Trident Warheads

The US has two types of warheads on Trident missiles – W88 and W76. Most missiles carry the W76, which is older and has a lower yield. The W76 is described by Los Alamos as "the most critical element of our nation's strategic deterrent". British warheads are a variant of the W76.

US warheads are identified by a letter, B for Bomb or W for Missile Warhead, and a two digit number. Changes to the design take two forms. Most are called Alterations (Alts). Substantial redesigns are referred to as Modifications. Each Modification is identified by an additional number.

The basic W76 warhead is now referred to as W76-0. There is a new modification under development and this is called the W76-1. The current version, W76-0, is due to remain in service for many years. So, in addition to the new modification, several components are being replaced on the W76-0.

Updating the current W76-0 warhead

United States

In the US the W76 entered service in 1978 and the warheads were produced until 1987.[1] From 1996 to 2000 the US conducted a major review of all the components of the warhead. This Dual Validation involved both Los Alamos and Lawrence Livermore laboratories. All the major components of the warhead were re-certified.[2] A number of "negative changes" in the warhead were identified during the review and re-certification. As a result several parts have been redesigned.

Missile tests use a re-entry vehicle with a dummy warhead and electronic components which transmit telemetry and other data. A Joint Test Assembly (JTA) with revised W76-0 components was tested in a flight test in August 2000.[3]

The parts which have been revised are the neutron generator and the tritium gas reservoir. The MC4380 Neutron Generator is being replaced by the MC4380A, with delivery to the Navy starting in April 2002.[4] New Acorn gas reservoirs were designed, with delivery due to start in FY2003.

There are more W76 warheads in the US arsenal than any other warhead. Substantial amounts are being spent on sustaining the W76-0. The budget for FY2005 allocates a total of $674 million to W76 stockpile systems between 2005 and 2009. This does not include expenditure on the W76-1.[5]

Britain

Britain deploys its own version of the W76. An official summary of nuclear policy says that the warheads were "anglicised" at Aldermaston.[6]

UK Trident warheads have a life of around 12 years, after which they need to be rebuilt. The key task is removing and replacing the High Explosive that surrounds the plutonium pit. This can only be carried out at the Atomic Weapons Establishment Burghfield. A wide range of other non-nuclear components will also be replaced.

Aldermaston played some role in the US review of W76. In 1998 Sandia Laboratories were asked to re-certify the neutron generators in British warheads.[7] Britain is also acquiring new components designed as a result of the review, including replacements for these Neutron Generators. Sandia Laboratories delivered the first revised MC4380A Neutron Generators to Britain in Summer 2002.[8] Britain is likely to also replace Gas Reservoirs with the new American design. The reservoirs for British warheads are filled at the Savannah River Site in the US. The tritium which goes into them

was manufactured at Chapelcross, or recovered from decommissioned British warheads, and is transported by air.[9]

Both the Neutron Generators and the Gas Reservoirs are external to the main warhead package. This means they can be replaced either at Burghfield or at Coulport.

The new warhead: W76-1

United States

In addition to making changes to the current W76-0 warhead the US also has a program for a substantial modification of its warheads, designated W76-1.[10] The W76-1 reuses the existing Plutonium and Highly Enriched Uranium components, but is a substantial refurbishment. Each warhead will be taken apart and rebuilt at the nuclear weapons assembly site at Pantex. The target is for the warheads to be in service for 30 years after refurbishment and for some to be deployed until 2040.[11] The following are key parts of the W76-1 programme:[12]

- Flight-testing. The first W76-1 flight test was to be carried out in FY2003.[13]
- Pits. Existing W76 plutonium pits will be re-qualified
- Secondary. The thermonuclear device will be refurbished.
- High Explosive. This will be replaced.
- Arming and Fusing and Firing System. A new MC4700 system is being developed and will include a radar and flight computer.[14] It will also include a contact fuse which will give the warhead a ground-burst capability.[15]
- Neutron Generator. The MC4380 and MC4380A will be replaced by the MC4600, which is currently under development.
- Gas Reservoir. A new gas transfer system is being developed.
- RV heatshield. There is a research programme to develop new materials.

The budget for FY2005 allocates $1,027 million to W76 Life Extension between 2005 and 2009 making it the most expensive item on the nuclear weapons Directed Stockpile Work list.[16] Development Engineering (Phase 6.3) is due to be completed by FY2006. Production Engineering (Phase 6.4) will be carried out between FY2004 and FY2007. The First Production Unit is to be delivered in FY2007. Thereafter 4% of Full-Scale Production (Phase 6.6) is to be carried out in FY2008, followed by 11% in FY2009. Refurbishment is to be completed by FY2013.[17]

Britain

The MoD must be considering how to stretch the life of warheads to take advantage of the American program. The US is planning a 30-year life for each W76-1 warhead after refurbishment. However it is unlikely that Aldermaston could match this. The High Explosives in US warheads is PBX 9501. Britain uses its own design of High Explosive, EDC 37, which has a different chemical composition.[18] A key part of US plans is their projection that PBX 9501 will remain viable after 30 years in service. Aldermaston is unlikely to be able to establish the same for EDC 37.

If the MoD does try to extend the life of Trident to match its service in the US, the warheads would be required to be able to be in service 37 years after manufacture. With one refurbishment each warhead would have a total planned life of between 20 and 28 years. The 28 year target could only be achieved if Aldermaston's programs to extend the life of the High Explosive and other warhead components is successful. Even if they are, a second round of refurbishment would still be required to fit in with the US timescale.

