phase 4 | Remove warheads from submarines | 8 weeks |
| Phase 5 | Remove missiles from two submarines | 10 weeks |
| Phase 6 | Disable nuclear warheads and remove Limited Life Components from Scotland | 1 year |
| Phase 7 | Remove nuclear warheads from Scotland | 2 years |
| Phase 8 | Dismantle nuclear warheads | 4 years |

Disarming Trident - Nuclear warhead numbers



Phase One – End operational deployment of submarines

The Royal Navy has four Vanguard class nuclear submarines. There is always one submarine undergoing refit at Devonport. The remaining three vessels are normally armed with Trident missiles and nuclear warheads.¹ One submarine is deployed on patrol. This study assumes a starting point where one vessel is on patrol, the second is on trials and the third is berthed at Faslane.

UK Trident submarines carry out operational patrols, fully armed, which last around 10 weeks. The vessel on patrol is formally on “several days” notice to fire. At any time the alert state could be covertly raised to 15 minutes notice to fire (SQ2) and remain at this higher state for the duration of the patrol.

The first step that could be taken would be to end the current practice of continuous patrols and to stop all operational deployment of Trident submarines. Nuclear submarines can travel long distances at speeds greater than 20 knots. The submarine on patrol could return to Faslane within about 7 days.

Phase Two – Remove keys and triggers

To launch a Trident missile, the Captain turns a key and the Weapons Engineering Officer (WEO) presses a trigger. The key and trigger are kept in separate safes on the submarine. As an initial disarmament step, these keys and triggers could be identified, removed from all submarines and stored in a secure site on shore. This could be carried out immediately for the submarine berthed at Faslane, and shortly after each of the other two vessels returned to port.²

Inspectors could place seals on the appropriate parts of the Fire Control System and the storage site. Continuous monitoring could be established at the storage site.



Trigger on HMS Victorious [BBC]

Phase Three – Disable missiles

There is a hatch in each missile tube which enables technicians to replace certain components on the missile while it is on the submarine. These parts include the guidance system and flight control system. Spare guidance and flight control components are stored in the Strategic Weapon System (SWS) building at Faslane. If these parts are removed then the missile can no longer be deliberately launched at any target.



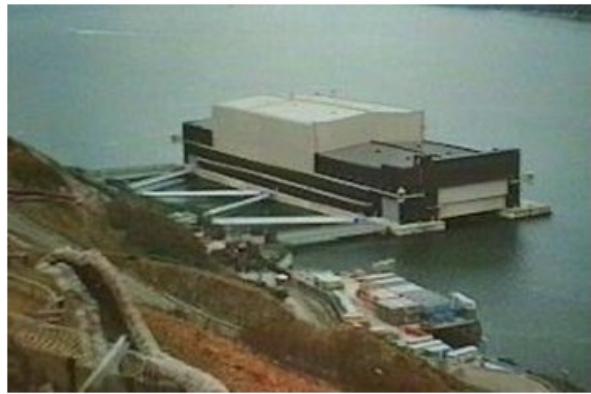
Removable Mark 6 Guidance Unit for a Trident D5 missile [Charles Stark Draper Laboratory]

These components are replaced on a routine basis. Following the Strategic Defence and Security Review of 2010, each Vanguard class submarine carries eight Trident missiles. The removal of vital components from one missile takes around 90 minutes.³ Eight missiles could probably be disabled within one day.

Similar components could be removed from any spare missiles stored in the Ready Issue Magazines at Coulport. Inspectors could set up seals on the missile access hatches. The components could either be stored in the existing room within the SWS building at Faslane or at another suitable site. Seals and continuous monitoring could be set up at the store.

**Phase Four –
Remove nuclear warheads from submarines**

RNAD Coulport has the facilities and equipment required to load and unload nuclear warheads from Trident missiles. It retains a team of specially trained and experienced personnel to carry out this work. To remove the warheads, each submarine would be taken, in turn, to the Explosives Handling Jetty (EHJ). Once securely berthed in the jetty, the warheads would be removed from the missiles while they were on the submarine.



Explosives Handling Jetty Coulport [Scottish CND]

Current practice is that the unloading of all the warheads on a submarine takes place once every three years, in the pre-refit period. Complete loading also takes place once every three years, at the end of the post-refit work up. In addition, small numbers of warheads are removed from one or two missiles several times each year, when operational submarines dock in the EHJ.

