

CHAPTER 3 US-UK NUCLEAR SHARING: DETECTING DISARMAMENT

John Ainslie

For over 50 years, the US and UK governments have shared information on the design of nuclear weapons. They have also traded warhead components including radioactive material. But these exchanges have been kept off the political radar. Linton Brooks, a former head of the US nuclear weapons programme, described the collaboration as “often unnoticed and inevitably unquestioned”.¹ The dialogue and trade is not only hidden from nuclear Non-Proliferation Treaty (NPT) meetings and other disarmament conferences—it is often even concealed from diplomats in the two participating countries. Most of the exchanges are in the form of secret meetings between technical specialists, isolated from wider policy discussions. According to Brooks, the US State Department and the British Foreign Office are, to a large extent, excluded. In most cases only technical experts are inside the bubble. For example, at least one senior US nuclear policy officer has a more intimate relationship with his British counterparts than with his own State Department.²

The main mechanism for US-UK nuclear sharing is the Mutual Defence Agreement (MDA). First signed in 1958, the Treaty has been amended and extended several times. It is very comprehensive and facilitates the exchange of blueprints, special nuclear material, and components for nuclear weapons. It also covers missiles and the reactors for nuclear submarines. Day-to-day exchanges are limited more by bureaucratic process than by the wording of the Treaty.

The second plank of the sharing arrangement is the Polaris Sales Agreement (PSA) of 1963, which, with its amendments, has given Britain access to US Polaris and Trident missiles and all the support systems that they require. The current arrangement is that Royal Navy submarines take a number of

John Ainslie is Coordinator of the Scottish Campaign for Nuclear Disarmament and over the last two decades has carried out research into the British nuclear weapons programme.

Trident missiles from a common pool.³ There are no distinct UK missiles.

The MDA was signed just after the UK detonated its first hydrogen bomb. But this British hydrogen bomb design was never put into production. Shortly after the Treaty was agreed, the Atomic Weapons Establishment (AWE) began manufacturing Red Snow hydrogen bombs. These were a direct copy of the US Mk-28 design.⁴ Subsequently, the UK Polaris, Chevaline, and WE-177 warheads all had a secondary (fusion stage) based on a US design.⁵ The UK has never deployed a thermonuclear weapon of genuinely British origin.

In 2008, on the eve of the fiftieth anniversary of the MDA, the Project on Nuclear Issues interviewed over 30 people who had been involved in implementing the Agreement. The resulting book and audio tapes provide valuable insights into the relationship.⁶ One lesson is that the exchanges have expanded in both breadth and depth over recent decades.

Richard Wagner, former US Assistant to the Secretary of Defence for Atomic Energy, said that the scale of collaboration increased from the 1980s onwards:

The general trend was to continually expand the scope of what could be talked about ... the technical people from both sides would propose expansion, this was discussed at policy level—sometimes the policy dimension wouldn't allow full expansion as requested from the technical level—but generally it did.... My main memory is of a continuous expansion.⁷

The exchanges became more important after 1992, when nuclear tests ended.⁸ From that point on, scientists had to rely on experimental data and modelling. It was useful for the United States to have access to an outside body which could check their calculations.

Glen Mara, Director for Weapons Programs at Los Alamos Laboratory, explained, "There has generally been an increasing slope through all the international agreements to enhance and expand collaboration ... as we approach this 50th anniversary and discuss enhanced collaboration I think it is just going to accelerate."⁹ He said that a key issue was the exchange of experimental data between the two countries, noting, "There are attempts now to speed up the process." The US Nuclear Posture Review in 2002 initiated new "enhanced collaborations" between AWE and the US nuclear weapons laboratories on specific topics.¹⁰ The 2010 Posture Review is likely to have a

significant impact on the UK programme, but the relevant details may not emerge into the public domain.

