

## **The Atomic Weapons Establishment (AWE) Aldermaston & Burghfield**

### **- preparing for the next generation of nuclear weapons**

The Comprehensive Test Ban Treaty dictates the way that nuclear designers at Aldermaston go about their work. Testing a warhead by blowing it up is no longer an option. Instead substantial scientific resources are dedicated to trying to understand exactly how a nuclear warhead ~~works~~behaves. This approach is called Science Based Stockpile Stewardship.

#### **Supercomputers**

At the centre of the design effort is the production of computer models. These simulate how a nuclear warhead functions. In 2002 AWE Aldermaston installed the Blue Oak computer, with a power of just under 3 Teraflops. In 2006 an order was placed for a new computer with a maximum power of 40 Teraflops. If this machine were in service today it would be the most powerful computer in Europe. And this is only a stepping-stone. Aldermaston plans to have a 100 Teraflop computer by 2010. The US example suggests that they won't stop there. Thoroughly assessing the reliability of a complete nuclear warhead would require a 350 Teraflop computer.<sup>1</sup>

The Aldermaston computing project is running 4 or 5 years behind its American equivalent. ~~For most of the last decade the biggest computers in the world have been those in the US nuclear weapon laboratories. The one exception has been the Japanese Earth model, which for a few years was at the top of the supercomputer league. The Japanese Earth model simulates tsunamis and the effects of climate change. The same money, technology and human ingenuity can be used either to prevent disaster or to cause it. It can be applied to understand climate change, or to construct Weapons of Mass Destruction.~~

#### **Experimental facilities**

The computer models are verified by comparing the results of the simulations with experimental data. Laser, hydrodynamic and sub-critical tests provide much of this data.

##### Lasers

AWE Aldermaston are is preparing to build a powerful new laser called 'Orion' in a large building within the site. British scientists currently have access to two lasers in the US – the National Ignition Facility (NIF) and the 'Omega' laser facility. The US laboratories primarily use NIF and 'Omega' to understand the secondary (fusion) element of nuclear weapons, although they can support other work. It is likely that the focus of work at 'Orion' will be similar. Its construction is a sign that scientists at Aldermaston envisage that they will continue to support and design high-yield thermonuclear weapons in the future.

##### Hydrodynamic facilities

New hydrodynamic testing facilities are planned as part of the redevelopment of AWE Aldermaston. Hydrodynamic tests analyse how metal responds when explosives detonate next to it. The tests use steel in place of plutonium. The resulting data illustrates how the primary (fission) part of a nuclear weapon works. The design of any new or modified primary will rely heavily on these tests.

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<sup>1</sup> The basis of the US approach to warhead certification is Quantified Modelling of Uncertainties (QMU). The US warhead development plan is to achieve QMU for the W76-1 warhead in 2009. By this time they plan to have a 350 Teraflop computer in service.

## Sub-critical tests

Sub-critical tests are similar to hydrodynamic tests, but use plutonium that is the material at the core of a nuclear weapon. High explosive is placed next to a small quantity of plutonium, which is not enough for a nuclear yield. This device is then detonated in an underground chamber. This provides further information on the primary (fission) part of the warhead.

There have been two British sub-critical tests – 'Etna' in February 2002 and 'Krakatau' in February 2006. Both took place at the Nevada nuclear test site in the US and both used devices manufactured at Aldermaston.

## **Is AWE Aldermaston designing a new nuclear bomb?**

In response to a question in Parliament, John Reid said that Britain is not designing a new nuclear weapon. However the MoD also says that AWE Aldermaston maintains the capability to design a new warhead, should one be required. When Aldermaston changed hands in 2000 the new owners were asked to come up with a plan of how they would achieve this goal of a new-design capability.

## US Developments

The nuclear warheads currently deployed on British submarines are Anglicised copies of the American W76-0 design. Today in the US there are two programmes to substantially modify the W76.

### *W76-1*

The first W76-1 warhead is due to be completed in 2007. This will re-use the nuclear material at the heart of a dismantled W76 warhead, but many crucial components will be replaced with new designs. It will have a new Arming, Fuzing and Firing system, a new Gas Transfer System and a modified high explosive package.

### *Reliable Replacement Warhead (W76-2)*

This is a programme to design a new weapon for the US arsenal. The study is initially focusing on a new plutonium pit for the primary of the W76 warhead. The likely designation of this warhead is W76-2. The new primary could also be used in other warheads.

The new US pit design is expected to avoid using Beryllium, which is a toxic component of the existing W76 warhead and its British counterpart. Beryllium for Trident warheads was originally fabricated at the Atomic Weapons Establishment in Cardiff. When this factory closed, vital equipment was transferred to Aldermaston. Machining Beryllium is a problematic issue for AWE Aldermaston.

The head of Los Alamos nuclear Laboratory has said that data from the British 'Krakatau' sub-critical test would be used for the *Reliable Replacement Warhead* project. He also said he would be surprised if the British were not watching this programme pretty closely.