The removal of all 40 warheads from one submarine would take between 7 and 10 days.⁴ In theory 120 warheads could be removed from the three armed submarines within one month. In practice this may take longer. There are detailed safety and security procedures for de-mating warheads from missiles and for moving warheads between the EHJ and the Reentry Body Magazines (RBMs) at Coulport. Additional preparation and training may be required prior to conducting unloading on the scale required. This could increase the total time required to 8 weeks. Inspectors could monitor the unloading process and establish seals and monitors in the RBMs.

Phase Five - Remove missiles from submarines

Missiles can be removed from submarines in the EHJ. The Ready Issue Magazines (RIMs) at Coulport can only store 16 missiles. Each submarine currently carried 8 missiles. It should be possible to store the missiles from two submarines, separately from the nuclear warheads, on-shore at Coulport. This would leave a further 8 missiles on the third submarine.



Removing the missiles from one submarine could take up to one week and would only take place after the warheads had been removed. Inspectors could seal and monitor the 16 missiles which had been moved into the RIMs. Monitoring the remaining unarmed missiles on the submarine would be more difficult.

*Unloading a Trident missile from a submarine in the EHJ
[www.mod.uk]*

*Re-entry Body Process Building, Coulport
[Google]*



Phase Six – Disable nuclear warheads and remove Limited Life Components from Scotland

A Trident warhead contains three Limited Life Components - the Arming Fuzing and Firing System (AF&F), Gas Transfer System and Neutron Generator.⁵ These items are routinely replaced in the Re-entry Body Process Building at Coulport.

Removal of these components would disable the warheads. The weapon cannot be triggered without the AF&F and Neutron Generator. Removing the Gas Transfer System would substantially reduce the warhead's yield. The removal of Limited Life Components from Trident warheads would render them ineffective.

In addition to the 120 "operationally-available" warheads, which are normally deployed on submarines, there are around 100 additional warheads at Coulport. In line with US practice, it is likely that some of these spare warheads will not have their Limited Life Components fitted.

Removing these components from the entire warhead stockpile at Coulport might take around one year. The components are less dangerous than the warheads themselves and so they are easier to transport. Although removing these components may be time consuming, transporting them out of Scotland could be carried out quickly. Inspectors could monitor and verify the removal and storage of Limited Life Components and their transport out of Scotland.

Limited Life Components of a UK Trident warhead



Arming, Fuzing and Firing System [www.sandia.gov]



Gas Transfer System [www.sandia.gov]



Neutron Generator [www.sandia.gov]

Phase Seven – Remove nuclear warheads from Scotland

The physical removal of nuclear warheads from Coulport would be a clear and significant step.

When Chevaline was withdrawn from service in the 1990s, some of the warheads were initially stored at RAF Honington in Suffolk, prior to being dismantled at Burghfield. The removal of Trident nuclear warheads from Scotland could be accelerated if some of the warheads were moved to Honington for temporary storage.



Special Ammunition Site RAF Honington [Google]

The Special Ammunition Site (SAS) at RAF Honington has 6 Igloo bunkers and 19 older bunkers. Each Igloo can store a significant number of nuclear weapons. During the 1970s large numbers of RAF and Royal Navy nuclear weapons were stored at Honington.⁶

Today RAF Honington plays a significant nuclear role as the home of the MOD's main Chemical Biological, Radiological and Nuclear warfare unit. It is no longer a base for fixed-wing aircraft but is a major centre for the RAF Regiment. Assuming the nuclear store at Honington is not currently operational, a number of steps would be required to re-activate it. These would include reviews of safety and security, improved security measures and the deployment of a small team of warhead experts from Coulport and Aldermaston/Burghfield.

Nuclear weapons are routinely moved between Coulport and AWE Burghfield in convoys. It would require 24 convoys, with 8-9 warheads each, to transport the entire stockpile out of Scotland to Honington and/or Burghfield. In the 1980s and 1990s there were periods when convoys were travelling regularly to Scotland once every four to six weeks. During this time additional convoys were transporting nuclear weapons around England. If convoys were travelling at four week intervals then it would take 2 years to remove the entire stockpile. Inspectors could monitor and verify the removal of nuclear warheads from Scotland.



