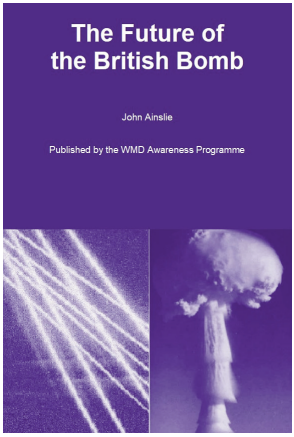
Nuclear dependency

Arguments from The Future of the British Bomb

John Ainslie



These excerpts are from The Future of the British Bomb *(2006), John Ainslie's comprehensive review of the issues raised by nuclear-armed Trident missiles carried on four British submarines. He begins by examining Britain's dependence on the United States for parts of Trident's warheads. The report was first published by the WMD Awareness Programme.*

The British Government acknowledges that Trident missiles are leased from the United States but claims that they carry British warheads. This description is questionable. The warhead is a copy of the US W76. A report by the Public Records Office refers to the Anglicisation of an American design. Several key components are produced in America. The warheads on Royal Navy Trident submarines could be more accurately described as Anglo-American rather than British.

The Neutron Generator is one vital part. It contributes to the initiation of nuclear fission. The MC2989 Neutron Generators initially deployed on British warheads were overhauled in the US in 1999. This implies that they were built there. A replacement Neutron Generator, MC4380, was manufactured in America and supplied to Britain in 2002. The Gas Reservoir in the warhead supplies tritium to boost the fission process. The reservoirs on British warheads are filled with tritium in the US. These are difficult components to build. This suggests that the reservoirs in British warheads are manufactured in America. The Arming, Fusing and Firing System triggers the warhead. The model used on British warheads was designed by Sandia Laboratory and almost certainly procured off-the-shelf from America.

The Trident system operated by Britain is not identical to that deployed by the US Navy, although it is very similar. One difference is the type of high explosive in the British warhead. US nuclear weapons laboratories are playing a critical role in assessing the long-term performance of this British explosive. A second difference is the Fire Control System. British submarines

carry a slightly different model. But all the hardware and software for it is created in America. It is significant that, even where the British Trident system differs from the American version, US support is essential.

The US role in handling tritium and making the Neutron Generators is known from publicly available American sources. Yet when asked about these issues in Parliament the Defence Minister refused to answer, on grounds of national security. Successive governments have withheld information to conceal dependence. There is a deliberate attempt to create ambiguity over the extent of dependence. The true limitations of independence are concealed. This is consistent with the policy of uncertainty that lies at the heart of British nuclear policy.

Reliance on American support is not only of historical and current significance. It will remain a crucial factor so long as Britain remains a nuclear-weapons state. The terms of the Mutual Defence Agreement [between the United Kingdom and the United States] constrain how information and material that has been exchanged can be used. The British nuclear weapons establishment today is almost entirely dependent on this information. Any future nuclear programme will build on what exists today. It will be subject to the same limitations and must be in the mutual defence interest of both Britain and the United States.

A truly independent nuclear weapons programme is not an option. A future system might be more or less dependent on US support than at present. Current and future US Administrations will determine the degree of independence. Also, the US can probably restrict the independence of the system in service, should there be a change in policy in Washington.

Targeting systems

In 1988, the National Audit Office reported that it was essential that Trident targeting software be produced in Britain. As Trident entered service it was revealed that ‘contractor support’ had been required to complete this work. This contractor support almost certainly came from the United States.

Targeting data on British Trident submarines is processed in the Fire Control System by software produced in America. This data is created in the Nuclear Operations and Targeting Centre in London. The centre relies on US software. In 2002 the Fire Control Systems on British and American Trident submarines were modified. Just before this the computers in the London targeting centre were upgraded. The American applications used for target planning and for fire control are complex and unique. It would be possible for US programmers to modify the software supplied to Britain, either openly or covertly, to restrict how Trident could be used.

Even those who operate the system may not have an accurate perception of its dependence. The British Trident system is only as independent as Washington wants it to be. It could be argued that constraints on independence would be consistent with the Mutual Defence Agreement.