Admiral Pete Nanos, formerly Director of Los Alamos National Laboratory, has said that the US-UK relationship has become so close that Aldermaston has “essentially become almost like a third weapons laboratory” for the US.¹¹

Frank Miller, an American official who was given a knighthood by Britain for his work implementing the MDA, has said that in the 1980s, the discussions between the US and UK governments moved beyond nuclear weapons technology to sharing nuclear policy and targeting concepts. The policy staff from the two countries have two annual week-long meetings where they share their thinking.¹²

Today, a US Joint Chief of Staff’s instruction outlines how British planners require access on “a daily and continuing basis” to information from the US nuclear targeting system.¹³ The US Navy supplies software for the UK’s nuclear target planning complex at Corsham in Wiltshire.¹⁴

The UK Trident warhead

The nuclear warhead deployed on Royal Navy submarines today is not a pedigree British bulldog. It is a mongrel: while the weapon has some British features, it has others which are identifiably American.

In December 2009, the UK government identified three of the parts of the warhead which are procured from the US: the Neutron Generator (NG), Gas Transfer System (GTS), and the Arming, Fusing, and Firing System (AF&F).¹⁵ The NG produces neutrons to start the fission process. The GTS inserts tritium into the pit to boost yield. The AF&F is the brains of the warhead. It controls when the device will explode and fires the detonators. These three “made in America” parts are each fundamental to the design. Without them the warhead would be a dud. The UK government buys these vital components from the US to save money.¹⁶

One ingredient which could be marked with a Union Flag rather than the Stars and Stripes is the high explosive. This is a distinct British formula, EDC 37, rather than the US equivalent, PBX9501. US laboratories have assisted in research to establish the effectiveness and safety of the British explosive.

It is likely that some of the radioactive materials in the UK Trident warhead are of US origin and that some others have been processed in US facilities. Under the MDA, the US supplied the UK with 7.5 tonnes of highly enriched uranium (HEU) and 6.7 kg of tritium in exchange for 5.4 tonnes of British plutonium between 1960 and 1979.¹⁷ There were subsequent transfers but the materials and quantities involved have not been disclosed. During the 1990s, tritium produced at Chapelcross power station in Scotland was supplied to the US. In January 2010, the UK government acknowledged that it obtained HEU for the military programme from the US Department of Energy under the MDA. It claimed that this “does not contravene our obligations under the non-proliferation treaty”.¹⁸

The plutonium pit and HEU secondary of the UK Trident warhead were fabricated at Aldermaston.¹⁹ It is not clear to what degree their designs are of British or American origin. In 1978, the UK tested a warhead design for a high velocity re-entry vehicle. This had a yield of less than half that of the US W76 warhead.²⁰ One purpose of this series of tests was to persuade the US to disclose information on their equivalent devices. The design of the UK Trident warhead was completed in the early 1980s. A significant increase in yield would have been difficult to achieve without substantial US input. The UK government claims that the warhead is a British design, but one US expert has described it as “their W76 variant”.²¹

Current collaborations

Mk4A upgrade. The UK Trident warhead is similar to the US W76-0/Mk4.²² These US warheads are being upgraded to a new W76-1/Mk4A version between 2009 and 2021. A significant part of this modernization has been the development of a new Mk4A AF&F. In 2007, the UK government acknowledged that it was introducing this Mk4A AF&F into the UK Trident warhead.²³

The W76-0/Mk4 warhead was initially designed for the relatively inaccurate C4 missile and so was not given a fuse that was suitable for hardened targets, such as missile silos and underground bunkers.²⁴ This warhead and its UK equivalent are now deployed on the D5 missile, which is more accurate. The improved fuse in the Mk4A was designed to take advantage of

the accuracy of the D5 missile. It gives the warhead a near-ground-burst capability.²⁵ This and other modern features mean that the Mk4A is more effective against hardened targets.

Sandia National Laboratory in the United States is helping AWE to incorporate the Mk4A AF&F into the UK warhead. In 2006, AWE was planning how to transfer “systems integration” capability from the US to the UK.²⁶

The W76-1/Mk4A life extension programme in the US affects not just the AF&F. A wide range of warhead components are being replaced, re-manufactured, or refurbished. The full scale of the UK Mk4A refurbishment programme is not known. One feature that is likely to be included is a new GTS. The costs of the upgrade are hidden within the £1 billion per year AWE modernization budget.²⁷