Nuclear weapons convoy [www.nukewatch.org.uk]

Phase Eight - Dismantle nuclear warheads

The only site in the UK that can disassemble nuclear warheads, including their Nuclear Explosives Package, is the Atomic Weapons Establishment (AWE) Burghfield in Berkshire. There are four assembly/disassembly cells in the existing facility. AWE are building a replacement building, Project Mensa, which will enter service in 2016. It will have a similar capability and probably four assembly/disassembly cells.⁷

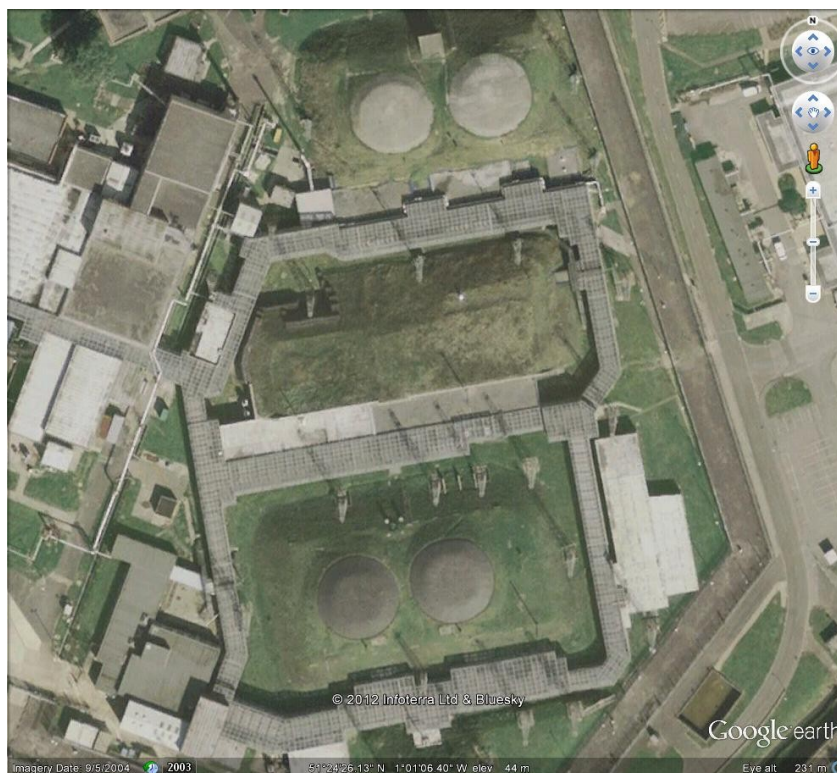
Dismantling a Trident warhead at Burghfield would involve the following steps:

1. Prepare cells for disassembly
2. Inspect warhead
3. Remove RV shroud
4. Cut and disconnect detonator cables
5. Remove firing set and neutron generator (if not removed at Coulport)
6. Cut open and remove radiation case
7. Remove primary
8. Remove secondary
9. Prepare for removal of High Explosive (primary)
10. Remove High Explosive (primary)
11. Package plutonium pit (primary)
12. Dismantle secondary⁸

The past workload at Burghfield provides a guide to how long it might take to dismantle the current stockpile of warheads. The planned rate for the production for WE-177 and Chevaline nuclear warheads was 36 per year.⁹ In 1981 it was assumed that Trident warheads would be manufactured at a rate of up to 60 per year. Actually assembly probably peaked at around 40 Trident warheads per year. WE-177 and Chevaline warheads were all dismantled by 1998 and 2002 respectively. Disassembly rates for these two weapons were probably between 20 and 40 per year.

These rates were achieved while Burghfield was assembling, refurbishing and disassembling more than one type of warhead at the same time. If all four cells at Burghfield were set up for Trident disassembly then higher rates, perhaps 50-60 warheads per year, could be achieved. On this basis, it would take around 4 years to dismantle the current stockpile of less than 225 warheads.

The output from disassembly at Burghfield would be the separated components of a nuclear warhead, including the plutonium pit. Further work would be required to convert the pit into a form where it could not be reconstituted into a nuclear weapon.



