Changing the Atomic Weapons Establishment

New warheads ?

For several years one of the missions of AWE has been to "maintain the capability to design and produce a new warhead". However the wording of this goal is misleading. One article more accurately reported that the aim was to *create* the capability to design and produce a new warhead.

Since 1991 [?] Britain has not been able to introduce a new design of nuclear weapon into service because no new warhead could be certified without nuclear testing. Like the US, and other nuclear-weapon states, the UK has been trying to develop the capability to certify new designs but is still some distance from achieving this objective. In addition, AWE cannot currently produce large quantities of all the components for a new warhead.[1]

In 2004 the Mutual Defence Agreement (MDA) was amended to give the UK access to highly classified information on "use control" technologies being developed for future American warheads. This category of data, on methods to prevent unauthorised use of nuclear weapons, had not previously been shared. These technologies were fundamental to the proposals for a new US warhead, the Reliable Replacement Warhead (RRW). The MDA was amended to enable the UK to participate in the RRW project. Subsequently British representatives attended RRW Working Groups as observers.

In July 2005, the day before Parliament began its summer recess, the Government announced a major programme to build new facilities and to recruit new staff at AWE. It is probably not a coincidence that this investment followed the amendment of the MDA. British plans for replacing Trident were discussed extensively between the MOD Chief Scientific Advisor and Lindon Brooks of NNSA. These talks ensured that Britain was pushing at an open door by the time the proposals were formally published in the White Paper in December 2006.

John Harvey, Director of Policy at the National Nuclear Security Administration (NNSA), said in January 2008 that Britain had its own project, similar to RRW, to develop a new warhead. David Gould, head of Defence Equipment and Support, said that the MOD's plan was to replace the whole Trident system, not just the submarine but also the missile and the warhead. Jeffrey Lewis of the New America Foundation has suggested that term "High Surety" was being used to describe the proposed new British warhead.

When these issues have been raised with Ministers, their response has been to say that no decision has been made on a new warhead. But, although the decision to design and build a new warhead has not been made, AWE have been actively

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[1] The closure of AWE Cardiff has meant that large scale production of some Depleted Uranium and Beryllium parts is likely to be difficult. Some non-nuclear components of the current Trident warhead are manufactured in the US and not by AWE.

working to create the capability to do so if required. Des Browne acknowledged that a Warhead Pre-Concepts Working Group had been looking at options. It is likely that some initial work on a new warhead has been done by this Working Group. There has also been research into areas which would be critical for a new warhead, for example the Enhanced Collaboration on Enhanced Surety with the US Laboratories.

In the US, although the RRW acronym is dead and buried, but the heads of NNSA and STRATCOM continue to argue that the nuclear arsenal must be modernised. The NNSA are treading water while they await the outcome of the Nuclear Posture Review. The leaders of the US laboratories have proposed a new path. This would involve new Life Extension Programs (LEPs) which transformed existing designs more radically than earlier LEPs.

RRW would have implemented an earlier proposal, from the SLBM Protection Program, to replace the pit in the W76 warhead. This idea of replacing the pit may survive beyond RRW. In 2009 the Congressional Commission into the Strategic Posture of the United States proposed that a future refurbishment of the W76 Trident warhead should be allowed to consider replacing both the pit and the secondary. This would amount to designing a new warhead, but calling it by the same name as the current one. It is likely that designing and producing a ~~new~~ pit ~~was~~ at the heart of AWE's plans for a new warhead, just as it was for RRW.

Some key components of the RRW project are continuing under other headings in the US budget. ~~Funding for developing certification techniques was increased.~~ Enhanced surety research, which was earlier focused on supporting RRW, is continuing. ~~President Obama's FY2010 budget reveals that~~ AWE have been and are continuing to be involved in this research. One Anglo-American project under this heading is research into multi-point safe warheads. It would be very difficult to incorporate multi-point safety into the current UK Trident warhead. But this is a feature that might be built into the design of a new pit.

The UK cannot be expected to go it alone with an RRW-type programme in the absence of any US equivalent. AWE's first choice is likely to be to follow the same course as the US programme. Both may make substantial changes to their Trident warheads, including a new pit and secondary, which would be presented as a modification of the current warhead rather than a new design.

