The future of the Atomic Weapons Establishment

In July 2005, just before a Parliamentary recess, the Government announced that £350 million would be spent in each of the next three years on capital projects at the Atomic Weapons Establishment (AWE). Four years earlier Aldermaston had published a site development plan. It was revised in 2003 and again in 2005. These documents are outline a plan to rebuild most of the major facilities of the Atomic Weapons Establishment on the existing sites at Aldermaston and Burghfield. If the plans were implemented in full the total cost would be more than the £1,050 million disclosed so far. The building programme would run well into the next decade.

Building projects at AWE in the 1980s

Aldermaston does not have a good record when it comes to major building projects. £1,200 million was spent on new facilities in the late 1980s and early 1990s. These developments were presented as a response to safety concerns raised in 1978. However the real intention was to build new facilities for Trident.

The key building was the A90 manufacturing plant. This was to make the nuclear components of Trident warheads. It should have been completed in 1986. However A90 was not operational until 1997, by which time the stockpile of Trident warheads had almost reached its current level. The nuclear parts had been made in the older A45 facility, despite the fact that this building had been identified as a safety hazard in 1978.

A91 was a second new facility built in the late 1980s. It was to process liquid nuclear waste arising during the production of Trident warheads. It was never operational. The Ministry of Defence (MoD) decided in 2000 that the A91 building was not fit for purpose. In November 2005 they wrote off the £147 million they had spent on it.

The new proposals

1. Research facilities

a. Supercomputers

Computer modelling is at the heart of the AWE research programme. Aldermaston would like to be able to simulate in great detail the detonation of a nuclear weapon. Today American nuclear scientists are using the most powerful supercomputers in the world to achieve this. The AWE computing project is copying the US example, but running approximately 5 years behind it.

In 2002 Aldermaston installed the Blue Oak computer, with a power of just under 3 Teraflops.[1] 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. This is only a stepping-stone. AWE would like to acquire more and more powerful supercomputers throughout the coming decade.

The primary function of the research facilities listed below would be to provide experimental data to support the computer models.

b. Orion Laser

AWE plan to build a powerful new laser in the West part of the Aldermaston site. If built Orion would be 1,000 times more powerful than the Helen laser currently operating in Aldermaston. AWE can carry out a limited number of experiments in the National Ignition Facility (NIF), the new American laser. It is likely that work in the two facilities would be coordinated. NIF will be used principally for thermonuclear

[1] One Teraflop is one thousand billion floating point operations per second.

research, to understand how high-yield nuclear weapons (hydrogen bombs) work. The same is likely to be true about Orion. Orion may be considered critical to the design of the secondary in any future thermonuclear weapon.

c. Core Punch Facility

AWE intend to submit proposals to build a substantial new hydrodynamic test building, called the Core Punch Facility. The objective of this will be to understand how the implosion system in the primary of a nuclear weapon works. Hydrodynamic tests analyse how metal responds when compressed by high explosives. The tests take place inside a blast-proof chamber. Steel is used in place of the plutonium in a real warhead. The Core Punch Facility would have an array of X-ray machines to analyse each explosion.

One option which AWE are likely to consider is the production of a new primary which could be used in future nuclear weapons. The Core Punch Facility would play a crucial role in this.

d. Material Sciences

It is proposed that new facilities will be built at Aldermaston, and possibly also at Burghfield, for research into material science.

2. Production facilities

a. Warhead assembly and disassembly facility

The assembly and disassembly of nuclear weapons currently takes place in Burghfield. In 2001 AWE considered closing Burghfield and building a new facility at Aldermaston. By 2005 they had revised their opinion. Burghfield will stay open. AWE now propose that a new assembly/disassembly facility be built within Burghfield on land adjacent to the current complex. Plans for this are likely to emerge during 2006.

b. Plutonium component manufacture

Plutonium pits for nuclear weapons are made in the A90 building. Research work into pits is also carried out there. The 2005 site plan suggests that A90 will be refurbished.

c. Highly Enriched Uranium component manufacture

Warhead components made from Highly Enriched Uranium (HEU) are currently produced in A45, a building which first became operational in 1957. Plans are being drawn up for the construction of a new facility to make HEU components. This would be located between A90 and A45. In addition the 2005 plan indicates that A45 will be refurbished.

d. High Explosives

Currently a number of buildings in Aldermaston and Burghfield process high explosives for nuclear weapons. AWE plan to centralise these and build a new Explosives Handling Facility.