AWE Burghfield. The four assembly/disassembly cells are visible from their circular contour. [Google]

Additional Steps

Two further measures could be taken

a. Return of Trident missiles to the US

The D5 missiles were initially loaded onto British submarines at the US Navy Trident facility at Kings Bay, Georgia. They would have to be returned to this site, or possibly the US Navy's other Trident base at Bangor in the Pacific. D5 missiles are currently only transported by sea on Vanguard class submarines.

As an alternative, it might be possible to dismantle Trident missiles at Coulport and then to destroy the components. However this would require the construction of new facilities on the site.

b. Dismantling Vanguard class submarines

Some Trident-related equipment on submarines could be dismantled while the vessels were at Faslane. For example, much of the Fire Control System and replaceable elements of the launch system could be removed.

The fuel core in the reactor of a Vanguard class submarine reactor can only be removed at 9 Dock in Devonport dockyard. The fourth Trident submarine HMS Vengeance is in 9 Dock for a three year refit and refuelling which began in 2012. After this, the MOD plan to carry out refits, without refuelling, on some of the other Trident submarines. This refit programme could be replaced with the defueling and decommissioning of these vessels.

Questions of where and how the final dismantlement of nuclear submarines should be carried out are the subject of the Ministry of Defence's Submarine Dismantling Project.



HMS Vigilant in 9 Dock at Devonport [www.defpro.com]

Verification

Norway, Russia, the US, the UK, the IAEA and NGOs have all been involved in research into how to verify that nuclear disarmament has taken place.¹⁰ Most of this work has focused on dismantling nuclear warheads (phase 8). The principles which have been established can also be applied to the earlier steps.

Britain and Norway collaborated in three exercises, between 2007 and 2011, which explored how a Non Nuclear Weapon State (NNWS) could verify that another country had dismantled its nuclear weapons. This UK-Norway Initiative was founded on the principle that NNWS can play an important role in verifying disarmament. In the event of Scottish independence, Scotland could play a similar role, confirming that the Trident system had been de-activated and that nuclear warheads had been removed from Scotland.

There is an underlying conflict between the NNWS's requirement for evidence and the Nuclear Weapons State's desire to keep information secret, partly to prevent the proliferation of nuclear weapon's technology. In the case of the UK Trident system, this is complicated by the fact that many of the classified components are of US origin.

The UK-Norway Initiative established that it is possible for two parties to agree on an Information Barrier which would indicate whether or not a package contained a nuclear weapon without disclosing classified details of the weapon.

Information Barrier at the Norwegian Disarmament Test Site¹¹



With regard to ending the deployment at sea of Trident submarines (phase 1), it is easy to monitor the movement of Trident submarines in and out of Faslane and Coulport. This would provide a basis for establishing that continuous patrols had ended. It would be harder to prove that vessels were not carrying out occasional ad-hoc patrols.

Verification of the initial de-activation steps, removal of keys/triggers and missile components (phases 2 and 3), might be limited. It would be feasible to establish a process of identifying these items, numbering them and placing them in monitored storage. However, these components are classified. An inspector would be unable to verify that each item was what it appeared to be. Radioactive monitoring would not be effective, because the parts don't contain nuclear material. Further research could be done, in advance, to develop a process which might improve the inspectors' confidence, without disclosing classified information.

Trident missiles can carry a mix of warheads and inert Re-entry Vehicles.¹² The latter are added to swamp the Moscow ABM system. The inert RVs look very similar to a warhead. With regard to the US Trident system, the START agreement allowed Russia to occasionally inspect a sample of submarines and to check whether there were missiles in specific launch tubes. The agreement did not, however, provide a way that Russian inspectors could check how many warheads were on each missile.

This suggests that it would be difficult for an external inspector to count the warheads on a UK Trident missile. However, an inspector could verify that all warheads and inert RVs had been removed (phase 4). To do this, the nose-cone of the missile would be removed and shrouds placed over the third stage and the Release Assembly fittings. In this way, it would be possible to show that there were no warheads or inert RVs present, without disclosing classified information about the missile's design.

There is a second way in which the removal of warheads from a submarine could be verified. An Information Barrier, as proposed in the UK-Norway Initiative, could be used to confirm when warheads were moved out of the Explosives Handling Jetty, after unloading. This technology would enable the NNWS (Scotland) to discriminate between nuclear warheads and inert RVs without inspecting them visually.

Monitoring warheads from when they were taken off each submarine would give greater confidence that later disarmament measures were comprehensive. This would establish the Chain of Custody at an early point in the process.