Mk4A refurbishment programme

Separately from any long-term plans, there is a refurbishment programme underway which will make the current British warhead significantly more effective. The Government has been reticent about this Mk4A Refurbishment Project, making only one brief mention of a "relatively minor" upgrade to keep the warhead in service into the 2020s. The equivalent American project, the W76-1/Mk4a LEP, has been NNSA's largest and most expensive warhead project in the past decade. It involves replacing a number of components in the warhead, some with remanufactured

items and others with new parts. The extent of the British project is not known. The Government have acknowledged that they are replacing the Arming, Fuzing and Firing (AF&F) system. In 2007 Des Browne said that the Mk4A AF&F would be introduced over the next decade. The Mk4A AF&F is at the heart of the US project. It will transform the warhead in two ways. It adds an Intent Strong Link which will make unauthorised detonation of the warhead more difficult. Secondly, a new fuzing system will make the warhead significantly more effective against hardened targets.[2]

Redeveloping AWE

Xx Bennet, Director of Strategic Technology at the MOD, has said that the new facilities were needed to keep Trident in service until the mid 2020s. But many of the projects in the 2005 AWE Site Development Plan would not be completed until 2015 or later. The research facilities would be unlikely to have a significant impact until several years after they were completed. Mr Bennet's suggestion, that the only function of the Site Development Plan was to support Trident until the mid 2020s, is not credible.

Mr Bennet also said that the facilities that would be needed to build a new warhead were indistinguishable from those required to sustain the current one. But this cannot be quite true. For example the current warhead uses Beryllium and so retaining the present warhead means some work with Beryllium. The new warhead would use a substitute material and so preparing for a new warhead means developing and proving alternative materials. Currently AWE has a practice of tricke production, making one or two new warheads each year. But this is not essential. If AWE abandoned trickle production then the current warhead could be sustained with production capabilities which were much less than would be needed to build a substantial number of new warheads.

At least one leading figure in the US programme has looked on with envy at the way in which the new British facilities were approved, without full political scrutiny, on the premise that they were required to keep the current warhead in service. This was in contrast with how Congress had obstructed the NNSA's plan to build RRW and the problems they have faced trying to transform the American nuclear weapons complex.

One insight into the true function of many of the new facilities at AWE comes from a 2002 AWE document on the future of Burghfield. In 2000 it was proposed that Burghfield could be closed and its functions transferred to Aldermaston. One of the main arguments against this was that combining all the functions on one site would

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[2] The original W76/Mk4 warhead was intended for use with the relatively inaccurate C4 missile. Its radar fuze has a choice of only three fixed heights at which the warhead will detonated, all of which would produce an airburst. It has a contact fuze but this is not considered to be reliable and is only a back-up system. The new Mk4A AF&F can reliably detonate the warhead close to the ground. It probably adds both a proximity radar capability and a path length fuze.

not leave space for "facilities for a successor system". Some of the projects in the AWE Site Development Plan should fall into this category. The Burghfield relocation report doesn't reveal which projects would only be required if there was a new warhead although it does indicates that a new warhead Assembly / Disassembly facility would be needed in any case.

The history of the Orion laser project suggests that the case for some of these new projects may not be clear cut. Prior to 2000 the UK was planning to play a major role in the National Ignition Facility (NIF) by funding a second chamber in this US facility. This proposal was dropped. An initial review of alternatives concluded that a new laser at AWE was not affordable. It is not clear why this decision was then reversed and the go-ahead given for the £173 m Orion project.

It is likely that the investment plan for AWE was influenced by US and British interest in building new nuclear weapons.

The new investment at AWE in the Nuclear Warhead Capability Sustainment Programme (NWSCP) does not sustain research capabilities at the current level. It substantially increases the capabilities in the establishment. For example the new Orion laser is many times more powerful than the Helen laser which is replaced. Each supercomputer which is built is more capable than its predecessor. The proposed new hydrodynamic facility will have pulsed power machines which are far more powerful than the existing Mogul machines. The NWSCP will substantially enhance the research and production capabilities at AWE.

If the intention is to build a new warhead, or to substantially change the current warhead, then a case can be made for these new facilities. However the argument is less convincing if the plan is to keep the existing warhead in service for longer. The computer models which are at the heart of modern nuclear weapon design are based on information from two sources: nuclear tests and experimental data. The further a design moves away from the device which was tested, the greater is the need for experimental data. It is this need for experimental data which is driving the investment in a range of new facilities at AWE. However the closer the warhead is kept to its original form, the less need there is the new facilities.