When asked about British participation in the W76-1 programme in February 2002 the Defence Minister, Dr Lewis Moonie, would only reveal that staff from the Nuclear Weapons Team at the

Defence Procurement Agency hold regular talks with their US counterparts on various issues including the W76 warhead.[19] In April 2000 a contract for current and future support for Trident Re-entry Systems referred to "support to joint US/UK activities that have been determined by SSP to be of mutual benefit to both governments".[20] Another heading in the contract refers to W76-1.

The timing of Britain's refurbishment programme does not fit in well with US proposals. The US plan for W76-1 involves refurbishing the primary and secondary which are inside the sealed main warhead package. An equivalent programme in Britain would have to be carried out at the Atomic Weapons Establishment. The differences between the US and British designs would mean that additional research work would have to be carried out, specific to the British warhead, before Aldermaston could rebuild warheads in the W76-1 configuration.

The US will have limited supplies of W76-1 components in FY2008, with larger quantities available in subsequent years. By this time Aldermaston will be well into its refurbishment program, replacing the High Explosive and other parts on British warheads. It is likely that the US would only be willing to supply components towards the tail end of the UK's rebuild program. They could be supplied later if a second round of refurbishment was introduced.

A decision to go ahead with a major Life Extension program may have the following implications for warheads:

- An approach would be made to the US to participate in the W76-1 Life Extension program
- Research would be carried out into the application of W76-1 modifications to British warheads
- Plans would be made for a second major refurbishment of Trident warheads

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[1] Over 3,000 W76 warheads were produced. As well as the operational warheads a significant number of spare plutonium pits for W76 are stored at the Pantex nuclear weapons factory. Blue Ridge Environmental Defence League 2001

[2] One of the componets re-certified was the MC2912 Arming, Fusing and Firing System. 19 AF&F units were disassembled and tested. www.globalsecurity.org

[3] Sandia Laboratory Accomplishments, February 2002.

[4] Recertification of the W76 NG is described in a Sandia Laboratory report, 14 January 1999.

[5] Directed Stockpile Work, Weapons Activities, Department of Energy, FY2005 Congressional Budget, p 62

[6] Operational Selection Policy, OSP11, Nuclear Weapons Policy 1967 – 1998, Public Records Office

[7] Sandia Lab News 15 January 1999.

[8] With regard to the MC4380A Neurtron Generator - "The effort began in August 2000 and was completed in April 2002, followed by completion of the first production unit in May and delivery of the first units to the Navy and the UK last summer Sandia Lab News, Vol 55 Special Issue, February 2003.

[9] On 25 November 1997 Lord Gilbert hinted that Special Nuclear Materials flights from Brize Norton to the US carried tritium; The US declassified the fact that tritium was in the past loaded into British reservoirs at the Savannah River Site.

[10] W76-1 / Mk4A Stockpile Life Extension Project. Los Alamos National Laboratory. LANL website

[11] Warhead life is extended from 20 to 60 years. A Rich Heritage of Naval Innovation, D Dwyer, SSP, in Naval Leafgue of the US.

[12] W76 www.globalsecurity.org

[13] The W76-1 Joint Test Assembly (JTA) was tested in DASO-18. Commander-in-Chief Flight Test FCET-30 in FY2004 is probably also a test of W76-1. Preparations for FCET-32 were due to be made in FY2004. Directed Stockpile Work, Department of Energy Budget FY2003 and FY2004. Sandia Labs News in March 2004 reported that the AF&F had just been tested for the first time in a flight test in FY2004.

[14] Sandia Accomplishments, February 2002; Studies into the performance of MC4700 and other W76-1 components in abnormal thermal environments were being conducted in 2003. Tri-Laboratory Engineering Conference, Schedule of Presentations, LANL forum, 22 October 2003.

[15] The earlier version of W76 may also have had a contact fuze. A fuze for the W76 was revalidated in 2000, Sandia National Laboratory, RM Cahoon, Manager Scientific Computing. The description of simulating contact fuze performance in Sandia Laboratory Accomplishments February 2002 may refer either to this or the fuze for W76-1.

[16] Directed Stockpile Work, Weapons Activities, Department of Energy, FY2005 Congressional Budget, p62

[17] Directed Stockpile Work, Weapons Activities, Department of Energy, FY2005 Congressional Budget, p68

[18] There are a number of technical reports which compare the performance of PBX9501 and EDC 37: "EDC37 consists of (by weight) 91% HMX, 1% nitrocellulose, and 8% K10, a liquid eutectic mixture of di-nitro-ethyl-benzene and tri-nitro-ethyl-benzene and has a nominal density of 1.84 g/cm^3." – abstract of Initiation of EDC37 Measured with embedded Magnetic Particle Velocity Guages, RL Gustavsen et al; The use of digital image cross-correlation to study the mechanical properties of a polymer bonded explosive, PJ Rae et al; Split Hopkinson Bar Measurements of PBX, CR Siviour et al:

[19] Written Answer by Dr Lewis Moonie, Defence Minister, 6 February 2002.

[20] Technical Engineering and Operational Services for currently deployed and future SLBM Reentry Systems, Solicitation N00030-01-R-0024, 20 April 2000, Commerce Business Daily.