In order to verify the removal of missiles from submarines into the Ready Issue Magazines (phase 5), the inspectors would require a level of access similar to that which the United States gave to Russian officials under the START agreement.

Monitoring the removal of the Tritium Reservoir, one of the Limited Life Components (phase 6) should be possible, because it contains radioactive material. An external inspector might be able to distinguish between a box containing a real tritium reservoir and a similar box which does not, without seeing the reservoir itself. This process could also be used to monitor the transport of Tritium Reservoirs out of Scotland. The Neutron Generator contains a small amount of tritium and so the same approach might be possible. Identifying Arming, Fuzing and Firing systems, without classified access, would be more difficult.

The removal of nuclear warheads from Scotland (phase 7) could be verified using an Information Barrier. This would allow an NNWS (Scottish) inspector to verify whether or not a container held a warhead, before it was placed in a lorry.

The verification of warhead disassembly (phase 8) has been the focus of significant research. A 1997 US study concluded that "moderate inspector confidence in the dismantlement of a nuclear warhead is

achievable without the need for two sides to engage in an exchange of classified information".¹³

In May 2002 the UK carried out an exercise which demonstrated that external inspectors could be given Managed Access to the warhead assembly/disassembly site at Burghfield. In a subsequent paper the UK concluded that "managed inspector access to sensitive nuclear warhead facilities, done properly, is able to permit some degree of access for non-security cleared personnel."¹⁴

The first exercises in the UK-Norway Initiative assumed that there was a good relationship and collaboration between the two parties. The third exercise was based on a scenario where there was greater hostility and suspicion. The NNWS had less confidence



*Workers inspect a United States W76 warhead
[www.sandia.gov]*

that disarmament had taken place where the underlying relationship was tense than when it was more friendly.

Some elements of an effective verification regime could be set up more quickly than others. Monitoring the presence of submarines at Faslane would be straightforward. Inspecting a missile, to confirm that all warheads and inert RVs had been removed, need not be a complex undertaking. This, and similar steps, would be easier if the United States government adopted a positive approach to the process. Developing Information Barriers could take some time. Delays to the timetable could be avoided if processes were established and experts identified before Day One. Alternatively, the more robust verification measures might only be introduced in the later stages of disarmament.

Security, Health and Safety

There are Health and Safety risks associated with these disarmament steps. However, the overall effect of this plan would be to reduce risks to the workforce and the general public. When Trident is dismantled, whether sooner or later, there will be risks associated with the movement and disassembly of nuclear warheads. If this is done earlier, then we will avoid the additional risks from keeping the system in service. If Trident is kept on patrol and nuclear warheads are upgraded then the risks will be greater. De-activating and dismantling Trident as soon as possible eliminates these avoidable risks.

The plan to remove all nuclear warheads from submarines within 8 weeks and to transport them in a series of convoys over a 2 year period would raise security issues. However, the risk of a terrorist attack would be lower than normal because this was clearly part of a disarmament initiative.

Disarming Trident after Scottish independence

A prohibition of nuclear weapons, or all Weapons of Mass Destruction, could be written into the constitution of an independent Scotland. In its constitution, the Philippines “adopts and pursues a policy of freedom from nuclear weapons in its territory”.¹⁵ Austria has passed a constitutional Act which says that “nuclear weapons must not be manufactured, stored, transported, tested or used in Austria”.¹⁶ Mongolia has an act which prohibits any individual or state from stationing or transporting nuclear

weapons on its territory.¹⁷ Legislation in New Zealand goes further and prohibits any person from aiding or abetting the manufacture, possession or control over nuclear weapons.¹⁸

The Government of an independent Scotland could set out a short, but realistic, timetable for disarmament. This would cover the de-activation of nuclear weapons and their removal from Scotland (phases 1-7). They could also recommend that the warheads were then completely dismantled (phase 8) in England.

This stance would enable Scotland to play a proper role as a responsible state implementing international law, in the light of the International Court of Justice opinion (1996) that “the threat or use of nuclear weapons would generally be contrary to the rules of international law applicable in armed conflict”. It would also be



*End of the Long Walk for Peace from Faslane to the Scottish Parliament, 19 September 2006.
Organised by Scotland's for Peace.
[Scotland's for Peace]*

consistent with calls from the General Assembly of the United Nations and the nuclear Non Proliferation Treaty review conference (2010) for progress towards nuclear disarmament.