British involvement in the US Reliable Replacement Warhead programme. John Harvey, Director of Policy at the US National Nuclear Security Administration (NNSA), has said that in 2004 the MDA was amended as well as extended. The change gave Britain access to information on use control technology—how warheads can be modified to prevent unauthorized detonation. This data was fundamental to the Reliable Replacement Warhead (RRW) design. According to Harvey, the MDA was amended to enable the UK to participate in RRW.²⁸ Frank Miller confirmed that British scientists had been working on their own equivalent of the RRW.²⁹ Some have called this the High Surety Warhead.³⁰ In 2007, Des Browne, the UK Defence Minister, said that work was being done, in collaboration with the US, to inform decisions on future warheads and that this included reference to RRW.³¹

In December 2006, there was an exchange of letters between President Bush and Prime Minister Blair on the renewal/replacement of Trident. This resulted in a new wave of enhanced collaborations with the US into how to refurbish or replace the UK Trident warhead.³²

The Obama administration has abandoned the RRW programme. The US Department of Energy is now focussed on refurbishing the W76 Trident warhead rather than replacing it. AWE can be expected to follow a similar course. As Glen Mara explained, “If the US decides to stay with the legacy stockpile ... it is much more difficult for the UK to embark on a transformed stockpile, i.e. to go it alone, because there are so many inter-dependencies ... in a large part I would expect the UK in many regards to follow the US.”³³

Collaboration on new fuses and multi-point safety. Plans for new US nuclear weapons are like ground-elder. You may think you have eliminated it, but the weed can pop up again next year, kept alive in a fragment of root. One part of RRW that has survived is the project to develop a new AF&F. The UK government is involved in this joint programme, along with the US Navy and US Air Force, to design a common fuse for the W78 intercontinental ballistic missile (ICBM) warhead and the W88 Trident warhead. But it is hard to reconcile the UK's involvement in this project with recent practice. AWE has been purchasing, from the United States, the AF&Fs used on the W76 warhead rather than making its own. There is no mention of the W76 in descriptions of the new common fuse programme.

A second remnant of RRW that is still growing is research on enhanced surety. This programme aims to produce new safety and security features for warheads by 2020. Under this heading, AWE is collaborating with the US laboratories in the development a multi-point safe warhead design.³⁴ Current warheads are "one-point safe," i.e. they should not produce a nuclear yield if the high explosive detonates at one point. A multi-point safe warhead would not produce a yield even if the explosive detonated simultaneously at several points. This change cannot be achieved by modifying the current British warhead.³⁵ Multi-point safety could only be accomplished in a new UK design.

Upgrading the Atomic Weapons Establishment. The great fear of scientists at AWE is that the flow of information from the US will reduce to a trickle, or even worse, that the tap will be shut off. Over 50 years, they have learned that if they want to see the blueprints for the latest American gadget, they have to bring something to the table that is of value to the US laboratories.³⁶ This creates an external imperative driving British scientists to develop more sophisticated features for nuclear weapons. Sometimes the demand to impress the US laboratories matches the requirements of their own production plan, but not always. And that production plan is itself fundamentally distorted by the "special relationship".

AWE is now two-thirds owned by two American companies, Lockheed Martin and Jacob's Engineering. From 2006 to 2009, the facility was run by Don Cook, an American scientist from Sandia National Laboratory. He has since moved on to the number two post in the US nuclear weapons programme.³⁷

In 2005, when AWE was looking forward to the prospect of developing an anglicized RRW, a massive programme was started to replace or modernize most the facilities at Aldermaston and Burghfield. This work was being done in conjunction with the US programme. From the US perspective, upgrading AWE will “improve British technical capability and thus the technical value of ongoing exchanges.”³⁸

There has for decades been joint research into high energy density physics to support the two nuclear weapons programmes. When the US National Ignition Facility (NIF) was first proposed, it was planned that the UK would build a module within it. This module was abandoned and instead a new laser, Orion, was built at AWE. The new US and UK facilities were designed to complement each other by accessing “different parts of the temperature and pressure space relevant to the operation of nuclear warheads,” and like the earlier generation US and UK laser physics collaboration, are intended to “allow experiments designed for one laser to be investigated further on a second laser.”³⁹

One rare example of how AWE’s expertise can be of value to the US laboratories has been hydrodynamic research. US scientists have “borrowed” the hydrodynamic test facilities at Aldermaston.⁴⁰ Today the capabilities of the new Los Alamos DAHRT building dwarf those at AWE. But there are plans for the UK to catch up by building a new facility, Hydrus, at Aldermaston. Hydrus would be invaluable if AWE were to design a plutonium pit for a new nuclear warhead. Going ahead with this project would signal that this is the UK’s intention.