3. Support facilities

Plans have been produced for a new conference centre and accommodation block in the Western part of the Aldermaston site.

In what scenarios would these new facilities be needed ?

Scenario 1 Trident is dismantled in the near future

If the objectives of Aldermaston and Burghfield became immediate disarmament then there would be no need to proceed with most of the planned developments. There would be no need for the Orion Laser, the Core Punch Facility or bigger supercomputers. The current stockpile could be dismantled in the existing facility at Burghfield before a replacement facility was built. If A90 was totally dedicated to disarmament then it could dismantle both the plutonium pits and the HEU secondaries. There would be no need for new HEU facilities. AWE could focus on developing the skills required for nuclear decommissioning.

Scenario 2 Trident remains in service for its original planned life

Trident warheads would all be withdrawn from service after 25 years, between 2020 and 2025. Both Britain and the US have extensive experience of keeping warheads in the stockpile up to this age. If the stockpile were retired when originally planned there would be no need to build Orion, the Core Punch Facility or new computers. These would only be fully functional for a few years supporting a warhead with a limited life. If the warhead life was restricted to 25 years then the warhead surveillance programme could be reduced. This would free up space in A90 and remove the need for new HEU facilities. A case could be made for building a new facility at Burghfield to dismantle Trident warheads.

Scenario 3 The life of Trident is extended

In 2001 an official statement said "the overarching objective of the UK nuclear warhead programme is to keep the Trident warhead in service, and to be able to underwrite its performance and safety over a period much longer than its originally intended service life." [2] This reflects the "Life Extension" approach which was predominant in the US until very recently. The aim of Life Extension is to keep warheads in service for as long as possible. Weapons are refurbished and upgraded but not fundamentally redesigned. AWE talk about how they need to understand how a weapon ages. When they do so they are not referring just to keeping Trident in service until 2025, but to increasing its life. The new facilities at AWE could be used to try to substantially extend the life of Trident, by 10 or 20 years.

Scenario 4 A new warhead is designed and produced

In their 2003 annual report AWE say that they must "maintain a capability to provide warheads for a successor system should Her Majesty's Government ever require one." The requirement is not only to be able to design, but also to produce a new nuclear weapon.

When AWE Ltd took over the running of Aldermaston and Burghfield one of their first tasks was to complete, by December 2000, a study showing how they would retain the capability to produce a successor warhead. The site development plan may be based on this study.

If the Comprehensive Test Ban Treaty were not in force then the development of a new weapon would require a series of nuclear tests between 2015 and 2020. It is likely that the full range of research facilities proposed are designed so that AWE will have a simulated testing capability by 2015.

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[2] High Energy Density Physics, National Nuclear Security Administration, April 2001, Appendix G – United Kingdom Statement on High Energy Density Physics.

Designing a new weapon would require substantially greater resources than sustaining an existing system. It is possible to see how the full range of facilities described in the site plan would be required in order to have the capability to design and build a replacement warhead.

A90 is a copy of the TA-55 building at Los Alamos. The US government plans to produce between 30 and 40 plutonium pits per year from TA-55. A90 will have a similar capability.[3] The age of A45 and other buildings means that it would be difficult for AWE to manufacture the HEU component of a new thermonuclear warhead in existing facilities. The plans to refurbish A90 and build a new HEU facility indicate that AWE intend to have the capability to manufacture a new thermonuclear weapon.

It is likely that the proposed new facility at Burghfield will be designed on the assumption that it could be used to assemble, refurbish and disassemble a new warhead between 2020 and 2050.

Life Extension or Replacement ?

The review of scenarios shows that AWE assume that the UK will continue to have nuclear weapons beyond 2025. This could be achieved either by extending the life of the current warhead or by designing and building a new one.

The US nuclear weapons establishment has concentrated on Life Extension in recent years. However this approach is now being challenged. Since 2005 there has been pressure to develop a Reliable Replacement Warhead (RRW). In May 2006 a Congressional Bill reallocated funds away from Life Extension and towards RRW. Studies into RRW will report within the next 12 months.

The British Trident warhead is an Anglicised version of the US W76-0 design. It contains several vital components procured off-the-shelf from America. W76 is at the centre of the Life Extension / RRW debate in the US. Under the Life Extension programme there is already a project to substantially modify the warheads, introducing many new components. The resulting W76-1 warhead will be available from 2007. The RRW study is looking at a more fundamental redesign of the warhead, principally the production of a new plutonium pit. As this is at the heart of the weapon it would make it a completely new warhead. It is likely to be called W76-2.