Practical implementation of these disarmament measures would largely be the responsibility of the Remainder of the United Kingdom (RUK). However, the Scottish Government should be able to verify that action had been taken.

The Government of an independent Scotland would be keen to establish positive relations with countries around the world and with RUK. Calling for the rapid de-activation and removal of nuclear weapons is not inconsistent with this. It would be a clear signal that Scotland intended to position itself as a forward-looking progressive member of international society, actively seeking to help the international community to achieve one of its objectives, the elimination of Weapons of Mass Destruction.

Notes

This paper complements "Trident: Nowhere to Go", a Scottish CND/CND report published in January 2012 which demonstrated that there were no viable alternative locations for Trident to be moved to, either in the UK or abroad. <http://banthebomb.org/ne/images/stories/pdfs/nowheretogo.pdf>

1 There is a gap of up to 12 months between when a submarine leaves refit and when it becomes operational. During this time there are only 2 operational submarines.

2 It would be possible to accelerate this process if keys and triggers were offloaded by helicopter before the submarines berthed.

3 Beyond the Nuclear Shadow, RAND, 2003, <http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA416560>; Bruce G. Blair, Global Zero Alert for Nuclear Forces (Washington, DC: Brookings Institution), 1995, pp. 88-89.

4 Based on the time taken to initially load warheads on HMS Vanguard in December 1994, prior to its first patrol.

5 In the case of the UK Trident warhead, the AF&F, Gas Transfer System and Neutron Generator are purchased from the United States.

6 In 1972 it was anticipated that the numbers of nuclear bombs at Honington would peak in mid 1976. The actual number has been redacted. The National Archive AIR 2-78147 y, 16 May 1972. Similar Igloos at US Air Force bases have each stored as many as 50 nuclear bombs. <http://www.fas.org/blog/ssp/2009/11/locations.php>. In the 1970s the RAF were planning to store around 36 WE177C bombs in two igloos at RAF Laarbruch in Germany. Satellite images show no visible changes to the Honington SAS since warheads were stored there. www.teraserver.com (September 2011 image)

7 A planning application document for Project Mensa referred to Cell A and Cells C. The design is symmetrical and there are probably four identical cells.

8 This is a simplified version of the procedures detailed in the US Department of Energy 1997 study, <http://www.fas.org/sgp/othergov/doe/dis/>

9 WE177C production was planned at a rate of 3 per month. The National Archive AIR 2-78147 y, 16 May 1972.

10 US Department of Energy dismantling study, <http://www.fas.org/sgp/othergov/doe/dis/>

UK-Norway Initiative, <http://www.mod.uk/DefenceInternet/AboutDefence/CorporatePublications/SecurityandIntelligencePublications/InternationalSecurity/UkNorwayInitiativeOnNuclearWarheadDismantlementVerification.htm>

Verifying Warhead Dismantlement: Past, present, future, David Cliff, Hassan Elbahtimy & Andreas Persbo, <http://www.vertic.org/media/assets/Publications/VM9.pdf>

11 http://www.norway-un.org/NorwayandUN/Selected_Topics/Disarmament/UK-Norway-Initiative-Research-into-the-Verification-of-nuclear-warhead-dismantlement/

12 Current loading is possibly 5 warheads and 7 inert RVs on each UK Trident missile

13 Verifying Warhead Dismantlement, page 13

14 Verifying Warhead Dismantlement, page 61

15 http://www.concourt.am/armenian/legal_resources/world_constitutions/constit/philipin/philip-e.htm

16 http://www.ris.bka.gv.at/Dokumente/Erv/ERV_1999_1_149/ERV_1999_1_149.pdf

17 https://www.unodc.org/tldb/pdf/Mongolia/MON_Nuclear.pdf

18 <http://canterbury.cyberplace.org.nz/peace/nukefree.html>

The Scottish Campaign for Nuclear Disarmament was founded in 1958 and has consistently worked with other organisations to promote nuclear disarmament. Scotland's for Peace is a joint initiative by a range of civic organisations, including churches, trade unions and peace groups with a common aim - "We desire that Scotland should be known for its contribution to international peace and justice rather than for waging war."