The UK government plans to build a new Enriched Uranium Facility (EUF). There have been exchanges between those working on EUF and on its US counterpart, the Uranium Processing Facility (UPF) at Y12. The two have similar missions.⁴¹ The main goal of the US plant is to manufacture the secondaries and radiation cases for thermonuclear weapons. It is reasonable to deduce that this is also the main purpose of the UK facility, although the UK government is unwilling to say as much. If the option of building a new warhead was deleted from the government’s plan, then EUF could be abandoned or reduced to an HEU storage facility.

US scientists and software engineers are creating simulations of nuclear explosions on the most powerful computers in the world. AWE is trying to emulate this. It has been said that US scientists do not give AWE com-

plete warhead codes. Nevertheless, there is extensive dialogue over how the simulations are created. The transfer of experimental data, from which the models are built, has accelerated.

The upgrading of AWE is not a short term project. It will be years before the new and refurbished manufacturing and warhead assembly buildings could be fully operational. The experimental facilities, Orion and Hydrus, and the related advanced computing facilities, are designed to make long-term contributions to the UK nuclear programme. These projects would be consistent with a plan which assumes that the UK will continue to have nuclear weapons in 2060. However, they are not in harmony with the UK's obligations, under Article VI of the NPT and the 13 practical steps agreed at the 2000 NPT Review Conference.

Future submarine programmes. Over the next ten years, as well as introducing the Mk4A warhead, the US Navy is upgrading the fire control, navigation, and missile guidance elements of the Trident weapon system.⁴² The combined effect will be to increase the flexibility, accuracy, and effectiveness of Trident. The UK purchases these systems from the US and has bought into all of the modernization projects.

The two countries are also working together to develop new ballistic-missile submarines. The first British vessel is due to enter service in 2024 and the last could still be at sea in 2060. The first new US submarine is scheduled for 2027 and some of the vessels are due to remain in service until 2080.⁴³ The fleet of 12 American vessels is expected to cost around \$80 billion.⁴⁴ The official estimate for the British programme is that procurement costs will be between £15 and £20 billion, plus operating costs of around £1.5 billion per year.⁴⁵ The two governments are funding the development, in the US, of a common missile compartment for the new vessels. The launch tubes will be designed to accommodate a new missile larger than Trident, which is scheduled to enter service in 2040.⁴⁶

Many politicians in the UK, from across the political spectrum, are saying that the price is too high.⁴⁷ Senior military figures have joined them in arguing that Britain can't afford to build a new version of the Trident system. The UK government plans to base the new submarines at Faslane in Scotland. The Scottish parliament and Scottish government, reflecting the views of civil society and the general public, are opposed to the renewal or replacement of Trident.⁴⁸

Significance of US assistance for the UK nuclear programme

The British nuclear weapons programme is like an old mill. The flow of information and material from the US is the water that keeps it turning. If the sluice-gate is closed and the flow stopped then the programme will grind to a halt. Then the machinery can be dismantled and the building converted to another function.

In the 1990s, the UK abandoned the air-delivered part of its nuclear forces, not because of a change in nuclear policy but because the US scrapped plans for the SRAM-T missile that the Royal Air Force had been hoping to deploy. A capability based on new free-fall bombs would not have been effective. An Anglo-French missile was not feasible. The UK government concluded that, even with French assistance, building a new nuclear missile without US help was unaffordable.⁴⁹

For many decades, the late Sir Michael Quinlan argued that Britain had to remain a nuclear weapon state. In his later years, he said that it would be preferable to keep nuclear weapons, but not at any price. Commodore Tim Hare, a former Director of Nuclear Policy at the MOD, has argued that US support is critical if Britain is to have an affordable nuclear force. He described the MDA and PSA as

pivotal to us being able to maintain an affordable nuclear deterrent capability in this country. I would go as far as to say that without those two agreements I think the road by which we have maintained an independent nuclear deterrent capability would have been much, much more rocky than it has been. Largely because through those two agreements we are able to maintain a capability at an affordable price and I think that has made it more acceptable to the nation and the public at large.⁵⁰