British warheads can be integrated into US attack plans. There are special arrangements for supplying US nuclear targeting information to Britain. The United Kingdom Liaison Cell at STRATCOM [Strategic Command] headquarters in Omaha plays a central role in this process. US support may also be required to produce plans for an independent attack.

The Nato Nuclear Planning System is a mechanism for preparing attacks by nuclear-armed aircraft. The crucial systems for targeting Britain's Trident force are bilateral. While there will be links between the British system and Nato headquarters, the essential networking is between London and the headquarters of STRATCOM. The instructions to order the use of British weapons are not issued in the form of Nato Emergency Action Messages, but through a unique system.

Trident missiles can only achieve the required level of accuracy if a special forecast of the weather over the target is available. This is supplied to British and American submarines in compressed messages transmitted every 12 hours by the US Navy. Trident also relies on gravity information from US sources. Without this weather and gravity data the missiles would be less accurate.

British Trident submarines are normally on a state of alert measured in days. There is a substantial American presence at the Northwood headquarters from where British submarine operations are controlled. If the alert state of British Trident were raised, the US would almost certainly know. This would give them several days' notice of any British nuclear attack.

Communications with British Trident submarines can be made through British or Nato systems. In addition there are bilateral systems. These are likely to be used for key data. Submarines can receive messages on a wide range of frequencies. In future it will be possible to use Extremely High Frequency (EHF), but only through a transmitter on an American satellite. EHF is important because it is considered to be less vulnerable than other systems during a nuclear war.

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The effects of nuclear use

A single Trident warhead used against a military installation, such as a naval base in Northern Russia, could cause around 23,000 civilian fatalities. If the target was inside a city then there could be 150,000 –

200,000 deaths. If the warheads from one British submarine were exploded at military targets in the Moscow area, most of them outside the city, this could result in around 3 million deaths. This figure would rise to between 9 and 30 million if the warheads on all three armed submarines were detonated. These figures only include short-term fatalities. The long-term effects of radiation, environmental damage and the destruction of infrastructure would substantially increase the death rate. Studies have shown that a US counterforce attack on strategic military targets in Russia would result in massive civilian casualties. The raw figures do not give a true picture of the horror that would be inflicted on individual women, men and children. The photographs and accounts from Hiroshima and Nagasaki provide a glimpse of the monstrosity of nuclear weapons.

Accident

A US study distinguishes three types of nuclear accident scenario. The first situation is an unauthorised launch of a weapon by a rogue commander or a terrorist. The second is where a launch takes places by mistake, as a result of a training accident or a system malfunction. The third scenario is where incorrect information results in an intentional launch.

A number of situations fall into this third category. There could be an error or malfunction in the early-warning systems which are designed to detect a missile attack. A non-threatening event could be misinterpreted. There could be a false perception that another country had launched a nuclear attack, or a misperception that a nuclear weapon had detonated within the homeland. Lastly, a training attack could be misinterpreted as a real attack.

The report touches on the connections between the possession of nuclear weapons, relations between Russia and the US, and the risk of accidental use. It suggests that de-alerting moves could improve relations between the two countries and so provide a basis for more substantial measures. It recommends that several immediate unilateral measures be taken within 6 to 12 months. One proposal is to move Trident submarines further from Russia. Britain's Trident force is not mentioned, but for geographical reasons it could be seen as a particular threat because of the proximity of patrol areas to Russia.

The analysis concludes, 'The risk of accidental or unauthorised nuclear use is too high given the markedly improved relationship between the United States and Russia. This is in part because nuclear weapons now play a role out of proportion to other aspects of the relationship'. Adherence to nuclear deterrence is an obstacle to progress towards

lowering risks and improving relations – 'A central reason for the phased approach is that some options for improving safety would push too far beyond current deterrence practices and orthodoxies to be acceptable'.

The risk of a nuclear weapons accident has been considered particularly in the context of the large American and Russian arsenals on a high state of alert. But the dangers also apply to other nuclear powers. For Britain's part there is a need to recognise that our nuclear weapons contribute to the risk of an accident. Also each step that we take towards disarmament will contribute to building a better relationship with Russia. What is blocking progress is continued adherence to outdated and dangerous theories about nuclear deterrence.