In February 2006 a nuclear warhead device, made at Aldermaston, was detonated in the Krakatau sub-critical test at the Nevada test site in America.[4] The MoD insisted that the purpose of the experiment was to look at ageing issues. However the head of Los Alamos admitted that data from the test would be used for their RRW study. He added that he thought it would be "pretty surprising" if AWE were not watching the RRW programme closely.

The pit of the current W76-0 warhead and it British equivalent contain Beryllium as well as Plutonium. Beryllium is not radioactive but it is toxic. The American RRW pit will probably avoid using Beryllium. The Beryllium components for Trident warheads were made at the Atomic Weapons Establishment in Cardiff which closed more than a decade ago. Equipment from Cardiff was moved to Aldermaston. Nevertheless Beryllium machining is a problematic issue for Aldermaston. For the longer term AWE may wish to move away from Beryllium and adopt an RRW-type warhead.

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[3] A90 has 4 operating bays. These can be used for manufacture, dismantlement or research. The bays can be modified to alter the balance between research and production in the workload.

[4] In sub-critical tests High Explosives are detonated next to a small amount of plutonium. The quantities involved are not large enough to produce a nuclear yield.

strategy is that there will be progressive reductions in concentrations of radionuclides in the marine environment resulting from radioactive discharge, such that by 2020 they add close-to-zero to historic levels. The strategy includes proposals for discharge reductions from the defence sector (which includes the AWE sites), and projected liquid effluent discharge profiles up to 2020. The Government intends to revise and reissue the strategy at periods of about 4 years.

2.7 The AWE submission

54 This review has been based on AWE's quinquennial review submission dated November 2001. The submission has been produced by AWE's Environmental Programmes Group (EPG) and is divided roughly equally between decommissioning, waste management, and site remediation. The submission consisted of an overview document supported by a series of documents covering specific topics in more detail. The overview document describes the policies, strategies and funding provisions put in place for the decommissioning of AWE sites up to site closure. The supporting documents address in more detail aspects such as: the decommissioning, waste management, and environmental policies; the option assessment methodology; the decommissioning, waste and environmental strategies; the decommissioning techniques; the liabilities estimate procedure; and an outline of the assumptions and uncertainties.

2.8 Overview of the site strategies

55 The following paragraphs present an overview of the strategies for the Aldermaston and Burghfield sites covering the main features. A more detailed discussion of specific aspects is given in the findings section of this report.

The Aldermaston strategy

56 The 1998 Strategic Defence Review states that Trident will be maintained as a deterrent for up to 30 years. Therefore, it is assumed in the AWE decommissioning strategy that weapons refurbishment for the Trident programme will continue until 2028, followed by a 10 year period to allow for weapon retirement. After this time, the current Trident facilities will be available for decommissioning. (It should be noted that a number of facilities are already undergoing decommissioning, and the decommissioning of others will start before the site operational phase is assumed to come to an end at around 2040). The dismantling of non-reactor facilities will generally be completed approximately 30 years after operations come to an end, and within 60 years for reactors (though the latter timescale is under review). It is assumed that all decommissioning activities on the site will be complete by 2060.

57 AWE's planning assumption is that a disposal route (or some other national long-term management solution) will become available between 2040 and 2140, with 2080 as the most likely date. It is also assumed that the ILW stores will be operational for at least 10 years after the disposal route becomes available. Based on these planning assumptions, conditioned wastes would not be removed from the site until about 100 years from now. A long-term objective is that the contaminated ground would be remediated to levels that will enable the site to be re-used.

Nuclear Technology ▪ Nuclear Fuels

Design Of The Gas Clean Up System For The New Tritium Facility At Awe Aldermaston

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Abstract: A Gas Clean Up System (GCUS) has been designed, built and installed for the new tritium handling facility at Atomic Weapons Establishment (AWE), Aldermaston. The system is in the process of being commissioned and once this is complete and the facility is operational, it will be used for the removal of hydrogen isotopes from gaseous waste arisings within the facility and concentrating them in waste packages. The system also provides a depression for the sources of these waste arisings, particularly the inert gas gloveboxes, as part of the contamination containment within the facility. This paper describes the details of various sub-systems within the GCUS and their engineering, construction, installation and testing. 3 refs., 2 figs.

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