He added that Britain would probably not have remained a nuclear weapon state if the public had been asked to pay as much as French governments had spent on their nuclear forces.⁵¹

For the UK, to deploy thermonuclear weapons on accurate submarine-launched ballistic missiles, without US assistance, would be extremely expensive. It would be cheaper for the country to have fission bombs which could be dropped by aircraft. But these would be less destructive and limited in their application.

The UK government has been like a shopper who sees an item at a sale price and feels that he must buy it—regardless of whether or not he needs it. He has been enticed by the fact that this special offer is available only to him and to no one else. But today his empty wallet is forcing him to consider whether perhaps this is something that he can do without.

Benefit to the US of nuclear sharing

The loss of British cooperation would have only a minor impact on the US. There have been areas where the UK has helped. For example, in recent years, the Los Alamos Nuclear Laboratory restarted the production of plutonium pits after a long pause. The UK, which had built a replica of the Los Alamos plant at Aldermaston in the 1990s, offered to assist. The US Department of Energy is manufacturing the new pits from cast rather than wrought plutonium. AWE has always used cast plutonium and has supplied data to the US on the performance of cast-plutonium pits, from hydrodynamic experiments at Aldermaston and from subcritical tests of British devices at the Nevada Test Site.

The US nuclear weapons programme has also benefited from the expertise of British scientists such as Charlie Martin. Martin was described by his American colleagues as “the father of pulsed power”.⁵² He has said that Aldermaston was repaid tenfold for every bit of help he gave to the US programme. Martin was at the forefront of hydrodynamics research—he led the development of experiments that examine the way a warhead implodes, by detonating dummy warheads. He pioneered the use of a non-fissile isotope of plutonium in these tests. At one time, the US laboratories were not permitted to conduct these experiments with non-fissile plutonium in America for legal reasons, so they conducted their tests in Aldermaston.⁵³

One of the perceived benefits to the US from the special relationship has been that the AWE can peer-review the work of the Los Alamos and Lawrence Livermore laboratories. But John Harvey of the NNSA has questioned whether this still works. The relationship with AWE has grown so close that British scientists are no longer outsiders. They have worked intimately with the US laboratories for so long that they share the same perspectives. Harvey compared the relationships that the United States has with the British

and the French nuclear programmes. The links with France are not as close, though the French have been able to peer-review some aspects of the US nuclear weapons, including safety issues, in a way that Britain no longer can.⁵⁴

Another benefit to the US is having an ally. As Frank Miller said, “It’s always useful to have someone else in the dock with you.”⁵⁵ He explained that at international disarmament conferences the US often faces criticism from many nations. One payback from the MDA is that Britain stands alongside America and shares its guilt.

The legality of US-UK nuclear sharing and the nuclear Non-Proliferation Treaty

The US has assisted, encouraged, and induced the UK to manufacture and deploy sophisticated thermonuclear weapons. Had the UK been a non-nuclear weapon state this would be a flagrant breach of Article I of the NPT. Article I prohibits any nuclear weapon state from assisting a non-nuclear weapon state to develop a nuclear capability. However, it is less rigorous in regulating exchanges between those countries which acquired nuclear weapons prior to 1970. Article I only explicitly prohibits the transfer of “nuclear weapons or nuclear explosive devices” between nuclear weapon states.

At the 1995 NPT Review Conference, the Mexican delegation argued that the exchanges of nuclear components and technology between the US and UK were in violation of Article I.⁵⁶ This view was supported by members of the Non-Aligned Movement but was refuted by the US, UK, and several other NATO members.