## British plans

When asked about British collaboration with the American W76-1, W76-2 and Reliable Replacement Warhead projects Defence Ministers have refused to confirm or deny their involvement, saying only that they discuss a range of issues with their American counterparts.

In 2000 a British contribution to a US scientific report said that the main objective of the British nuclear weapon's programme was to ensure that the Trident warhead could remain in service for significantly longer than its original planned life. This paper was probably written in AWE Aldermaston.

This emphasis on planning beyond the original lifespan (2025) is revealed in other statements. When quizzed about the 'Krakatau' sub-critical test the MoD said their interest was in understanding the effects of ageing on the warhead. Their concern is not just about how the warhead will perform during its planned life, but whether they can continue to use the nuclear components at the heart of each warhead for many years after 2025.

It is unlikely that AWE Aldermaston are is seriously considering continuing with the current design as it is. A number of critical components are procured off-the-shelf from the US. These include the Arming, Fuzing and Firing System, the Gas Transfer System and the Neutron Generator. In 2002 a new American model of Neutron Generator began to be installed on British warheads. It is likely that Aldermaston plans to replace several components when new ones become available from the US.

The US Laboratories currently plan to convert only a limited proportion of their Trident warheads to W76-1. They have not yet decided whether to roll out this programme further, or to replace it with the W76-2. The MoD ~~have~~ has probably not yet chosen whether they will adopt the W76-1, W76-2 or an alternative. However it is likely that AWE Aldermaston are carrying out initial work on a range of possibilities to keep their options open.

While the emphasis will be on Trident, their work will extend beyond this. One possible option would be to resurrect the warhead design developed for the Tactical Air to Surface Missile (TASM) in the 1980s. This design was tested in the 1980s but never built. One problem is that the US equivalent was also never manufactured.

### **Production and refurbishment**

The original batch of Trident warheads was assembled at Burghfield between 1992 and 1998. However production did not stop then. New warheads Aldermaston ~~has~~ been manufactured ~~new warheads every year since and plans~~ remain ~~to continue~~ to do so for many years.

Each year several Trident warheads are returned from Scotland to Burghfield where they are dismantled. Some of the warheads are then rebuilt with several components, such as the high explosive, replaced. But other warheads are decommissioned. Their nuclear components are taken apart and analysed. New warheads, assembled from scratch, replace those that have been decommissioned. It is not clear what proportion of returned warheads are replaced rather than refurbished.

The Strategic Defence Review and Parliamentary answers in 1998 showed that at the time there were between 180 and 200 Trident warheads in the stockpile. The total has probably been sustained around the same level since then.

The two main facilities in AWE Aldermaston are A90 and A45. A90 is a copy of a building in Los Alamos and produces plutonium pits for new warheads. A45 produces the secondary part of the warhead, using Highly Enriched Uranium and other materials. A45 is almost 50 years old and parts of it are being decommissioned.

### **New weapons for new roles**

The US laboratories are being asked to design weapons that can be used in new scenarios, as well as in an all-out attack on Russia. The new emphasis is on increased accuracy and lower-yield. This is seen as making nuclear weapons more "useable".

There is no clear indication that a lower-yield or variable-yield warhead for Trident is being developed in by the US Laboratories or Aldermaston AWE. However both are probably interested in going down this road. The variable-yield option is more likely as it would enable a smaller stockpile of weapons to be used for a variety of roles.

Lockheed Martin hasve designed an "Accuracy Adjunct" for the Trident warhead. This was flight tested in 2002 and 2005. It substantially increases the accuracy of Trident by adding flaps to the Re-entry Vehicle so it can be manoeuvred. The Accuracy Adjunct was designed for nuclear Trident. Current proposals to arm some US Trident missiles with conventional warheads are based on the same technology. The Accuracy Adjunct would provide the increased accuracy ,which a lower yield warhead would require. So it is likely that Britain is interested in this.

### **Expenditure**

In 2000 the new operators, AWE Management Ltd were issued a contract worth £2.3b to operate Aldermaston for 10 years, later increased to over a 25 year contract worth a further????????/ £5.1b period. In 2005 the government announced that an additional £1.5 billion would be spent on building new facilities over a three-year period. If AWE Aldermaston continues to design and produce nuclear warheads then this is likely to involve substantial additional expenditure over many years.

### **An alternative use for Aldermaston**

Today a small part of the work of Aldermaston AWE is monitoring observance of the Comprehensive Test Ban Treaty. A report by Pugwash has explained how the resources of the Atomic Weapons Establishment could be diverted away from building nuclear weapons towards verifying nuclear disarmament.<sup>2</sup>

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<sup>2</sup> Verifying Nuclear Disarmament: A Role for AWE Aldermaston, Tom Milne & Henrietta Wilson, British Pugwash Group, 1999.