The Orion laser was built to support computer modelling of the secondary (fusion) stage of nuclear warheads. Its principle function may be to demonstrate a UK capability in order to maintain access to information from the more substantial US fusion programme.[3] If AWE intend to build a new secondary or substantially modify the current design then it would be essential that they develop more sophisticated

[3] The UK programme has been heavily dependent on US designs for the fusion stages of its warheads. Polaris, Chevaline and WE177 all used a variants of a secondary which was based on a US design.

models with American help. This is less important if the plan is to keep the current design in service without any major changes.

Hydrodynamic facilities detonate non-fissile mock-ups of the primary of a warhead. These experiments would be critical to the development of a new pit. If AWE are planning to design a new pit then the new Hydrus hydrodynamic facility would play an essential role. If the existing pit is kept in service then similar tests could be carried out to determine the reliability of the design, but they would be less critical and data from the existing facilities ~~would probably~~ may be sufficient.

Four crucial issues which should be considered are: the warhead requirement, the relationship with the US, surety, and maintaining expertise and capability.

~~Warhead requirement~~

The question might be asked – what facilities does Britain need in order to be able to remain a nuclear-weapon state ? However the answer depends on what type of nuclear weapon is envisaged. Producing a simple fission weapon which could be used in a freefall bomb requires less facilities than producing an effective thermonuclear weapon which fits into the re-entry vehicle on a long-range ballistic missile.

Archive documents give some indication of the criteria used to measure the capability of the British nuclear arsenal in the past. In 1978 a number of cities in the Soviet Union, including Moscow, were to be subject to Unacceptable Damage. This was defined as irreparable damage to 40% of the buildings in the city. From such criteria it was possible to work back and determine the required numbers, yield and reliability of nuclear warheads.

If it were felt that a small number of basic fission weapons were sufficient and that there was no need for boosted fission or thermonuclear weapons then the facilities at AWE could be much less than today. If a low level of reliability were accepted then warhead ageing would become less of an issue. There would be less need to allocate resources to understanding and correcting any changes that appeared in the warhead over time. These issues of yield and reliability can also be combined. If only the secondary of the warhead fails then it will still produce a fission yield. If a lower level of reliability from the secondary was accepted, then there could be less investment in facilities for designing, producing and monitoring the components for ~~the secondary~~.

In the past British nuclear policy rested on a sequence of highly unlikely hypotheses. In the unlikely event that a situation arose where there was a threat to Britain's

supreme interests and where the United States was not prepared to use their nuclear weapons, a potential adversary could not entirely discount the possibility that British nuclear weapons might be used, even though ordering their use would be neither rational nor ethical. Assuming that the policy today rests on a similar logic then it makes little difference whether the warheads are reliable or not. If British deterrence theorists are consistent, surely they don't need to convince a potential opponent that it is certain that a British warhead would detonate, or that it would produce a 100 kiloton yield, but only leave some doubt in their mind that it might.

Relationship with the United States

On the face of it the nuclear exchanges with the United States have brought great benefits to AWE. For the UK to pursue the same programme without American help would have been far more expensive. The Mutual Defence Agreement and the Polaris Sales Agreement have made it affordable for Britain to remain in the big league of nuclear weapon states. They have enabled Britain not just to continue to have nuclear weapons, but to deploy one of the most potent nuclear weapon systems in the world.

In recent years the Anglo-American nuclear relationship has not been static. It has grown closer. The last Nuclear Posture Review initiated a series of Enhanced Collaborations which were further developed when the Mutual Defence Agreement was amended in 2004. Senior figures in the US programme assumed that the relationship would grow yet closer if the proposals for RRW came to fruition. There are also moves to make it easier for experimental data to be transferred between the two nations.

Britain is like a shopper who sees a luxury item on display at a reduced price and decides that he must buy it. But the shopper should pause and ask - is this really something that I need, and is there a catch ?

One downside of this bargain is that it makes the independence of the British nuclear force suspect. In a situation where America was opposed to the use of British nuclear weapons, a potential adversary may feel that the threat to launch an independent nuclear attack is not credible. A suspicious opponent may conclude that America would not give away such a potent nuclear capability without building an operational veto into the system.

If the force is designed not for independent use but to enable Britain to play a supporting role in a US nuclear strike, this could be achieved far more cheaply by deploying dual-control weapons. There could either be American nuclear bombs allocated to the Royal Air Force, or perhaps American W76 warheads stored in Coulport under US control. In either case there would be no need for any capability at AWE.