Financial costs

Cost will be a major factor determining the future of British nuclear weapons. Michael Quinlan [civil servant] concedes that if today he had to decide whether or not to embark on the Trident programme then the cost would not be justified. Admiral Sir Raymond Lygo suggested that the cost of Trident should be capped at a level relative to the threat from Russia and China.

The substantial overheads of the nuclear-powered submarine programme are partly due to Trident and partly to the conventionally-armed force. The primary mission of the latter is the protection of Trident. There are huge potential savings to be made by giving up nuclear-powered submarines. Estimates of the cost of decommissioning defence nuclear facilities have increased several times in recent years. The long-term costs of storing nuclear waste will increase with each year Britain continues to have nuclear weapons and nuclear-powered submarines.

In assessing the cost of upgrading Trident, or acquiring a replacement, the budget should include not only capital costs but also the total revenue cost throughout the planned life of the system, including decommissioning.

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John Ainslie sent this additional paper to the Defence Select Committee in 2007 after he gave evidence to their inquiry on nuclear weapons. It develops some of the issues raised in The Future of the British Bomb.

Is Trident Crippled?

In 1988, an Audit Office report into the Trident programme said:

'proving the effectiveness of the system for UK purposes is dependent on the

production in the UK of software for targeting, modelling and effectiveness assessment'.

The report pointed out that at the time the Director General Strategic Weapon Systems was having difficulty recruiting suitable staff. In 1994, the Defence Minister said that software development work had been completed using a mix of internal expertise and specialist contractor support.

Reliance on US software

The designers of the Trident D5 adopted a systems-wide approach to meet the accuracy specifications of the missile. They studied and modelled each factor that could reduce accuracy and created a substantial complex of software, computer models and data. These are not static but are regularly updated. While the United Kingdom does produce some software for the British Trident system, much of it is of US origin.

The Applied Physics Laboratory of Johns Hopkins University in Maryland (APL) evaluates the UK Trident missile system. APL designed the systems used to monitor missile tests and they analyse all British tests. Additional analysis is carried out by Charles Stark Draper Laboratories, who make the missile guidance system.

The Trident Fire Control hardware is manufactured by General Dynamics Defense Systems (GDDS). The US Navy regularly places contracts with GDDS for updates of software for the UK fire control system.

K Department of the Naval Surface Warfare Center at Dahlgren in Virginia develops and tests the targeting and fire control software for Trident. The contractor who supports K Department is required to – 'coordinate the development of fire control specifications for the United States and United Kingdom submarine-launched ballistic missile (SLBM) systems and support specification testing … perform the verification, acceptance, static and/or dynamic testing tasks for up models including Fire Control support software, United Kingdom reference/simulation models, US/UK targeting models and SLBM general purpose tools'.

The models referred to are at the heart of the Trident system. They are used for shore-based targeting and performance assessment. In addition parts of these models are integrated into the fire control software on Trident submarines.

In the British software facility programmers maintain, update and modify US codes and models for inclusion in the suite of codes for the UK Trident system.

Validation of US software in the United Kingdom

When asked about the verification of US fire control software, Defence Minister Des Browne said,

> 'Each new release of Trident fire control software is certified by the US Government under the terms of the Polaris Sales Agreement (as amended for Trident). Under the agreement, the UK has the capability to validate the software models for software performance and verify that the findings are correct. This is undertaken and independently verified by UK experts to ensure the software meets our requirements before being issued to Royal Navy submarines.'

Adam Ingram, junior Defence Minister, was asked about US software for the shore-based system and said,

> 'The UK shore-based target planning system for Trident is validated through a range of UK and US research programmes. UK experts then independently verify the system against requirements before issuing it to Royal Navy submarines'.

Work on software for Trident is carried out in the Corsham Computer Centre also referred to as the Corsham Software Facility. This is an underground complex close to Basil Hill Barracks in Wiltshire. Mass Consultants Ltd manage the IT system in the centre, on behalf of the Strategic Systems Integrated Project Team. Analysts who assess the performance and effectiveness of Trident use the IT facilities in centre.