The US and the UK argue that nuclear sharing under the MDA was practiced at the time the NPT was being negotiated. During these negotiations there was no indication that these practices would end and there were no objections to them before 1995. However, an argument can be made that the US did not make this position clear prior to the opening of the Treaty and did not formally communicate this to other states when they signed and ratified the Treaty.⁵⁷

One key issue is whether the supply of designs, materials, and components constitutes the transfer of a nuclear explosive device. The NPT does not define the terms “nuclear weapon” or “nuclear explosive device”. If the

US supplied a complete flat-pack nuclear weapon, for assembly in the UK, this would be a clear breach of Article I. This would apply even if the parts and drawings were delivered separately and at different times. The actual practice has been more complex. At least three key components are procured from the US and there are extensive consultations over design and production. Some of the radioactive material may be of US origin or processed in the US. A case can be made that these exchanges are so comprehensive that they constitute the transfer of nuclear explosive devices in breach of Article I.

Even if this trade was not formally prohibited by Article I, it is damaging because it reinforces the widely-held impression that the Treaty is an unfair bargain. There cannot be one acceptable practice for two nations and another for the rest of the world. If the US and UK continue to engage in this wholesale nuclear trade across the Atlantic then it will become more difficult for other countries to listen when the US and UK call for action to prevent similar information and materials from crossing other national boundaries.

Consideration should also be given to the obligations placed on the US and UK by Article VI, in the context of the preamble to the Treaty.⁵⁸ The preamble recognizes the need to make every effort to avert the danger of nuclear war. The effect of the nuclear sharing arrangement is to increase rather than reduce this risk. For example, the introduction of the Mk4A fuse will make the UK Trident warhead more effective and more suitable for a preemptive strike.

The preamble also calls for the cessation of the nuclear arms race. The nuclear sharing arrangement has encouraged the UK to produce sophisticated nuclear weapons which Britain would not otherwise have developed. Aldermaston continues to endeavour to be at the forefront of nuclear weapons technology in order to retain access to information on the latest American designs. This is not consistent with ending the nuclear arms race.

The MDA has resulted in the UK deploying more potent nuclear forces than would otherwise have been affordable. Britain is only able to have thermonuclear warheads on submarine-launched ballistic missiles because of the assistance provided by the US. So the MDA has been an obstacle. It has discouraged the UK from making progress towards disarmament, as required by Article VI.

The MDA is directed towards “improving the UK’s atomic weapon design, development or fabrication capability” and “improving the UK’s state

of training and operational readiness⁵⁹. The AWE website says that the UK programme has made significant advances in several areas of research because of the MDA. Legal advice on the renewal of the MDA in 2004 concluded,

These statements make it clear that the MDA is important to the UK's ongoing nuclear programme. It is strongly arguable that this is not in accordance with the obligations under Article VI or the assertion of the 2000 Review Conference to take steps leading to nuclear disarmament.⁶⁰

The US and UK governments are obliged to fulfill the 13 practical steps agreed to at the 2000 NPT Review Conference. There is room for the UK to be more transparent about its nuclear forces, but the MDA prevents the disclosure of information which might otherwise be made public. The UK could take concrete measures to reduce the operational status of its nuclear forces by ending Continuous At Sea Deterrence (CASD) and storing all warhead on-shore, but this would involve breaking with US practice. The UK could make further unilateral steps to reduce its nuclear capability, reduce the role of nuclear weapons in its security policy, and make progress towards the elimination of its nuclear arsenal. The US government's support for the British programme does not encourage the UK government to take these steps. On the contrary, the special relationship is leading the UK to modernize its nuclear arsenal and to make plans that assume Britain will still retain nuclear weapons in 2060.

There is a glimmer of hope in this relationship. Both countries have projects which are considering how to tackle nuclear proliferation. They are each exploring methods of detecting illicit nuclear transport and procedures for verifying disarmament. The budgets for this work are small compared with the amounts spent on sustaining and renewing nuclear weapons. But this points to an alternative way that scientists from the US and UK can collaborate to promote rather than discourage disarmament.

Recommendations

- The US and UK governments should end their exchange of nuclear weapons information and materials in the interest of respecting their obligations under the NPT and promoting rather than deterring disarmament and non-proliferation.
- Other governments and civil society should hold the US and UK governments accountable to their obligations under the NPT and should encourage the US and UK governments to promote disarmament by ending their nuclear sharing arrangements.
- The US and UK governments should instead increase their collaboration on verification, non-proliferation, and disarmament technologies.