A further disadvantage of pursuing cooperation with the US is that it may be pushing AWE into modifying the warhead to a greater extent than would otherwise be the

case. AWE is engaged in collaborative efforts to develop new warhead components, rather than placing their emphasis on how to maintain the current design.

Surety

A major force driving the further sophistication of US nuclear weapons is the desire to design weapons which are safer and more secure against unauthorised use. In recent years there has been a similar focus to research work at AWE. This is an area where collaboration has increased over the years. In 1984 the Mutual Defence Agreement was amended to give the UK access to US research into how to make nuclear warheads safer, such as Insensitive High Explosives, and in 2004 the Agreement was amended to cover technologies to prevent unauthorised use of nuclear weapons. With regard to the building programme at AWE it is argued that one reason that many of the new facilities are needed is to improve safety standards at the site.

Reducing the risk that there could be a nuclear accident or that a terrorist could detonate a seized weapon may both appear to be worthy goals, however the real need to pursue this agenda is questionable.

The dangers associated with nuclear weapons can be put into three categories: the risk of an accident, the risk of unauthorised use and the risk of deliberate use. If both the probability and the consequences of each category are considered, then the greatest danger is not from an accident but from the deliberate use of nuclear weapons, because the consequences would be so catastrophic. The most important issue is to reduce this risk through progress towards disarmament. Where there is a conflict between the need to reduce the risk of an accident and the need to make progress towards disarmament then the latter should be the first concern. Likewise the pace of disarmament should not be slowed in order to modify warheads to make them tamper proof.

If AWE were on a path towards disarmament it would be hard to justify devoting resources to long-term programmes to designing warheads which are safer and more secure, or to modifying existing warheads.

In the meantime there are alternative ways of addressing surety issues. Removing warheads from submarines would reduce the risk of an accident during warhead loading and unloading at Coulport. Returning warheads to AWE would reduce the risks of an accident or terrorist seizure of a weapon while it was being transported by road. Dismantling all warheads and storing the components separately at AWE would reduce the risk of an accidental or unauthorised nuclear explosion. Taking these steps would mean that the dangers of unloading, transporting and dismantling would only be faced once and not several times as would be the case if the warheads were repeatedly refurbished or replaced.

The risks to staff at AWE can be reduced by ending the current programme of trickle production, making one or two new warheads each year, rather than by building new facilities. A conscious decision to neither build a new warhead nor replace the pit or secondary in the current warhead would substantially reduce the risks to personnel, not only from production facilities but also from research facilities. Buildings such as A45 which do not meet modern safety standards could be mothballed rather than replaced.

Maintaining expertise

A common concern in both the US and British nuclear weapons establishments has been the danger that key expertise could be lost, particularly as the scientists and engineers with nuclear-test experience retire. ~~It would appear that~~ this ~~concern~~ was a major driver behind the RRW project. It was argued that LEP projects only challenged staff to produce the particular components which were replaced, whereas RRW challenged them across the whole spectrum of nuclear warhead work.

But skill-retention is a weak argument for producing a new warhead. Just as the case for RRW was distorted so the argument for current research projects should be questioned. Is there really any point in AWE scientists spending time and money designing a new multi-point safe warhead when there is very little prospect that a warhead with such a radical design would be manufactured in the near future ? If the simplest way for Britain to retain a nuclear arsenal for a few years more is to maintain the existing warhead, then it would make more sense for research work to focus on keeping key components in service, rather than designing new features and materials.

Two recent examples from the US programme suggest that it is not impossible to restart a capability once it has been stopped, it just takes time and money.

Having not made any warhead pits since the Rocky Flats facility was closed, LANL were able to produce and certify new pits for the W88. The main reason for the delay in certifying the new pits was a change in the method of production between the old pits (wrought) and the new ones (cast).

The remanufacture of Fogbank for the Canned Sub Assembly of the W76 also presented a problem. The scientists with experience of making this secret material had retired, the facility for producing it had been dismantled and the records of how to make it were incomplete. Production of Fogbank was delayed and additional costs were incurred. But the first batch of material has been produced.

The idea that unless there are new projects to maintain skills then current capabilities will be lost forever is not correct. If we are on a course towards disarmament then we should be willing to say that it is unlikely that many capabilities will be needed in the future.