The one company in the United Kingdom with expertise in analysing submarine-launched ballistic missile trajectories was Hunting Engineering Ltd. The company changed its name to INSYS and then to Lockheed Martin UK. They now are a subsidiary of the US firm with the main Trident contract. Some of the validation will be carried out at Corsham but other work is probably contracted out to Lockheed Martin UK.

Removal of classified items from US software

British experts will be hampered in their attempt to validate the software by the constraints of US security restrictions. The Joint Strike Fighter deal showed the difficulties of purchasing equipment which is dependent on sensitive American software. In the case of Trident the United States does supply the software codes, but not in their original complete form.

A substantial proportion of US nuclear targeting information is classified so that only US citizens can see it. The Chief of Staff has issued

a directive specifying how classified items should be removed from nuclear targeting information, in a process called sanitising, before it is handed to the Corsham Computer Centre, the London targeting centre or the British contingent at Strategic Command in Omaha. The contractor at Dahlgren has to check that any software handed to Britain has been sanitized, as part of the Quality Assurance (QA) process –

> 'For the QA of UK models, the contractor shall analyse the software, data and documentation to verify that all US-only items have been removed.'

This implies that the process is as follows:

1. US contractors produce software items for the US Trident system
2. US-only items are removed from the code, data tables and instruction manuals
3. A US contractor verifies that these items have all been removed
4. The cut-down software is handed to the Corsham Computer Centre
5. Corsham and Lockheed Martin UK check that the software works
6. The software is issued to submarines, the London Targeting Centre and/or the Corsham Computer Centre as appropriate.

Implications for the independence of UK Trident

From the perspective of Washington it would be desirable to create the impression that Britain can use Trident independently while at the same time maintaining a veto over actual use. One particular concern will be the potential for Britain to launch 144 nuclear warheads at the United States. How could the software stop a Trident launch?

General restrictions

Preventing the use in all circumstances except tests, or preventing the missiles from being fired westwards, towards the United States from the normal patrol areas, should be possible.

Restricting the system to only NATO or joint US/UK plans

The fire control system can probably distinguish an independent British plan from a NATO or Anglo-American plan. Any allied or joint plan would have to be deconflicted. This is a process of integrating two plans to ensure that they do not undermine each other's effectiveness. For example debris in the fallout cloud from the explosion of a British nuclear explosion could cripple a US nuclear weapon and prevent it from

detonating. For reasons of complexity and classification it is not possible to run a US attack plan through the British computer system. Deconflicting can only be carried out by running the British plan through the main US nuclear planning system at Strategic Command in Omaha. This deconflicting process is likely to leave a trace in the data which could be detected by the fire control software on the submarine. If the software can distinguish a Nato plan from an independent one, then it could possibly prevent the independent plan from being implemented.

Restricting use by manipulating weather data

A NATO or Anglo-American plan would probably use US weather data. The fire control system requires details of weather over the target area if it is to achieve the desired level of accuracy. For an attack on Russia a large amount of data is required on wind speed and air density at various altitudes. This data has to be transmitted over very low frequency (VLF). It is compressed and formatted in the US into Ballistic Parameters (Balpars). These are transmitted every 12 hours. There are similar mechanisms for producing detailed weather data when Trident is being re-targeted against specific targets. It is possible that information could be contained within Balpars or other weather data that would have the effect of switching on or off the UK fire control system.

If the US tampered with the software, would we find out? The US Navy asked Mountain State Information Systems to check the security of the US Trident software. The company's description of this work reveals that this was a complex task for which they had to develop new techniques. This suggests that if the US programmers tried to hide commands within the software it would not be easy for British experts to find them.

The task is made particularly difficult because of the holes in the code, data and manuals where items have been removed for reasons of security. This means that there will be parts of the UK software which do not make sense. But the US manufacturers will not be able to explain the anomalies because the missing material is classified.

As the software has a mixture of cut-down US components and British elements it will be a difficult task to get it to work. This is probably the main focus of the British software effort. Checking to see if the Americans have crippled the code is probably not a priority.

This does not establish that the software has been crippled, but does suggest that it could be. The only way that Britain can guarantee that the Trident software has not been modified would be to produce it all ourselves. But we do not currently have the expertise to do this.